User Manual Supplement

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e-SIM Ltd.
POB 45002
Jerusalem
91450
Israel

Tel: 972-2-5870770
Fax: 972-2-5870773

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Contents

ABOUT THE RAPIDPLUS DOCUMENTATION

About the User Manual Supplement

This manual provides the information you need to use the new objects and features added since Rapid 4.0. It supplements the information found in the *Rapid User Manual*.

- Chapter 1: “Managing Projects” describes how to work with RapidPLUS on a project-wide basis (simultaneously editing the parent application and its user objects). It also describes how to implement team development and version control using XML application files.
- Chapter 2: “RapidPLUS Applications in XML” explains how to work with applications saved to XML format and the benefits of working with projects in XML.
- Chapter 3: “Comparing Applications in the Differencing Tool” explains how to use the Differencing Tool to compare objects, modes, user objects, and/or interface of two applications.
- Chapter 4: “Debugging Applications” describes how to filter and capture the Debugger output in a log that can be viewed, saved, and printed.
- Chapter 5: “Logic Error View” describes how this tool displays errors and warnings for logic and XML applications.
- Chapter 6: “Pasting Operations” explains how to cut/copy and paste objects, modes, and logic elements between RapidPLUS applications.
- Chapter 7: “Writing Logic Using Loops and Branches” describes how to use loop statements to execute a block (i.e., a set of activities) over and over again, and how to use branch statements to execute a block when specified conditions are satisfied.
- Chapter 8: “Find and Replace” explains how to search for and replace strings in the application logic and logic references to specific objects.
- Chapter 9: “Verification Test” explains how to run a verification test to perform a basic check on an application’s logic design.
- Chapter 10: “Nongraphic Objects” describes how to work with nongraphic objects in the Object Layout. It describes the nongraphic objects in the data, time, and signal classes and system objects.
- Chapter 11: “Constant Objects” describes how to define and use this class of data objects whose values are defined in the Object Layout and cannot be changed dynamically during runtime. Constant objects are generated as *#define* and *enum* statements.

- Chapter 12: “Graphic Displays” describes how to add and define a graphic display object/graphic display-true color in the Object Layout and define its logic. The graphic display works in conjunction with the font object and with bitmap objects. Topics covered include working with the object’s colors, working with text and bitmaps, and various drawing modes. This chapter also details how to use graphic display buffers to extend the object’s functionality.
- Chapter 13: “Bitmap, Image, and Font Objects” teaches how to define bitmap, image, and font objects in the Object Layout and Logic Editor. Bitmaps and images are used to enhance the visual appeal of simulations and make them more realistic. In simulations that have a graphic display, bitmaps and images—together with text strings and font objects—play an essential part; they constitute the content to be presented on the graphic display.
- Chapter 14: “Touch Screen Object” describes how to incorporate a touch screen into a RapidPLUS application.
- Chapter 15: “Database Access Object” presents an object that links the RapidPLUS application to any database that supports the ODBC (Open Database Connectivity) driver (version 2.0 or higher). In the Object Layout, you define the link parameters and build an initial SQL (Structured Query Language) statement to retrieve the desired records from the database. The resulting query result table is available to all objects in the RapidPLUS application. The SQL statement can be changed and the query rerun dynamically during runtime. Depending on the nature of the link, it is also possible to add, delete, and modify records in the database itself.
- Chapter 16: “Applink Object” describes how to use the Applink object to enable RapidPLUS applications to communicate with external applications via shared memory.
- Chapter 17: “Using ActiveX Controls” describes how to add, register, and use ActiveX controls as objects in RapidPLUS applications.
- Chapter 18: “Hosting RapidPLUS Simulations in Windows Programs” describes how to use the RapidPLUS Simulator ActiveX object to link or embed the Rapid Reviewer in a Windows program so that the Windows program can manipulate and control a RapidPLUS application.
- Chapter 19: “Using JavaBeans in RapidPLUS” describes how to add, register, and use JavaBeans as objects in RapidPLUS applications.
- Chapter 20: “OpenGL Object” describes how to use the OpenGL object to implement complex graphic objects in RapidPLUS applications. OpenGL is a platform-independent graphics language that supports the fast rendering of 2-D and 3-D graphics.

- Chapter 21: “Graphic Object Stack Order” explains how to control the graphic object stack order (Z-order) in both the Object Layout at design time and in the Prototyper at runtime.
- Chapter 22: “User Objects with Messages” provides detailed information about how a user object message works, how to build a user object message and use its logic, how to use data containers, and how to import a message structure from a header file.
- Chapter 23: “State Matrix” explains how to export logic data to Microsoft Excel. The exported data appears in Excel’s workbook format (XLS). A RapidPLUS application’s state matrix enables you to systematically check the application’s modes, triggers, and transitions.
- Chapter 24: “Exporting State Charts to Visio” explains how to export a state chart to Microsoft Visio. The exported chart follows the UML conventions for state charts.
- Chapter 25: “Generating Reports” explains the various reports that can be generated for objects, modes, user object interface, and project components. It also describes XML reports that can be generated, and the API for these reports.
- Chapter 26: “Object Enhancements” provides detailed descriptions of the new functionality that has been added to existing RapidPLUS objects, such as holders, arrays, strings, integers, and DLLs.
- Chapter 27: “Additional RapidPLUS Enhancements” introduces new features and enhancements of existing features.
- Chapter 28: “Application Packager” describes this distribution utility, which is used for packaging a RapidPLUS application and its supporting files.
- Appendix A: “RapidPLUS Search Paths” lists the paths that RapidPLUS searches for files.

Conventions Used in This Manual

The RapidPLUS documentation uses the following conventions:

- “Choose File|Save Application” means to select the Save Application command from the File menu.
- Names of properties, functions and events are italicized:
  idReceived property, *checkForData* function, *dataReceived* event

- File names are italicized:
  main.c
- Complete phrases of RapidPLUS logic are presented in bold, sans serif font:
  & Switch2.position3 is connected

New in version 8.0

- In Chapter 27: "Additional RapidPLUS Enhancements," features that are new in version 8.0 are marked in the tables that appear at the beginning of the chapter.

RapidPLUS Help

RapidPLUS offers you Help on procedures, menu commands, dialog boxes and object properties and functions. You can open Help by choosing Help|Rapid Help Topics in any of the RapidPLUS windows.

All of the RapidPLUS dialog boxes have a Help button, allowing you to get explanations on how to use the dialog box.

You can also get context-sensitive Help on a particular item (button, menu command, etc.,) by clicking the Help button in the tool bar and then clicking the item.

❖ *NOTES: To get Help on a menu command or on a function in the Logic Palette, you can also highlight the command or function (with the mouse or using the keyboard arrow keys) and press F1.*

CHAPTER 1

Managing Projects

The main RapidPLUS application (the RPD file) typically includes multiple user objects (the UDO files), which themselves often contain other user objects. Each user object is an autonomous unit, which exists independently of the applications that include it. When editing affects the interface of the user object to its parent application, RapidPLUS automatically updates the interface and reverifies the logic.

In this chapter, we use the following terminology:

A **project** is a RapidPLUS application (RPD or UDO file) that includes user objects.

Project components are all the applications that make up the project, i.e., the RPD file and each of its UDO files.

Main application is used exclusively to refer to the RPD file.

RXD and **UXO** files are RPD and UDO files that were generated to XML format.

This chapter presents:

- What happens during the automatic interface update and logic reverification.
- How to switch among project components.
- How to edit project components within the parent application.
- How to replace and rename user objects in a project.
- How to apply various operations to an entire project.

- How to use the Properties option to keep track of changes in the application.
- How to add notes to modes and objects.
- The RapidPLUS search path.
- How to implement team development and version control using XML application files (RXD and UXO files).

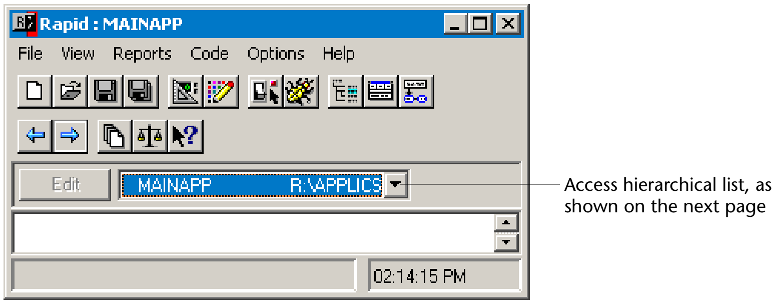
SWITCHING AMONG PROJECT COMPONENTS

The Project Components list in the Application Manager window shows all the applications in the project hierarchically. The main application is first on the list. It is followed by all the user objects in alphabetical order. If a user object contains other user objects, they are listed alphabetically under it. You can manually switch among the components of a project in order to:

- Edit the selected component.
- Set debug breakpoints.
- Open object inspectors.
- View the mode tree of the selected component when running the prototyper with the trace option enabled.
- Add linked items from any user object to the parent application's document layout in the Document Manager window.

To view the Project Components list:

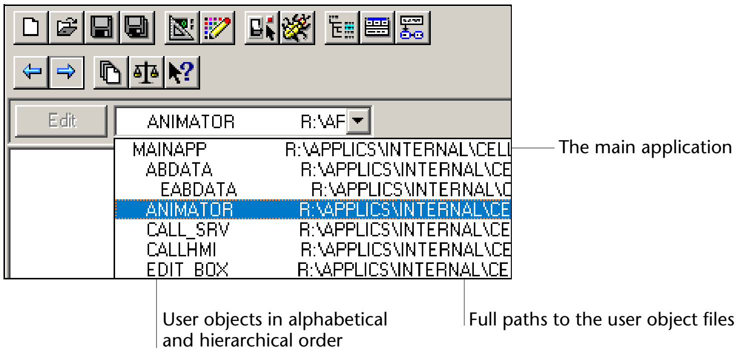
- In the Application Manager, click the list arrow:



To switch among project components:

1 Click the Project Components list arrow.

2 Select the desired user object from the Project Components list, as shown below.


Edit
ANIMATOR R:\AF
The main application
User objects in alphabetical and hierarchical order
Full paths to the user object files

```
MAINAPP        R:\APPLICS\INTERNAL\CELL
  ABDATA         R:\APPLICS\INTERNAL\CE
    EABDATA        R:\APPLICS\INTERNAL\C
  ANIMATOR       R:\APPLICS\INTERNAL\CE
  CALL_SRV       R:\APPLICS\INTERNAL\CE
  CALLHMI        R:\APPLICS\INTERNAL\CE
  EDIT_BOX       R:\APPLICS\INTERNAL\CE
```

While debugging an application, RapidPLUS **automatically** switches user object views when:

- Stepping into an exported function called by the parent application.
- Hitting a breakpoint set in the user object.

❖ *NOTE: The Prototyper window is always dedicated to the parent application regardless of which user object is currently active or how it became so (either automatically during debugging or by manual switching).*

Switching components while the Prototyper is running

Project components cannot be edited while the Prototyper is running. Any editing of a component automatically stops the Prototyper.

If the Prototyper is running, and you select a project component that is not already in edit mode, the selected component opens in read-only mode. This is indicated by the Edit button next to the Project Components list becoming available.

If you click the Edit button, the selected component opens in edit mode, and only then does the Prototyper stop running.

OPENING A PROJECT

When you open an application, RapidPLUS treats it as a project. It scans the interfaces of all the components to see if any updates are required. Updates are needed when changes made in the individual components affect their interfaces to the parent applications (refer to “Changing a User-Defined Object that is Part of an Application” on p. 19-21 of the *Rapid User Manual*).

When RapidPLUS detects mismatches, it automatically updates the interface. Mismatches that generated error messages are available in a report that you can print and save.

Automatic Interface Updates

RapidPLUS uses the following rules to make the needed interface changes in the parent application:

- Exported properties and functions that exist in the user object interface to the parent application, but not in the user object, are removed from the interface. The logic is re-evaluated and, where necessary, commented out. Otherwise, this process is transparent to the user.
- Exported properties, events, and functions that were modified in the user object, but not in its interface to the parent application, are removed from the interface and replaced by new same-type, same-name objects (i.e. properties, events, and functions).
- Functions with the same name in both the user object and its interface to the parent application, but with different argument types, are modified so that the argument types in the interface match those in the user object.
- Messages (unions) are processed recursively down to their fields. The fields receive the same treatment as exported properties.
- New exported properties and functions, that do not exist in the user object’s interface to the parent application, are added to the interface.

Automatic Interface Logic Reverification

An application needs logic reverification when an update involves the removal or change of properties or functions. Invalid logic is displayed in the Logic Error View, where you can double-click any line to open it in the Logic Editor. In the Logic Error View window, the lines of invalid logic are grouped by user objects, and the user objects are listed alphabetically.

Missing or Defective User Objects

A project that is missing one or more user objects, or contains a defective graphic user object, can be opened. When it is first opened, the Logic Error View opens notifying you that the user object is missing.

A missing graphic user object appears as a crossed-out rectangle in the Object Layout. This rectangle will also appear in state transition charts, and in Document Manager documents. A missing/defective graphic user object can be manipulated on the layout and in the logic like any other graphic object, however, it cannot be manipulated like a user object. In other words, it is not listed in the Project Components list and it has no interface. More importantly, it will cause a fatal runtime error when you run the application in the Prototyper.

A missing or defective nongraphic user object appears in the Nongraphic Objects dialog box, but also cannot be manipulated like a user object.

Examples of Usage

Adding a Property or Function to a User Object

You have a project with many instances of *EDITOR.UDO* in its components. You edit *EDITOR.UDO* by adding to it several new properties and functions. When you open the main application after editing *EDITOR.UDO*, RapidPLUS automatically includes the new properties and functions in all the relevant interfaces, and you can immediately proceed to use them in the Logic Editor.

Renaming a Property in a User Object

You have an application with many instances of *BUTTON.UDO*. The user object has two properties, *width* and *height,* that control the size of the button. These properties are used in many places throughout the project, whenever the button user object is used.

You now want to add an optional bitmap on the button and allow control of the bitmap size. You therefore add two new properties to the user object: *bitmap_width* and *bitmap_height* and, to avoid any confusion, you change the names of the button size properties from *width* and *height to button_width* and *button_height*, respectively. As a result, all the logic that uses the button size properties becomes invalid.

RapidPLUS automatically updates all the interfaces of the button user object, and lists all the errors involving the *width* and *height* properties in the Logic

Error View. You can now use project-wide Find & Replace to substitute *button_width* for *width* and *button_height* for *height.*

Changing the Definition of an Exported Function

You have an application with many instances of *UDO1.UDO*. This user object has one exported function called *dialNumber* that receives an integer argument. The function is defined as follows:

dialNumber: <Integer: phoneNumber>

You now decide that the phone number should accept characters as well as digits. You therefore change the exported property *dialNumber* in *UDO1.UDO* as follows:

dialNumber: <string: phoneNumber>

The logic is still valid because the string argument accepts integers, so the application is automatically corrected when it is next opened.

If the change in the function affects its type (for example, you changed the argument type from a string to an integer, or you added an argument to the function), the change is automatically applied the next time the application is opened, and all the lines that have become invalid as a result of the change are listed in the Logic Error View window.

Adding Arguments to a Function

In your application you use the user object *LAMPS.UDO*. This user object has a function called *setShape: <Integer>,* which receives an integer argument. You decide to change the function so that it will receive an additional argument for the color of the lamps. Now the function is defined as *setShape: <Integer> color: <Integer>*. As a result, all calls to this function throughout the project become invalid.

When you open the main application, all the interfaces of *LAMPS.UDO* to its parent applications are automatically updated. All logic errors resulting from the modifications in the function throughout the project appear in the Logic Error View window. You still have to correct each logic line manually, but all the errors from the entire project are grouped together.

EDITING PROJECT COMPONENTS

You can edit any component from the Project Components list.

To edit a project component:

1 Click the Project Components list to open it.

2 Select a component from the list. All of the open RapidPLUS tools display the selected component.

When editing affects a component's interface to its parent application, RapidPLUS will automatically update the interface as described in "Opening a Project" on p. 1-4. The update process is launched in the following cases:

- When you select a different component from the Project Components list.
- When you start the Prototyper.
- When you save the application.
- When you start the Code Generator.

Invalid logic is displayed in the Logic Error View window.

REPLACING AND RENAMING USER OBJECTS

You can replace one user object by another. You can also use this option to rename user objects.

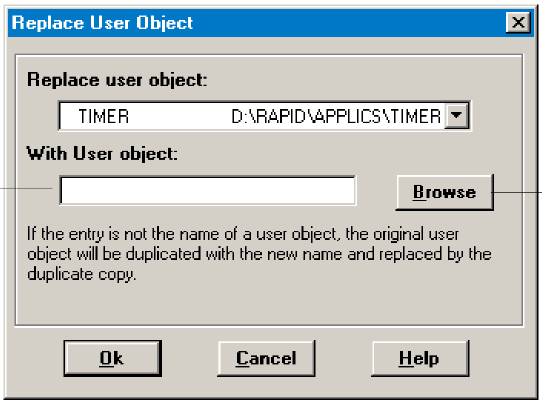
❖ *NOTE: You cannot replace nor rename the main application. You can however use the Save as option to create the main application with a different name.*

Replacing a User Object

To replace a user object:

1 Choose File|Advanced|Replace User Object; the Replace User Object dialog box opens.

2 Select the user object you want to replace.



If the entry is not the name of a user object, the original user object will be duplicated with the new name and replaced by the duplicate copy.

To replace: browse to select the substitute user object

To rename: type in the new name for the user object. Verify that a user object with this name does not already exist

3 Browse to select the substitute user object, or type its name into the box.

4 Click OK.

All the references to the original user object, in the interface to the parent application as well as in all the relevant holders and arrays, are automatically replaced by references to the substitute user object. The original user object is removed from the project.

Renaming a User Object

You can also use the Replace User Object dialog box to rename a user object. Renaming a user object is a special case of replacement where RapidPLUS first duplicates the original user object with the new name, then uses the duplicate to replace the original user object. As in a standard replace operation, all references to the original user object are automatically replaced with references to the new name, and the original user object is removed from the project.

To rename a user object:

1 Choose File|Advanced|Replace User Object; the Replace User Object dialog box opens.

2 Select the user object you want to rename.

3 Type the new name in the “With user object” box. Make sure that a user object with this name does not already exist.

4 Click OK. RapidPLUS notifies you that it was unable to locate the specified user object, and that it will duplicate the original user object with the new name, then use the duplicate to replace the original.

5 Click Yes to continue. The user object gets the new name.

COMPACTING FILES

When you delete an object from a RapidPLUS application (RPD or UDO file), the space that it occupied in the file remains empty. As you subsequently add objects to the application, RapidPLUS utilizes this empty space for the new objects.

To eliminate empty spaces in the application file:

- Choose File|Advanced|Compact in the Application Manager. Any difference in file size will be seen the next time that you save the file.

❖ *NOTE: You must activate this command each time you want to compact.*

ENTIRE PROJECT VS. SINGLE COMPONENT OPERATIONS

The Save, Compact, and Reverify Logic options have been supplemented by the complementary options: Save All, Compact All, and Reverify Logic All. With the new options you can save, compact, and reverify logic for the entire project. These options also offer an easy way to upgrade RapidPLUS applications created in earlier versions.

The Save, Compact, and Reverify Logic commands apply only to the currently selected project component (the file shown in the Project Components box). If the currently selected component is not in edit mode, the three options are unavailable.

❖ *NOTE: The three single-file operations do not apply to sub-components that are nested in the selected component.*

Reverifying Logic for an Entire Project

To reverify the logic of an entire project:

- Choose File|Advanced|Reverify Logic All.

Compacting an Entire Project

To compact the entire project:

- Choose File|Advanced|Compact All.

Saving an Entire Project

To save the entire project:

- Choose File|Save All or click the Save All button.

Upgrading Applications Created in a Lower Version

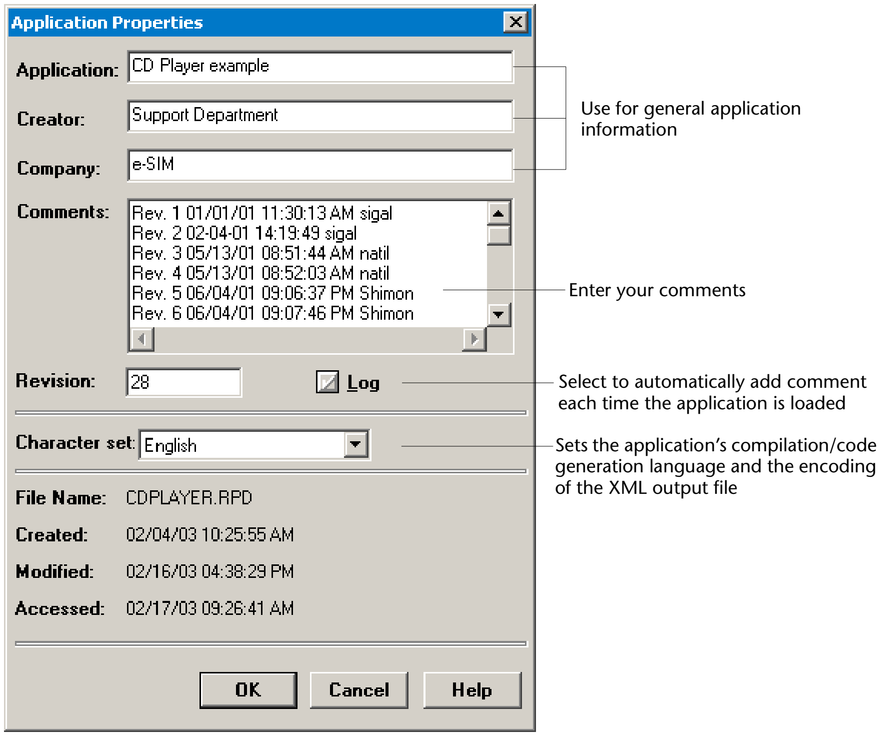
When you open an application that was created in a lower version of RapidPLUS, reverify the application's logic, compact it, then save it. If the application contains user objects, be sure to use the Reverify Logic All, Compact All, **and** Save All commands.

USING THE APPLICATION PROPERTIES DIALOG BOX

This dialog box stores information that applies to RapidPLUS applications.

To use the Application Properties dialog box:

1 Choose File|Properties. The Application Properties dialog box opens for the file (RPD or UDO) shown in the Components List Box.



Application: CD Player example
Creator: Support Department
Company: e-SIM
Comments:
Rev. 1 01/01/01 11:30:13 AM sigal
Rev. 2 02-04-01 14:19:49 sigal
Rev. 3 05/13/01 08:51:44 AM natil
Rev. 4 05/13/01 08:52:03 AM natil
Rev. 5 06/04/01 09:06:37 PM Shimon
Rev. 6 06/04/01 09:07:46 PM Shimon
Revision: 28 ✓ Log
Character set: English
File Name: CDPLAYER.RPD
Created: 02/04/03 10:25:55 AM
Modified: 02/16/03 04:38:29 PM
Accessed: 02/17/03 09:26:41 AM

Use for general application information

Enter your comments

Select to automatically add comment each time the application is loaded

Sets the application's compilation/code generation language and the encoding of the XML output file

2 Use the top three boxes to enter information about the application. Initially they display the name of the RapidPLUS application file, as well as the logged-in user name, and company name as they appear in the registry.

3 The **revision number** is automatically incremented each time the application is loaded. When the **Log** check box is selected, RapidPLUS also adds a comment each time the application is loaded.

   This comment consists of the version number, the date, the time, and the name of the logged-in user. You can edit both version number and comments. To add your own comments, type directly into the **Comments** list.

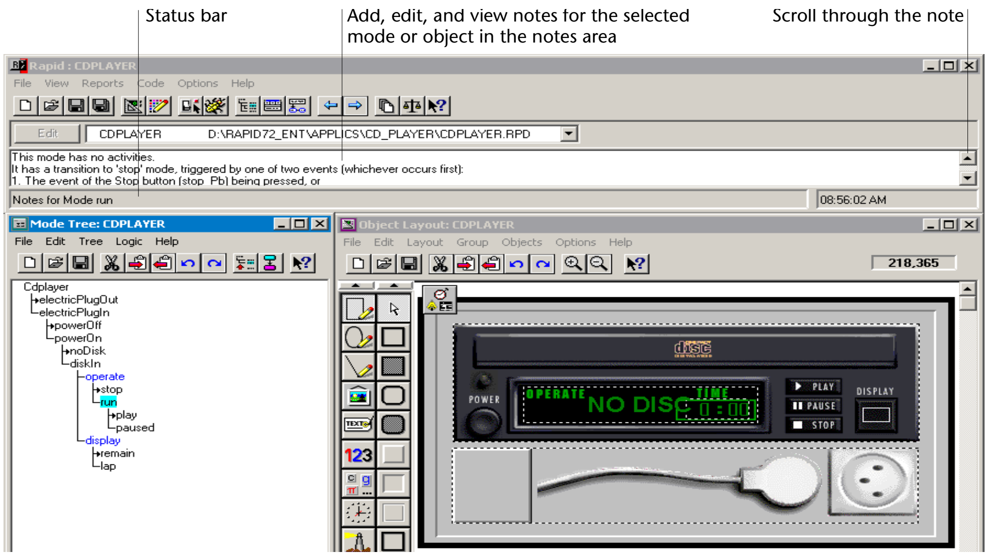
   ❖ *TIP: We recommend that the Log check box always be selected so that projects can be accurately compared—unless you are working with an external version control application. For details about how this check box affects comparisons in the Differencing Tool, see "Comparing Projects" on p. 3-11.*

4 By default, the language used for the application's compilation and code is the system's local language that was used when the application was created. You can change the language in the **Character set** box. The language selected will be used for the encoding of XML reports.

❖ *NOTE: The automatically added log entry does not mark the file as having been changed. The log entry is, however, saved with the properties when you save the application.*

NOTES ON MODES AND OBJECTS

Notes on modes and objects are added, edited, and viewed in the Application Manager window, as shown below:



This mode has no activities.
It has a transition to 'stop' mode, triggered by one of two events (whichever occurs first):
1. The event of the Stop button (stop_Pb) being pressed, or

Notes for Mode run | 08:56:02 AM

To add notes to a mode:

1 In the Mode Tree, click the selected mode. The status bar below the notes area shows the type of mode: exclusive or concurrent.

2 Type your notes in the notes area. You can adjust the size of the notes area by resizing the Application Manager window. When typing, use the Enter key to adjust the text to the size of the notes area.

To add notes to an object:

1 In the Object Layout, click the selected object. The status bar below the notes area shows the type of object: flat pushbutton, square corners filled frame, etc.

2 Proceed as in step 2 above.

❖ *NOTE: In nongraphic objects, you can also add notes when you first create the object, by clicking the Notes button in the nongraphic object dialog box. These notes are then displayed in the notes area of the Application Manager window.*

To edit notes:

1 Select the mode/object you want to edit. Its notes are displayed in the notes area. The status bar shows the text: “Notes for the mode/object:” followed by its name.

2 Edit the text in the notes area. Adjust the size of the notes area and/or use the scroll bar buttons to navigate in it.

SEARCH PATH FOR OBJECTS

When loading applications or adding user objects (UDO) external objects (RPX), ActiveX objects (OCX, DLL), or JavaBean objects (JAR), RapidPLUS looks in the following locations, listed in order of priority:

- The application folder and all its subfolders.
- The RapidPLUS \objects folder.
- The RapidPLUS \applics folder.
- The RapidPLUS folder (wherever *Rapidxx.exe* is located).

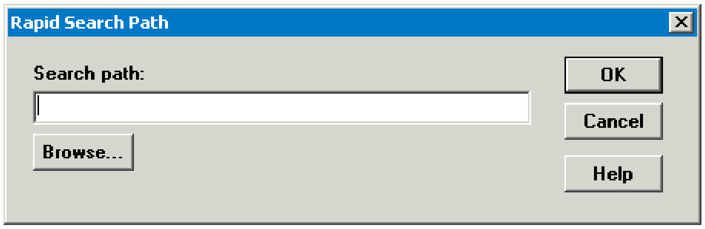
In addition, **in the development environment**, the search is extended to include the user-defined RapidPLUS search path, and **in the Rapid Reviewer**, the RAPID_AUX_PATH environment variable is used.

❖ *NOTE: We recommend keeping all the project files in the application folder and its subfolders. This will simplify moving the project to a different drive or a different computer.*

Defining a Search Path

To define the RapidPLUS search path:

1 In the Application Manager, select Options|Search Path; the Rapid Search Path dialog box opens:



2 Either type in the search path, or click Browse to select the folder. You can define several search paths using the semi-colon as a separator (for example: c:\my_objects;d:\objects) or just browse to another folder to add it to the search path.

3 The search path is not saved with the application. To keep the defined search path beyond the current session, use one of the Save Settings options. The search path is then saved in the RapidPLUS INI file.

❖ *NOTES: When the Reviewer loads an application, it does* ***not*** *read the Rapidxx.ini file. However, the Reviewer* ***does*** *look for a RAPID_AUX_PATH system environment variable, in which you can set a RapidPLUS search path. On Windows NT4 systems, for example, you set environment variables via the System icon in the Control Panel.*

The RapidPLUS search path feature can be especially useful for group development of an application. All group members would define the same search path to the folder where the shared resources are located.

Beware of user objects with the same file name

Let's assume that your application contains a user object instance based on the file *C:\RapidPLUS\Objects\Display.udo*. Let's also assume that, for some reason, there is a *DISPLAY.UDO* (with a different interface and/or functionality) located in your application folder.

When you load the application, RapidPLUS looks first in the application directory, finds a *DISPLAY.UDO* and looks no further. Your user object instance is now based on a different user object file than intended. If the interfaces of the two *display.udo* files are not identical, RapidPLUS will automatically perform the interface update and logic reverification process.

Therefore, be careful about where you locate your user object files and about giving them unique names.

Locating a User Object

When loading an application, RapidPLUS may be unable to locate a user object in any of the search paths described in the preceding section “Defining a Search Path.” In this case, a dialog box opens that prompts you to locate the user object file.

❖ *NOTE: The new path is not saved. You will have to locate the user object file each time you open the application.*

TEAM DEVELOPMENT AND VERSION CONTROL USING XML FILES

RapidPLUS can store its components in binary format files (RPD and UDO) or in XML format files (RXD and UXO). Using the XML format has advantages when working with version control tools because it is a text format, which enables comparison, merging, and editing of the files outside of RapidPLUS.

The benefits of developing RapidPLUS projects in XML format are:

- External tools become available to the project, thereby providing greater possiblities and flexibility for team development and version control.
- Different versions of the same component can be compared using an external comparison tool, including the comparison tool of the version control system.
- Developers can work in parallel on the same project component, merging the changes when the work is done.

This section provides information about:

- Checking projects or components in and out of a version control system.
- Synchronizing component changes.
- Comparing application and component versions.
- Merging applications and components.

For information about the XML files , see Chapter 2: “RapidPLUS Applications in XML.”

Checking In/Out Projects or Components

This section presents a process for using a version control system during RapidPLUS team development.

When setting up the project, all project files should be checked into the version control system and should be made read-only. The project files comprise the main application file (RXD), the user object files (UXO), and the project settings file (CSX). Other files that should be checked in include the shared resources (linked bitmaps, array data loaded during runtime, etc.) Also, ActiveX and JavaBean objects should be checked in.

Developers should copy the entire release from a network folder to their local work folder. Before working on a file, the developer must check it out of the version control system to the work folder.

❖ *TIP: If you open the main application or a user object and receive unexplained errors in the Logic Error View window, they may be the result of changes in a related user object. Try checking out the relevant files again.*

When work is completed, developers should check in their components.
If two or more developers have worked on the same component, they should merge their version with the latest checked-in version.

❖ *RECOMMENDATION: After making all necessary changes, each developer should compare the changed version to the checked-in version to see the changes.*

When developers are working on components where the changes interact (such as user object interface), it is important that they coordinate their releases. Otherwise, RapidPLUS may find logic errors when opening a component affected by another developer's changes.

❖ *TIP: If you make a change in a user object that causes logic errors in other user objects (e.g., renaming an object that is referenced elsewhere), you should verify the logic of the related user objects, save them, and check them in.*

The project manager, who is responsible for the version build, should use a script to check out all released files to a network folder and make the version. The project manager should perform all the manual activities to complete the build such as integrating the output of the external tools into the RapidPLUS files to produce a complete working version.

When all necessary files have been checked in and merged into a valid version, the files should be made read-only (this reduces the risk that a developer will accidently save a file before checking it out of the version control system). The project manager can declare a new release ready for additional work and the developers can then copy the new release to their working folder.

Recommendations for Checking In Resource Files

External resources, such as bitmaps, may be checked into the version control system as individual files, so that developers can lock individual files and work on them. An alternative method is to compress all the bitmaps into a single ZIP file for easier check out. In this latter case, only one person at a time can lock the entire set of bitmap files in order to make changes on any given file.

For the purposes of team development and version control, we recommend that all data for arrays and data stores be placed in external files (TXT or CSV), which can be called using the *loadFromFile*: function. Both TXT and CSV formats support change merges. Merging is more difficult for RAR and RDS file formats.

Synchronizing Component Changes

RapidPLUS's support for team development and version control enables developers to synchronize changed files that were checked out from a version control system or copied from another location—without closing the project in RapidPLUS.

When a project component's interface has been changed, the other components that use its interface are affected. RapidPLUS can either mark these components as changed or not. If they are not marked as changed, they will not be saved unless you make direct changes in them. Because the files are not saved, RapidPLUS will perform the automatic interface update (as described on p. 1-4) each time the main application is opened, which adds to the load time.

You can circumvent this process by using a command that updates the components that are affected by a changed component.

To update components that are affected by a changed component:

1 Choose File|Advanced|Update Changed User Objects.

2 Choose File|Save All to save all the components.

Comparing Application and Component Versions

You can use a version control system, or a stand-alone XML or compare tool to browse the differences between two versions of a RapidPLUS application or component. Likewise you can use a directory comparison tool to compare two lists of project components.

Merging Applications and Components

During group development, developers may work in parallel on the same project or even the same component. When the developers are ready to check in their versions, they must merge the changes made on the same base versions. The details of how to merge the versions depend on the version control system.

In RapidPLUS XML format, every change in the application or component affects only a single place in the file. When developers make changes in different sections of the application or component file, there are no resulting conflicts. In this case, most version control systems allow an automatic merge. For example, if two developers added different objects to the same application, the files can be merged without conflict.

There are cases, however, where developers make changes in the same element of an application or component, resulting in a conflict during merge. Following are examples of changes that result in merge conflicts:

- Both developers made changes to the same line of logic.
- One developer changed an object's properties and the other developer deleted the object.
- Two developers adding elements to the same array.

In each case of conflict, someone must manually indicate which version to keep in the merged edition.

❖ *TIP: Every time you save and reopen an application or component, RapidPLUS increases the version number, adding a line of code to the resulting XML file. This change causes a conflict when merging application or component versions. You can turn off the automatic version number feature in the File|Properties dialog box. Clear the Log check box . Keep in mind that clearing the Log check box will disable project comparisons in the Differencing Tool (but modes, objects, user functions, and interface can still be compared). For more information, see "Comparing Projects" on p. 3-11.*

CHAPTER 2

RapidPLUS Applications in XML

RapidPLUS applications can be saved to XML format in addition to the standard binary RapidPLUS format (RPD and UDO). The XML format offers many development benefits:

- Group development: the XML format can be used by configuration management tools for check in/check out of projects, comparing versions, and merging versions (for details, see “Team Development And Version Control Using XML FIles” on p. 1-16).
- Use of external tools to edit project components: XML-based or text-based editors can be used for editing object properties and application structure.
- Integration of third-party tools with project files: external tools can be used for tasks such as generating reports and documents. Also RapidPLUS application files can be created and modified by external tools.
- Readable text files: XML application files are readable as text files without the need to open them in RapidPLUS.
- Ability to fix corrupted applications.

❖ *CAUTION: Applications saved to XML format cannot be packaged by the Application Packager and cannot run in the Rapid Reviewer.*

This chapter presents:

- How to save a RapidPLUS application to XML.
- How to open a project in XML format.
- The XML output files.

- How to edit the XML application files.
- The RapidPLUS schema file.

SAVING APPLICATIONS TO XML FORMAT

The native format for all RapidPLUS applications is the binary RPD format. Whenever an application is saved to XML format, a corresponding RPD file is saved in the cache, which is located in the application folder in a subfolder named $RP_CACHE_.

❖ *NOTE: After an application has been saved and opened as XML, the Save operation maintains the XML format. To return to using the RPD format, you must use the Save As operation.*

Saving Applications and User Objects to XML

To save an application to XML:

1. Choose File|Save As.
2. In the Save As dialog box, select Rapid XML Application (*.RXD) in the Save as type box.
3. Type in a file name, change the path if necessary, and then click Save.

The RXD file is written to the specified folder and the RPD file is written in the cache.

If the application has user objects, an XML file is created for each user object (UXO extension), and all of the UXO files are saved in a folder tree reflecting the user object hierarchy in the project. The UDO files are written in the cache. Also, a file containing the project's code-generation preferences is saved in the application folder (CSX extension).

❖ *NOTE: If you do a "Save as XML" operation to a folder other than the application folder, you are prompted to save the UXO files in the new folder with the RXD file or to save them in the original application folder.*

To save a user object to XML:

1. Open the user object in RapidPLUS (independent of a parent application).
2. Choose File|Save As.
3. In the Save As dialog box, select XML User Defined Object (*.UXO) in the Save as type box.
4. Type in a file name, change the path if necessary, and then click Save.

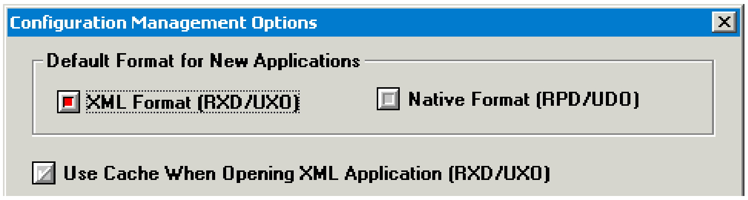
The UXO file is written to the specified folder and the UDO file is written in the cache.

Designating XML as the Default Application Format

By default, RapidPLUS applications are saved in the binary RPD format. You can make XML format the default file format.

To designated XML as the default format:

1. In the Application Manager, choose Options|Configuration Management Options.
2. In the dialog box under the "Default Format for New Applications" group, select the "XML Format" button:


Configuration Management Options

Default Format for New Applications

[✓ XML Format (RXD/UXO)] Native Format (RPD/UDO)

[✓] Use Cache When Opening XML Application (RXD/UXO)

OPENING APPLICATIONS IN XML FORMAT

When an RXD or UXO file is opened, either the XML-formatted file or the binary RPD file stored in the cache is loaded. The file type that is loaded depends on a setting in the Configuration Management Options dialog box.

The "Use Cache When Opening XML Application" check box is selected by default (as shown above). When the XML application file is first loaded, RapidPLUS compares the signature of the file against the signature of the corresponding RPD/UDO file stored in the cache.

If the signatures are identical, the application is opened from the RPD/UDO file and the operation is complete. If the signatures differ (or there is no cache), then the cache is deleted and RapidPLUS opens the application from the XML version. The cache is also invalidated if there are errors when loading the XML file.

When the “Use Cache When Opening XML Application” check box is not selected, the XML version is loaded.

Opening an XML Application File

To open the application:

1 Choose File|Open.

2 In the Open Application dialog box, select the file and click Open.

❖ *CAUTION: If errors are detected in the opening operation, do not save the application. Fix the errors and then reload.*

When Errors are Detected in the Opening Operation

When RapidPLUS detects errors while opening an RXD or UXO file, the Logic Error View window opens displaying the XML errors. There are three types of XML errors:

ERROR TYPE	ICON	DESCRIPTION
Warning	✗ XML	Possible error that has no effect on the application behavior.
Error	!!! XML	Error that may affect the application behavior, but the application can still be fully loaded.
Fatal error	● XML	Error that prevents the element it belongs to from being loaded. The related object or logic will not be loaded and the application behavior will be affected.

To correct an error:

1 Select the line in the error list and click the Go To button, or double-click the line.

  RapidPLUS opens the XML file in the default editor, with the cursor at the line containing the error. (The default editor is an internal text editor.)

2 If you edit the file directly in the default editor, RapidPLUS detects the change and prompts you to reload the file.

  If you prefer to use an editor other than the default text editor, make the necessary changes in the RXD or UXO file and then reopen it in RapidPLUS. (For details about changing the default editor, see “Changing the Default XML Editor” on p. 2-12.)

3 Reverify the changes.

❖ *IMPORTANT: Syntax errors in the XML file can cause logic errors in RapidPLUS. For example, if the element name “OBJECT” is accidentally edited to “OBJEC” in a given instance, the object will be removed from the application, logic that referenced the object will become invalid, and a fatal error warning will appear in the Logic Error View. In this case, fixing the XML error externally will restore the object in RapidPLUS and correct related logic errors.*

To reverify changes made externally in the XML code:

1 Reload the changed RXD/UXO file.

2 Once you have closed the Logic Error View, you must reload the XML file to see the list of XML-related errors.

Examples of XML Errors

- RapidPLUS cannot locate the schema. By default the schema is located in the main Rapidxx folder. RapidPLUS searches in this folder and the application file’s folder.
- An XML syntax error causes a fatal error. View the line in the Logic Error View for a description of the error.
- RapidPLUS loads a user object, but the mode tree is empty or the objects have disappeared: a fatal error has occurred.

WORKING WITH THE XML OUTPUT

There may be times when you will want to edit the RXD or UXO files outside of RapidPLUS, for example, when merging two revisions of the same file. It is important that you be familiar with the structure of the files and the mechanics of handling the schema file. This section presents information about the RXD and UXO files and the CSX settings file.

Before looking at the files, however, you should be aware of a setting that affects the XML output files. A setting in the Configuration Management Options dialog box determines the type of indentation used in the XML files.

To set the indentation type:

1 In the Application Manager, choose Options|Configuration Management Options.

2 In the dialog box under the XML Output group, the indentation type is set to Tabs by default. To use spaces instead of tabs, select the Spaces button.

❖ *WARNING: When multiple developers work on an application, they must all use the same indentation setting; otherwise, it will be difficult to merge the files.*

RXD/UXO File Structure

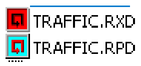
The structure of RXD and UXO files is similar. Both file types contain elements presenting document information, metadata, exported interface, objects, the mode tree, transitions, and logic.

Document Information

The `<module>` element defines the application name and the applied schema. The `<import>` element lists external components used by the module. The `<class>` element names the RPD or UDO file. The `<extends>` element is reserved for use in future RapidPLUS versions.

Example

Application Files **Document Information**

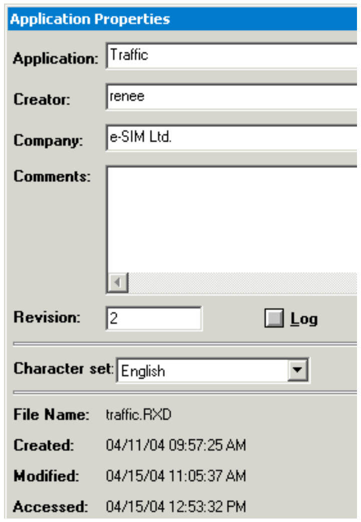

TRAFFIC.RXD
TRAFFIC.RPD

```
<module xmlns:xsi="http://www.w3.org/2001/
XMLSchema-instance"
xsi:noNamespaceSchemaLocation="Rapid20030803.
xsd">
 <import lib="OBJLIB.RPX" type="rpx"/>
 <class name="traffic">
   <extends>UDO</extends>
```

Metadata Element of the Class Element

The `<metadata>` element contains information from the Application Properties dialog box.

Application Properties **<metadata> Element**



Application: Traffic
Creator: renee
Company: e-SIM Ltd.
Comments:
Revision: 2

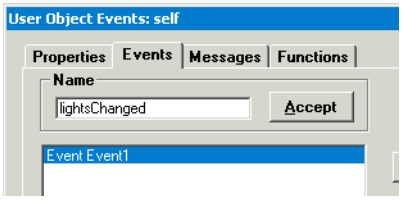
Character set: English
File Name: traffic.RXD
Created: 04/11/04 09:57:25 AM
Modified: 04/15/04 11:05:37 AM
Accessed: 04/15/04 12:53:32 PM

```
<metadata>
    <String name="appName">Traffic</String>
    <String name="creator">renee</String>
    <String name="company">e-SIM Ltd.</String>
    <Integer name="revision">2</Integer>
    <Integer name="countryCode">1</Integer>
    <boolean name="logEnabled">false</boolean>
    <String name="comment">

    </String>
</metadata>
```

Exported Interface Element

The `<export>` element contains the definitions of exported elements: functions, properties, events, and messages. This section generally appears in user objects (UXO files).

User Object Interface



Name: lightsChanged

Event Event1

<export> Element

```
<export>
      <Event name="lightsChanged"/>
   </export>
```

This element will also appear in applications (RXD files) that export interface elements to the Rapid Simulator ActiveX object.

Objects

The `<private>` element contains all of the application's objects. The order of the objects reflects their z-order in the application.

In order to make the XML files as small and readable as possible, RapidPLUS saves only the object attributes that differ from the default values. For example, a lamp's default blink period is 500 msec. If the application maintains this default period, RapidPLUS does not write it to the XML file. If the blink period is changed to a new value, the value is written in the next Save operation.

You can include all object attributes—including default values—in the XML file by changing a setting in the Configuration Management Options dialog box. This change is especially useful if you plan to process the XML file with an external tool such as an external report generator.

To include all attributes:

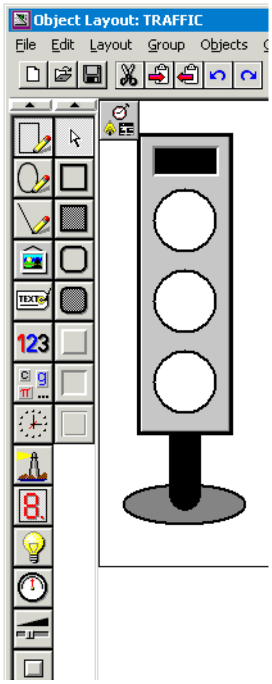
1 In the Application Manager, choose Options|Configuration Management Options.

2 In the dialog box under the XML Output group, select the “Include Object's Default Values” check box.

When selected, RapidPLUS saves all object attributes in the XML file. When the check box is not selected, only the object attributes that differ from the default values appear in the XML file.

The internal resources of the saved RapidPLUS objects—including bitmaps and other graphic objects, as well as binary data of ActiveX and JavaBean objects—are embedded inside the file using Base64 encoding.

Objects **<private>Element**



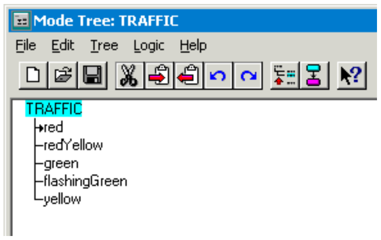
```
<private>
      <object class="TopPanel" name="traffic">
         <note>
            This is the top panel for the application
         </note>
         <rect x="0" y="0" width="140" height="365"/>
         <boolean name="enableQuickDraw">true</
          boolean>
      </object>
      <object class="Filled_Ellipse" name="">
         <rect x="18" y="299" width="98" height="34"/>
         <short name="lineWidth">2</short>
         <Color name="forground" rgb="128 128 128"/>
         <Color name="indication" rgb="0 0 0"/>
         <Color name="background" rgb="0 0 0"/>
         <Color name="shade" rgb="0 0 0"/>
      </object>
      <object class="Solid_Line" name="">
         <rect x="54" y="240" width="26" height="81"/>
         <point name="initialStart" x="13" y="13"/>
         <point name="initialEnd" x="13" y="68"/>
         <short name="lineWidth">25</short>
       .
       .
      </object>
      <object class="Timer" name="general_Timer">
         <long name="initialCount">5</long>
      </object>
   </private>
```

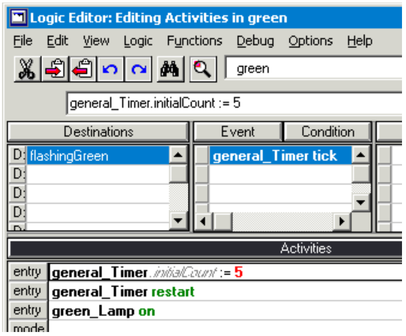
❖*NOTE: Object coordinates are relative to the position of the object's upper left corner in the containing application/user object.*

Mode Tree, Transitions, and Logic

The <stateMachine> element contains all the data from the Mode Tree and Logic Editor.

Mode tree, transitions, & logic




Logic Editor: Editing Activities in green
File Edit View Logic Functions Debug Options Help
green
Destinations
Event
Condition
Activities

general_Timer.initialCount := 5

Destinations	Event
D: flashingGreen	general_Timer tick

	Activities
entry	general_Timer.initialCount := 5
entry	general_Timer restart
entry	green_Lamp on

<stateMachine> Element

```
<stateMachine>
.
.
   </exclusiveMode>
   <exclusiveMode name="green">
      <transition type="default"
      destination="flashingGreen">
        <event>general_Timer tick</event>
      </transition>
      <activities>
        <entry>general_Timer.initialCount
        := 5</entry>
         <entry>general_Timer restart
         </entry>
         <entry>green_Lamp on</entry>
      </activities>
   </exclusiveMode>
.
.
</stateMachine>
```

The CSX Settings File

(This section applies to code generation only.)

The CSX file, which contains the code-generation preferences for the project, is automatically created when you save an application to XML format.

You can edit this file to create multiple CSX files for a single application. Doing so allows you to set code generation preferences outside of RapidPLUS. The CSX file that will be used with the application must have the name *<application name>.csx*.

EDITING AN XML FILE

RapidPLUS requires that the XML documents be both well-formed and valid. A well-formed XML document meets the basic rule of XML that all tags are balanced, i.e., that all elements containing character data are contained between pairs of start and end tags. A valid XML document contains an XML declaration at the top. It conforms to a referenced schema and can be validated by a validating parser.

There are three types of editors that you can use to edit the XML files:

- Text editor: treats the XML as text, without understanding the XML structure or semantics.
- XML editor that does not recognize schema: checks that the XML is well-formed, but will not validate the XML against the schema.
- XML editor that recognizes schema: checks that the XML is well-formed and valid. If you edit an RXD or UXO file in an XML editor that recognizes schema, the editor will look for the schema in the same folder as the file being edited.

Upon loading RXD and UXO files, RapidPLUS notifies you about any syntax or semantic errors made during editing.

❖ *NOTE: RapidPLUS cannot open files with invalid XML syntax that do not conform to the schema. An invalid XML file will result in a fatal error in RapidPLUS.*

You can work on an open application in RapidPLUS and an external editor. If you make a change in the XML file in the external editor and save the file, RapidPLUS detects that the file has changed and prompts you to reload it. Likewise, if you make and save a change in RapidPLUS, you can reload the file and see the change in the external editor.

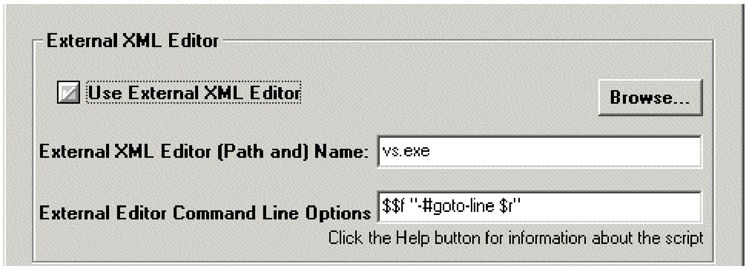
Embedded resources appear in the XML file in Base64 encoding. All external resources remain external to the RXD and UXO files.

Changing the Default XML Editor

The default XML editor is an internal text editor.

To change the default editor:

1. In the Application Manager, choose Options|Configuration Management Options; the Configuration Management Options dialog box opens.
2. From the External XML Editor group, select the "Use External XML Editor" check box:


External XML Editor

[✓] Use External XML Editor

Browse...

External XML Editor (Path and) Name: vs.exe

External Editor Command Line Options: $$f "-#goto-line $r"

Click the Help button for information about the script

3. Click the Browse button to browse to the editor's EXE file.
4. In the "External Editor Command Line Options" box, specify the command line options required by the external editor to open a specified XML file to a specified location in the file. The format of the script is:

   `<escDef>*<esc>f*<esc>r*<esc>c*`

   where stars are any text;

   `<escDef>` is the character subsequently used as the escape character in the rest of the script;

   `<esc>` is the escape character as specified by `<escDef>`;

   `<esc>f` is a placeholder for the file name;

   `<esc>r` is the placeholder of the row number;

   `<esc>c` is the placeholder of the column number; and

   `<esc><esc>` escapes the escape character.

   The `<escDef>` character must be the first character of the script; however, the order of the other placeholders is insignificant.

For example, if the default external editor is defined as Visual SlickEdit and there is an XML error in the file *myApp.rxd* in line 4, column 45, the script `$$f "-#goto-line $r -#goto-col $c"` will result in the command line:

```
vs.exe myApp "-#goto-line 4 -#goto-col 45"
```

For other editors, check the documentation for the correct command-line switches.

5 (For an external editor that recognizes schema) In the XML Output group, make sure that the “Save Schema With XML Files” check box is selected.

If this check box is not selected, the XML editor will not be able to find the schema file when the application file is loaded, which will cause an error.

The Schema File

The schema file is used by RapidPLUS and external tools to validate the syntax of the XML application files (RXD and UXO files). By default, the schema file is located in the main RapidPLUS folder. The file name convention is *Rapid_XX.XSD*, where the XX represents the schema version number. Copies of the schema file can be kept locally in the XML application folder or in any other folder, on the network, or at a remote URL. If you are using an external XML editor that recongnizes schema, it will only look for the schema in the XML application folder.

To have RapidPLUS save the schema file in the XML application folders:

1 In the Application Manager, choose Options|Configuration Management Options.

2 In the dialog box under the XML Output group, select the “Save Schema with XML Files” check box.

❖ *IMPORTANT:* ***The schema is a read-only file and should never be edited.*** *Changing the schema may cause fatal errors in RapidPLUS and render your application unusable.*

RapidPLUS can open applications using old schemas, as long as it can locate the schema file. When you next save the RXD or UXO file, RapidPLUS automatically updates the application to the latest schema.

Every XML file can contain one reference to a schema file in its header. When opening an RXD or UXO file, RapidPLUS first looks for the schema in the main Rapid folder. If it does not find the schema, it looks for it according to the reference. If you move the application or check it into a version control system, you should manually copy the schema file to the application folder (if it is not already located there).

❖ *TIP: To assist in your understanding of the RapidPLUS schema file, see the annotated version (RapidXML.html) which is located in the Rapidxx\XML folder.*

CHAPTER 3

Comparing Applications in the Differencing Tool

The Differencing Tool is used to compare the objects, modes, user objects, and exported interfaces of applications, and the components of projects. It is particularly useful for comparing two versions of the **same** application or project. The ability to compare applications and projects is especially useful when several people work on them.

The Differencing Tool window is divided into two vertical panes, one for each application/project. The applications are opened in read-only view in a hierarchical tree format, with more specific information presented below the tree. This format enables you to easily compare the similarities and differences between the applications.

You can copy sections from either of the panes, and then paste them into a RapidPLUS application. You can also generate a Differences report about the comparison.

The Differencing Tool can stay open while you work on the currently active application (although not in Always on Top mode).

This chapter presents:

- An explanation of the Differencing Tool.
- How to select applications/projects for comparison.
- How to navigate among the differences and matches.
- What you see when you compare projects, modes, objects, user functions, and interfaces.

USING THE DIFFERENCING TOOL

To open the Differencing Tool:

- In the Application Manager, choose View|Differencing Tool, or click the Differencing Tool button. Its window opens in Project view (i.e., the Project tab is selected) with the focus on the left pane.

  The application that is currently open in RapidPLUS is displayed in both panes.

To close the Differencing Tool:

- In the Differencing Tool, choose File|Exit Differencing.

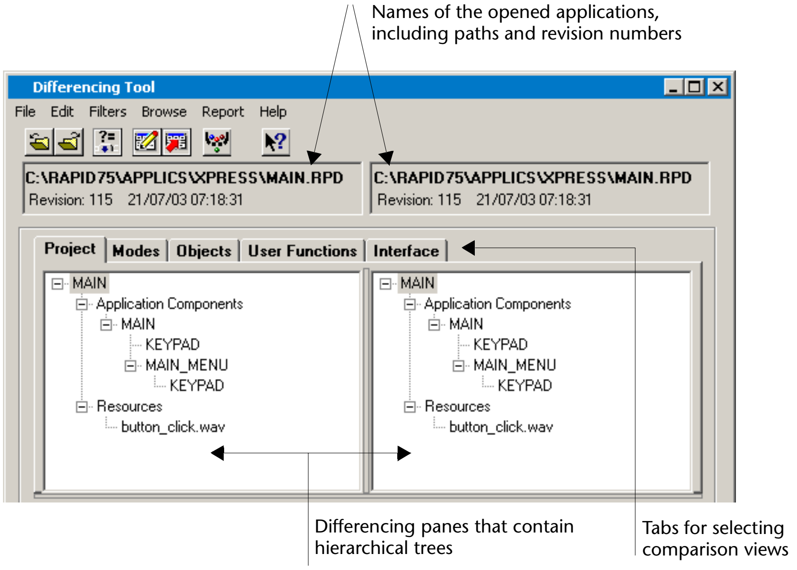
Structure of the Window

The window comprises:

- An upper section that contains a global view of the applications.
- A lower section that contains more detailed information.

  Each of these sections is resizable.

Upper section of the Differencing Tool window (Project tab):


Names of the opened applications, including paths and revision numbers
Differencing Tool
File
Edit
Filters
Browse
Report
Help
Project
Modes
Objects
User Functions
Interface
Differencing panes that contain hierarchical trees
Tabs for selecting comparison views

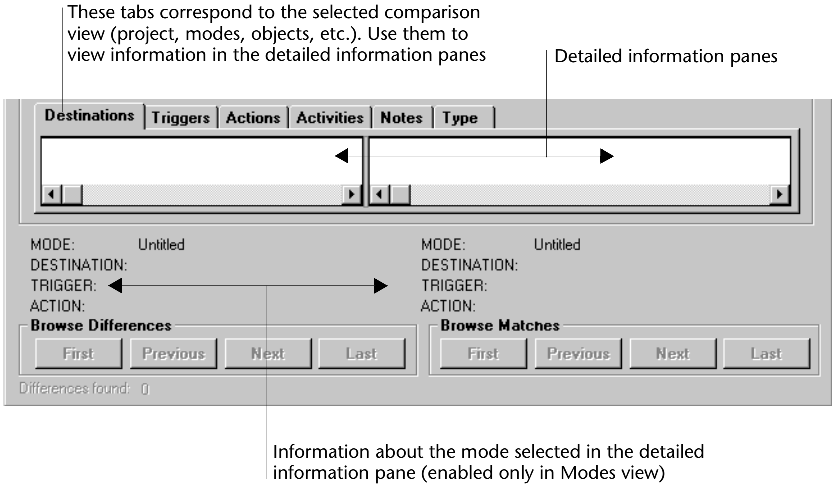
C:\RAPID75\APPLICS\XPRESS\MAIN.RPD
Revision: 115   21/07/03 07:18:31

C:\RAPID75\APPLICS\XPRESS\MAIN.RPD
Revision: 115   21/07/03 07:18:31

```
MAIN
  Application Components
    MAIN
      KEYPAD
      MAIN_MENU
        KEYPAD
  Resources
    button_click.wav
```

```
MAIN
  Application Components
    MAIN
      KEYPAD
      MAIN_MENU
        KEYPAD
  Resources
    button_click.wav
```

Lower section of the Differencing Tool window (Modes tab):


These tabs correspond to the selected comparison view (project, modes, objects, etc.). Use them to view information in the detailed information panes
Detailed information panes
Destinations
Triggers
Actions
Activities
Notes
Type
MODE: Untitled
DESTINATION:
TRIGGER:
ACTION:
MODE: Untitled
DESTINATION:
TRIGGER:
ACTION:
Browse Differences
First
Previous
Next
Last
Browse Matches
First
Previous
Next
Last
Differences found: 0
Information about the mode selected in the detailed information pane (enabled only in Modes view)

The Basics of Using the Differencing Tool

The basic steps for using the Differencing Tool are:

1. Select an application for each pane. RapidPLUS automatically compares them. The differences and matches are displayed in the upper panes (see p. 3-5 for an explanation of the icons and colors used in the upper pane).
2. Use the Browse buttons at the bottom of the window to navigate among the differences and matches (see p. 3-7 for details).
3. Click the Project/Modes/Objects/User Functions/Interface tabs to focus on different elements of the applications. For an explanation of the Differencing window in:
   - Project view see p. 3-11
   - Modes view see p. 3-12
   - Objects view see p. 3-14
   - User functions view see p. 3-15
   - Interface view see p. 3-16
4. You can change the items compared using the Filters dialog box (see p. 3-8 for details).

5 You can select an item, then go to it in the currently open application (see p. 3-9 for details).

6 You can copy items from the applications in the Differencing tool to the currently open application (see p. 3-10 for details).

7 You can generate reports about the applications and application components (see p. 3-10 for details).

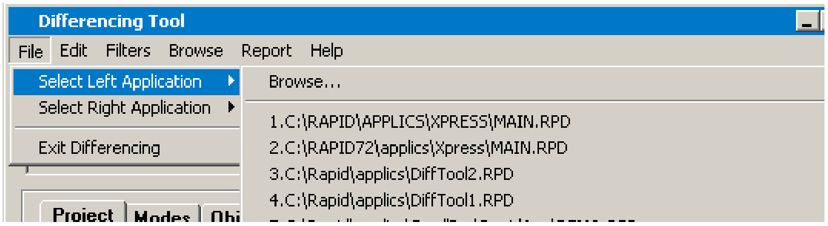
Selecting Applications

The procedure for selecting applications for the left and right panes is identical.

To select an application:

Left Right

1 Choose File|Select Left Application (or Select Right Application).


Differencing Tool
File Edit Filters Browse Report Help
Select Left Application
Select Right Application
Exit Differencing
Browse...
1.C:\RAPID\APPLICS\XPRESS\MAIN.RPD
2.C:\RAPID72\applics\Xpress\MAIN.RPD
3.C:\Rapid\applics\DiffTool2.RPD
4.C:\Rapid\applics\DiffTool1.RPD
Project Modes

2 Choose Browse to locate an application or select from the list of previously opened applications. You can also right-click one of the panes to open the popup menu and choose Select Application.

Comparing the Applications

Once you have selected the applications, they are automatically compared. Each time you select a different application for a pane, the two applications are automatically compared. Whenever you make a change in the application that is currently open in RapidPLUS, the Differencing Tool prompts you to reload the application.

To manually compare the applications:

- Choose Edit|Compare.

To compare one branch:

1 Click a tab to choose a view (Project/Mode/Object, etc.).

2 Select an item in the tree and click the Compare Selected button.

❖ *NOTE: The comparison operation is based on the text of the compared items. If the items differ textually, they will show up as different. For example, if a logic line in Application 1 is written as Lamp1<space>on and in Application 2 as Lamp1<space><space>on, the Differencing Tool will see them as different.*

Comparing Project Components

When you compare applications that contain components (i.e, user objects), you can compare the components without having to open each component separately.

To compare project components:

(These instructions assume that the projects in the panes are different.)

1 In the Project view, select one of the components listed under "Application Components."

If this component exists in both projects (and the Synchronize Selection option is selected), it will be selected in both panes.

2 Click the Compare Selected button.

Comparison Table

The following icons and colors are used to illustrate differences and matches:

COMPARISON ICON	COLOR	MEANING
✓	Green	Item appears in both applications and they match.
✚	Yellow	Item exists in this application, but not in the other application.
▭	Gray and yellow	Placeholder—item does not exist in this application, but exists in the other application.
?	Red	Item was not compared.

COMPARISON ICON	COLOR	MEANING
👤≠	Black and red	Item appears in both applications, but there are differences. • In Project view: the components and/or resources are different. • In Modes view: the mode types and/or logic are different. • In Objects view: the properties and/or parameters are different. • In User Functions view: a function is exported in one application and is not exported in the other application. • In Interface view: the interface elements are different.
≠👥	Black and red	Items are identical, but either: (i) there are differences in their children, (ii) one of the items does not have children, or (iii) they have a different number of children.
👤≠👥	Black and red	There are differences in the items and their children.

Navigating Among Differences and Matches

After the applications are compared, the options in the Browse menu and the eight Browse buttons at the bottom of the Differencing Tool window are enabled. You can use these options and buttons to navigate among the differences and matches.

❖ *NOTE: The differences and matches displayed depend on the items selected in the Filters dialog box (see* p. 3-8 *for details about setting the filters).*

The four browse buttons are:

BROWSE BUTTON	DESCRIPTION
First	Selects the first difference/match.
Previous	Selects the previous difference/match.
Next	Selects the next difference/match.
Last	Selects the last difference/match.

Synchronizing the Selection

You can synchronize the two panes so that when you select an item in one pane, the corresponding item in the other pane is also selected.

If item selection is not synchronized, when you select an item in one pane, the corresponding item in the other pane is not selected.

To synchronize item selection:

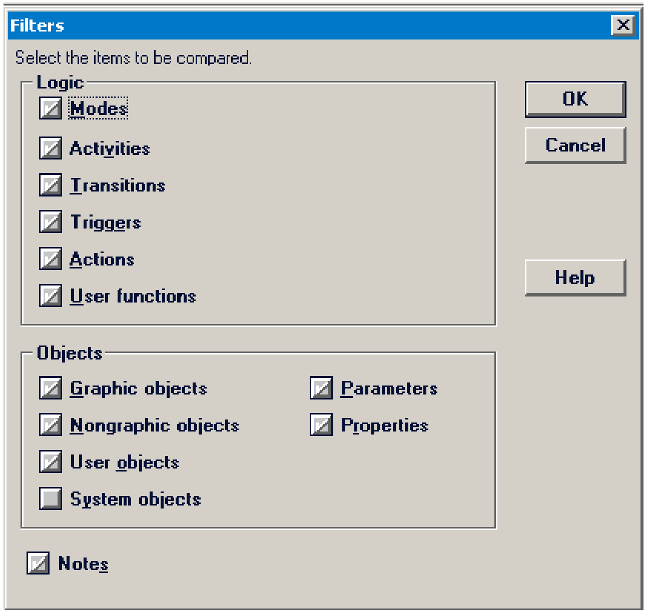
- Choose Edit|Synchronize Selection. You can also right-click in one of the panes to open the popup menu and choose Synchronize Selection.

Selecting Comparison Filters

You can control the logic and objects that are compared by using the Filters dialog box. (The Differencing Tool always compares components and resources.)

To select the filters:

1 Choose Filters|Open Filters Dialog or click the Open Filters button in the toolbar. The Filters dialog box opens:



Select the items to be compared.

Logic
- ✓ Modes
- ✓ Activities
- ✓ Transitions
- ✓ Triggers
- ✓ Actions
- ✓ User functions

Objects
- ✓ Graphic objects
- ✓ Nongraphic objects
- ✓ User objects
- ☐ System objects
- ✓ Parameters
- ✓ Properties

✓ Notes

2 Select the items you want the Differencing Tool to compare, then click OK.

Going to an Item Selected in the Differencing Tool

3 You can select an object, mode, or logic statement in one of the panes and then go to the selected item in the application that is currently open in RapidPLUS.

Open App

If the item is in an application that is not currently open in RapidPLUS, the Go to operation is unavailable. To open the application, choose Edit|Edit Left/Right Application or click the Open Application button.

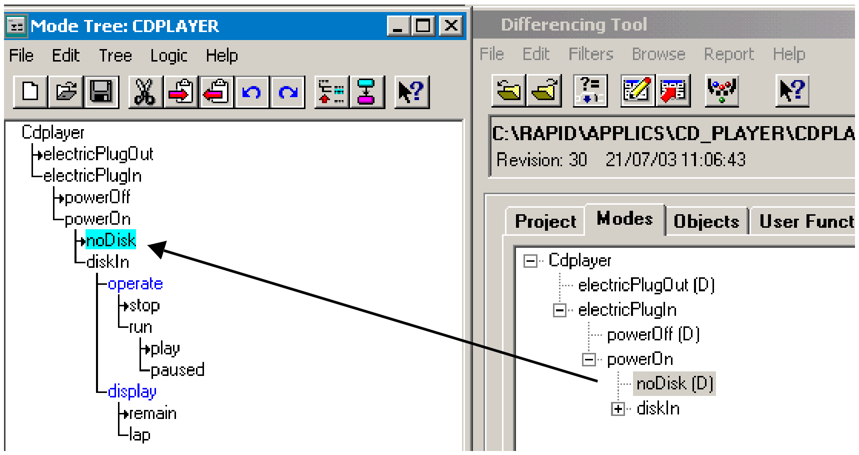
To go to an item in the open application:

1 Select the item you want to go to. You can select an object or mode in the upper pane or a logic statement in the detailed information pane.

Go To

2 Right-click to open the popup menu and choose "Go to" or click the "Go to item" button. The corresponding window opens (either the Object Layout, Mode Tree, or Logic Editor) and the item is selected.

In the following example, the Differencing Tool is in Modes view. A mode was selected and the "Go to" button was clicked. The Mode Tree opens with the same mode highlighted:



Example of going to a selected mode

Copying Items in the Differencing Tool

The applications are displayed in read-only view in the Differencing Tool. Modes, objects, and logic can be copied from either application and then pasted in the application that is currently open in RapidPLUS.

To copy an item:

1 Select the item you want to copy. You can select an object or a mode in the upper pane or logic statements in the lower detailed information pane.

2 Right-click to open the popup menu and choose Copy. The item is copied to the internal paste buffer. The item can now be pasted an open application.

❖ *NOTE: When you copy an item to the currently open application, you have changed the application and must reload it to continue comparing items. RapidPLUS will prompt you to reload it.*

Generating Differences Reports

You can generate reports about the applications that have been compared:

- A report about the left application/project.
- A report about the right application/project.
- A report about the selected application component.

The amount of information shown in the reports is determined by the items selected in the Filters dialog box (see p. 3-8 for details on setting the filters).

To generate a differences report for one of the applications in either pane:

1 (If necessary) Modify the items selected in the Filters dialog box.

2 Choose Reports|Left Application (or Right Application). The report opens in the Report Viewer.

To generate a differences report for one of the application's components:

1 (If necessary) Modify the items selected in the Filters dialog box.

2 Select an application component in either of the panes.

3 Choose Reports|Selected Application Component. The report opens in the Report Viewer.

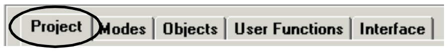
For details about using the Report Viewer, see “Working with Reports in the Report Viewer” on p. 25-3.

COMPARING PROJECTS

In the Project view, you can see the comparison of project components and resources (e.g., audio and graphic files). You can also select individual components to be compared.

To compare projects:

- Click the Project tab.

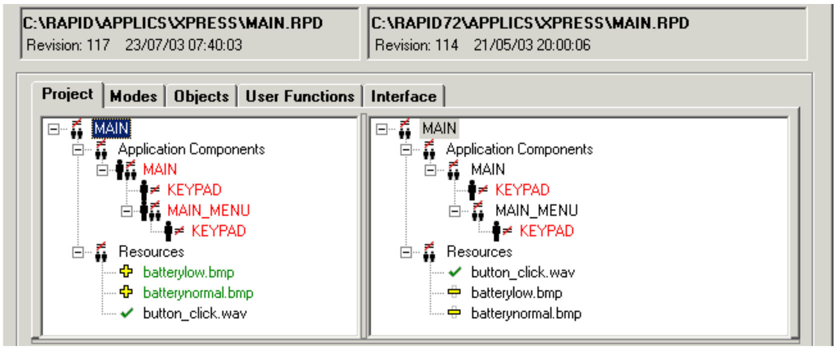


The comparison is based on each component's properties, or more specifically, their revision comments. For a component comparison to be accurate, the Log check box must be selected in each component's Application Properties dialog box. This check box enables RapidPLUS to keep track of the component's revisions. If this check box was not selected from the first time the component was created, project comparisons will not be accurate; however, all the other comparisons (modes, objects, etc.) will be accurate. For details about the Log check box, see "Using the Application Properties Dialog Box" on p. 1-11.

❖ *IMPORTANT: If you are using an external version control application, we recoommend that you clear the Log check box because as it increases the version number, it adds a line of code to the resulting XML file. This change causes a conflict when merging application or component versions. Keep in mind that clearing the Log check box will disable project comparisons in the Differencing Tool (but modes, objects, etc. can still be compared).*

The following illustrations show the Differencing window in Project view. See the Comparison table on p. 3-5 for an explanation of the comparison icons and colors.

Upper section of the Differencing Tool window in Project view:


C:\RAPID\APPLICS\XPRESS\MAIN.RPD
Revision: 117 23/07/03 07:40:03

C:\RAPID72\APPLICS\XPRESS\MAIN.RPD
Revision: 114 21/05/03 20:00:06

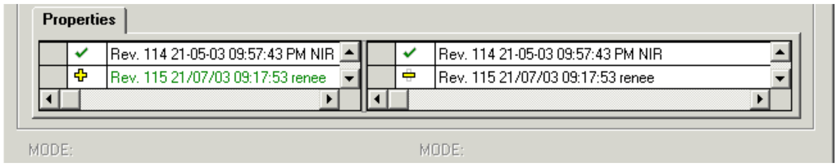
```
MAIN
  Application Components
    MAIN
      KEYPAD
      MAIN_MENU
        KEYPAD
  Resources
    batterylow.bmp
    batterynormal.bmp
    button_click.wav
```

```
MAIN
  Application Components
    MAIN
      KEYPAD
      MAIN_MENU
        KEYPAD
  Resources
    button_click.wav
    batterylow.bmp
    batterynormal.bmp
```

All of the application components are listed in the order in which they appear in the Project Components list. All of the resources that are located in the application's search path are listed (for details about the search path, see "Search Path for Objects" on p. 1-14).

❖ *NOTE: Embedded bitmaps are not listed with the resources.*

Lower section of the Differencing Tool window in Project view:



✓	Rev. 114 21-05-03 09:57:43 PM NIR	
✚	Rev. 115 21/07/03 09:17:53 renee	

✓	Rev. 114 21-05-03 09:57:43 PM NIR	
⊟	Rev. 115 21/07/03 09:17:53 renee	

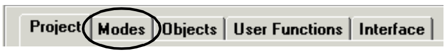
When you select a component, the detailed information panes list its revision information.

COMPARING MODES

In the Modes view, you can see the comparison of destinations, triggers, actions, activities, notes, and mode type (i.e., exclusive or concurrent and default mode status).

To switch to Modes view:

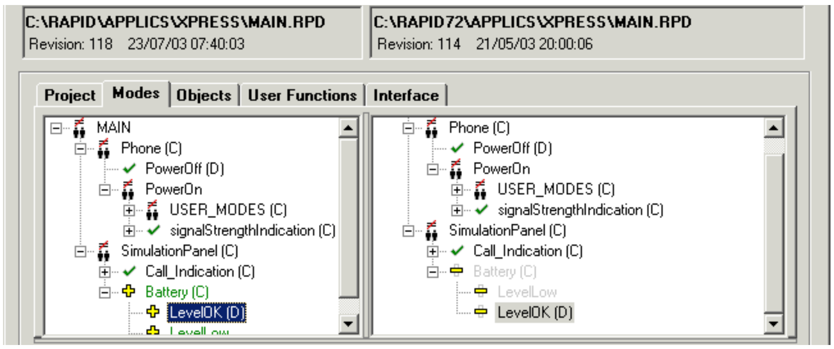
- Click the Modes tab.



By default modes, activities, actions, destinations, triggers, and mode type are compared. To change the default setting, use the Filters dialog box (see p. 3-8 for details about setting the filters).

The following illustrations show the Differencing Tool window in Modes view. See the Comparison table on p. 3-5 for an explanation of the comparison icons and colors.

Upper section of the Differencing Tool window in Modes view:



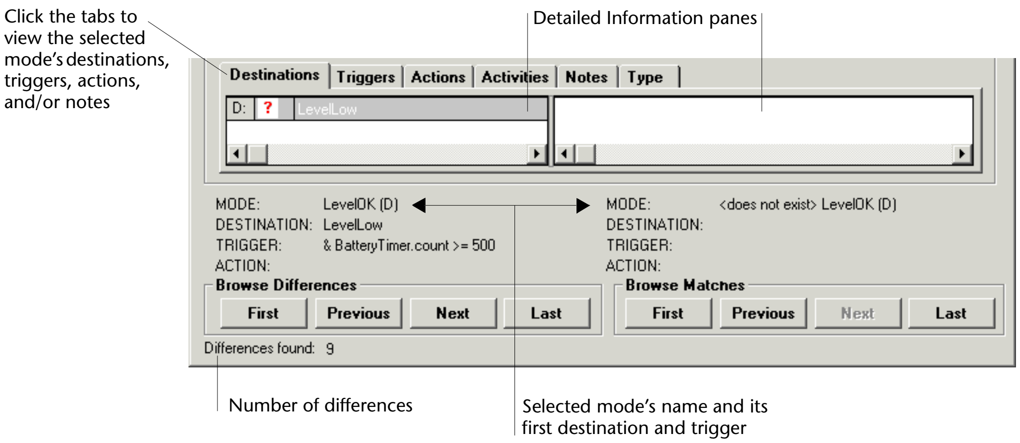
C:\RAPID\APPLICS\XPRESS\MAIN.RPD
Revision: 118 23/07/03 07:40:03

C:\RAPID72\APPLICS\XPRESS\MAIN.RPD
Revision: 114 21/05/03 20:00:06

```
MAIN
  Phone (C)
    PowerOff (D)
    PowerOn
      USER_MODES (C)
      signalStrengthIndication (C)
  SimulationPanel (C)
    Call_Indication (C)
    Battery (C)
      LevelOK (D)
      LevelLow
```

```
Phone (C)
  PowerOff (D)
  PowerOn
    USER_MODES (C)
    signalStrengthIndication (C)
SimulationPanel (C)
  Call_Indication (C)
  Battery (C)
    LevelLow
    LevelOK (D)
```

Lower section of the Differencing Tool window in Modes view:



Click the tabs to view the selected mode's destinations, triggers, actions, and/or notes
Detailed Information panes
Destinations
Triggers
Actions
Activities
Notes
Type
D: ? LevelLow
Browse Differences
First
Previous
Next
Last
Browse Matches
First
Previous
Next
Last
Number of differences
Selected mode's name and its first destination and trigger

```
MODE:         LevelOK (D)                      MODE:        <does not exist> LevelOK (D)
DESTINATION:  LevelLow                         DESTINATION:
TRIGGER:      & BatteryTimer.count >= 500      TRIGGER:
ACTION:                                        ACTION:
```

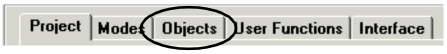
Differences found: 9

COMPARING OBJECTS

In the Objects view, you can see the comparison of graphic, nongraphic, ActiveX, JavaBean, and/or user objects.

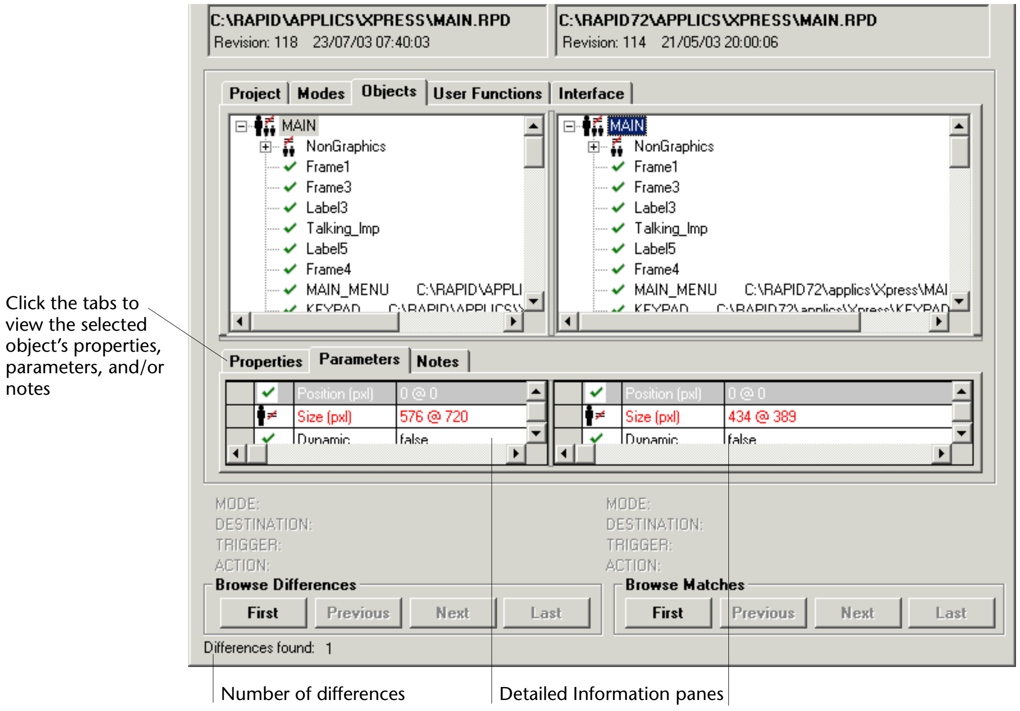
To switch to Objects view:

- Click the Objects tab.



By default properties, parameters, and notes are compared. To change the default setting, use the Filters dialog box (see p. 3-8 for details about setting the filters).

The following illustration shows the Differencing Tool in Objects view. The detailed information panes list the properties of the selected objects. See the Comparison table on p. 3-5 for an explanation of the comparison icons and colors.


C:\RAPID\APPLICS\XPRESS\MAIN.RPD
Revision: 118 23/07/03 07:40:03

C:\RAPID72\APPLICS\XPRESS\MAIN.RPD
Revision: 114 21/05/03 20:00:06

```
MAIN                          MAIN
  NonGraphics                   NonGraphics
  Frame1                        Frame1
  Frame3                        Frame3
  Label3                        Label3
  Talking_Imp                   Talking_Imp
  Label5                        Label5
  Frame4                        Frame4
  MAIN_MENU  C:\RAPID\APPLI     MAIN_MENU  C:\RAPID72\applics\Xpress\MAI
  KEYPAD     C:\RAPID\APPLICS\  KEYPAD     C:\RAPID72\applics\Xpress\KEYPAD
```

	Left		Right
Position (pxl)	0 @ 0	Position (pxl)	0 @ 0
Size (pxl)	576 @ 720	Size (pxl)	434 @ 389
Dynamic	false	Dynamic	false

MODE:
DESTINATION:
TRIGGER:
ACTION:

MODE:
DESTINATION:
TRIGGER:
ACTION:

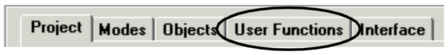
Differences found: 1

COMPARING USER FUNCTIONS

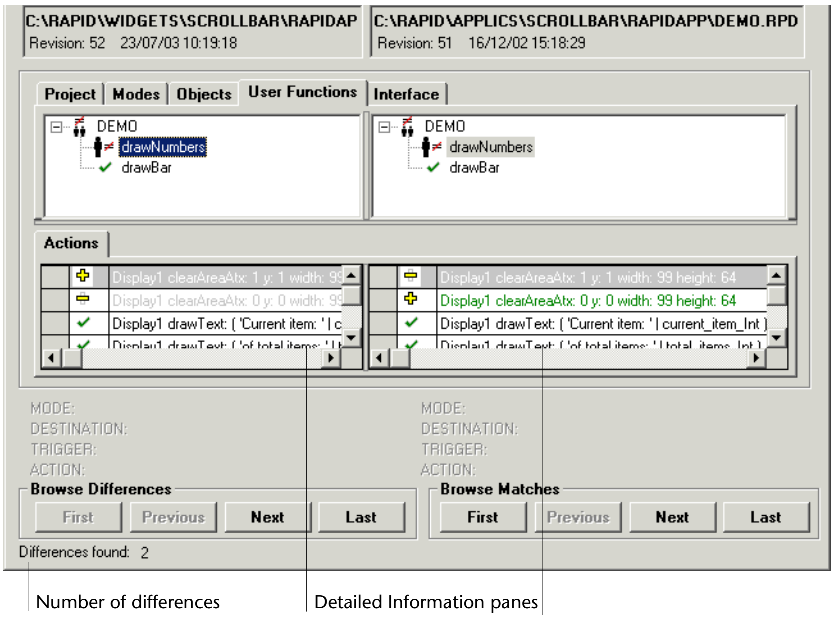
In the User Functions view, you can compare the logic of user functions.

To switch to User Functions view:

- Click the User Functions tab.



The following illustration shows the Differencing Tool in User Functions view. See the Comparison table on p. 3-5 for an explanation of the comparison icons and colors.



C:\RAPID\WIDGETS\SCROLLBAR\RAPIDAP
Revision: 52 23/07/03 10:19:18

C:\RAPID\APPLICS\SCROLLBAR\RAPIDAPP\DEMO.RPD
Revision: 51 16/12/02 15:18:29

Display1 clearAreaAtx: 1 y: 1 width: 99
Display1 clearAreaAtx: 0 y: 0 width: 99
Display1 drawText: ('Current item: ' | c
Display1 drawText: ('of total items: ' | t

Display1 clearAreaAtx: 1 y: 1 width: 99 height: 64
Display1 clearAreaAtx: 0 y: 0 width: 99 height: 64
Display1 drawText: ('Current item: ' | current_item_Int)
Display1 drawText: ('of total items: ' | total_items_Int)

MODE:
DESTINATION:
TRIGGER:
ACTION:

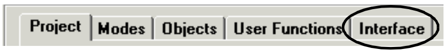
Differences found: 2

COMPARING INTERFACES

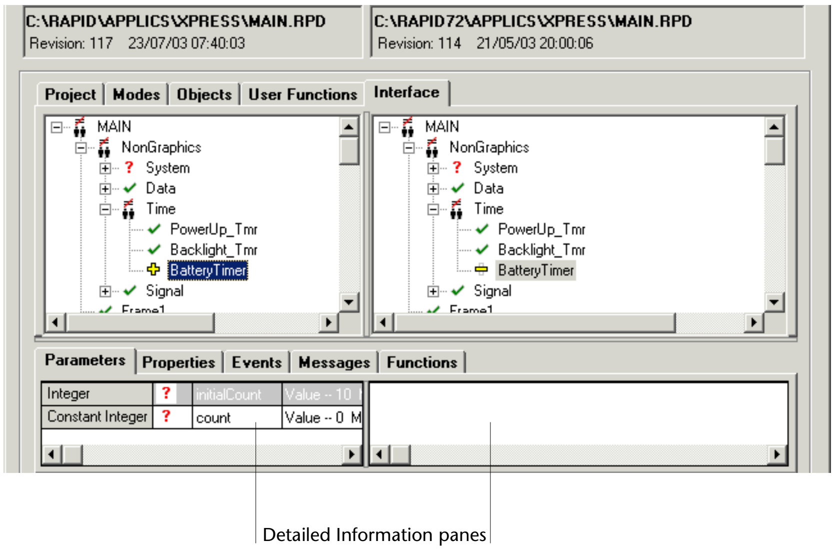
In the Interface view, you can compare exported properties, events, messages, and functions.

To switch to Interface view:

- Click the Interface tab.



The following illustration shows the Differencing Tool in Interface view. The detailed information panes display the exported properties, events, messages, and functions, but not the details about them. See the Comparison table on p. 3-5 for an explanation of the comparison icons and colors.



Integer	?	initialCount	Value -- 10
Constant Integer	?	count	Value -- 0 M

C H A P T E R 4

Debugging Applications

The RapidPLUS Debugger tool helps you to identify and isolate errors in an application. With the Debugger, you can see the “inner workings” of the application by checking the value of variable or the contents of objects.

The Debugger takes control of the application as it runs in the Prototyper, pausing at designated breakpoints. You can use the Debugger to examine step-by-step execution of logic commands and how it affects the application.

The Debugger includes two utilities with which you can closely follow application execution: the Logger and the Call Stack. The Logger displays the flow of the application as it runs in the Prototyper, including information on user object interface execution. The Call Stack displays a sequence of stack frames leading up to the current logic statement.

The Debugger, Logger, and Call Stack, help you find which points in the logic or which object values are causing unexpected or undesirable results.

This chapter presents:

- How to control an application with the Debugger.
- How to log the execution of an applications and read the Logger pane.
- How to manage and navigate Logger files.
- Logger usage examples.
- How to use the Call Stack.
- How to inspect the contents of objects.

❖ *NOTE: This chapter replaces Chapter 15: “Debugger” of the Rapid User Manual.*

USING THE DEBUGGER TOOL

With the Debugger, you can control the Prototyper in a way that enables you to closely inspect those parts of an application's logic that are of particular interest.

A common way to do this would be to set breakpoints at mode entries or exits, or at specific logic lines. Once set, you run the Prototyper via the Debugger and the Debugger pauses the Prototyper automatically when it encounters a breakpoint. You can also manually pause the Prototyper at any time during execution.

Once the Prototyper is paused, you can use the Debugger controls to execute the application's logic step by step. While you are stepping through logic with the Debugger, you can observe which logic line is about to be executed in the Logic Editor.

The basic steps for using the Debugger:

1 Open the Debugger.

2 Set breakpoints by one of the following methods:

   - In the Debugger, click the breakpoint buttons to set breakpoints at the selected mode’s entry or exit.
   - In the Mode Tree, right-click a mode name and choose Break on Entry (Ctrl+B) or Break on Exit (Ctrl+K).
   - In the Logic Editor, click the gray selection button to the left of any logic line.

3 Run the Prototyper. It pauses automatically at a breakpoint. The breakpoint button, mode name, and/or logic line are highlighted.

4 Use the Debugger stepping buttons to step through the application logic.

Additional options for debugging applications with the Debugger include:

- Making use of the Logger and the Call Stack panes.
- Opening Inspector windows to examine the contents of objects and the values of variables in the current state.
- Setting filters and other options in the Debug and Logging Options dialog box.

Opening the Debugger Toolbar

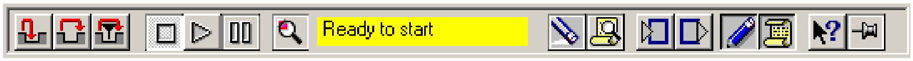
With the Debugger toolbar, you can control aspects of the Prototyper, as well as the Logger and the Call Stack.

To open the Debugger:

Ctrl+G
Ctrl+Shift+L

- In the Application Manager, choose View|Debugger or click the Debugger button.

  The Debugger toolbar opens. Note that some buttons appear only when the Logger and Call Stack panes are showing:



The toolbar buttons are described in the following table:

ITEM	DESCRIPTION
Stepping buttons	Used to run an application step by step: • The first button executes the next logic line, stepping into a user function (if relevant). • The second button executes the next logic line, executing a user function as one block (if relevant). This button also has special functionality when used with the call stack. (See “Activating a Stack Frame” on p. 4-27.) • The third button executes application logic, and then pauses at the next logic line that matches the logging filters. See “Controlling the Application” on p. 4-7.
Prototyper control buttons	Used to stop, start, and pause/resume the application running in the Prototyper. See “Controlling the Application” on p. 4-7.
Inspect button	Used to examine the status of an object. See “The Inspector Window” on p. 4-27.

ITEM	DESCRIPTION
Ready to start *Status line*	Displays application status messages. See "Onscreen Notifications" on p. 4-8.
Breakpoint buttons	Used to set entry and exit breakpoints on a selected mode. See "Adding and Removing Breakpoints" on p. 4-5.
Clear button	Used to erase the Logger. This button appears when the Logger pane is showing. See "Managing Logs" on p. 4-21.
Find button	Used to find strings in the Logger. This button appears when the Logger pane is showing. See "Managing Logs" on p. 4-21.
Enable/Disable Logging button	Used to enable or disable logging. See "Logging Application Execution" on p. 4-10.
Show/Hide Panes button	Used to show or hide the Logger and Call Stack panes. See "Using the Call Stack" on p. 4-24.
Help button	Used to access context-sensitive Help for toolbar buttons and menu commands.
Always on Top button	Used to enable or disable Always on Top for the Debugger toolbar and panes.

If only the toolbar is displayed, you can click the Show Panes button to show the Logger and the Call Stack panes. Descriptions of the Logger and Call Stack elements can be found in this chapter:

- "Logging Application Execution" on p. 4-10.
- "Using the Call Stack" on p. 4-24

The Debugger menu bar becomes available when the panes are open. Menu commands are also available when you right-click the Debugger toolbar or status line.

Adding and Removing Breakpoints

A **breakpoint** is a logic line, mode entry, or mode exit in an application that causes the application to pause in the Debugger. Breakpoints enable you to observe the state of an application at specific stages.

You can set a breakpoint at any logic line (i.e., destination, trigger, action, activity, or user function line), or at the entry or exit point of any mode. You can add or remove breakpoints at any time, even while the Debugger is running.

To add or remove a breakpoint in a logic line:

1. Select a logic line in the Logic Editor.
2. Click the gray selection button to the left of the logic line. You can also choose Breakpoint from the Debug menu or popup menu.

   Once set, the selection button appears green when the Debugger is closed, and red when the Debugger is open.

To add or remove a breakpoint in the Mode Tree:

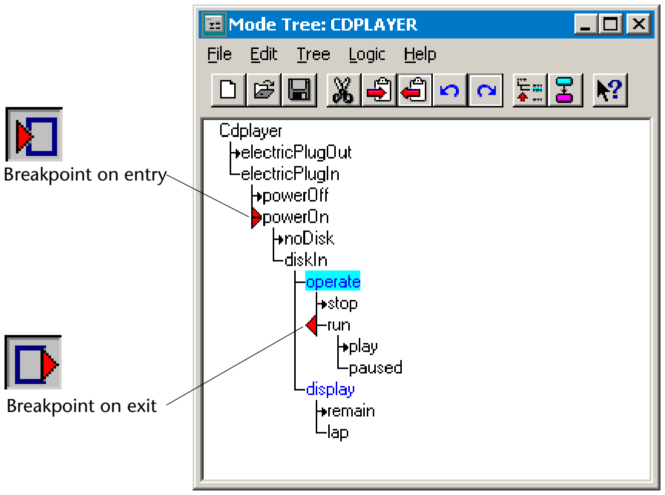
Breakpoint on entry

Breakpoint on exit

1. Select a mode in the Mode Tree.
2. To set a breakpoint at the **mode entry**, click the Breakpoint on entry button in the Debugger toolbar. You can also choose Break on Entry from the Mode Tree's Tree menu, or from the mode's popup menu.

   To set a breakpoint at the **mode exit**, click the Breakpoint on exit button in the Debugger toolbar. You can also choose Break on Exit from the Mode Tree's Tree menu, or from the mode's popup menu.

Once set, a breakpoint appears by the mode in the Mode Tree. The breakpoint appears green when the Debugger is closed, and red when the Debugger is open.



To remove all breakpoints simultaneously:

- In the Debugger, choose Breakpoints|Clear all breakpoints, or in the Logic Editor, choose Debug|Remove all breakpoints. Breakpoints are removed from the Logic Editor and the Mode Tree.

STEPPING INTO APPLICATIONS

With the Debugger, you can monitor the behavior of an application by executing a block of logic and then pausing the Prototyper. The Debugger contains the following controls for the application:

- Prototyper controls, which run the application until it encounters a breakpoint and automatically pauses, or until you pause the application manually.
- Stepping controls, which automatically pause the Prototyper after executing one line (or block) of logic.

Controlling the Application

You can run an application from either the Prototyper or the Debugger. If you run the application from the Prototyper, be sure that the Debugger is already open. Otherwise, you will have to stop and restart the application to use the Debugger features.

The Debugger toolbar contains some of the same buttons for running the application as the Prototyper: Stop, Play, Pause/Resume. You can also access these controls from the Debug menu in the Debugger menu bar.

Specific to the Debugger, though, are stepping buttons—Step Into, Step Over, and Step by Filter—which are used to execute a line or block of logic and then pause automatically. These buttons can be used to start the application or to continue after it has been paused. They are described in the following table:

BUTTON	DESCRIPTION
Step Into	Step to the first, or next, logic line in the application. If the highlighted logic line is a call to a user function, Step Into stops at the first logic line in the user function. You can also choose Debug|Step Into or press F7.
Step Over	Step to the first, or next, logic line in the application. If the highlighted logic line is a call to a user function, Step Over executes the entire user function and then stops at the next logic line. This button has special functionality when used with the active frame in the call stack. (See “Activating a Stack Frame” on p. 4-27.) You can also choose Debug|Step Over or press F8.
Step by Filter	Step to the first, or next, logic line in the application that matches the logic items selected in either the Filters menu or the Debug and Logging Options dialog box, Filters tab. See “Filter Options” on p. 4-19 for details. You can also choose Debug|Step by Filter.

If the application requires user input in order to continue, the application will remain idle (with the status message “Prototyper Running”) after you've resumed the Debugger. **You must provide the required input for your**

application to continue (e.g., click a pushbutton or change a switch position).

Onscreen Notifications

As you run an application with the Debugger, the application's status is reflected through one or more of the following notifications:

- Status messages are displayed in the status line and the Debugger window's title bar.
- The current mode in the Mode Tree is highlighted.
- The logic line which is about to be executed is highlighted in the Logic Editor.
- A breakpoint button in the Debugger window may turn yellow.

Status Messages

The following status messages are displayed in the Debugger window status line, and are reflected in the window's title bar:

DEBUGGER STATUS	STATUS MESSAGE
Stopped	Ready to start
Started in run mode	Prototyper Running
Started in stepping mode	**For destination, mode entry and mode exit:** <mode name>: Stepped At: <logic line description>, such as Destination, Mode Entry, Exit Activity, Trigger, etc. **For triggers, actions, and activities:** the actual logic line as it appears in the Logic Editor.
Paused by the user when no logic line is being executed (such as when the application is waiting for user input)	<mode name>: User Break At: Idle
Paused by the user at a trigger, action, or activity	The logic line as it appears in the Logic Editor.

DEBUGGER STATUS	STATUS MESSAGE
Paused at a breakpoint	<mode name>: Hit Breakpoint At: <breakpoint location>, such as Mode Exit, Entry Activity, etc.
In run or stepping mode, when a user action is required to continue	Prototyper Running

The background of the status line message is yellow when no logic line is highlighted in yellow in the Logic Editor. The background of the status line message is gray when a logic line is highlighted in the Logic Editor.

Active Modes and Current Logic Lines

If the Mode Tree window is open, then the current mode—i.e., the mode of the logic line currently being executed—is highlighted in yellow. In addition, a yellow arrow by a mode indicates that the mode is about to be entered or exited. A red arrow by the mode indicates that a breakpoint has been set on that mode's entry/exit. (See "Adding and Removing Breakpoints" on p. 4-5.)

If the Logic Editor display is synchronized with the execution (see the following section), then the next logic line to be executed is highlighted in yellow. When the Debugger pauses at a breakpoint that was set in the Mode Tree or with a Breakpoint button, then the first activity for the mode is *selected* in the Logic Editor, but not highlighted.

Synchronizing the Logic Editor and the Debugger

In the Logic Editor and the Debugger, there are two options to control synchronization between these tools:

- **Follow Execution:** When this option is selected, each time the Debugger *pauses* an application, the Logic Editor highlights the logic line to be executed next.
- **Synchronize:** When this option is selected, the Logic Editor highlights the logic line that is to be executed next.

Follow Execution vs. Synchronize

You may be wondering why you would need to synchronize the Logic Editor and Debugger if you have Follow Execution enabled.

The Synchronize command is useful when you have been browsing to other modes in the Logic Editor while the Debugger is paused. You can then choose Debug|Synchronize to immediately resynchronize the Logic Editor and the Debugger.

LOGGING APPLICATION EXECUTION

The Logger is a debugging utility used to follow the flow of an application as it runs in the prototyper. With the Logger, you can record and present descriptions of logic execution.

You can enable logging at any time, even while the application is already running in the Prototyper. While logging an application, you can open the Logger pane in order to view the log as it is being created, or close the pane and let the log run in the background. You can also suspend and continue logging while the application continues to run.

Enabling and Viewing the Log

You can enable or disable logging, and open or close the Logger pane at any time, even while the application is running.

To control logging:

1 Click the Enable/Disable logging button in the Debugger or the Prototyper toolbar. Alternatively, choose Logging|Enable logging from the Debugger menu.

2 Click the Enable/Disable logging button to suspend logging and click again to continue.

An ellipsis (...) in each column of the Logger pane marks the point where logging was suspended and then continued.

When logging is enabled, a log is created even if the Debugger is closed or the Logger pane is not showing.

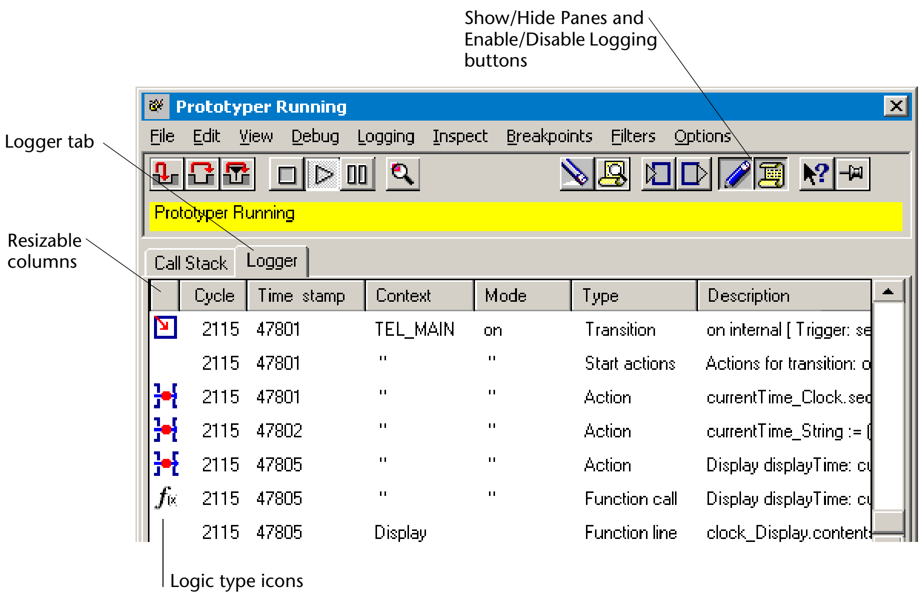
To view the Logger pane:

1 In the Debugger, click the Show/Hide Panes.

2 Click the Logger tab to see log data.

❖ *NOTE: Showing the pane while logging may slow down the application's execution. If this creates a* ***performance problem,*** *you should close the pane and let the Logger run in the background. You can view the log data at any time by just opening the pane.*

The following illustration shows a typical Logger pane after the Prototyper has started:


Show/Hide Panes and Enable/Disable Logging buttons
Logger tab
Resizable columns
Logic type icons
Prototyper Running
File Edit View Debug Logging Inspect Breakpoints Filters Options
Prototyper Running
Call Stack
Logger

	Cycle	Time stamp	Context	Mode	Type	Description
	2115	47801	TEL_MAIN	on	Transition	on internal [Trigger: se
	2115	47801	"	"	Start actions	Actions for transition: o
	2115	47801	"	"	Action	currentTime_Clock.sec
	2115	47802	"	"	Action	currentTime_String := [
	2115	47805	"	"	Action	Display displayTime: cu
fx	2115	47805	"	"	Function call	Display displayTime: cu
	2115	47805	Display		Function line	clock_Display.content

The columns in the Logger pane present the following information:

COLUMN	DESCRIPTION
Logic type icons	Icons to help easily identify logic types.
Cycle	State machine cycle.
Time stamp	Elapsed time, in milliseconds.

COLUMN	DESCRIPTION
Context	The component (parent application or user object) that contains the executed logic line.
Mode	Mode in which the executed logic line is located.
Type	Logic type (e.g., transition, action, function line).
Description	Logic line and/or a description of the logic.

See "Managing Logs" on p. 4-21 for more details.

To show or hide columns:

1 With the Logger pane open, choose View|Logger.

2 Select columns you want to show, and clear the mark by columns to hide.

To enable automatic Logger scrolling while debugging:

- In the Logger pane, drag the scroll box to the bottom-most position. The Logger scrolls automatically so that the most recent entries are visible.

Understanding the Logger Icons and Descriptions

The Logger pane can show icons for the different types of logic, so that you can easily identify specific logic types in the application. You can determine what kind of logic is logged through the Debug and Logging Options dialog box (see "Configuring Log Data" on p. 4-16). The following tables list logic types that are related to application execution, and logic related to user object interface.

Note that listed logic types are used for stepping by filter as well as for the log.

Logic Related to Application Execution

The following information can be displayed for a running application. Note that by default, the filters for user functions, mode entry/exit activities, and mouse movements are not selected.

ICON	LOGIC TYPE	DESCRIPTION AND EXAMPLES
Activities		Entry, mode, and exit activities. Examples:
	Entry	**lamp1 on**
	Mode	**counter changeBy: 1**
	Exit	**lamp1 off**
Transitions		Type of transition (default, history, deep history, or internal), its source and destination modes, and the trigger. Examples:
	Internal	**off internal [Trigger: Pushbutton1 in]**
	Default	**off -----> on [Trigger: Pushbutton1 in]**
	History	**off -----> on [Trigger: Pushbutton1 in]**
	Deep history	**off -----> on [Trigger: Pushbutton1 in]**
Conditions		Evaluation of a condition and the result (true or false). Example:
	Condition	**& PB1 is in [false]**

ICON	LOGIC TYPE	DESCRIPTION AND EXAMPLES
Actions		Transition actions, preceded by the log entry "Start actions" (which defines the transition). Example:
(no icon)	Start actions	**Actions for transition: -----> on**
●	Action	**Timer1 start**
●	Action	**Lamp1 on**
User functions		Logic line of a user function. Example:
(no icon)	Function line	**icons_Array[<Icon_idx>] on**
Mode entry/exit		Indication that a mode was entered or exited. It can be useful to track the flow among modes if the application has no or few entry/exit activities. Example:
▷□	Mode entered	**Mode outgoingCall was entered**
□▷	Mode exited	**Mode outgoingCall was exited**
User input		Event caused by user input in the Prototyper—that is, actions that can be recorded in the Recorder—such as clicking pushbuttons and flipping switches. Example:
⚡	User event	**Sw1.up make**
Internal events		Event generated internally by the logic, such as timer *tick* events or applink object's *dataReceived* event. Example:
⚡	Internal event	**Applink1 dataReceived**
Runtime errors		Logic line and cause of fatal or non-fatal runtime error. Example:
❗	Runtime error	**lamp_Array[Integer1] blink [lamp_Array : Index out of bounds]**

ICON	LOGIC TYPE	DESCRIPTION AND EXAMPLES
Dynamic user object allocation		Indication that an instance of an object defined in a holder was allocated during runtime or deleted during runtime. Examples:
	Dynamic allocation	**1$MyUDO_Holder_classDefault was allocated**
	Dynamic allocation	**1$MyUDO_Holder_classDefault was deleted**

Logic Related to User Object Interfaces

The following information can be displayed for the interfaces of user objects.

ICON	LOGIC TYPE	DESCRIPTION AND EXAMPLES
Property changes		An exported property has been changed. Example:
	Property changed	**PBS.scanCode**
Function calls		An exported function has been called. Example:
	Function call	**Icons iconOn: 2 [calling: iconOn:]**
Events		An exported event has been triggered. Example:
	Object event	**PBS.pb1_in triggered**

ICON	LOGIC TYPE	DESCRIPTION AND EXAMPLES
Structures		Structure-related log entries. Examples:
(red on black S)	Structure assigned	Union Structure **calls.outgoingCall assigned**
(red on black S)	Structure sent	Recipient **calls.outgoingCall sent [=>TEL_NET]**
(black on red S)	Structure received	Sender **calls.outgoingCall received [<=Network]**
(black on red S)	Structure deactivated	**calls.incomingCall deactivated**

Configuring Log Data

For large and complex applications, a complete log of all activities could be difficult to interpret and analyze. You can configure the Logger to include more- or less-specific logic types, modes, and user objects while it logs the application execution. The Debug and Logging Options dialog box can determine the extent and type of data to be logged.

To access the Debugger and Logger configuration options:

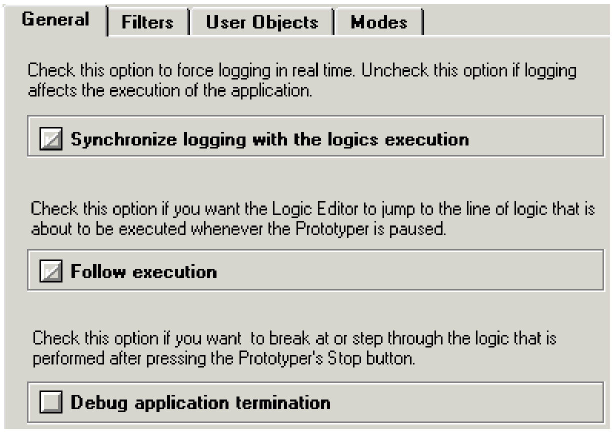
- Choose Options|Open Options Dialog; the Debug and Logging Options dialog box opens.

The dialog box has four tabbed pages:

TAB	DESCRIPTION	REFERENCE
General	Sets options for: • Synchronizing logging with logic execution. • Following logic execution in the Logic Editor. • Debugging logic carried out after the application is stopped in the Prototyper.	p. 4-17
Filters	Selects the types of logic activities to be included in the log, or as stepping destinations when stepping by filter.	p. 4-19
User Objects	Specifies which user object interfaces and which application modes are to be logged (according to the filters defined in the Filters tab).	p. 4-20 and p. 4-21
Modes		

General Options

The General tabbed page presents options for coordinating the application execution in the Prototyper, its logging, and following its logic in the Logic Editor.



Check this option to force logging in real time. Uncheck this option if logging affects the execution of the application.

[✓] Synchronize logging with the logics execution

Check this option if you want the Logic Editor to jump to the line of logic that is about to be executed whenever the Prototyper is paused.

[✓] Follow execution

Check this option if you want to break at or step through the logic that is performed after pressing the Prototyper's Stop button.

☐ Debug application termination

❖ *NOTE: You can also set these options directly in the Debugger's Options menu, without opening this dialog box.*

Synchronizing the log with the logic's execution

Selecting this option updates the log (when the log pane is open) at the end of the current state machine cycle.

Clearing this option updates the log when the Prototyper is idle and waiting for user input, or when paused (by a breakpoint, after a step, or by clicking the Pause button).

❖ *NOTE: When looking for timing problems in an application, it is advisable to clear this option. When selected, synchronizing the log may interfere slightly with the application's performance.*

By default, this option is selected.

Follow execution

Selecting this option highlights the line of logic about to be executed in the Debugger when the Prototyper is paused (by a breakpoint, after a step, or by clicking the Pause button). The line of logic in the Logic Editor will be highlighted in yellow.

This option applies to the Debugger, and does not affect the log. It is the same as the Follow Execution command discussed on pp. 4-9–4-10.

By default, this option is selected.

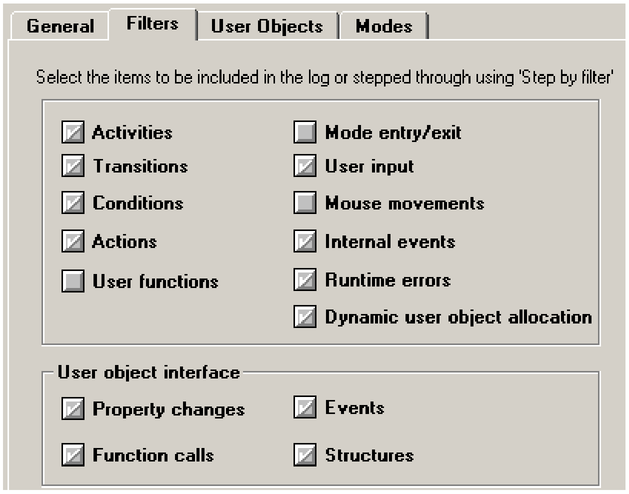
Debug application termination

Some logic lines (such as the root mode's exit activities) are performed only after you stop the Prototyper. Selecting this option enables you to beak at or step through application logic that is performed only after stopping the Prototyper.

By default, this option is not selected.

Filter Options

The Filters tabbed page presents options for the log and for stepping by filter.



Select the items to be included in the log or stepped through using 'Step by filter'

- [✓] Activities
- [✓] Transitions
- [✓] Conditions
- [✓] Actions
- [ ] User functions
- [ ] Mode entry/exit
- [✓] User input
- [ ] Mouse movements
- [✓] Internal events
- [✓] Runtime errors
- [✓] Dynamic user object allocation

User object interface

- [✓] Property changes
- [✓] Function calls
- [✓] Events
- [✓] Structures

❖ *NOTE: You can also set these options directly in the Debugger's Filters menu, without opening this dialog box.*

Selected items appear in the log pane and determine at what points the application pauses when using Step by Filter.

For example, if you select "Activities" only, then:

- The log includes entry, exit, and mode activities, but no other logic.
- Step by Filter executes all intervening logic without pausing, and then pauses at the next activity.

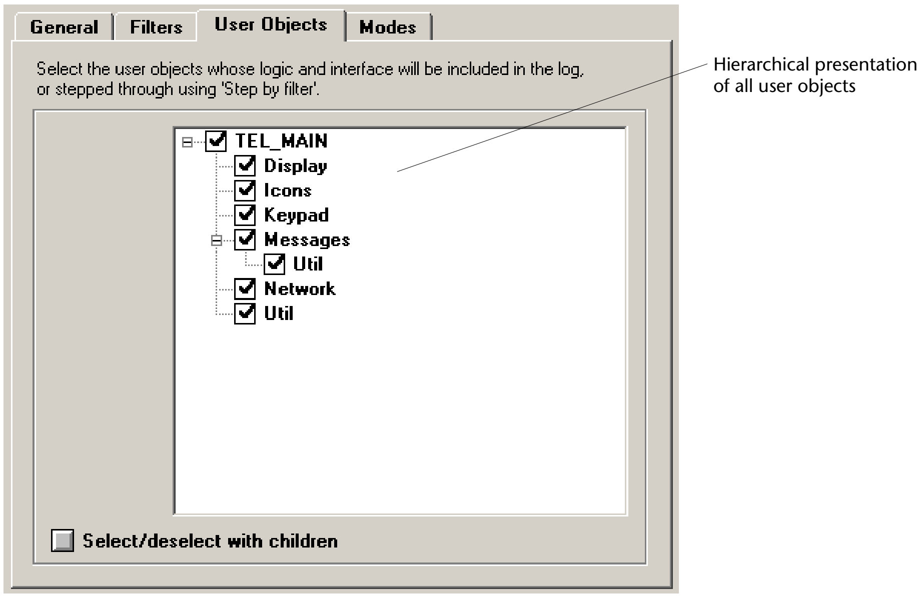
Thus, if you are paused at the last exit activity of ModeA, on a transition to ModeB, clicking Step by Filter executes all actions (if any) related to the transition and then pauses at the first entry activity of ModeB.

Descriptions and examples of the different kinds of logic can be found in "Managing Logs" on p. 4-21.

User Object and Mode Options

In the User Objects and Modes tabbed pages, you can designate which user object interfaces and which application modes should be included for logging information and for stepping filters. Keep in mind, that the scope of the logic (i.e., which types of logic statements to include) is determined in the Filters tabbed page.

Selecting user objects



Select the user objects whose logic and interface will be included in the log, or stepped through using 'Step by filter'.

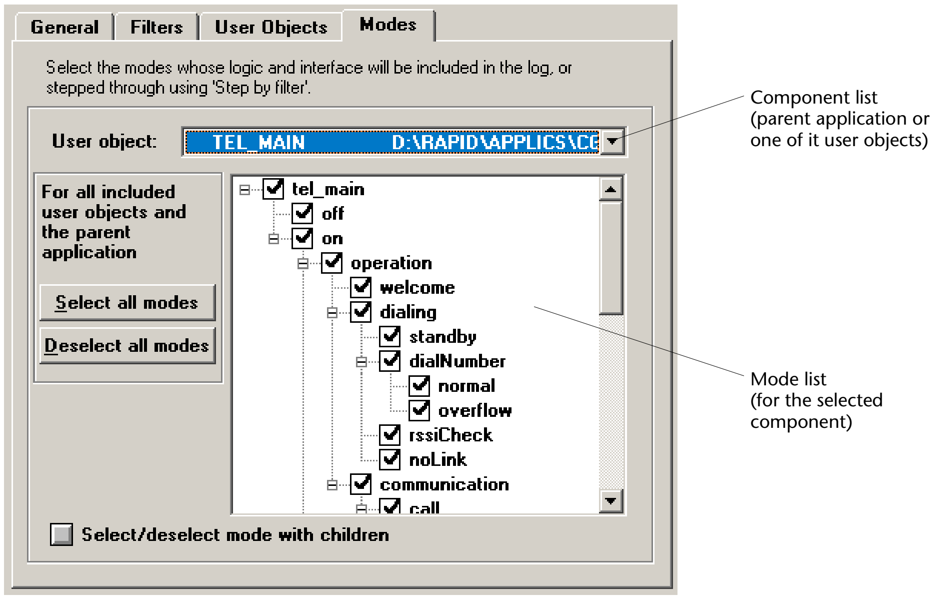
- ✓ TEL_MAIN
  - ✓ Display
  - ✓ Icons
  - ✓ Keypad
  - ✓ Messages
    - ✓ Util
  - ✓ Network
  - ✓ Util

☐ Select/deselect with children

Logic from selected user objects will be included in the log pane and used for stepping filters.

Selecting the “Select/deselect with children” check box automatically enables you to select (or deselect) all of a parent application’s nested user objects.

Selecting modes



Select the modes whose logic and interface will be included in the log, or stepped through using 'Step by filter'.

For all included user objects and the parent application

Logic from selected modes will be included in the log pane and used for stepping filters.

MANAGING LOGS

Logs can be saved and then reopened, or printed. The Logger pane can be cleared without stopping the Prototyper. In addition, you can search for text strings in the log, and use log entries to go straight to the corresponding logic statement in the Logic Editor.

To save the log showing in the Logger pane:

1 Choose File|Save As.

2 Browse to the folder in which you want to save your log, and click Save.

By default, the file name is *<application_name>.RPL*, but you can rename the file. You can also select to save the file as ASCII text (TXT) from the File Type list or by choosing File|Save As Text.

The two formats differ in the following way:

- Binary (RPL) files can be reopened in the log pane.
- ASCII text (TXT) file can be opened in any text editor.

To open a log file in the Debugger:

1 Choose File|Open log file.

2 Browse to a log file with the RPL extension, and click Open.

To print a log file:

1 Choose File|Print. A read-only preview of the log appears, as well as the standard Microsoft Windows Print dialog box.

2 Select a printer and paper orientation (you may want to set it for landscape orientation) and click OK.

To clear the log pane:

Ctrl+C

- Choose Edit|Clear, or click Clear. The log pane remains open, but all the log entries are deleted. If you have not saved the log to file, it can no longer be retrieved.

NAVIGATING WITH THE LOGGER

You can go directly from a log entry to the equivalent logic statement in the Logic Editor. You can also perform a text search within the Logger pane.

To go to the logic statement in the Logic Editor:

1 Select the line in the Logger.

1 Choose Edit|Goto, or double-click the line. The Logic Editor opens with the corresponding logic statement selected.

To find text in the Logger pane:

Ctrl+F

1 Choose Edit|Find, or click Find. A dialog box opens.

2 Enter the text string and click OK. The search starts at the currently selected line.

If the text string is not found when the end of the log is reached, you are asked to confirm continuing the search from the beginning.

3 Choose Edit|Find next to find the following instance of the string.

LOG USAGE EXAMPLES

The following examples illustrate situations in which the Logger can be very efficient in pinpointing the source of application problems.

Tracing a Bug in the Application Logic Flow

Sometimes, the precise execution flow of the logic is not obvious during application development, which leads to unexpected results during runtime. For example, you may have an application in which there is a transition from ModeA to ModeB based on the trigger:

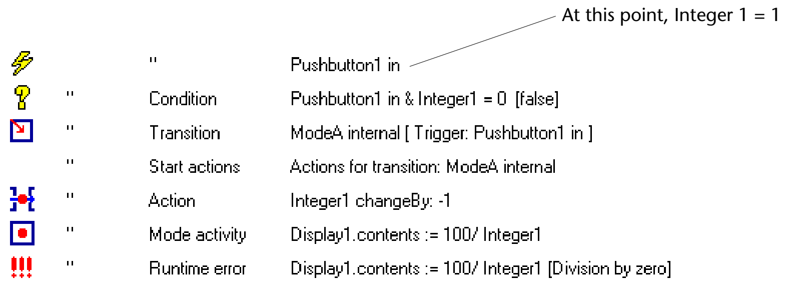
Pushbutton1 in & Integer1 = 0

In addition, Mode A has a mode activity:

Display1.contents := 100/Integer1

During runtime, a "division by zero" runtime error occurs at the transition from ModeA to ModeB. This is puzzling, since it seems that the transition to ModeB should take place as soon as Integer1 reaches zero, leaving the mode **before** the mode activity is executed.

You could use the Logger to quickly analyze the problem. In the Filters tabbed page of the Debug and Logging Options dialog box, limit the logic types to Activities, Transitions, Mode entry/exit, and Runtime errors. Then run the application, with logging enabled and the Logger pane open. At the time that the runtime error occurs, the log entries are:



```
        "                Pushbutton1 in
   "    Condition        Pushbutton1 in & Integer1 = 0  [false]
   "    Transition       ModeA internal [ Trigger: Pushbutton1 in ]
   "    Start actions    Actions for transition: ModeA internal
   "    Action           Integer1 changeBy: -1
   "    Mode activity    Display1.contents := 100/ Integer1
   "    Runtime error    Display1.contents := 100/ Integer1 [Division by zero]
```

From the log, it becomes clear that the RapidPLUS state machine executes the mode activity **before** the transition takes place, thus unintentionally causing a runtime error.

Very High CPU Usage

Condition-only triggers on internal or recursive (i.e., from the mode to itself) transitions are repeatedly evaluated the entire time that the mode is active. This virtually constant evaluation places serious demands on the CPU during runtime and can visibly slow down the application's execution or cause other performance difficulties.

With conditions included in the logging filters, it is very easy to spot condition-only triggers that are constantly demanding CPU time. Even when the Prototyper is idle (i.e., waiting for user input in order to continue), condition log entries are being continuously added to the Logger.

❖ *NOTE: You should correct this situation by adding an event (such as a timer tick) to the trigger, in which case the trigger is only evaluated when the event takes place.*

USING THE CALL STACK

The Call Stack displays a sequence of stack frames leading up to the current logic statement. The Call Stack is displayed while the Debugger is paused at a point that logic is executed. The Debugger pauses at a breakpoint, by a Stepping button, at a runtime error, or by clicking the Pause button,

Viewing the Call Stack

To view the Call Stack:

1 In the Debugger, click the Show/Hide Panes button.

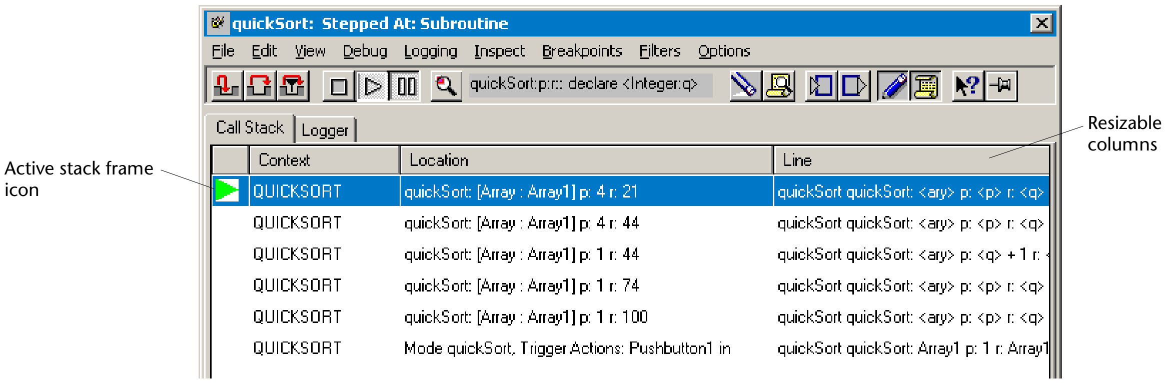
2 Click the Call Stack tab to see stack frame data.

The Call Stack pane remains inactive until the Debugger is paused and displays a status message:

- <application is stopped> when the Prototyper is stopped.
- <application is running> when the Prototyper is running.

- <call stack is unavailable> when the Prototyper is paused at a point where no logic is executed (e.g., while exiting a mode or evaluating a trigger).

The following illustration shows a sample Call Stack pane while stepping through an application:


quickSort: Stepped At: Subroutine
File Edit View Debug Logging Inspect Breakpoints Filters Options
quickSort:p:r:: declare <Integer:q>
Call Stack
Logger
Active stack frame icon
Resizable columns

	Context	Location	Line
▶	QUICKSORT	quickSort: [Array : Array1] p: 4 r: 21	quickSort quickSort: <ary> p: <p> r: <q>
	QUICKSORT	quickSort: [Array : Array1] p: 4 r: 44	quickSort quickSort: <ary> p: <p> r: <q>
	QUICKSORT	quickSort: [Array : Array1] p: 1 r: 44	quickSort quickSort: <ary> p: <q> + 1 r:
	QUICKSORT	quickSort: [Array : Array1] p: 1 r: 74	quickSort quickSort: <ary> p: <p> r: <q>
	QUICKSORT	quickSort: [Array : Array1] p: 1 r: 100	quickSort quickSort: <ary> p: <p> r: <q>
	QUICKSORT	Mode quickSort, Trigger Actions: Pushbutton1 in	quickSort quickSort: Array1 p: 1 r: Array1

The top row is the most recent stack frame and contains the logic line where the Debugger has paused. Each row of the Call Stack provides the following information:

COLUMN	DESCRIPTION
Active stack frame icon	Indicates the active frame in the stack.
Context	The component (parent application or user object) that contains the calling logic.
Location	Logic position of the calling function, including: • Entry, mode, or exit activity. • Trigger evaluation. • Action in a transition. • Subroutine call. See “Examining the Logic Location” below.
Line	Logic line that contains the calling logic.

To show or hide columns:

1 With the Call Stack pane open, choose View|Call Stack.

2 Select columns you want to show, and clear the mark by columns to hide.

Examining the Logic Location

The Location column of the Call Stack pane contains the following information:

LOGIC LOCATION	DESCRIPTION AND EXAMPLE
Activity	The mode name and the type of activity (entry, mode, or exit). Example: **Mode quickSort, Entry activity**
Trigger evaluation	Transition source and destination modes, and the trigger logic. Examples: • Default transition: **standby---->operate, Trigger: Pb_operate in** • Internal transition: **Mode quickSort, Trigger: Pb1 in**
Actions in a transition	Transition source and destination modes, and the trigger logic. Examples: • Default transition: **standby---->operate, Actions for trigger: Pb_operate in** • Internal transition: **Mode quickSort, Actions for trigger: Pb1 in**
Subroutine call	The full name of the subroutine (user function), including the values of the arguments. The argument values are in the same format for local variable values in the logic palette. Example: **drawString: 'Hello' atX: 3 y: 5 with GDO: [Graphic_Display: gdo1]**

Activating a Stack Frame

By default, the most recent stack frame is active. Double-clicking a row in the Call Stack makes it active. For any active stack frame, the following applies:

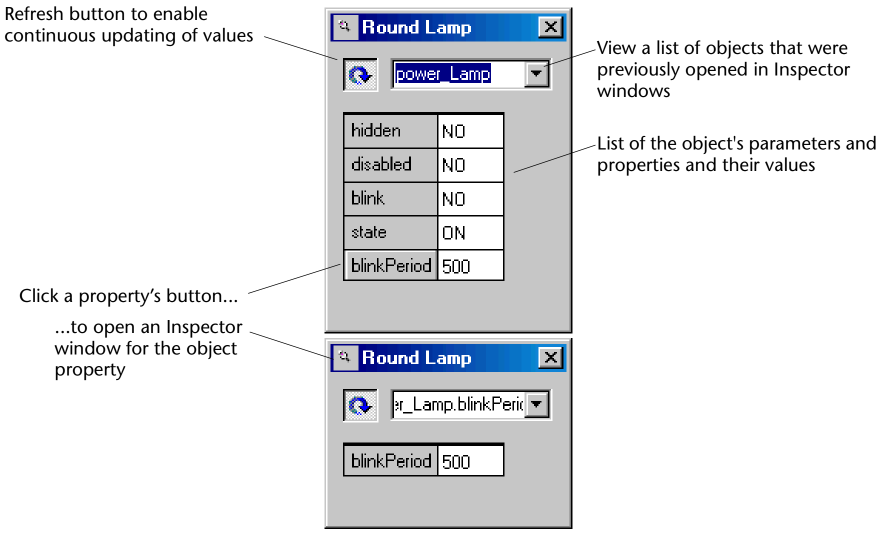
- The corresponding logic line is highlighted in the Logic Editor.
- The values of local variables for *that frame* appear in the Logic Palette's Object list.
- The Step Over button will stop at the next line, which is either in the active frame or a less recent stack frame. This can be especially helpful to step over recursive functions.

THE INSPECTOR WINDOW

Sometimes when an application is running in the Prototyper, you will want to know the current status of graphic and nongraphic objects. RapidPLUS provides this information in Inspector windows.

An Inspector is a stand-alone window that displays status information about an object while the Prototyper is running. A separate window opens for each object and any number of Inspector windows can be opened. An Inspector is a debugging utility, which can be accessed with or without the Debugger.

Typical Inspector windows looks like these two windows:


Refresh button to enable continuous updating of values
View a list of objects that were previously opened in Inspector windows
List of the object's parameters and properties and their values
Click a property's button...
...to open an Inspector window for the object property
Round Lamp
power_Lamp
Round Lamp
r_Lamp.blinkPeric

hidden	NO
disabled	NO
blink	NO
state	ON
blinkPeriod	500

blinkPeriod	500

Opening Inspector Windows

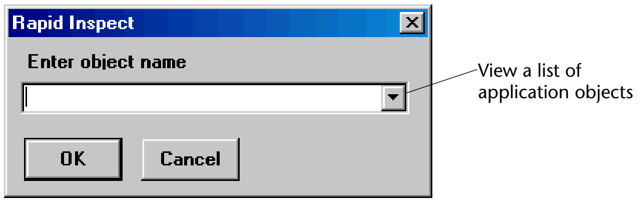
When the Prototyper is running, Inspector windows can be opened from the Debugger, the Logic Editor, and the Logic Palette. Also, once an Inspector window is opened, you can view other application objects in it.

To open the Inspector window from the Debugger:

The Prototyper must be started.

F6

1 Choose Inspect|Inspect, or click the Inspect button; the Rapid Inspect dialog box opens:



2 Type in the name of the object you want to inspect, or click the arrow to select an object from the list of objects, then click OK.

An Inspector window opens displaying the selected object's current status.

To open the Inspector window from the Logic Editor:

The Prototyper must be started.

1 In the Edit line, enter an object's name in one of the following ways:
   - Type in the name.
   - Click a logic line that contains the object and highlight the object.

F6

2 Choose Debug|Inspect, or click the Inspect button.

   An Inspector window opens displaying the selected object's current status. If the logic line contained more than one object—and no object is highlighted—a separate Inspector window opens for each one.

❖ *NOTE: If the edit line is blank or does not contain an object name, the Rapid Inspect dialog box opens (see illustration above), in which you select an object.*

To open the Inspector window from the Logic Palette:

The Prototyper must be started.

1 In the Object List, select the object you want to inspect.

F6

2 Right-click and choose Inspect, or click the Inspect button.

   An Inspector window opens displaying the selected object's current status.

To inspect other objects in an opened Inspector window:

- Overtype the current name with the name of another application object.

Navigating Opened Inspector Windows

Any number of Inspector windows can be opened at a time. Each time an Inspector window is opened, its object is added to the bottom of the Inspect menu in the Debugger.

To navigate among open Inspector windows:

1 In the Debugger, click the Inspect menu. All of the open Inspector windows are displayed at the bottom of the menu.

2 Choose an Inspector window from the list. This window comes into focus.

Closing Inspector Windows

You can close Inspector windows individually by clicking their Close buttons or you can close them all at once.

To close all Inspector windows from the Debugger:

- Choose Inspect|Close all inspectors.

  All the Inspector windows close, but the Prototyper remains open.

To close all Inspector windows from the Logic Editor:

- Choose Debug|Close all inspectors.

  All the Inspector windows close, but the Prototyper remains open.

To close all Inspector windows from the Prototyper:

- Close the Prototyper.

CHAPTER 5

Logic Error View

The Logic Error View is a tool that displays errors and warnings for logic lines that may have become invalid, extraneous, or corrupted due to alterations. It contains options for identifying problematic logic, locating the logic in the Logic Editor, and reverifying logic that has been changed. The tool opens automatically any time problematic logic is detected that may require reverification.

The Logic Error View can also display errors while opening an XML-formatted application (RXD or UXO file). You can use the tool to identify XML lines that are invalid, and open the file in a text editor.

This chapter presents:

- How an application can come to have invalid logic.
- A detailed description of the Logic Error View window and its contents.
- How to reverify logic.

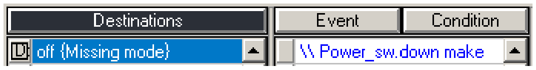
EXAMPLES OF INVALID LOGIC

When certain editing operations render logic invalid, the affected logic is commented out and the Logic Error View opens automatically. Operations that can cause the Logic Error View to open are listed below. Examples follow the table.

TOOL	OPERATION
Mode Tree	Pasting modes that contain references to missing objects or missing modes.
Object Layout	Editing graphic or nongraphic objects, such as: • Deleting objects referenced in the logic. • Replacing objects that have logic references to properties that are missing from, or invalid for, the target object. • Updating a user object that contains changes to referenced properties or functions.
Logic Editor	Pasting logic that contains references to missing objects, properties, or user functions.
Application Manager	File operations that may cause the Logic Error View to open: • Opening an invalid RXD or UXO file. • Reverifying logic through the File menu (File|Advanced|Reverify Logic or Reverify Logic All).

Examples

- In the Mode Tree, you pasted a mode with an outgoing external transition to mode “on” and there is no such mode in the target application. The Logic Error View opens and in the Logic Editor, the trigger logic is commented out and the missing destination mode looks as follows:



Destinations	Event	Condition
off {Missing mode}	\\ Power_sw.down make	

- In the Object Layout, you replaced a 4-position rotary switch with a 3-position rotary switch. The target application included the following condition trigger:

  & Switch1.position4 is connected

  After the paste operation, the trigger is invalid. The Logic Error View opens and the following appears in the Logic Editor:

  \\* & Switch1.position4 {Missing Property} is connected**

  Special comment mark (two backslashes and three asterisks)

  Explanatory comment inside two curly brackets

- In the Logic Editor, you paste the following activity:

  Display1 drawText: 'hello' atx: 0 y: 0

  In the “Paste Conflicts: Duplicate Elements Referenced by Pasted Logic” dialog box (see p. 6-17), you choose to keep the source application’s Display1, which is a text display (not a graphic display). Since the pasted logic is invalid if applied to a text display, the Logic Error View opens, and the pasted activity is commented out (\\***) in the Logic Editor.

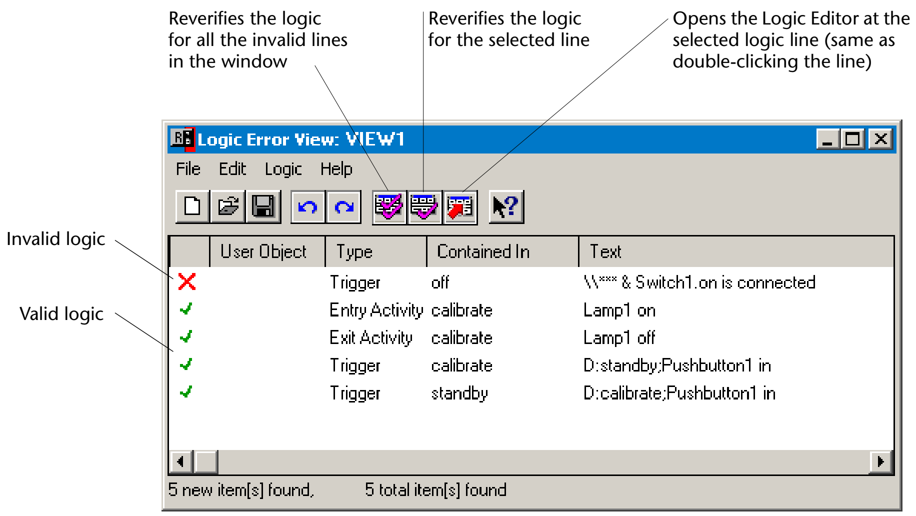
VIEWING INVALID LOGIC

It is up to you to make the required changes to the application in order to fix invalid logic. To easily identify and navigate affected logic, the logic lines are displayed in the Logic Error View whenever an operation occurs that causes invalid logic. You can also open the Logic Error View from the Application Manager.

To open the Logic Error View:

- In the Application Manager, choose View|Logic Error View. The Logic Error View opens showing previous validity checks from the current session.

The following illustration shows an example of the Logic Error View window:


Reverifies the logic for all the invalid lines in the window
Reverifies the logic for the selected line
Opens the Logic Editor at the selected logic line (same as double-clicking the line)
Invalid logic
Valid logic
Logic Error View: VIEW1
File
Edit
Logic
Help

	User Object	Type	Contained In	Text
✗		Trigger	off	*** & Switch1.on is connected
✓		Entry Activity	calibrate	Lamp1 on
✓		Exit Activity	calibrate	Lamp1 off
✓		Trigger	calibrate	D:standby;Pushbutton1 in
✓		Trigger	standby	D:calibrate;Pushbutton1 in

5 new item[s] found, 5 total item[s] found

The columns of the Logic Error View are as follows:

COLUMN	DESCRIPTION
Logic Status (no column title)	Shows status of the changed logic line, as follows: ✗ The logic line is invalid. **Invalid lines will remain commented out when the Logic Error View is closed.** ✓ The logic line is valid. This appears for valid logic lines that were pasted at the same time invalid logic lines were pasted, and for logic lines that have been successfully reverified. ! The logic line has been edited since the window opened, and what appears in the Logic Error View may not reflect the current logic line. A logic line shown in this state cannot be reverified in the Logic Error View. ⚠ The logic line contains syntax that appears to be acceptable, but may actually produce unexpected results or runtime errors. Examples include: a block heading that is not followed by an indented logic block; a user function that references more than 255 objects or properties; or a constant array that is assigned a non-constant parameter. ✗XML This is a warning that the line in the XML file may contain an error that has no effect on the application behavior. !!!XML The line in the XML file contains an error that may affect the application behavior, but the application can still be fully loaded. ❗XML The line in the XML file contains a fatal error that prevents the element it belongs to from being loaded. The related object or logic will not be loaded and the application behavior will be affected. ❖ *NOTE: The XML-related icons appear while opening an RXD or UXO file. For more information about files in XML format, see Chapter 2: “RapidPLUS Applications in XML.”*
User Object	Lists the user object where the item is located; blank if located in the parent application.
Type	Lists the type of logic (action, trigger, activity, user function, or XML text) in which the item appears.

COLUMN	DESCRIPTION
Contained In	Lists the mode or user function to which the item belongs, as follows: • For an activity or action, shows the mode name. • For a trigger, shows the source mode name. • For a user function, shows the user function name. • For an invalid RXD or UXO file, this column is blank.
Text	For logic, lists the complete logic statement in which the edited item is contained. For XML text, lists the validation problem and its location (line and column numbers) in the XML file.

REVERIFYING LOGIC

With the Logic Error View, you can locate the problematic logic lines in the Logic Editor. After you correct errors, you can use the tool to reverify the logic and thus, automatically remove the comment marks.

To correct an error:

1 In the Logic Error View, select a logic line.

2 Choose Logic|Go To, or click the Go To button. Alternatively, double-click the logic line.

3 Correct the invalid logic as required (e.g., add a missing item, change an object's properties, update the Mode Tree).

Ctrl+T Ctrl+I

4 Choose one of the Reverify options from the Logic menu, or click one of the Reverify buttons in the Logic Error View.

If the logic is valid, reverification will remove the comment marks and explanatory comments. The invalid logic icon (✗) will change to the valid logic icon (✓). If the logic is still not valid after reverification, the invalid logic icon changes to the edited logic icon (!). Although you can make the logic line valid and manually remove a comment (e.g., by right-clicking the logic line and choosing Remove Comment), you can no longer reverify this logic line through the Logic Error View.

Copying logic lines

You can copy a logic line as text from the Logic Error View by right-clicking the line and choosing Copy to Clipboard. You can paste the copied logic into the Logic Editor's edit line and edit as needed.

Example: fixing a transition with a missing destination mode

In the Mode Tree, you pasted a mode with a transition to a mode that does not exist in the application, and the Logic Error View opens.

To correct this error:

1. In the Mode Tree, add the missing mode.
2. In the Logic Error View, select the appropriate entry and click the Reverify Selected button. If RapidPLUS can verify the transition to the destination mode, it removes the comment from the logic line in the Logic Editor, uncomments any associated triggers, and changes its status in the Logic Error View window from invalid (✗) to valid (✓).

CHAPTER 6

Pasting Operations

You can use the cut, copy, and paste operations to exchange lines of logic, graphic and nongraphic objects, or modes in an application or between two applications. An application's objects, logic, and/or modes can be reused in other RapidPLUS applications.

This chapter presents:

- Which application elements can be cut, copied, and pasted.
- How RapidPLUS completes a paste operation.
- How paste conflicts are solved if duplicate objects or modes are found in the target application.
- Using Copy and Paste operations to retrieve stored objects.

ELEMENTS YOU CAN CUT, COPY, AND PASTE

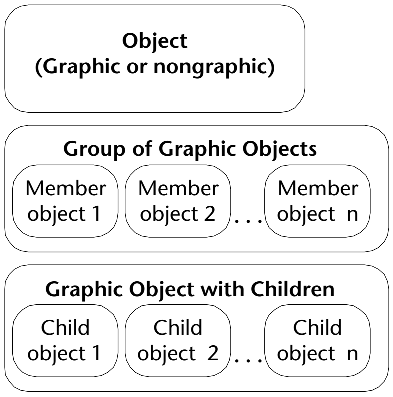
In order to properly understand cutting, copying, and pasting between applications, you must understand what is actually brought over from the source application to the target. For example, when you cut/copy and then paste an entry activity, you are also bringing in the RapidPLUS object referenced by the logic. We call this referenced object a **related element** of the copied logic.

This section outlines the RapidPLUS elements that can be moved from a source application to a target, including a description of the related elements that they bring with them.

Objects

The most basic paste element is a single object, either graphic or nongraphic. When you cut or copy a group of graphic objects, all individual group members are included in the paste as related elements. When you cut or copy a graphic object that has children, all of its children are brought with it, regardless of the status of the Select Children option in the Options menu. However, deleting an object (via Edit|Delete or the Delete key) does not delete the object's children if Options|Select Children is not selected.

Objects that can be pasted:



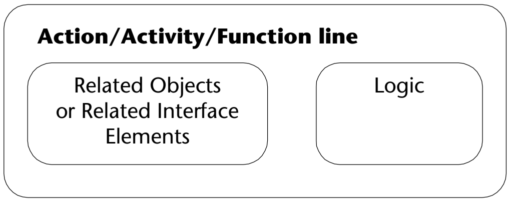
User Object Interface Elements

User object interface elements (properties, events, unions, and top-level structures) can be copied in the User Object Properties dialog box of the source application and pasted in the User Object Properties dialog box of the target application. They are also copied indirectly when copying a logic line that references an interface element.

Logic

Action/Activity/Function Line

The most basic logic element that can be pasted into a target application is a single action or activity (including an activity line in a user function). The chart below illustrates the element(s) pasted into the target application:


Action/Activity/Function line
Related Objects or Related Interface Elements
Logic

Example

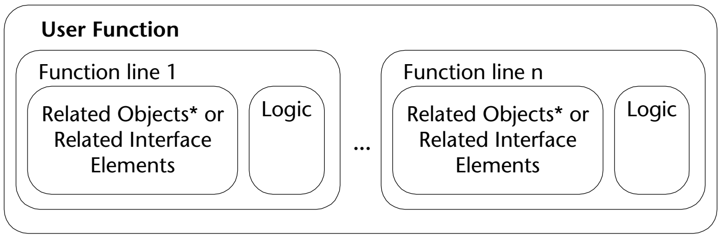
Copying and pasting the activity:

Display1.contents:= Integer2 * Integer3

also pastes the display object and the two integer objects referenced by the logic.

User Function

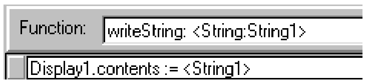
User functions can be copied and pasted directly via the User Object Properties dialog box—or indirectly by copying and pasting a logic line that calls a user function. In either case, the entire user function is pasted, as follows:


User Function
Function line 1
Related Objects* or Related Interface Elements
Logic
...
Function line n
Related Objects* or Related Interface Elements
Logic

* Not to be confused with argument variables

Example

When pasting the following user function, Display1 is pasted, but String1 is not:

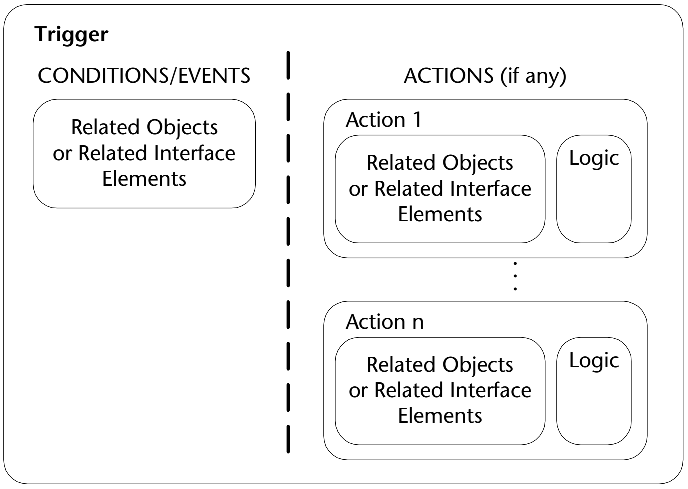


```
Function: writeString: <String:String1>
Display1.contents := <String1>
```

❖ *NOTE: A user function may include calls to other user functions. A call to such a nested function is treated the same way as any logic line that calls a user function, that is, the entire user function is copied and pasted.*

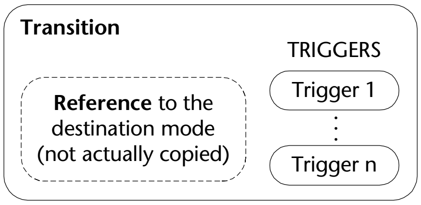
Trigger

The following chart illustrates the elements that are pasted when you copy and paste a trigger.


Trigger
CONDITIONS/EVENTS
Related Objects or Related Interface Elements
ACTIONS (if any)
Action 1
Related Objects or Related Interface Elements
Logic
Action n
Related Objects or Related Interface Elements
Logic

Transition

The following chart summarizes the elements that are pasted when copying a transition:



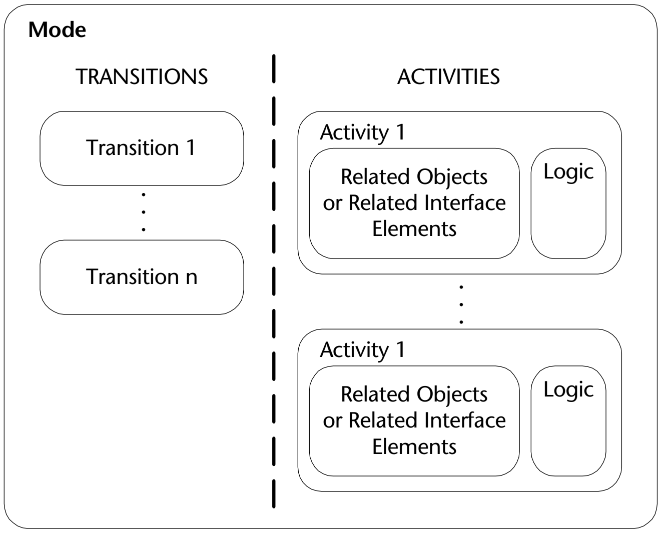
For a detailed description of what's included in each trigger block, please refer to the Trigger chart on p. 6-5. In addition, RapidPLUS takes note of the transition's destination. When pasting the transition in the target, RapidPLUS attempts to reconnect to the referenced destination mode.

If RapidPLUS finds a single mode in the target that matches the referenced destination mode, then the paste operation takes place without further intervention on your part. If, however, there are several modes in the target application that match the referenced destination mode, you are prompted to resolve the conflict, as described in Step 2 in “Pasting Logic in the Logic Editor” on p. 6-11.

❖ *NOTE: If the transition is internal, the paste operation is always straightforward, since RapidPLUS does not have to check for a destination in the target application.*

Mode

As illustrated below, pasting a mode pastes its activities and their related objects. It also pastes its transitions and their related elements, as described in the Transition chart on p. 6-5.


Mode
TRANSITIONS
ACTIVITIES
Transition 1
Transition n
Activity 1
Related Objects or Related Interface Elements
Logic
Activity 1
Related Objects or Related Interface Elements
Logic

Mode with Children (Subtree)

When copying a mode that has children (that is, when copying a subtree), **each** mode is pasted into the target application with its related elements, as shown in the Mode chart above.

In previous versions of RapidPLUS, cutting or copying a mode or subtree in the mode tree automatically deleted outgoing external transitions (if any) when the mode or subtree was pasted back into the tree. Outgoing external transitions are now preserved when you paste.

A PASTE GLOSSARY

Since the following terms are used frequently throughout the rest of this chapter, it is important that their meanings be clear and precise.

Related Element

If a cut or copied element in a source application references other elements, then these referenced elements are pasted as related elements. For example, when you paste an activity, you are also pasting (as a related element) the RapidPLUS object referenced by the logic.

Example

Copying and pasting the activity: **String1 := String2** also pastes the two string objects reference by the logic.

Duplicate Object

A duplicate object is an object in the target application with the same name and class as a pasted object (either pasted directly or as a related element).

Duplicate User Function

A duplicate user function is a user function in the target application with the same keywords as the paste function. However, RapidPLUS does **not** check the argument types.

Examples

DUPLICATE USER FUNCTIONS	NOT DUPLICATE USER FUNCTIONS
User fuction to be pasted: **write:<string> at: <integer>**	User fuction to be pasted: **write:<string> at: <integer>**
User function in target: **write:<string> at: <constant integer>**	User function in target: **write:<string> at: <constant integer>**

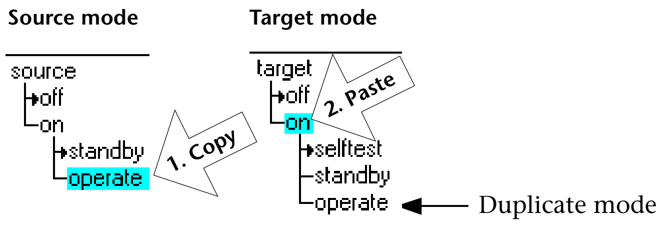
Duplicate Interface Element

A duplicate interface element is a property, event, union, or definition-only structure in the target application with the same name as the pasted interface element.

Duplicate Mode

A duplicate mode is a child mode in the target application subtree with the same name as the pasted mode.

Example

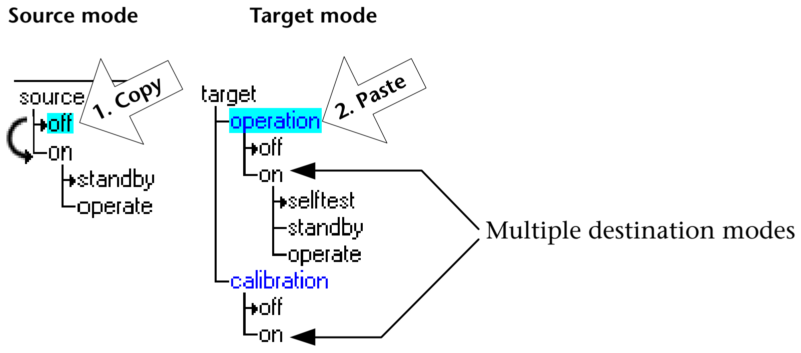


If "operate" mode were pasted to "off" mode in the target application, there would be no conflict.

Transition Conflict

A transition conflict occurs when RapidPLUS has to choose between several possible destinations that have the same name.

Example



A dialog box opens in which you indicate whether to reconnect the pasted mode's off->on transition to operation\on or to calibration\on.

❖ *NOTE: When a duplication or conflict is detected during the paste operation, RapidPLUS displays an easy-to-use interface that alerts you to these conflicts and offers you several ways to handle their resolution. For more details, see "Resolving Duplicate Element Conflicts" on p. 6-15 and "Resolving Transition Conflicts" on p. 6-18.*

PASTING ELEMENTS INTO AN APPLICATION

This section describes how RapidPLUS handles objects, modes, and logic elements that are taken from a source application and pasted into a target application.

Multiple paste operations

Each copy and paste operation is unique to the editing context in which it takes place. Thus, for example, in the source application you can copy both an object in the Object Layout **and** a mode subtree in the Mode Tree without the second copy operation overwriting the first.

In the target application, selecting Edit|Paste Object in the Object Layout pastes the object, and selecting Tree|Paste in the Mode Tree pastes the subtree.

In the Object Layout

Each of the following object types is a unique copy/paste operation:

- Graphic objects
- Nongraphic objects
- User object properties
- User object events
- User object unions and top-level structures
- User functions

In the Logic Editor

Each of the following logic types is a unique copy/paste operation:

- Transitions
- Triggers and user condition function lines
- Function lines, actions, entry/exit activities, and mode activities

Pasting Objects in the Object Layout

1 In the source application's Object Layout, cut or copy the desired objects.

2 In the target application's Object Layout:

Ctrl+V

- For graphic objects: choose Edit|Paste Object, or click Paste Object.
- For nongraphic objects: choose Edit|Paste Nongraphics, or open the Nongraphic Objects dialog box and click the Paste button.

To complete the paste operation, RapidPLUS:	**EXPLANATION**
Checks for a duplicate object in the target application.	If there is a duplicate object, the Paste Conflicts: Duplicate Elements dialog box opens. For details about using the dialog box, see "Resolving Duplicate Element Conflicts" on p. 6-15.
For a graphic object, displays the crosshairs.	Click the mouse to paste the object at the crosshairs location.
For a nongraphic object:	The object is added to the list in the Nongraphic Objects dialog box

Pasting User Object Interface Elements in the Object Layout

1 In the source application, open the User Object Properties dialog box (by choosing Edit|User Object Properties).

2 Go to the appropriate tab(s) and copy the desired interface element(s).

❖ *NOTE: You can use the standard Ctrl-click and Shift-click selection methods to select multiple elements in each tab. In the Messages tab, select the Show Top Level Only option (see p. 22-6) to facilitate multiple selection.*

3 In the target application, open the User Object Properties dialog box, select the appropriate tab(s) and click Paste.

If there is a duplicate interface element in the target application, the Paste Conflicts: Duplicate Elements dialog box opens. For details about using the dialog box, see "Resolving Duplicate Element Conflicts" on p. 6-15.

Pasting Logic in the Logic Editor

❖ *NOTE: For details about logic types that can be pasted and their related elements, see "Elements You Can Cut, Copy, and Paste" on pp. 6-2 to 6-6.*

1 In the source application, cut or copy the desired logic element(s).

Ctrl+V

2 In the target application, select a location for pasting the logic element and choose Edit|Paste or Paste by Type, or click Paste Logic.

To complete the paste operation, RapidPLUS:	**EXPLANATION**
1. Checks if there are duplicate objects (i.e., same name and type) for the objects being pasted as related elements.	If there is a duplicate, then the "Paste Conflicts: Duplicate Elements Referenced by Pasted Logic" dialog box opens. For details about using the dialog box, see "Resolving Duplicate Element Conflicts" on p. 6-15.
2. Pastes the logic line into the target application.	If you are pasting a transition, RapidPLUS tries to reconnect the transition with its destination mode. • If there is no mode in the target application with the same name as the transition's destination mode, the transition is commented out in the Logic Editor. • If there is one matching mode, the transition is reconstructed. • If there are multiple duplicate modes, the Transition Conflict dialog box opens, as described on p. 6-18.

To complete the paste operation, RapidPLUS:	**EXPLANATION**
3. Verifies the application logic.	RapidPLUS checks that: • Any application logic that references changed object(s) is still valid. ***Example*** You paste the activity **Frame1 bringToFront**. The target application has a filled frame of the same name and you choose (in Step 1) to replace the application object. However, the *Frame1* in the target application was dynamic and there is application logic based on its *fillColor* property. Since the pasted *Frame1* is **not** dynamic, the application logic based on the *fillColor* property is no longer executable and is commented out in the Logic Editor. • The pasted logic, and its related logic elements, are executable by the application. ***Example*** You paste the activity **Switch1.position4 connect**. The target application has a rotary switch of the same name and you choose (in Step 1) to keep the application object. However, the *Switch1* in the target application does **not** have a *position4* property. Thus, the pasted logic is not executable, and is commented out in the Logic Editor.
4. If there is invalid logic or you are pasting a user function: Displays the Logic Error View window.	An entry relating to the pasted user function appears in the Logic Error View window, with its status indicating whether or not the pasted function’s logic is valid in the target application. See Chapter 5: “Logic Error View” for details about invalid logic and working with the Logic Error View window.

Pasting Modes in the Mode Tree

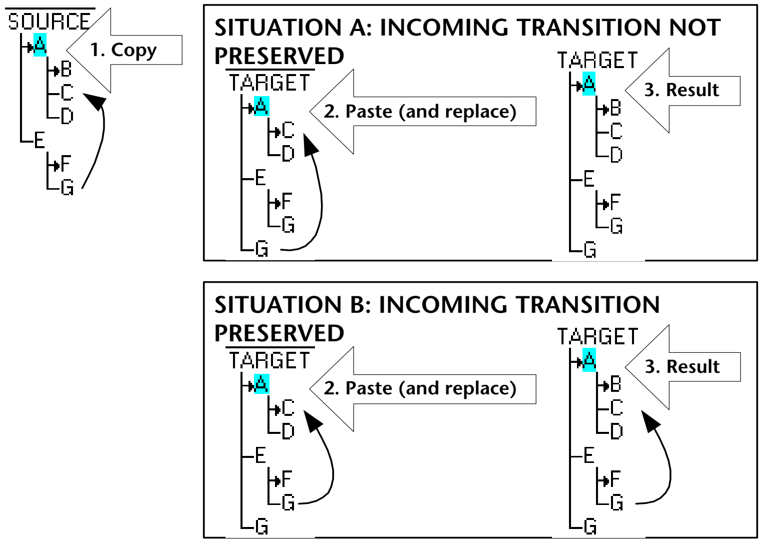
1 In the source application, cut or copy the desired mode(s).

Ctrl+V

2 In the target application, select the mode you want to be the parent of the paste mode and choose Tree|Paste, or click Paste Mode.

To complete the paste operation, RapidPLUS:	EXPLANATION
1. Checks for a duplicate mode.	RapidPLUS checks that there is no other child mode in the target subtree with the same name as the pasted mode. If there is a duplicate mode, the Paste Conflicts dialog box opens. For details about using the dialog box, see "Resolving Duplicate Element Conflicts" on p. 6-15.
2. Checks if there are duplicate objects and/ or user functions for related elements.	RapidPLUS checks that none of the objects or user functions related to the pasted mode has a conflict with objects or user functions currently in the target application. If there is a conflict, the "Paste Conflicts: Duplicate Elements Referenced by Pasted Logic" dialog box opens. For details about using the dialog box, see "Resolving Duplicate Element Conflicts" on p. 6-15.
3. Tries to reconstruct outgoing external transitions (if any)	If there is no mode in the target application with the same name as the transition's destination mode, the transition is commented out in the Logic Editor (see Step 6 below). If there is one matching mode, the transition is reconstructed. If there are duplicate modes, the Transition Conflict dialog box is displayed, as described on p. 6-18.

To complete the paste operation, RapidPLUS:	EXPLANATION
4. If replacing modes in the target application: Tries to preserve incoming transitions.	The illustration below shows that the replacing mode's incoming transition was preserved (Situation B) when the replaced mode in the target application already had an incoming transition from a mode with both the same name **and** hierarchical level.



To complete the paste operation, RapidPLUS:	EXPLANATION
5. Verifies the application's logic.	RapidPLUS checks that: • The pasted logic can be executed by the application. • In the target application logic, references to changed object(s) are valid. ❖ *NOTE: For examples, see Step 3 on p. 6-12.*
6. Displays the Logic Error View window.	All logic in the target application affected by the mode paste operation is displayed in the Logic Error View window: A logic line that has become invalid (e.g., it references a non-existing object property or mode) is commented out with two backslashes and three asterisks(\\***) in the Logic Editor and is appropriately tagged in the Logic Error View window. See Chapter 5: "Logic Error View" for details about invalid logic and working with the Logic Error View window.

RESOLVING DUPLICATE ELEMENT CONFLICTS

The major challenge when pasting elements between RapidPLUS applications is resolving conflicts between the elements cut/copied from the source application and existing (duplicate) elements in the target application. As described in detail in "A Paste Glossary" on pp. 6-7 to 6-8, the duplicate element can be an object, a mode, an interface element (property, event, union, or definition-only structure) or a user function.

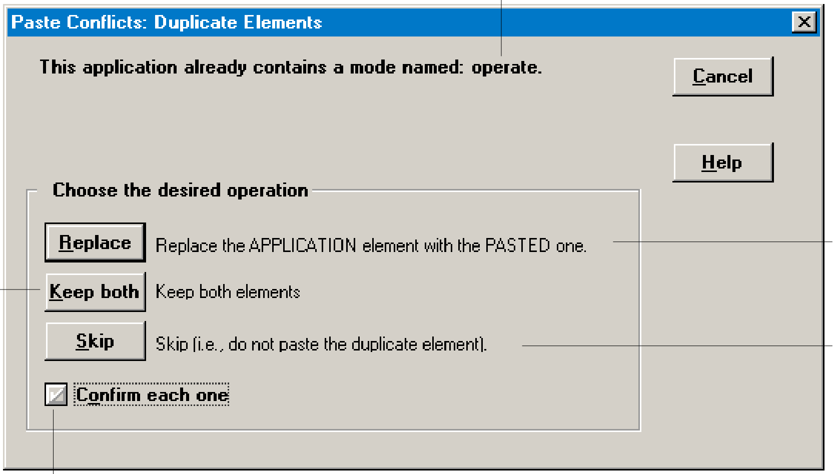
The options for resolving duplicate element conflicts differ somewhat depending on whether the paste element (such as a mode or an object) was cut/copied **directly** in the source application, or whether it is being pasted as a **related** element of another pasted element.

Resolving Conflicts for Pasted Elements

When you cut/copy a mode or an object in the source application and a duplicate mode or object exists in the target application, the following dialog box opens in which you resolve the conflict:

The pasted element is added to the target application, without replacing the duplicate element. A numeric suffix is added to the name of the pasted element

Element from the source application that conflicts with an element in the target application


Paste Conflicts: Duplicate Elements
Cancel
Help
Choose the desired operation
Replace
Keep both
Skip
Confirm each one

This application already contains a mode named: operate.

Replace the APPLICATION element with the PASTED one.

Keep both elements

Skip (i.e., do not paste the duplicate element).

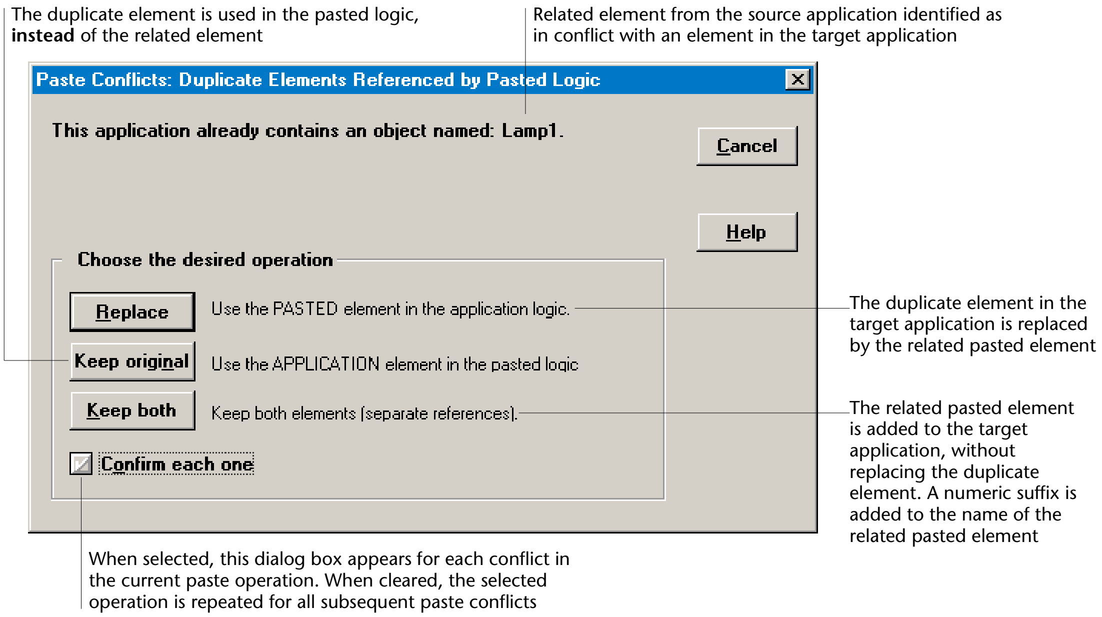
The duplicate element in the target application is replaced by the pasted element

No paste operation takes place

When selected, this dialog box appears for each conflict in the current paste operation. When cleared, the selected operation is repeated for all the subsequent paste conflicts

Resolving Conflicts for Pasted Related Elements

As described in “Elements You Can Cut, Copy, and Paste” on pp. 6-2 to 6-6, there are numerous cases where pasting one element (such as an activity) brings with it other, related elements (such as an object referenced by the activity). When a duplicate element exists in the target application for a pasted related element, a dialog box opens in which you resolve the conflict:


The duplicate element is used in the pasted logic, **instead** of the related element

Related element from the source application identified as in conflict with an element in the target application

Paste Conflicts: Duplicate Elements Referenced by Pasted Logic

This application already contains an object named: Lamp1.

Choose the desired operation

Replace — Use the PASTED element in the application logic.

Keep original — Use the APPLICATION element in the pasted logic

Keep both — Keep both elements (separate references).

Confirm each one

The duplicate element in the target application is replaced by the related pasted element

The related pasted element is added to the target application, without replacing the duplicate element. A numeric suffix is added to the name of the related pasted element

When selected, this dialog box appears for each conflict in the current paste operation. When cleared, the selected operation is repeated for all subsequent paste conflicts

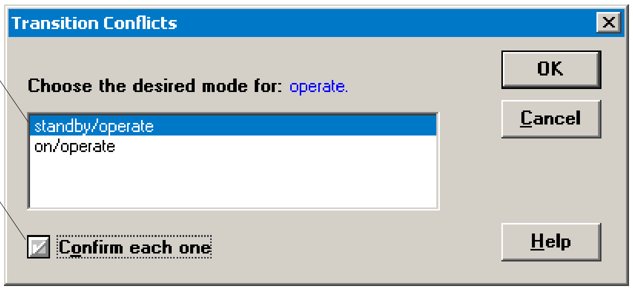
Example

You copied and pasted the activity **Lamp1 off** and there is a duplicate *Lamp1* in the target application.

Selected Operation	RESULT
Replace	The duplicate *Lamp1* is replaced in the Object Layout by the *Lamp1* pasted as a related element.
Keep original	The duplicate *Lamp1* is now the *Lamp1* used in the pasted activity.
Keep both	*Lamp1_1* is added to the Object Layout and the pasted activity is **Lamp1_1 off.**

RESOLVING TRANSITION CONFLICTS

When pasting one or more modes, RapidPLUS attempts to reconstruct their outgoing, external transitions (if any). If the mode tree in the target application contains more than one mode that matches the transition's destination mode, then the Transition Conflicts dialog box opens:



Choose the desired mode for: operate.

standby/operate
on/operate

Confirm each one

Modes identified as a valid destination for the transition

When selected, this dialog box opens for every transition conflict in the current paste operation. When cleared, RapidPLUS connects all broken transitions to the first proposed destination mode and you will not be prompted about further conflicts during this paste operation

❖ *NOTE: The destination modes are listed according to their order in the target application's mode tree.*

STORING OBJECTS

You can create applications to store objects for reuse.

To store objects for reuse:

1 Create an application and save it with a meaningful name (such as *MySwtchs.rpd* for switches, *MyArrays.rpd* for arrays, and so on).

2 Each time you create an object—in a different application—that you want to store, copy it:

- For graphic objects, use Edit|Copy or click the Copy Object button.
- For nongraphic objects, use the Copy button in the Nongraphic Objects dialog box.

3 Open the objects application (*my<object>.rpd*), and paste the object into it.

- For graphic objects, use Edit|Paste Object or click the Paste Object button.
- For nongraphic objects, use Edit|Paste Nongraphics or the Paste button in the Nongraphic Objects dialog box.

CHAPTER 7

Writing Logic Using Loops and Branches

In programming, loops and branches are powerful control structures used to repeatedly or conditionally execute a series of instructions in a single cycle of the state machine.

Loop statements are used to execute a block (i.e., a set of activities) over and over again. Branch statements are used to execute a block only when some condition is satisfied. RapidPLUS uses the following logic constructs:

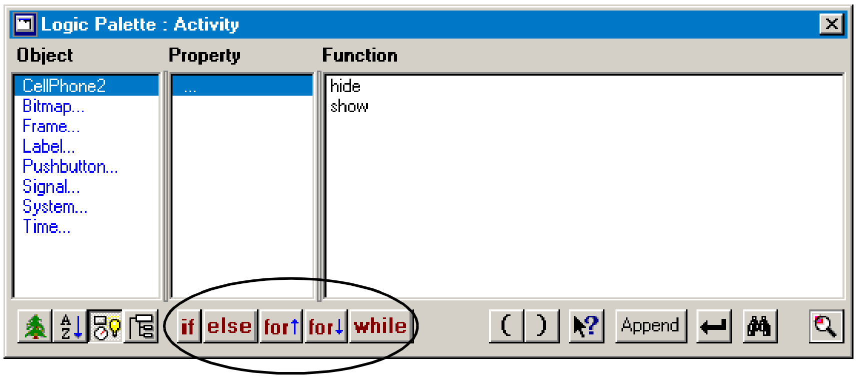
CONTROL STRUCTURE	SYNTAX	DESCRIPTION
while loop	**while <condition>** **<Activity 1>** **<Activity 2>**	Repeats the block of activities **while** the condition is true.
for loop	**for <int object> from <int> to <int> step <int>** **<Activity 1>** **<Activity 2>**	Repeats the block of activities **for** a set number of times.
if...else branch	**if <condition>** **<Activity 1>** **<Activity 2>** **else (optional)** **<Activity 3>** **<Activity 4>**	Executes the block of activities **if** the condition is true. If the condition is false and there is no Else statement, no activity is performed. If the condition is false and there is an Else statement, the second block of activities is performed.

This chapter presents:

- Changes in the Logic Palette to accommodate loops and branches.
- How to build While loops.
- How to build For loops.
- How to build If...else branches.
- An explanation of loop and branch logic execution.

NEW BUTTONS IN THE LOGIC PALETTE

The Logic Palette now contains buttons for building While loops, For loops, and If...else branches:



These buttons are described in the following sections.

WORKING WITH WHILE LOOPS

The While loop has two parts:

PART	DESCRIPTION
Header	The line that holds the construct keyword “while” and the While condition.
Block	Contains activities that will execute as long as the While condition is true.

A typical While loop looks like:

```
Int1 :=1
while ((Array[ Int1] modulo:2) < > 0)                            \\While header
     Int1   changeBy: 1        “continue searching”              \\While block
First_Even_Number := Array[Int1]
```

Notice that the block is indented and that the block’s single activity appears on its own line. For more information about block indentation, see “Understanding Indentation in Loops and Branches” on p. 7-9.

In this While loop, the array index, Int1, continuously changes by 1 until an even number is encountered.

Don’t create While loops that never execute or terminate!

During runtime, a loop is performed as a single activity. That is, RapidPLUS executes the loop header and block as a single piece of logic.

When a loop is being performed, RapidPLUS does not change the application’s state—except for the changes made by the loop itself. Therefore you must be careful when using a loop. For example, why is this While loop improper?

```
while Switch1.up is connected
```

Because during execution of the loop, the state of the switch can never change so either the loop is never executed (not connected) or is infinitely executed (is connected). Another example is:

```
while Timer1. is running
```

Defining a While Loop

A While loop can be used in entry activities, exit activities, actions, and user function activities.

Defining a While Header

To define a While header:

while

1 In the Logic Palette, click the While button. (You can also type the construct keyword “while” in the edit line.)

- The following logic is appended to the Logic Editor’s edit line:

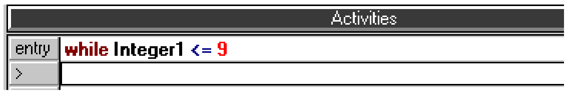
  while <Condition>

- The Logic Palette is set to condition-editing mode and prompts you to enter a condition.

2 Enter the condition.

3 Accept the While header by either clicking the New Line button or pressing Enter.

If the header is valid, a new line is opened below the header. It is automatically indented for the body of the While loop.

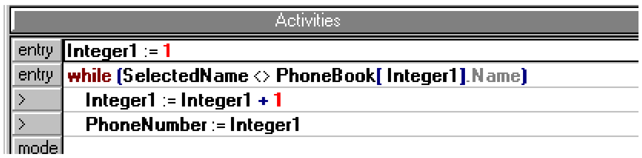


```
while Integer1 <= 9
```

A sample While header

Defining a While Block

A while block contains one or more activities. Below is a sample While loop (header + block).



```
Integer1 := 1
while (SelectedName <> PhoneBook[ Integer1].Name)
   Integer1 := Integer1 + 1
   PhoneNumber := Integer1
```

To define a While block:

The focus should be on the line under the header.

1 Build an activity, then accept it by either clicking the New Line button or pressing Enter.

  The next line is selected and is indented exactly like the previous line.

2 Continue adding activities until the While block is complete.

To end a While block:

- Click the New Line button twice or press enter twice. (See the tip below for more ways to end the block.)

Ways to end an activity block

- Click the New Line button twice.
- Press Enter twice.
- Right-click in the empty line after the block to open the popup menu and choose Decrease Indent.
- In the edit line for the line after the block, delete the symbolic tab (>).

WORKING WITH FOR LOOPS

The For loop has two parts:

PART	DESCRIPTION
Header	The line that holds the construct keyword “for.” Designates the number of times the block of activities will be executed and the value for incrementing the counter.
Block	Contains activities that will execute as long as the For condition is true.

A typical For loop looks like:

```
for <Integer:i>  from 1 to LampArray size step 1              \\For header
    LampArray [<i>] on                                         \\For block
```

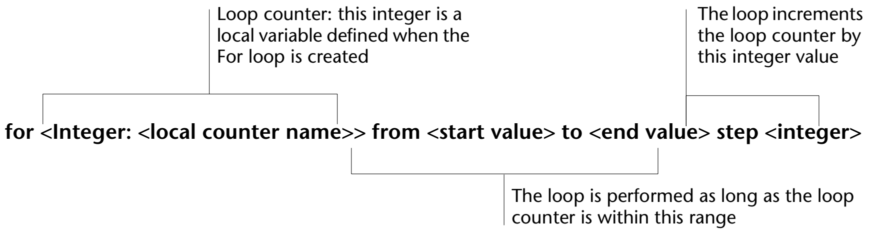
Notice that the block is indented and that each activity appears on its own line. For more information about block indentation, see "Understanding Indentation in Loops and Branches" on p. 7-9.

Defining a For Loop

A For loop can be used in entry activities, exit activities, actions, and user function activities.

Defining a For Header

The syntax of a For header is:



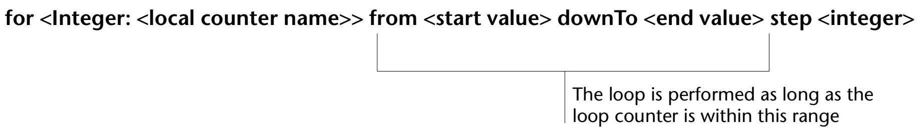
```
for <Integer: <local counter name>> from <start value> to <end value> step <integer>
```

Loop counter: this integer is a local variable defined when the For loop is created
The loop increments the loop counter by this integer value
The loop is performed as long as the loop counter is within this range

❖ *NOTE: The start value, end value, and step can be expressions.*

The Loop counter's initial value is the *start value*. The Loop counter automatically increments—by the *step* value—after each cycle of the loop until it reaches the *end value*.

When the start value is **greater than** the end value, a backward loop should be created. In this case, the syntax includes the keyword "downTo":



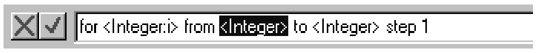
```
for <Integer: <local counter name>> from <start value> downTo <end value> step <integer>
```

The loop is performed as long as the loop counter is within this range

To define a For header:

1 In the Logic Palette, click the For button.

The following logic is appended to the Logic Editor's edit line:



for <Integer:i> from <Integer> to <Integer> step 1

2 The loop counter is assigned a default name. The counter name for the outermost For loop is "i". The subsequent default counter names for nested loops are: j, k, l,....

You can change the loop counter name as desired.

3 You are prompted to enter a starting integer and an ending integer. Enter the starting integer value or expression, and press Tab; enter the ending integer.

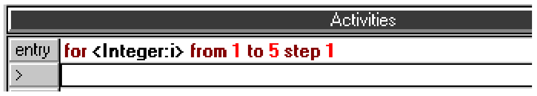
❖ *NOTE: The starting integer's value should be less than the ending integer's value.*

4 The default step (increment) value is 1; change it if necessary.

❖ *NOTE: The step's value must be positive.*

5 Accept the For header by either clicking the New Line button or pressing Enter.

If the header is valid, a new line is opened below the header. It is automatically indented for the body of the For loop.



Activities

entry for <Integer:i> from 1 to 5 step 1

>

A sample For header

To define a backwards For header:

1 In the Logic Palette, click the ForDownTo button.

2 Perform steps 2–4 above.

❖ *NOTE: The step's value must be positive.*

The starting integer's value should be ***greater*** *than the ending integer's value.*

Defining a For Block

To define a For block:

The focus should be on the line under the header.

1 Build an activity, then accept it by either clicking the New Line button or pressing Enter.

   The next line is selected and is indented exactly like the previous line.

2 Continue adding activities until the For block is complete.

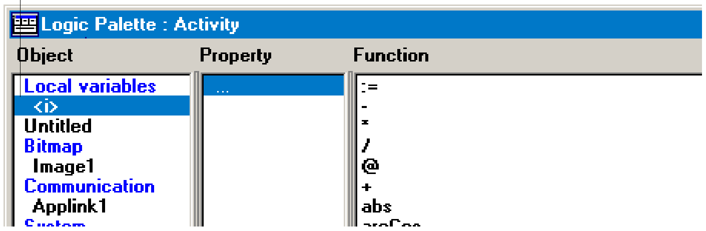
To end a block:

- Click the New Line button twice or press enter twice (see "Ways to end an activity block" on p. 7-5 for other ways to end the block).

Using Loop Counters in Logic

Once a For loop has been created, its loop counter (i, j, etc.) becomes a local variable in the Logic Palette. The local variable is visible only when the focus is within the block of the For loop.

Local variable from the For loop



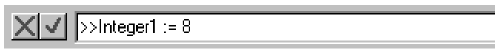
The local variable has all the functions appropriate for a constant integer object, plus the assign (:=) operator.

UNDERSTANDING INDENTATION IN LOOPS AND BRANCHES

Each line in a block is indented under its header. If you create the header first, RapidPLUS will automatically indent the next line when you open a new line below it.

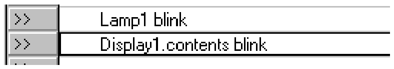
When a line is indented:

- The edit line contains a right angle bracket (>) for each indent. The edit line shown below contains two indents:



```
>>Integer1 := 8
```

- The Line Selector for each activity in a block contains a right angle bracket for each indent and the text is indented accordingly:



```
>>    Lamp1 blink
>>    Display1.contents blink
```

Changing the Indent Width

The default indent width is 4 spaces. You can change the width in the Indentation Width dialog box (Options|Indent Width).

Increasing/Decreasing Indentation

There are two ways to increase or decrease indentation.

To increase indentation:

- Right-click the line to open the popup menu and choose Increase Indent:

  or

- Add a “>” at the beginning of the Edit line.

To decrease the indentation:

- Right-click the line to open the popup menu and choose Decrease Indent:

  or

- Delete a ">" at the beginning of the Edit line.

❖ *NOTE: The first and second options are available only when the result of the changes creates valid logic blocks.*

Pasting Lines into a Block

When a line is pasted into a block, the pasted line adopts the indentation of the target. For example, if the pasted line contains two tabs, but the activity above the paste site only contains one tab, RapidPLUS will reset the pasted line's indentation to one tab.

BREAK/CONTINUE IN FOR AND WHILE LOOPS

You can manipulate the processing of For and While loops using Break and Continue statements.

A Break statement can be used to terminate a loop. A Continue statement can be used to terminate the current cycle of a loop and continue with the next cycle. When there are nested loops, Break and Continue statements affect the innermost loop.

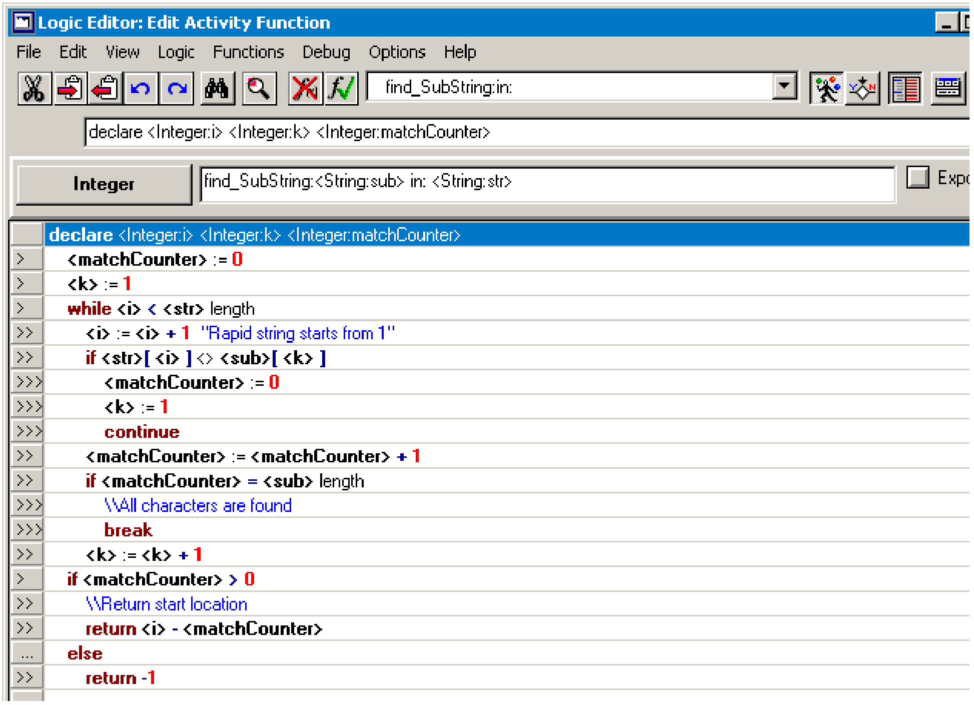
To add a Break statement:

- At the appropriate place in the loop, choose Logic|Break. **break** is appended to the Logic Editor's edit line.

To add a Continue statement:

- At the appropriate place in the loop, choose Logic|Continue. **continue** is appended to the Logic Editor's edit line.

The following user function illustrates the use of Break and Continue statements:


Logic Editor: Edit Activity Function
File Edit View Logic Functions Debug Options Help
Integer
Expo

```
find_SubString:in:
declare <Integer:i> <Integer:k> <Integer:matchCounter>
find_SubString:<String:sub> in: <String:str>

declare <Integer:i> <Integer:k> <Integer:matchCounter>
  <matchCounter> := 0
  <k> := 1
  while <i> < <str> length
    <i> := <i> + 1  "Rapid string starts from 1"
    if <str>[ <i> ] <> <sub>[ <k> ]
      <matchCounter> := 0
      <k> := 1
      continue
    <matchCounter> := <matchCounter> + 1
    if <matchCounter> = <sub> length
      \\All characters are found
      break
    <k> := <k> + 1
  if <matchCounter> > 0
    \\Return start location
    return <i> - <matchCounter>
  else
    return -1
```

WORKING WITH IF...ELSE BRANCHES

If...else branches are used to execute blocks of activities that are dependent on one or more conditions being true. There are three main types of branches:

BRANCH	SYNTAX	DESCRIPTION

if	**if Integer1 = 1**
	    PowerSwitch on
	    Lamp1 on
		Executes a block of activities if the condition is true.
		If the condition is false, none of the activities are performed.

if...else	**if Integer1 = 1**
	    PowerSwitch on
	    Lamp1 on
	else
	    BatteryLowLamp on
		Executes the first block of activities if the condition is true.
		If the condition is false, the second block of activities is executed.

if...
else if...
else
...and so on
	if Interger1 = 0
	    PowerSwitch off
	    BackupLamp on
	else if Integer1 = 1
	    PowerSwitch on
	    Lamp1 on
	else
	    BatteryLowLamp on
		This is a nested branch. It executes the first block of activities if the first condition is true.
		If the first condition is false, the second condition is checked. If it is true, the second block of activities is executed.
		If the second condition is false, the third block of activities is executed.

Notice that the blocks are indented and that each activity appears on its own line. For more information about block indentation, see “Understanding Indentation in Loops and Branches” on p. 7-9.

Defining an If Branch

An If branch can be used in entry activities, exit activities, actions, and user function activities.

To define an If header:

1 In the Logic Palette, click the If button. (You can also type the keyword “if” in the edit line.)

- The following logic is appended to the Logic Editor’s edit line:

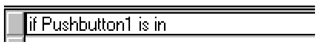
  if <Condition>

- The Logic Palette is set to condition-editing mode, prompting you to enter a condition.

2 Enter the condition.

3 Accept the If header by either clicking the New Line button or pressing Enter.

   The next logic line is selected and is automatically indented for the body of the If branch.



```
if Pushbutton1 is in
```

A sample If header

To define an If block:

1 Build an activity, then accept it by either clicking the New Line button or pressing Enter.

   The next line is selected and is indented exactly like the previous line.

2 Continue adding activities until the While block is complete.

To end an If block:

- Click the New Line button twice or press enter twice. (See "Ways to end an activity block" on p. 7-5.)

Defining an If...Else Branch

An If...else branch can be used in entry/exit activities, actions, and user function activities.

To define an If...else branch:

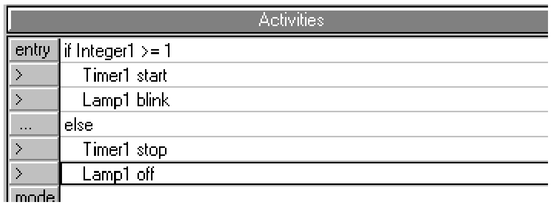
1 Build the If header and block by performing the steps in "Defining an If Branch" above. (You do not need to end the block.)

2 In the Logic Palette, click the else button. (You can also type the keyword "else" in the edit line.)

- The indentation is decreased to align "else" with "if."
- **else** is appended to the Logic Editor's edit line.

3 Build the Else block.

4 End the Else block by clicking the New Line button twice or pressing Enter twice.



```
if Integer1 >= 1
   Timer1 start
   Lamp1 blink
else
   Timer1 stop
   Lamp1 off
```

A sample if...else branch

Defining If...Else If Nested Branches

You use If...else if branches when you want to designate more than one condition.

You can build these branches either in the traditional programming style—with another indent for each new If condition, or in a condensed style—placing the Else and If condition on the same line. Both styles are valid in RapidPLUS.

The table below presents each type.

If...else if...else if branch

LONG STYLE	"ELSE IF" STYLE

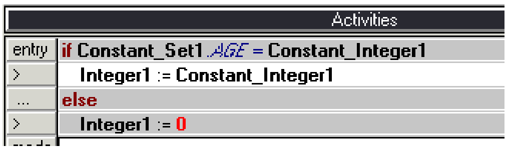
if Integer1 = 1
    Lamp1 on
else
    if Integer1 = 2
        Lamp2 on
    else
        if Integer 1 = 3
            Lamp 3 on
        else
            Lamp 4 on
	if Integer1 = 1
	    Lamp1 on
	else if Integer1 = 2
	    Lamp2 on
	else if Integer 1 = 3
	    Lamp 3 on
	else
	    Lamp 4 on

As you can see, the ability to place an If condition on an Else line enables you to build compact, nested branches.

Defining If...Else Branches That Use Constant Objects

Constant objects can be used in If and Else conditional statements (for example, **if Constant_Integer** < **2**). When a constant object is used, its value is immediately evaluated. The logic lines in the If or Else blocks whose values evaluate to False are displayed with a gray background. The logic lines whose values evaluate to True are displayed like other logic statements (that is, without the gray background). Also, the If and Else headers are displayed with a gray background.

Example



```
entry  if Constant_Set1.AGE = Constant_Integer1
>         Integer1 := Constant_Integer1
...    else
>         Integer1 := 0
```

The immediate evaluation is performed on:

- Constant values (e.g., 2, 1.5, 'abc').
- Constant integers, constant numbers, constant strings, and constant sets.
- Relational opereators (=, >, <, >=. <=, <>).
- Boolean operators (and, or).
- Arithmetic operators (+, -. *, /).

The immediate evaluation is **not** performed on:

- Constant arrays.
- Expressions with type mismatch (e.g., no conversion from String to Integer).
- Functions other than relational functions.
- User functions.

HOW LOOP AND BRANCH LOGIC IS ACCEPTED

RapidPLUS logic is accepted when you click the Confirm or New Line button, press Enter, or move the focus to another line in the Logic Editor.

Warnings about block problems (such as an “else” without a preceding “if”) are issued only when:

- Saving the application.
- Running the Prototyper.
- The logic is about to disappear from the screen, such as when closing the Logic Editor, changing the active mode, or changing the transition (for action blocks).

EXECUTION OF LOOPS AND BRANCHES

RapidPLUS executes loops and branches differently from other logic. The entire statement is executed as a single piece of logic. While it is being executed, no transitions are performed.

❖ *NOTE: Graphics are updated after a loop or branch has been executed.*

Execution of While Loops

while <Condition>

A While loop is executed as follows:

i. RapidPLUS evaluates the While condition.

ii. If the result is true, the While block is performed.

iii. If the result is false, the loop is terminated.

iv. Step a is repeated.

Execution of For Loops

for <Integer: <local counter name>> from <start value> to <end value> step <integer>
for <Integer: <local counter name>> from <start value> downTo <end value> step <integer>

A For loop is executed as follows:

i. RapidPLUS evaluates the start value.

ii. RapidPLUS assigns the start value to the counter variable.

iii. If the counter is greater than the end value, the loop is terminated. (In downTo loops: if counter is less than end value, the loop is terminated.)

iv. The For block is executed.

v. RapidPLUS increments the counter by "step."
(In downTo loops: RapidPLUS decrements the counter by "step.")

vi. Steps c, d, and e are repeated until the loop terminates.

❖ *NOTE: The step, start value, and end value can be expressions. If so, the step and end values are re-evaluated on each cycle.*

Execution of If...Else Branches

if <Condition>
else

An If...else branch is executed as follows:

i. RapidPLUS evaluates the If condition.

ii. If the result is true, the If block is performed.

iii. If the result is false, the Else block is performed.

Running Loops in the Prototyper

If the Debugger is not open and the logic contains a long or infinite loop, only the Stop button will work. All other Prototyper buttons, as well as all RapidPLUS tools, will not respond while the loop is being executed.

CODE GENERATION

Code that is generated for loops and branches uses the native construct of the target language thereby generating more efficient code. The C code for If...Else branches that use constant objects in their conditional statements can be optimized. For details, refer to the *Generating Code for Embedded Systems* manual.

CHAPTER 8

Find and Replace

The Find and Replace feature enables you to search for and replace a string or substring in the application logic—in triggers, actions, activities, and user functions. You can also search for logic references to a specific object, or limit the search to specified logic categories.

This chapter presents:

- How to define a search string and set various search options.
- How to replace a string in all or some logic statements.
- How to focus a search on specified types of logic statements and/or on statements that reference a specific object.
- Additional Find and Replace features.
- Usage examples.

❖ *NOTE: This chapter replaces Chapter 14: "Find and Replace" of the Rapid User Manual.*

Ctrl+F

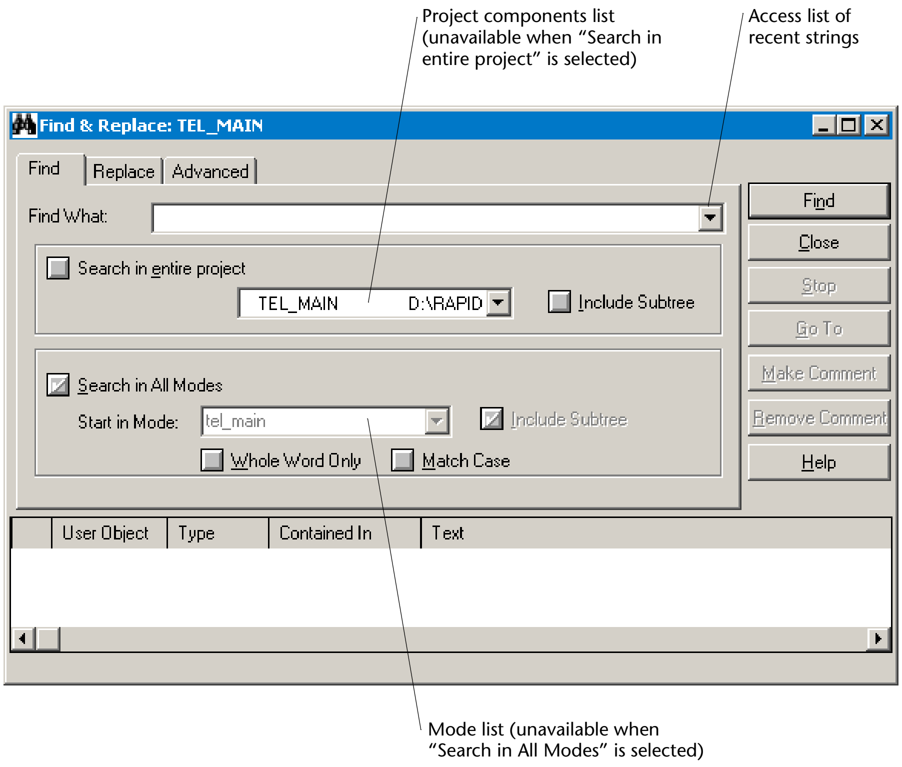
To open the Find & Replace dialog box, do one of the following:

- In the Logic Editor, click the Find/Replace button.
- In the Mode Tree or Logic Editor, choose Edit|Find/Replace.
- In the Application Manager, choose View|Find/Replace.

Each tabbed page in the Find & Replace dialog box—Find, Replace, and Advanced—presents a different set of operations.

USING FIND

On the Find tabbed page, set options to look for a specific string or substring in the application logic.



The available search options are as follows:

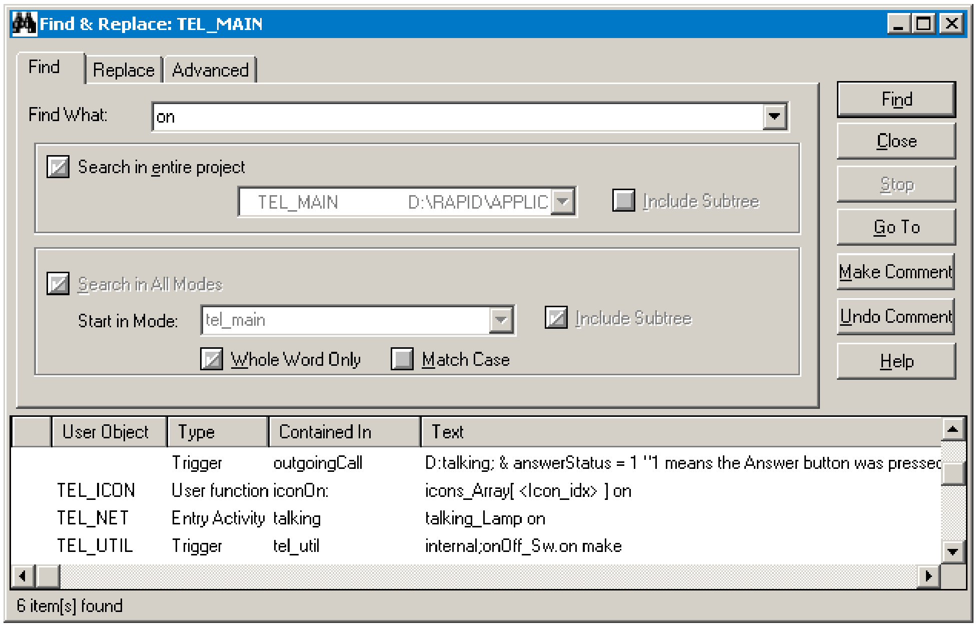
OPTION	DESCRIPTION
Find What	Enter the string or substring that you want to search for. You can also choose a recent search string from the list. Use an asterisk (*) as a wild card to represent any group of characters. It can be used before, in the middle of, or after the string. ❖ *NOTE: Using a wild card disables the Whole Word Only option.* ***Example*** Suppose your application has three objects, named Switch1A, Switch2A, and Switch3A. To search for all the logic items containing the name of any of these objects, type **Switch*A** in the Find What box.
Project Search	
Search in entire project	When selected, searches through the entire project (i.e., the parent application and all its user objects). When cleared, searches through the component selected in the box.
Include Subtree	When selected, extends the search to components nested in the selected component.
Mode Search	
Search in All Modes	When selected, searches through all modes in the selected component. When cleared, searches through the mode selected in the box.
Include Subtree	When selected, extends the search to modes nested in the selected mode.

OPTION	DESCRIPTION
Whole Word Only	When selected, the search for matching strings that are enclosed by nonalphanumeric characters (such as a space, comma, colon, or an ampersand). ***Example*** For the search string is "lamp" and the "Whole Word Only" option selected, the search results list has the following characteristics: • Does **not** show matches such as **lamp1 on** or **Redlamp blink.** • **Does** show matches such as **lamp.blinkPeriod:=300** and **&lamp is on.**
Match Case	When selected, the search is case-sensitive.

To apply search filters, see "Using Filters (Advanced Options)" on p. 8-11.

Displaying Search Results

Press the Find button to begin the search. When the search is complete, all the logic lines that match the search parameters appear in a list, as in the following example:



Find What: on

[✓] Search in entire project

TEL_MAIN D:\RAPID\APPLIC

[ ] Include Subtree

[✓] Search in All Modes

Start in Mode: tel_main

[✓] Include Subtree

[✓] Whole Word Only [ ] Match Case

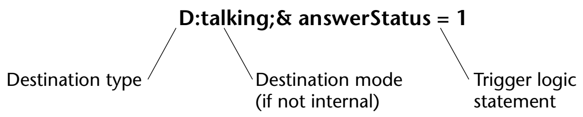
	User Object	Type	Contained In	Text
		Trigger	outgoingCall	D:talking; & answerStatus = 1 "1 means the Answer button was pressec
	TEL_ICON	User function	iconOn:	icons_Array[<Icon_idx>] on
	TEL_NET	Entry Activity	talking	talking_Lamp on
	TEL_UTIL	Trigger	tel_util	internal;onOff_Sw.on make

6 item[s] found

Logic lines that cannot be changed through the Find & Replace dialog box, such as block headers and user function names, appear in the search results list, but they are disabled. The syntax of the search results is summarized below:

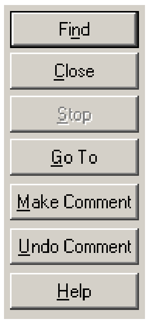
COLUMN	DESCRIPTION
Logic Status (no title)	Shows status of replacement request. See "Validating Logic" on p. 8-9 for details.
User Object	Lists the user object where the search item has been located; blank if located in the parent application.
Type	Lists the logic type (action, trigger, activity, or user function) in which the string appears.

COLUMN	DESCRIPTION
Contained In	Lists the mode or user function to which the found item belongs, as follows: • For an activity or action, shows the mode name. • For a trigger, shows the source mode name. • For a user function, shows the user function name.
Text	Lists the complete logic statement in which the search item is contained. ***Example*** For triggers, the syntax is shown as follows:

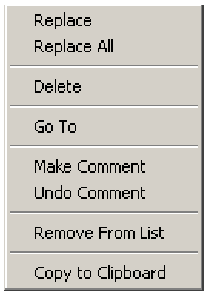

D:talking;& answerStatus = 1
Destination type
Destination mode (if not internal)
Trigger logic statement

Working with Search Results

The following options are available through buttons in the Find & Replace dialog box or through the popup menu that appears after right-clicking a line in the search results list.



Button options



Popup menu

These options are described in the following table:

OPTION	DESCRIPTION
Close button	Closes the Find & Replace dialog box and saves the current search options as the default settings the next time you open the dialog box.
Stop button	Interrupts the search in process.
Go To button (and menu item)	Jumps to the corresponding trigger, action, activity, or user function in the Logic Editor that is highlighted in the search results list.
Make Comment button (and menu item)	Turns the selected search result lines into comments in the Logic Editor by adding two backslashes (\\) at the beginning of the line.
Undo Comment button (and menu item)	If the selected search result lines are comments, this undoes the comment by removing the two backslashes at the beginning of the line.
Delete menu item	Deletes the selected logic lines from the Logic Editor.
Remove From List menu item	Removes the selected logic lines from the search results list.
Copy to Clipboard menu item	Copies the selected logic lines as text from the search results list to the Clipboard.

USING REPLACE

After performing the Find operation, you can replace **any** string contained in the search results list. The string designated to replace on the Replace tabbed page can be different from the string that was used to perform the search.

Replacing a String

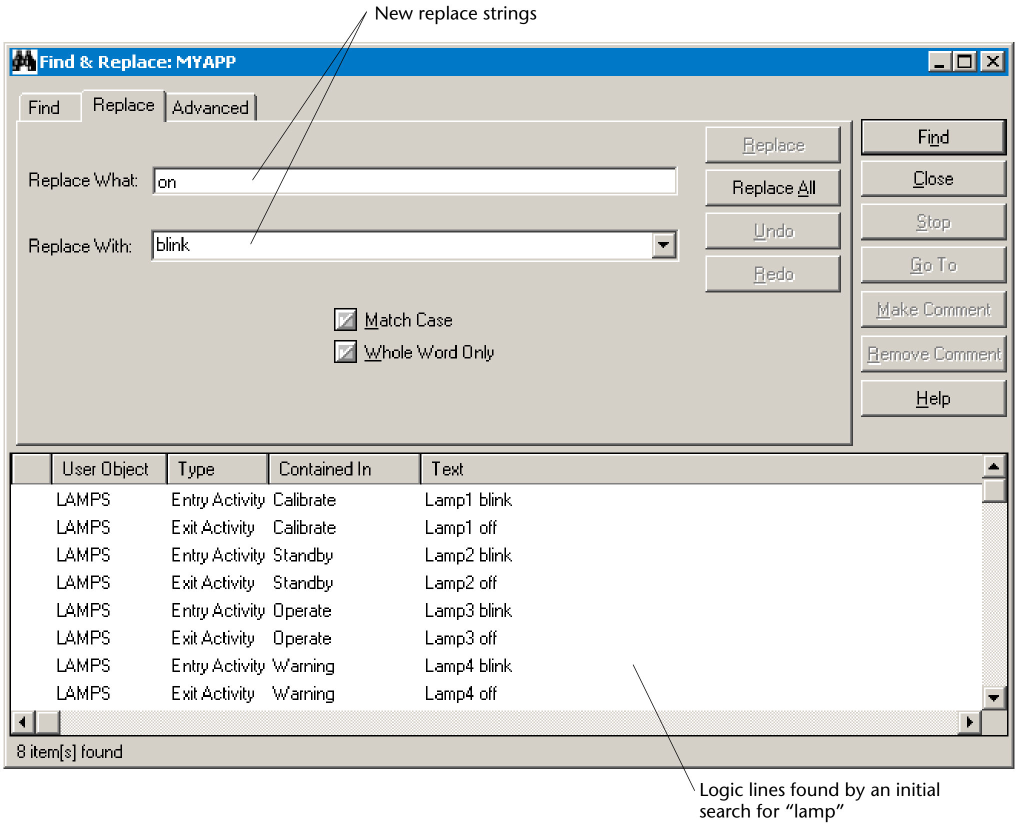
Before you replace a string, you must perform the Find operation from the Find tabbed page.

To replace any string in the listed search results:

1. Click the Replace tab.
2. In the Replace What box, type any string to replace in the search results.
3. In the Replace With box, type the replacement string.
4. Replace selected or all instances of the string:
   - To replace **specific** instances in the search results list, select the lines to be changed and click Replace. You can use the standard Windows functions of Shift+click and Ctrl+click to select multiple lines.
   - To replace **all** the instances of the search string, click Replace All.
5. If you change your mind, click the Undo or Redo button to change your recent activities. These buttons in the dialog box function the same way as the Undo/Redo buttons in other tools.

Example

To change all blinking lamps to on, you first perform a search for all instances of “lamp.” On the Replace tabbed page, type “blink” in the Replace What box, and type “on” in the Replace With box. Select Match Case and Whole Word Only. The dialog box would appear similar to the following illustration:



Replace What: on

Replace With: blink

Match Case

Whole Word Only

	User Object	Type	Contained In	Text
	LAMPS	Entry Activity	Calibrate	Lamp1 blink
	LAMPS	Exit Activity	Calibrate	Lamp1 off
	LAMPS	Entry Activity	Standby	Lamp2 blink
	LAMPS	Exit Activity	Standby	Lamp2 off
	LAMPS	Entry Activity	Operate	Lamp3 blink
	LAMPS	Exit Activity	Operate	Lamp3 off
	LAMPS	Entry Activity	Warning	Lamp4 blink
	LAMPS	Exit Activity	Warning	Lamp4 off

8 item[s] found

Validating Logic

RapidPLUS checks that the lines of logic created by the replacements are logically valid, i.e., that they are both syntactically correct and executable within the context of your application's logic.

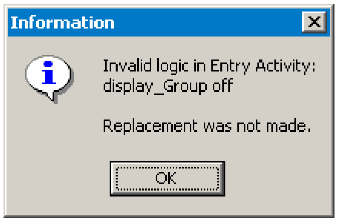
Logic Status Icons

The results of this logic validity check are given in the status column of the search results list. The possible status icons are as follows:

STATUS ICON	MEANING
✓	The logic statement is valid after the replacement.
✗	The logic statement would be invalid after the replacement; the replacement is not carried out and an error message appears (see below).
⛔	The logic statement is a block header or user function name and cannot be changed through the Find and Replace dialog box.

Error Messages

If a line were to become invalid after the replacement then, in addition to getting a red *x* at that line, a message such as the following appears:

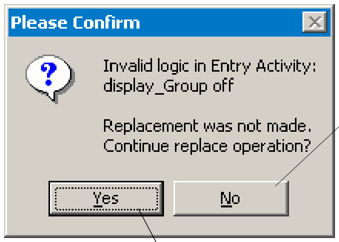

Information

Invalid logic in Entry Activity:
display_Group off

Replacement was not made.

In this example, the string “hide” was replaced with the string “off”. The resulting action (“display_Group off”) is not logically valid. When an error such as this occurs, the replacement is not carried out.

If there had been more than one logic statement to replace, the error message would be as follows:


Please Confirm

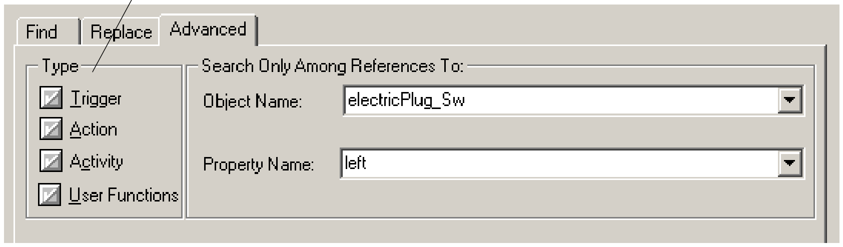
Invalid logic in Entry Activity:
display_Group off

Replacement was not made.
Continue replace operation?

Yes
No
Cancel replacement operation
Continue replacement operation for other logic statements

USING FILTERS (ADVANCED OPTIONS)

On the Advanced tabbed page, set options to focus the search on logic types or objects of interest.



Object Name: electricPlug_Sw

Property Name: left

The filter options are:

OPTION	DESCRIPTION
Type	Select the logic types to include in the search.
Object Name	Select or type the name of an application object. You can use wild cards (such as **Lamp***) for the search.
Property Name	Select a property for the selected object. If left blank, the search will return all logic related to the specified object.

FIND AND REPLACE EXAMPLES

The following examples show how you can combine various Find and Replace features to achieve certain results.

Example 1: Change Logic

Scenario: You implemented transitions between certain modes in subtree *PowerOn* via the event *Pushbutton1 in* and now you want to implement some of those transitions with the event *Switch1.up make*.

1 In the Find tabbed page, set the following:

- Find What: *Pushbutton1 in*
- Start in Mode: PowerOn
- Include Subtree: selected

2 In the Advanced tabbed page, set the following:

- Type: only Trigger should be selected
- Object Name: you could, optionally, enter Pushbutton1 here, but your search string in the Find tabbed page eliminates this as a necessity.

3 Click the Find button.

4 When the search is complete, click the Replace tab.

5 In the Replace With box, type in *Switch1.up make*.

6 Select the triggers that you want to change.

7 Click Replace.

Example 2: Replace Text

Scenario: You want to replace the string *power* with *Power* in all places where it appears as part of text display contents. This example assumes that all text display names in your application include the substring *disp*.

1 In the Find tabbed page, set the following:

- Find What: *power*
- Search entire project: selected
- Match Case: selected
- Whole Word Only: selected

2 In the Advanced tabbed page, set the following:

- Type: all selected except Trigger
- Object Name: **disp**
- Object Property: because you have used a wild card, you cannot specify a property. If you were to select a particular display object in Object Name, then you could select the contents property here.

3 Click the Find button.

4 When the search is complete, click the Replace tab.

5 In the Replace With box, type in *Power*.

6 If the search (because of the Object Name wild card) found logic lines that are not of interest:

a. Ctrl+click to select those lines.

b. Right-click anywhere and choose Remove From List from the popup menu.

7 Click Replace All.

Example 3: Going to an Activity

Scenario: You have a large application. During runtime, many of its modes are active simultaneously. A text display named Display1 clears during runtime and this is undesirable.

1 In the Find tabbed page, set the following:
   - Find What: *blank*
   - Search entire project: selected
2 In the Advanced tabbed page, set the following:
   - Type: select Action and Activity only
   - Object Name: select *Display1* from the list
   - Object Property: select *contents* from the list
3 Click Find.
4 Scrolling through the search results list, you notice that the cause of the problem is a mode activity that should be an entry activity.
5 Select the line and click Go To.
6 In the Logic Editor, change the activity from mode to entry.

CHAPTER 9

Verification Test

With the Verification Test tool, you can perform a basic check on an application's logic design. The verification test checks for the following potentially problematic areas:

- Modes that cannot be reached or exited.
- Transitions without triggers, to missing destination modes, and certain condition-only transitions.
- Objects that are not referenced in the logic.

At the end of the test, a list of detected logic problems is displayed and you can then debug them one by one.

You can run the verification test on a mode subtree or on the whole application.

❖ ***CAUTION!*** *The verification test is not exhaustive and may miss potential problem areas, particularly in a complex application.*

This chapter presents:

- How to run a verification test.
- How to use the verification test to locate errors.
- Descriptions and examples of warning messages.

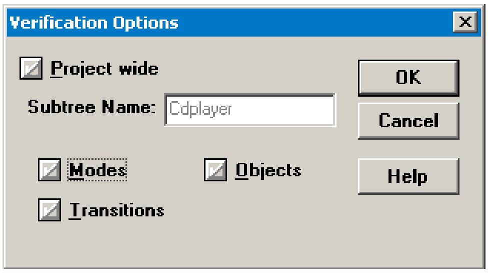
❖ *NOTE: This section replaces the section "Verification Test" on pp.12-38 to 12-42 of the Rapid User Manual.*

RUNNING THE VERIFICATION TEST

In the Verification Test window, you can run the verification test, set options, and view logic warnings.

To run a verification test:

1. In the Application Manager, choose View|Verification Test.
2. In the Verification Test window, choose Options|Options. Set the options you require (see description below) and click OK.



☑ Project wide

Subtree Name: Cdplayer

☑ Modes ☑ Objects

☑ Transitions

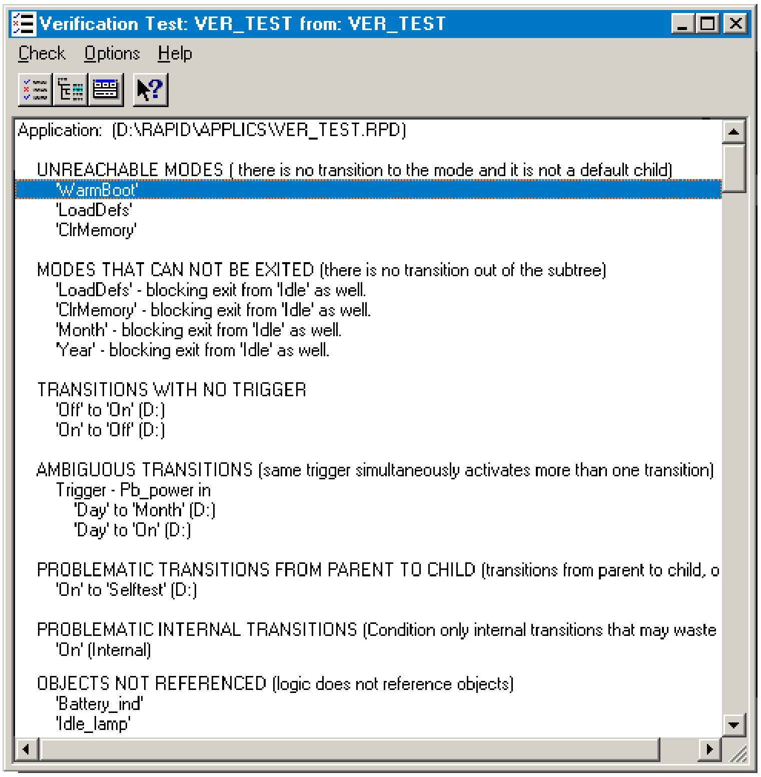
OPTION	DESCRIPTION
Project wide	Select to test the whole application (parent application and user objects). When selected, the Subtree Name box becomes disabled.
Subtree Name	If not running a project-wide test, select the topmost mode in the Mode Tree or type the mode name. The test will run only on that mode's subtree.
Mode, Transitions, Objects	Select categories to be included in the verification test.

Ctrl+K

3. In the Verification Test window, choose Check|Check or click the Start Test button.

   When all selected categories have been checked, the logic warnings (if any) appear in the Verification Test window. For a project-wide verification test, results are listed in the order of the components in the Project Components list. Each component section is preceded by the component name and full file path.

The following illustration is a sample of a verification test:



```
Application:  (D:\RAPID\APPLICS\VER_TEST.RPD)

  UNREACHABLE MODES ( there is no transition to the mode and it is not a default child)
    'WarmBoot'
    'LoadDefs'
    'ClrMemory'

  MODES THAT CAN NOT BE EXITED (there is no transition out of the subtree)
    'LoadDefs' - blocking exit from 'Idle' as well.
    'ClrMemory' - blocking exit from 'Idle' as well.
    'Month' - blocking exit from 'Idle' as well.
    'Year' - blocking exit from 'Idle' as well.

  TRANSITIONS WITH NO TRIGGER
    'Off' to 'On' (D:)
    'On' to 'Off' (D:)

  AMBIGUOUS TRANSITIONS (same trigger simultaneously activates more than one transition)
    Trigger - Pb_power in
      'Day' to 'Month' (D:)
      'Day' to 'On' (D:)

  PROBLEMATIC TRANSITIONS FROM PARENT TO CHILD (transitions from parent to child, o
    'On' to 'Selftest' (D:)

  PROBLEMATIC INTERNAL TRANSITIONS (Condition only internal transitions that may waste
    'On' (Internal)

  OBJECTS NOT REFERENCED (logic does not reference objects)
    'Battery_ind'
    'Idle_lamp'
```

EXAMINING LOGIC ERRORS

You can use the warnings in the Verification Test window to locate errors in the Mode Tree and Logic Editor. It is up to you to make required changes.

To examine errors:

1 Select the warning in the window that you want to examine.

2 Use the Check menu commands or toolbar buttons as follows:

Ctrl+L

- **Check|Select:** Selects (in the Mode Tree and the State Chart) the mode where the error was detected. Use this option if you just want to identify the referenced mode.

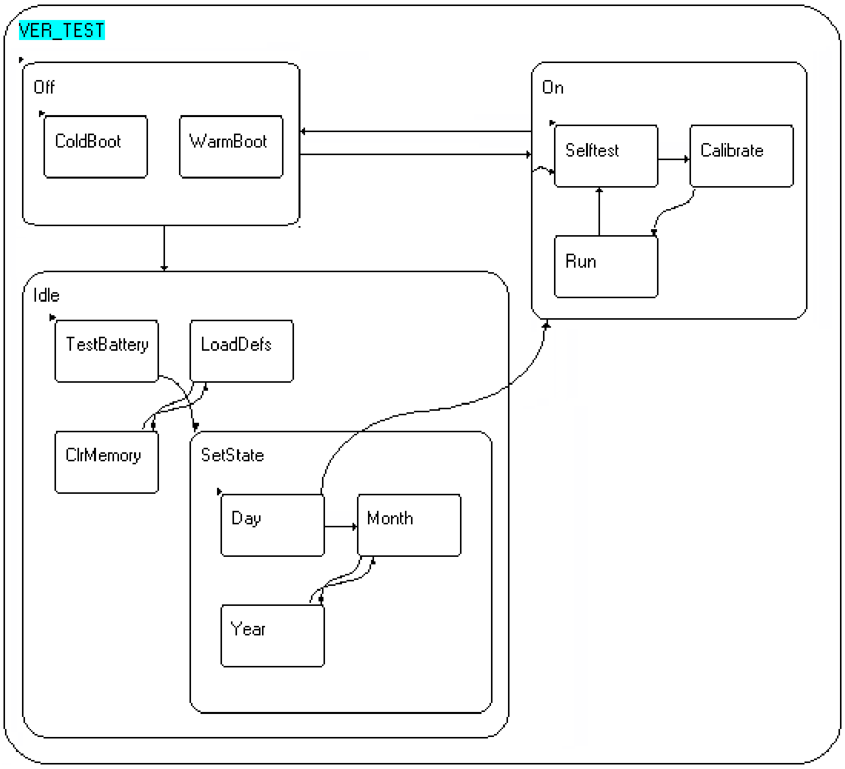
Ctrl+E

- **Check|Edit:** Opens the Logic Editor and selects (in the Mode Tree and the State Chart) the mode where the error was detected. Alternatively, double-click the warning in the window to open the Logic Editor. Use this option when you want to investigate the warning in more detail.

WARNING MESSAGES

This section describes the warning messages that can appear in the Verification Test window. The warnings are grouped according to their categories: mode, transition, and object warnings. The following state chart is used to explain some of the mode warnings. (Modes shown are exclusive.)

❖ *NOTE: Generated warnings are not necessarily indications of error; RapidPLUS cannot always distinguish between an actual problem and an intentional feature of the application design.*



Modes

UNREACHABLE MODES

Looks at the application's modes and transition destinations, and finds modes which cannot be reached. Listed modes are not referenced by an indirect or direct transition destination.

❖ *NOTE: This check does not test triggers.*

Syntax:

```
'<mode>'
'<mode>'
```

Example:

```
'WarmBoot'
'LoadDefs'
'ClrMemory'
```

MODES THAT CAN NOT BE EXITED

Tests the modes and transition destinations in order to find any mode which, once entered, cannot be exited. A mode is regarded as "exitable" if there is a transition from it (or from one of its ancestors or reachable descendants) to a destination that is outside the mode's own subtree.

Syntax:

```
'<mode>'
'<mode>' - blocking exit from
  '<parent mode>' as well
```

Example:

```
'LoadDefs' - blocking exit from 'Idle' as well
'ClrMemory' - blocking exit from 'Idle' as well
'Month' - blocking exit from 'Idle' as well
'Year' - blocking exit from 'Idle' as well
```

In the VER_TEST state chart, once the modes listed above are entered, they cannot be exited. Only the mode Day, the default child of SetState, has a transition external to the Idle subtree.

❖ *NOTES: Since TestBattery (the default child of Idle) has a valid transition to SetState (whose default child, Day, is exitable), it is not considered a mode which cannot be exited.*

If a child mode can not be exited, the warning takes note of the fact that the exit from the child's parent is also blocked.

Transitions

TRANSITIONS WITH NO TRIGGER

Tests all the transitions' triggers, and issues a warning for any transition that has no trigger (i.e., the transition can never take place).

Syntax:
```
'<source mode>' to '<destination mode>'
(<transition type>)
```

Example:
```
'Off' to 'On' (D:)
'On' to 'Off' (D:)
```

In the VER_TEST application, the warning indicates that no triggers have been defined for the transitions between the Off and On modes. Although they show in the state chart, they cannot take place.

AMBIGUOUS TRANSITIONS

Tests all the transitions' triggers and issues a warning for any trigger which simultaneously activates more than one transition.

Syntax:
```
Trigger - <trigger syntax>
  '<source mode1>' to '<destination mode1>'
   (<transition type>)
  '<source mode1>' to '<destination mode2>'
   (<transition type>)
```

Example:
```
Trigger - Pb_power in
  'Day' to 'On' (D:)
  'Day' to 'Month' (D:)
```

In the VER_TEST application, this warning indicates that the same trigger activates both transitions out of Day mode. During runtime, when Day mode is active and Pb_power is pressed, RapidPLUS activates the first transition in the list.

PROBLEMATIC TRANSITIONS FROM PARENT MODE TO CHILD MODE

Tests all the transitions and issues a warning for condition-only transitions from parent to default child or from mode to itself, containing actions. Such transitions may cause unpredictable behavior and should be avoided.

Syntax:
```
'<parent mode>' to '<default child mode>'
  (<transition type>)
```

Example:
```
'On' to 'Selftest' (D:)
```

In the VER_TEST application, this warning indicates that the parent-to-default child mode transition from On to Selftest is a condition-only transition that contains actions.

PROBLEMATIC INTERNAL TRANSITIONS

Tests all the transitions and issues a warning for condition-only internal transitions containing actions. Such transitions may cause intensive CPU usage, and therefore, should be avoided.

Syntax:
```
'<mode>' (Internal)
```

Example:
```
'On' (Internal)
```

Objects

OBJECTS NOT REFERENCED

This check tests each object and issues a warning if an object is not referenced by any action, activity, or trigger.

Syntax:

```
'<object>'
'<object>'
```

Example:

```
'Battery_ind'
'Idle_lamp'
```

In the VER_TEST application, his warning indicates that the objects Battery_ind and Idle_lamp are not referenced anywhere in the logic.

❖ *NOTE: When performing the mode or object checks, RapidPLUS occasionally discovers internal inconsistencies in the mode or object tree structure that may cause display problems. In these cases, RapidPLUS alerts you to the situation and requests permission to correct the problem, which involves some restructuring of the tree.*

CHAPTER 10

Nongraphic Objects

Nongraphic objects are objects that do not have graphic representations on the layout, but play important “behind the scenes” roles in a RapidPLUS application’s behavior. Examples of nongraphic objects are objects that measure time, such as timers and stopwatches; objects that hold data, such as strings and integers; and objects that produce sounds, such as the sound object, which generates a predefined sound and the WaveAudio object, which plays WAV files.

The procedure for adding nongraphic objects to the Object Layout is the same for all of them; however, each object has its individual parameters and logic.

Some nongraphic objects are present in all applications. Because they do not need to be added to the application, they are referenced only through the Logic Palette, and not in the Object Layout. These nongraphic objects are referred to as system objects. Examples of system objects are SystemTime, which holds the system’s real-time clock, and the mouse object, which makes the system mouse available to the logic.

This chapter presents:

- How to add nongraphic objects.
- How to manage nongraphic objects—renaming, editing, copying, deleting, and replacing.
- The classes and types of nongraphic objects. The objects are presented in the order in which they appear in the Object Palette.

ADDING NONGRAPHIC OBJECTS

The Object Palette presents the following nongraphic class and object buttons:

Data

String
Number
Integer
Random Number
Holder
Array
Data Store
Point

Constant Data

Constant String
Constant Number
Constant Integer
Constant Array
Constant Set

Time

Timer
Stopwatch
Date
Time

Signal

Event
Sound
Cursor
Message

Communication

DDE Client
DDE Server
DLL
Commlink
Simulation Manager
Database Access
Applink

Multimedia

Wave Audio
Dig. Video
Animation
Audio CD
Sequencer
VCR
Videodisk
DAT
Scanner
Overlay
Other

The following instructions apply to all nongraphic objects.

To add a nongraphic object to the Object Layout:

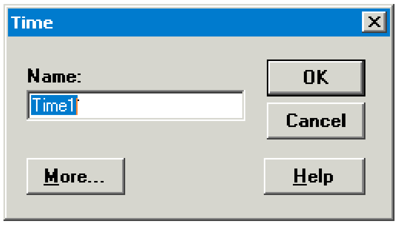
1 Select the object you want to add. To do so, either:

Choose Objects|Add, then select the object from the New Objects list;

Or:

From the Object Palette, select an object class in the left column and the object in the right column.

2 A dialog box, like the one shown below, opens:



A sample dialog box for adding a nongraphic object

a. To change its name, overtype the default name in the Name box.

b. To change its value, click the More button to open the object's dialog box. (Refer to each object's section in this chapter for an explanation of its parameters.)

c. Click OK.

The Nongraphic Objects Icon

After you have added a nongraphic object, the nongraphic objects icon appears in the top-left corner of the layout frame.

If this icon is hidden behind a graphic object, you can show it as follows.

To show a hidden nonngraphic objects icon:

1 Select the graphic object that is hiding the icon.

2 Place the cursor in the upper-left corner where the icon is located, then press the Tab key; the icon is selected.

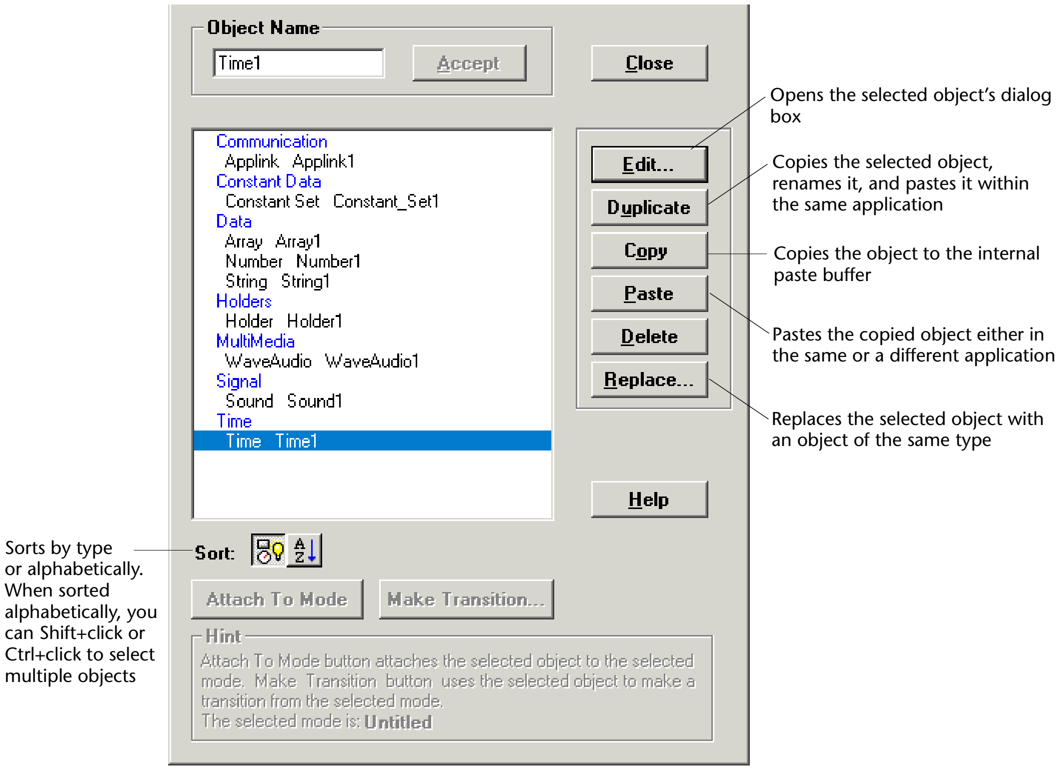
3 Choose Layout|Order|Bring to Front.

MANAGING NONGRAPHIC OBJECTS

Once you have added a nongraphic object to the layout, you can rename, edit, copy, duplicate, delete, or replace it using the Nongraphic Objects dialog box. You can also add notes about it.

To use the Nongraphic Objects dialog box:

1. Choose Edit|Nongraphics or double-click the nongraphic objects icon; the Nongraphic Objects dialog box opens.
2. Select an object from the list. Its name appears in the Object Name box and the management buttons (i.e., Edit, Duplicate, etc.) are enabled.


Object Name
Time1
Accept
Close
Edit...
Duplicate
Copy
Paste
Delete
Replace...
Help
Sort:
Attach To Mode
Make Transition...
Hint
Opens the selected object's dialog box
Copies the selected object, renames it, and pastes it within the same application
Copies the object to the internal paste buffer
Pastes the copied object either in the same or a different application
Replaces the selected object with an object of the same type
Sorts by type or alphabetically. When sorted alphabetically, you can Shift+click or Ctrl+click to select multiple objects

Communication
Applink Applink1
Constant Data
Constant Set Constant_Set1
Data
Array Array1
Number Number1
String String1
Holders
Holder Holder1
MultiMedia
WaveAudio WaveAudio1
Signal
Sound Sound1
Time
Time Time1

Attach To Mode button attaches the selected object to the selected mode. Make Transition button uses the selected object to make a transition from the selected mode.
The selected mode is: **Untitled**

A sample Nongraphic Objects dialog box

❖ *NOTE: System objects (e.g., SystemTime and mouse) do not appear in the list because you cannot edit them.*

Renaming a Nongraphic Object

An object's name is used to identify it in the Object Layout and Logic Editor. By default, the name consists of the object type and a sequential number.

To rename an object:

1 Select the object in the Nongraphic Objects list. Its name appears in the Object Name box.

2 Modify the name in the Object Name box, then click Accept.

For rules about naming objects, see p. 27-9.

Editing a Nongraphic Object

To edit a nongraphic object:

1 Select the object in the Nongraphic Objects list.

2 Click the Edit button or double-click the object; the object's dialog box opens.

3 Make the necessary changes, then click OK.

Adding Notes to a Nongraphic Object

All notes about objects and modes are added in the Application Manager.

To add notes to a nongraphic object:

1 Select the object in the Nongraphic Objects list.

2 Add text to the notes area of the Application Manager window.

Copying and Pasting Nongraphic Objects

The Copy and Paste buttons are used to copy and paste nongraphic objects within the same application or between applications.

To copy and paste a nongraphic object:

1 Select the object in the Nongraphic Objects list.

2 Click the Copy button; the object is copied to RapidPLUS's internal paste buffer (not to the Clipboard).

3 Click the Paste button; the Paste Conflicts: Duplicate Elements dialog box appears (see “Resolving Duplicate Element Conflicts” on p. 6-15), with the Keep Both button in focus.

4 Click the Keep Both button; the copied object is added to the Nongraphic Objects list and a numeric suffix is added to its name.

❖ *NOTE: If you have copied a nongraphic object and then closed the Nongraphic Objects dialog box, you can choose Edit|Paste Nongraphic to paste the object.*

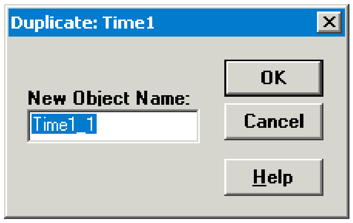
Duplicating a Nongraphic Object

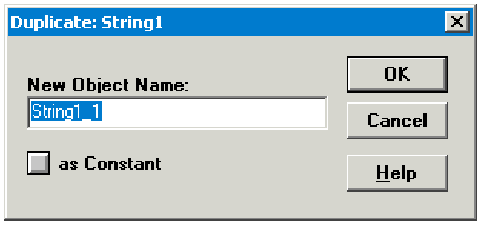
The Duplicate button is used to copy and paste nongraphic objects within the same application. It cannot be used to copy objects to other applications.

To duplicate a nongraphic object:

1 Select the object in the Nongraphic Objects list.

2 Click the Duplicate button; the Duplicate dialog box opens:


Duplicate: Time1
New Object Name: Time1_1


Duplicate: String1
New Object Name: String1_1
as Constant

Sample Duplicate dialog boxes

The “as Constant” option appears only for nongraphic objects that can be constant data objects. When selected, the duplicate object becomes a constant data object.

3 Click OK. If the “as Constant” check box is not selected, the copied object is added to the Nongraphic Objects list and a numeric suffix is added to its name. If the “as Constant” check box is selected, the copied object is added as a constant data object.

Deleting a Nongraphic Object

To delete a nongraphic object:

1. Select the object in the Nongraphic Objects list.
2. Click the Delete button; RapidPLUS asks you to confirm the delete operation.
3. Click Yes.

If the object is used in the logic, RapidPLUS warns you that deleting the object will delete the related logic. You can continue or cancel the Delete operation.

Replacing a Nongraphic Object

You can replace a nongraphic object with another object of the same type (e.g., a stopwatch with another stopwatch). This feature is especially useful if you have already built logic around the object that you want to replace.

To replace a nongraphic object:

1. Select the object in the Nongraphic Objects list.
2. Click the Replace button to open the Replace dialog box.
3. Enter the name of an object—of the same type—that appears in the Nongraphic Objects list, then click OK.

The replaced object is removed from the list.

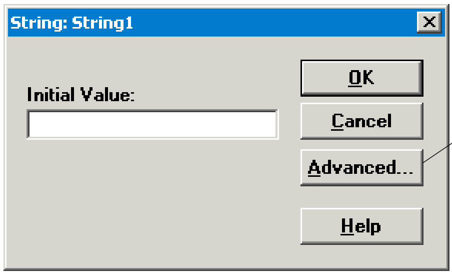
DATA OBJECTS

This class of nongraphic objects comprises objects that hold various kinds of data in a variable. There are eight types of data objects: string, number, integer, random number, holder, array, data store, and point.

String

The string object is a variable that holds an alphanumeric text string. If you use a string as part of an arithmetic procedure, RapidPLUS automatically converts it into a number. For example the character “3” is converted into the numeric value 3.0.

The String dialog box opens when you add or edit a string object. It is used to assign or change the string object’s initial value in the Prototyper.

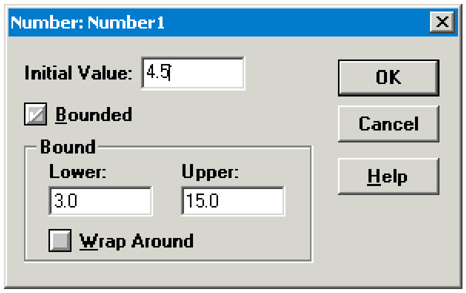


Opens a dialog box for setting a maximum string length value.
This value is applicable for C code generation. For details, see p. 10-31

The string dialog box also opens when you define a string property for an active primitive object or for a user property of a user object.

Number

The number object is a variable that holds a real number. If you enter an integer, RapidPLUS converts it to a real number (e.g., 3 is converted to 3.0). The Number dialog box opens when you add or edit a number object.



Initial Value: 4.5
Bounded [✓]
Bound
Lower: 3.0
Upper: 15.0
Wrap Around [ ]

A sample Number dialog box

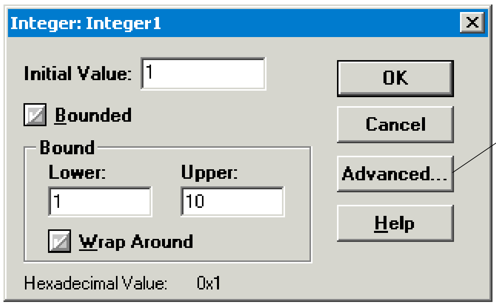
OPTION	DESCRIPTION	DEFAULT
Intial Value	Intial value in the Prototyper	0.0
Bounded (number)	When selected, sets bounds to prevent RapidPLUS from assigning numbers less than the lower bound or greater than the upper bound. For example, if the upper bound is set at 15.0 and the application logic assigns a value of 16.3, the actual value of the number object will be 15.0.	Not selected
Wrap Around	When selected, RapidPLUS wraps around to the lower bound when the value of the number exceeds the upper bound. For example, the lower limit is set at 3.0, the upper limit is set at 15.0, and the value of the number object is currently 15.0. If the activity, *changeBy:* 1.2, produces the value, 16.2, the actual value of the number object will be 4.2.	Not selected

The number object is accurate to six decimal places. The maximum value of a number object is 1.0e37.

The number dialog box also opens when you define a number property for an active primitive object or for a user property of a user object.

Integer

The integer object is a variable that holds an integer. The Integer dialog box opens when you add or edit a number object.



Opens a dialog box for setting a data type for the object. This value is applicable for C code generation. For details, see p. 10-30

A sample Integer dialog box

OPTION	DESCRIPTION	DEFAULT
Intial Value	Intial value in the Prototyper.	0.0
Bounded (integer)	When selected, sets bounds to prevent RapidPLUS from assigning integers less than the lower bound or greater than the upper bound. For example, if the upper bound is set at 15 and the application logic assigns a value of 16, the actual value of the object will be 15.	Not selected
Wrap Around	When selected, RapidPLUS wraps around to the lower bound when the value of the integer exceeds the upper bound. For example, the lower limit is set at 3, the upper limit is set at 15, and the value of the number object is currently 15. If the activity, *changeBy:* 1, produces the value, 16, the actual value of the object will be 3.	Not selected

You can enter a value in decimal format or hexadecimal format for the initial or bounded values. When you enter a value in decimal format, the equivalent hexadecimal value is displayed and vice versa. Even if you enter a value in hexadecimal format, the value will appear in its equivalent decimal value the next time you open the dialog box.

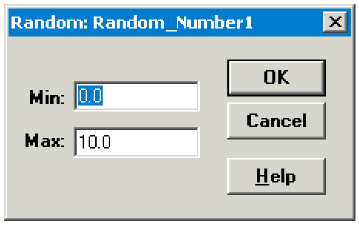
Hexadecimal values are translated by RapidPLUS into signed long integers. The permissible range is 0x00 to 0x7FFFFFFF (or 2147483647).

The integer dialog box also opens when you define an integer property for an active primitive object or for a user property of a user object.

Random Number

The random number object is a read-only number that is assigned a random value by RapidPLUS. The random number object produces a number value with up to six decimal places. It has all the functions of the number object, except := (assign) and *changeBy:* because only RapidPLUS assigns the values.

You can set minimum and maximum values to a random number object in its dialog box:


Random: Random_Number1

Min: 0.0

Max: 10.0

Just like the number object, entering bounds prevents RapidPLUS from assigning numbers less than the minimum value or greater than the maximum value. These values cannot be changed in the Logic Editor.

When you start the Prototyper, RapidPLUS generates a random number. The *next* function is used to generate a new random number. (The number remains constant until the *next* function is performed.)

❖ *NOTE: Do not expect to get the same random number value after you save an application, because the value changes when you load the application.*

Holder

Holder objects hold other objects. They are useful in applications containing several objects of the same type that use the same logic. Instead of writing logic for each object, you can write the logic once for the holder, and then instruct the holder to hold each object in turn. Holders can also dynamically generate and delete objects in runtime. A holder possesses the properties and functions of the object being held as well as its own functions.

Holders are useful in projects for holding instances of user objects so that a user object does not need to be nested in each application/user object that requires its functionality.

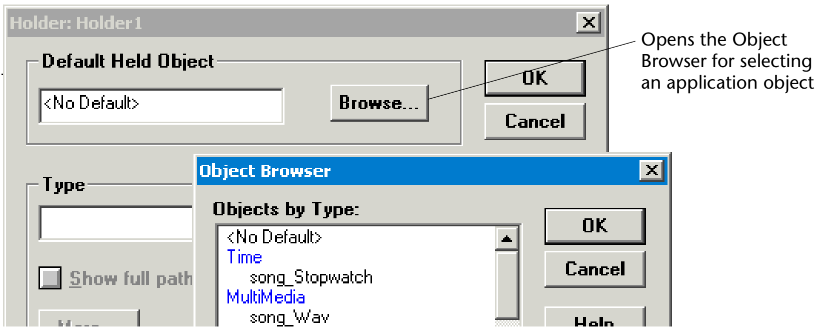
The objects that can be held are active objects; active primitive objects; groups; user objects; and nongraphic objects, except for data objects, system objects, properties, and copies of other holders. In addition, object types can be held, that is, the type of object/user object is held, but not an actual instance of the object/user object.

❖ *NOTE: Arrays and data stores can also be held by holders, but not using the holder object. For instructions about holding an array, see "Creating an Array" on p. 10-15. For instruction about holding a data store, see "Basic Steps for Creating a Data Store" on p. 10-21.*

An application can contain more than one holder, but only one object can be held in each holder at a time. In the application's logic, you can only replace the object that is initially stored in the holder with objects of the same type.

To assign an object to a holder:

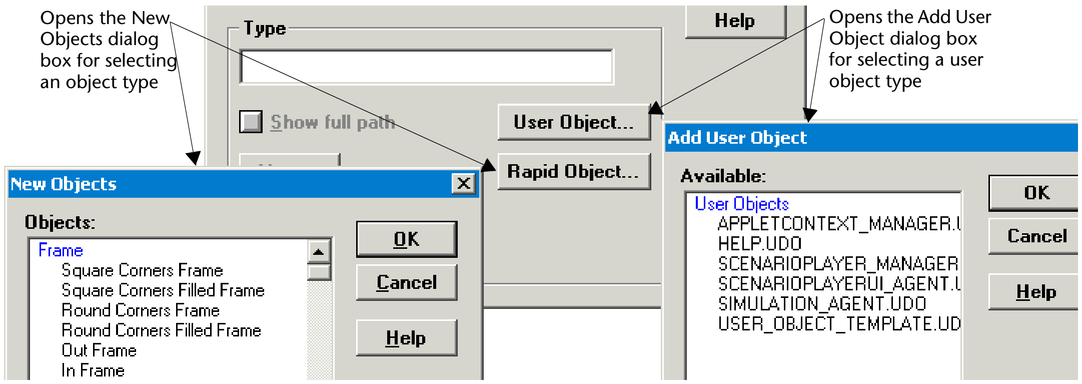
1 In the Holder dialog box, click the Browse button next to the Default Held Object box. The Object Browser opens displaying a list of objects that have been added to the application.



2 In the Object Browser, select an application object and click OK.

To assign an object type to a holder:

1 In the Holder dialog box, click either the User Object or the RapidPLUS Object button and select a user object type/object type:


Opens the New Objects dialog box for selecting an object type
Opens the Add User Object dialog box for selecting a user object type
Type
Help
Show full path
User Object...
Rapid Object...
New Objects
Objects:
OK
Cancel
Help
Add User Object
Available:
OK
Cancel
Help

Frame
Square Corners Frame
Square Corners Filled Frame
Round Corners Frame
Round Corners Filled Frame
Out Frame
In Frame

User Objects
APPLETCONTEXT_MANAGER.U
HELP.UDO
SCENARIOPLAYER_MANAGER
SCENARIOPLAYERUI_AGENT.U
SIMULATION_AGENT.UDO
USER_OBJECT_TEMPLATE.UD

2 If the selected user object/object type is graphic, you can select the Dynamic and/or Drag & Drop options in the Holder dialog box. These options add dynamic and drag & drop properties and functions in the Logic Palette.

3 If a user object type was selected, you can view/edit the user object interface in the parent application by clicking the More button to display the user object's interface dialog box.

❖ *NOTE: Holders without default objects can be used to share the parent application's objects (including user objects) among all of its children user objects, without having to add instances of those objects to the user objects themselves. All logic in the user objects is carried out on a holder that holds the object* ***type****. At start up, the parent application uses an exported function to pass the actual object instance to the user object holder. For more information, refer to the Methodology Guide: Building Applications for Embedded Systems.*

Using the Properties of an Empty Holder

In the logic, you can clear the holder of its held object and access its properties.

Example

A user object, *const.udo*, contains an exported constant set property called Colors. In the parent application, there is a holder object, Holder1. Holder1's default object is *const.udo*.

The following logic can be executed without causing runtime errors:

```
Holder1 clear
Integer1 := Holder1.Colors.Red
```

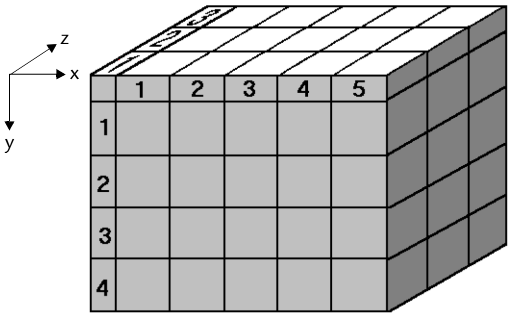
Array

The array object is a multi-dimensional matrix that can contain the following types of data:

- Integer
- Number
- String
- Objects

The array is useful when a value is determined by multiple variables, such as an array of temperatures indexed by latitude, longitude, and altitude.

The illustration below uses a 3-dimensional array to schematically represent the structure of a multi-dimensional array object. For obvious reasons, however, the geometrical representation of multi-dimensional arrays breaks down after the third dimension.



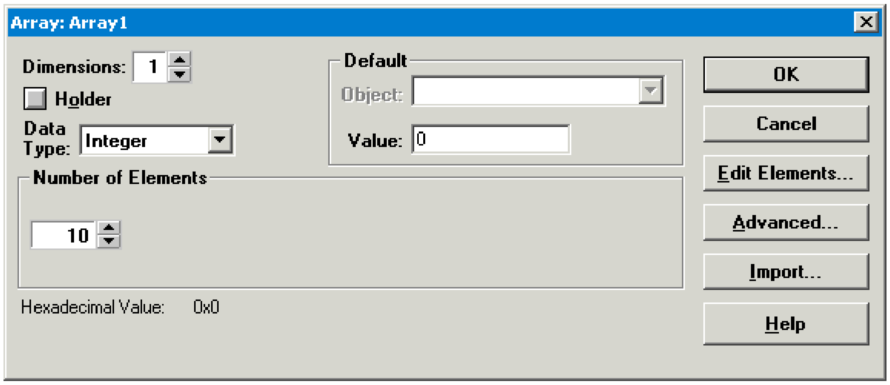
Array of Objects

An array of objects is an array that contains a specified type of graphic object (i.e., active objects, active primitive objects, and groups) or a user object. For example, you can create an array of lamps or an array of user objects, each of which contains a specialized lamp.

An array of objects allows you to carry out identical logic on a series of different objects of the same type by referring to array indexes (made up of integers) rather than to specific objects. It can also generate copies of existing objects, and delete generated objects, in runtime.

Creating an Array

When you add an array, the following dialog box opens:



OPTION	DESCRIPTION
Dimensions	Number of dimensions. Range: 1 – 7.
Holder check box	When selected, creates the array in a holder. This option is available for integer, number, and string arrays. This option is useful in projects that contain user objects that share the same data. When the Holder check box is selected, the Edit Elements, Advanced, and Import buttons are disabled. For details about holders, see p. 10-12.
Data Type	Integer, number, string, or object.
Default Object	When an object data type is selected, you must select an application object or user object. Clicking the arrow displays all of the applications and user objects in the application. This object is the default value for all of the array's elements.

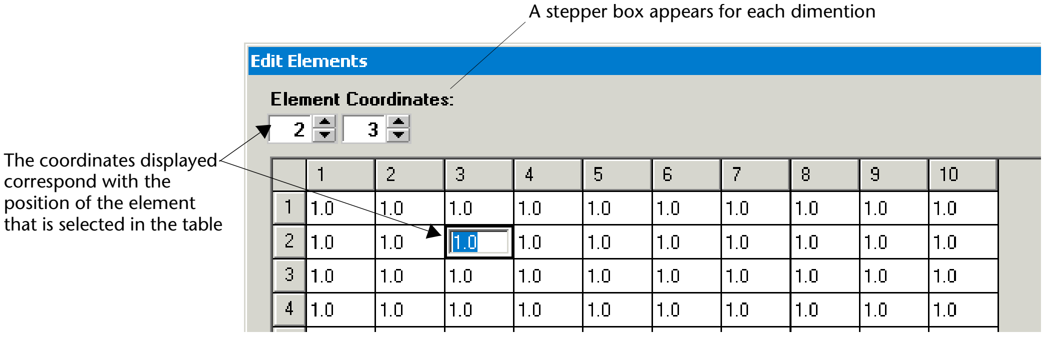
OPTION	DESCRIPTION
Default Value	When an integer, number, or string data type is selected, you can select a value for all of the array's elements. If no value is selected, the default value is used: Default values: number – 0.0, integer – 0, string – empty. ❖ *NOTE: For an integer data type, you can enter the value in decimal or hexadecimal format. The equivalent value is displayed at the bottom of the dialog box. Hexadecimal values are translated by RapidPLUS into signed long integers. The permissible range is 0x00 to 0x7FFFFFFF (or 2147483647).*
Number of Elements	Number of elements in each dimension. There is one stepper box for each dimension. Range: 1 – 999 for each dimension.
Edit Elements buttons	Opens the Edit Elements dialog box for editing the individual array elements.For details, see the next section.
Advanced button	Opens a dialog box for setting values that are applicable for C code generation. The advanced dialog box is the same for number, object, and string arrays. For details about string arrays, see p. 10-31. For details about integer arrays, see p. 10-33.
Import button	Opens the Open Import File dialog box for importing data from TXT, CSV, and RAR files. For details, see p. 10-18.

Editing an Array's Elements

Initially, all of the array's elements have the same value or hold the same object—the one defined as the default value/object in the Array dialog box. You can edit the value of individual elements so that their initial values will be different.

To edit individual elements:

1 Click the Edit Elements button. The Edit Elements dialog box opens displaying the array's elements in a table. The following illustration shows a partial view of a two-dimensional array:


A stepper box appears for each dimention
The coordinates displayed correspond with the position of the element that is selected in the table
Edit Elements
Element Coordinates:
2
3

	1	2	3	4	5	6	7	8	9	10
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

The column are numbered according to the number of elements in the last dimension. The rows are numbered according to the number of elements in the next-to-last dimension (in this case, the first dimension since there are only two dimensions).

The columns are resizeable.

2 Select an element by clicking it in the table or setting it in the Element Coordinates stepper boxes. When you select an element in an object array, a list presents all application obects of the same type as the default object.

You can move among the elements using the Ctrl + arrow keys.

3 For an integer, number, or string element, overtype the element's value. For an object element, either select an application element from the list or type its name.

4 Repeat steps 2–3 for each value you want to change.

Making an Object Array

An alternate way to create and populate an object array is through the command, Objects|Make Object Array.

To make an object array:

1 Select compatible objects on the layout that you want to include in the array.

2 Choose Objects|Make Object Array.

The first object selected determines the default object of the array. If any of the selected objects is not compatible with the default object, RapidPLUS does not create the array, and displays an appropriate message.

When the array is successfully created, RapidPLUS displays the name of the created array. The objects are entered into the array's Edit Elements dialog box, in the order in which they were selected.

❖ *NOTE: If you are working in Windows® 2000 and you made the object array from imported bitmaps, the bitmaps might not appear in the order in which they were selected (due to a bug in the Windows 2000 Import Bitmap File dialog box).*

Importing Data into Arrays

Data can be imported into one- and two-dimensional arrays from TXT, CSV, and RAR files.

- RAR files are RAPIDPLUS files that are created via array logic.
- CSV (comma delimited) files are created in Microsoft® Excel.
- TXT files are created in Microsoft Excel or any text editor. TXT files containing Unicode cannot be imported.

Before you import data into an array, the data must be formatted correctly. RAR files have preset formats that are created when the objects' *saveToFile*: function is used. See "Formatting Data in Microsoft Excel (CSV files)" on p. 10-19 and "Formatting Data in a Text Editor (TXT files)" on p. 10-20 for information about formatting the files.

To import data into an array:

1 (Optional) Select the Number of Dimensions (either 1 or 2) and the Data Type (integer, number, or string). This step is optional because if you don't perform it, RapidPLUS will import the file and overwrite the default settings in the dialog box.

2 Click the Import button.

3 The Open Import File dialog box opens. Select a file and click Open.

❖ *NOTE: The Data Type in both the imported file and the array must match; otherwise, RapidPLUS will ask you if you want to replace the current array with the imported one.*

The imported values are added to the array.

❖ *NOTE: During runtime, the loadFromFile: function can be used to import data from TXT, CSV, and RAR files.*

Formatting Data in Microsoft Excel (CSV files)

When you create a Microsoft® Excel workbook that will be imported into an array, be sure to save the workbook in the CSV (comma delimited) format.

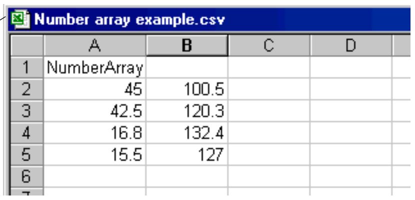
❖ *NOTE: If your system's default language uses a delimiter other than a comma, you must manually change the system's default delimiter. To do so, open the Regional Options dialog box from the Control Panel. Click the Numbers tab and change the List Separator selection to a comma.*

The imported file can contain data for the elements only—in which case the array will be a string array—or data for the elements and array type (number, integer, and/or string). Keep these points in mind when creating a CSV file:

- To designate the array type, the first cell in the workbook, "A1," must present the array type in the following format: <Type>Array. The available types are: IntegerArray, NumberArray, and StringArray. The other cells in the first row remain empty.
- If the wookbook contains element values only, the file will be imported as a string array.

Example

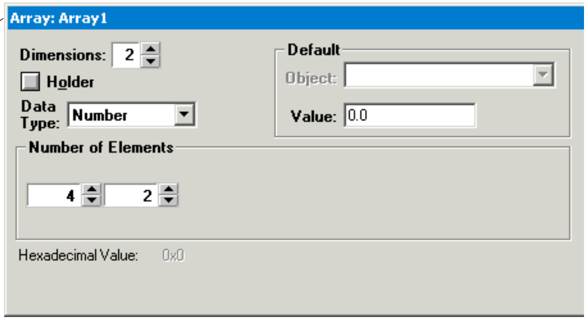
In this example, a CSV file is created in Excel and imported into an array:



Number array example.csv

	A	B	C	D
1	NumberArray			
2	45	100.5		
3	42.5	120.3		
4	16.8	132.4		
5	15.5	127		
6				

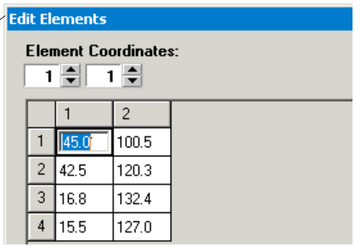
The CSV file in Microsoft Excel. This workbook contains the array type and element values



Array: Array1

Dimensions: 2
Holder
Data Type: Number
Number of Elements: 4 2
Default
Object:
Value: 0.0
Hexadecimal Value: 0x0

After the CSV file has been imported, the array now contains a two-dimensional number array



Edit Elements

Element Coordinates: 1 1

	1	2
1	45.0	100.5
2	42.5	120.3
3	16.8	132.4
4	15.5	127.0

The Edit Elements dialog box presents the values from the CSV file as numbers

Formatting Data in a Text Editor (TXT files)

The data must be be separated by tabs and should be arranged as follows:

```
[<Type>Array]
data_11[tab]data_12[tab]data_13...
data_21[tab]data_22[tab]data_23...
data_31[tab]data_32[tab]data_33...
...<carriage return>
```

If the first line does not include the array type, the array will be imported as a string array. If the last line is not blank, data from the last line of text might not be read.

Example

```
NumberArray
45.0100.5
42.5120.3
16.8132.4
15.5127.0
<empty line>
```

Data Store

The data store object is a two-dimensional matrix of integers, numbers, and/or strings. The structure of a data store can be compared to that of a table with varying numbers of columns and rows. Each row is a record; each column is a field. A field can be either an integer, number, or string—with the same rules that apply to integer, number, and string objects. A single data store can contain all the field types. In the Logic Palette, each field appears as a property of the data store.

The illustration below shows a schematic representation of the data store structure.

	Field 1 (string)	Field 2 (number)	Field 3 (integer)	.... Field n
Record 1				
Record 2				
Record 3				
Record 4				
: Record n				

Basic Steps for Creating a Data Store

1 Add a data store object to the layout area, then click the More button to open its dialog box.

2 In the Number of Records box, select the number of records and click the Update button.

3 For each field that you want to add, click the Add Field button to open the Add Field dialog box in which you define the field's name, type, and initial value.

4 View the structure of the data store by clicking the View Records button. In this view, you can assign names to the records.

5 (Optional) Instead of inputting field and record information, you can import data from TXT, CSV, and RDS files by clicking the Import button.

6 (Optional) To create the data store in a holder, select the Holder check box. When selected, the Advanced and Import buttons are disabled, and the records cannot be edited.

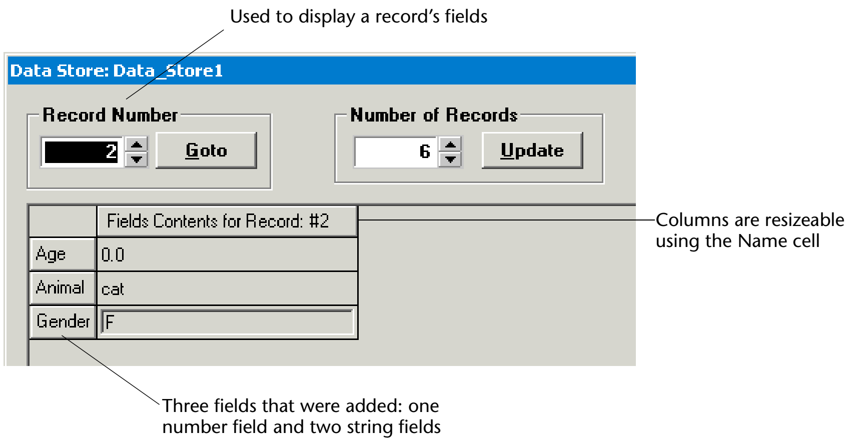
This option is useful in projects that contain user objects that share the same data. For details about holders, see p. 19-12.

7 (For C code generation) To set values that are applicable for C code generation, click the Advanced button. For details, see p. 10-31.

The next two illustrations show a data store with six records and three fields:

Fields view

This view shows all the fields of one particular record. It is your initial view when you open the Data Store dialog box.


Used to display a record's fields
Data Store: Data_Store1
Record Number
Goto
Number of Records
Update
Columns are resizeable using the Name cell
Three fields that were added: one number field and two string fields

Record Number: 2
Number of Records: 6

	Fields Contents for Record: #2
Age	0.0
Animal	cat
Gender	F

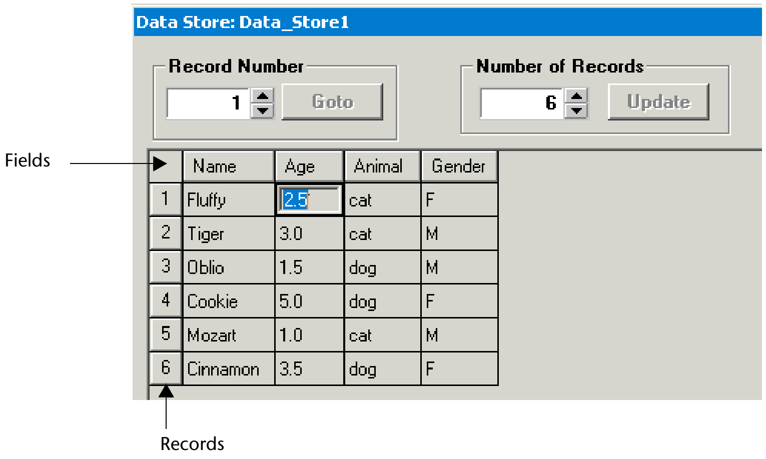
To display a specific record's fields:

1 In the Record Number box, click the up/down arrow or type a number.

2 Click the Goto button.

Records view

This view shows all of the records and their fields in a table. By default, each record is identified by its record number. A blank “Name” column is available for assigning names to the records. If you want to assign names, the data store must be in Records view. In the logic, you refer to each record by either its number or name.



	Name	Age	Animal	Gender
1	Fluffy	2.5	cat	F
2	Tiger	3.0	cat	M
3	Oblio	1.5	dog	M
4	Cookie	5.0	dog	F
5	Mozart	1.0	cat	M
6	Cinnamon	3.5	dog	F

To edit field values:

1 Select the cell you want to edit by clicking it or by moving to it using the Ctrl + arrow keys.

2 Overtype the element’s value.

Importing Data into Data Stores

Data can be imported into data stores from TXT, CSV, and RDS files.

- RDS files are RapidPLUS files that are created via data store logic.
- CSV (comma delimited) files are created in Microsoft® Excel.
- TXT files are created in Microsoft Excel or any text editor. TXT files containing Unicode cannot be imported.

Before you import data into a data store, the data must be formatted correctly. RDS files have preset formats that are created when the objects’ *saveToFile*: function is used. See “Formatting Data in Microsoft Excel (CSV files)” on p. 10-24 and “Formatting Data in a Text Editor (TXT files)” on p. 10-25 for information about formatting the files.

To import data into a data store:

1 Open the data store's dialog box.

2 If the data you will be importing includes all the information (that is, field names, record names, and element values), click the Import button.

If the data you will be importing includes element values only, add the appropriate fields, then click the Import button.

3 In the Open Import File dialog box, select a file and click Open.

❖ *NOTE: The number of fields and field types in both the imported file and the data store must match; otherwise, RapidPLUS will ask you if you want to replace the current data store with the imported one.*

The imported values are added to the data store.

4 (Optional) If the imported data did not include record names, add them in the Name column.

Formatting Data in Microsoft Excel (CSV files)

When you create a Microsoft® Excel workbook that will be imported into a data store, be sure to save the workbook in the CSV (comma delimited) format.

❖ *NOTE: If your system's default language uses a delimiter other than a comma, you must manually change the system's default delimiter. To do so, open the Regional Options dialog box from the Control Panel. Click the Numbers tab and change the List Separator selection to a comma.*

The imported file can contain data for the element values only, or data for element values, field names and/or record names. See the Usage Examples on p. 10-27—10-28 to learn how to enter data in Excel workbooks.

Here are points to keep in mind when creating a CSV file:

- When you give names to data store fields, you must follow the conventions for naming RapidPLUS objects (see "Modification to the Rules for Naming Objects" on p. 27-9). If you do not follow these conventions, the file cannot be imported.
- Field names must specify the field type (string, integer, or number). See the example on p. 10-27 to learn how field names and types are entered.

- If the cell at position A1 is left blank, the elements listed in Column A will become record names in the data store. See the example on p. 10-28 to learn how record names are imported.
- If no field names are entered, all of the element values will be imported as strings. See the example on p. 10-26.

Formatting Data in a Text Editor (TXT files)

The data should be arranged as follows:

```
[Field_Name1(<type>)[tab]Field_Name2(<type>)[tab]Field_Name3(<type>)]...
[RecordName1][tab]data_11[tab]data_12[tab]data_13...
[RecordName2][tab]data_21[tab]data_22[tab]data_23...
[RecordName1][tab]data_31[tab]data_32[tab]data_33...
...<carriage return>
```

The first line and the record names are optional. Field name types are not case sensitive. For example, you can enter a type as (string) or (String). If the last line is not blank, data from the last line of text might not be read.

Example

```
Name(string)Age(number)Birth_Year(integer)
Arlene45.01957
Mike42.51959
Ronnie16.81985
Karen15.5   1986
<empty line>
```

See the following usage examples for more examples.

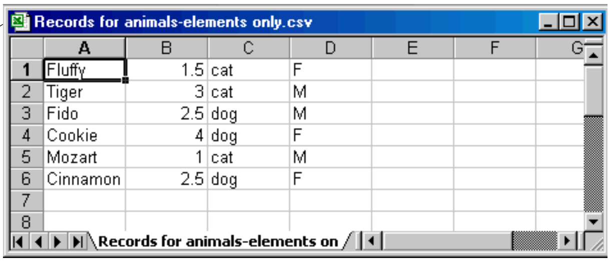
Usage Examples: Formatting Data for Import Into Data Stores

Each of the following three examples shows:

- A CSV file and a TXT file with a certain amount of data.
- A data store as it appears when either of the files is imported.

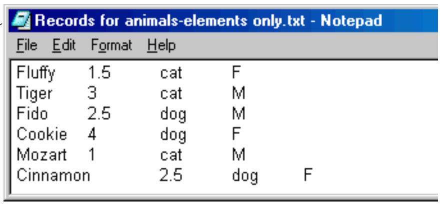
Example of elements imported from CSV and TXT files

The CSV file in Microsoft Excel. This workbook contains element values only.


Records for animals-elements only.csv
Records for animals-elements on

	A	B	C	D	E	F	G
1	Fluffy	1.5	cat	F			
2	Tiger	3	cat	M			
3	Fido	2.5	dog	M			
4	Cookie	4	dog	F			
5	Mozart	1	cat	M			
6	Cinnamon	2.5	dog	F			
7							
8							

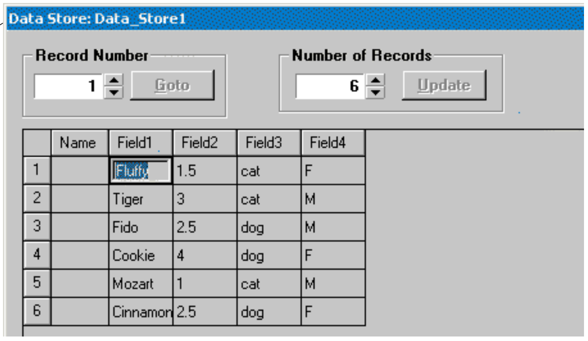
The TXT file in Microsoft Notepad. This file contains element values only. The elements are separated by tabs.



```
Fluffy    1.5       cat       F
Tiger     3         cat       M
Fido      2.5       dog       M
Cookie    4         dog       F
Mozart    1         cat       M
Cinnamon            2.5       dog       F
```

The CSV or TXT file imported into a data store.

Notice that the Name column is empty and the firelds have default names.



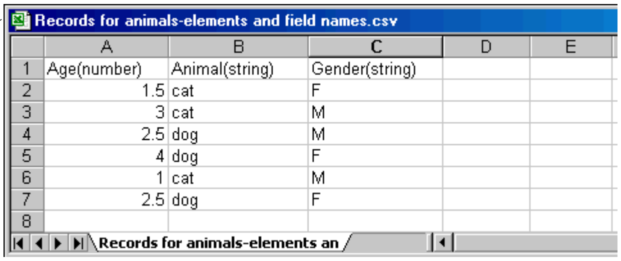
	Name	Field1	Field2	Field3	Field4
1		Fluffy	1.5	cat	F
2		Tiger	3	cat	M
3		Fido	2.5	dog	M
4		Cookie	4	dog	F
5		Mozart	1	cat	M
6		Cinnamon	2.5	dog	F

In the data store above, the Field type for all of the fields is “string” because no fields were defined in either the CSV or TXT file.

Example of elements and field names imported from CSV and TXT files

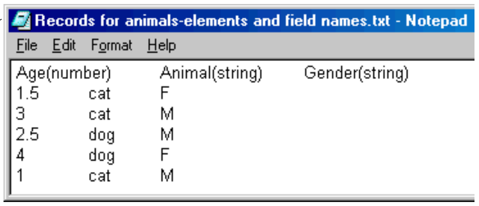
This workbook contains element values and field names and types.

The field type must appear next to the field name and be enclosed in parentheses.


Records for animals-elements and field names.csv

	A	B	C	D	E
1	Age(number)	Animal(string)	Gender(string)		
2	1.5	cat	F		
3	3	cat	M		
4	2.5	dog	M		
5	4	dog	F		
6	1	cat	M		
7	2.5	dog	F		
8					

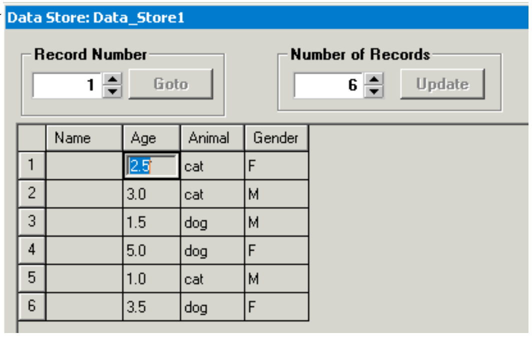
The TXT file contains element values and field names and types (in parentheses). The elements are separated by tabs.


Records for animals-elements and field names.txt - Notepad

```
Age(number)     Animal(string)  Gender(string)
1.5     cat     F
3       cat     M
2.5     dog     M
4       dog     F
1       cat     M
```

The CSV or TXT file imported into a data store.

Notice that the Name column is empty. The field names and types appearing in the first row became the data store's fields.


Data Store: Data_Store1

Record Number: 1

Number of Records: 6

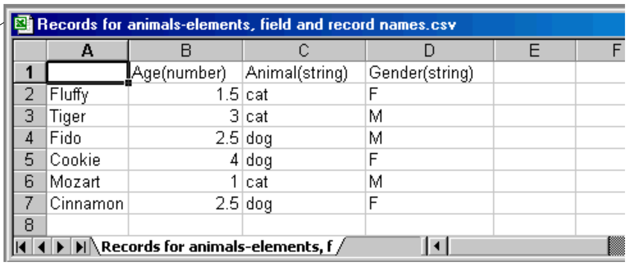
	Name	Age	Animal	Gender
1		2.5	cat	F
2		3.0	cat	M
3		1.5	dog	M
4		5.0	dog	F
5		1.0	cat	M
6		3.5	dog	F

In the data store above, the record name column is empty because this column was not defined in either the CSV or TXT file.

Example of element, record names, and field names imported from CSV and TXT files

This workbook contains element values, field names and types, and record names.

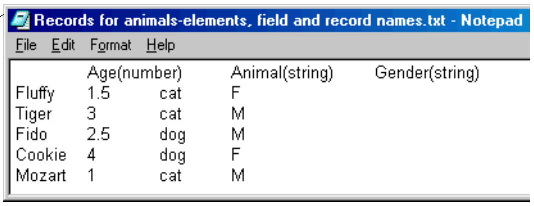
Notice that cell "A1" is empty. This empty cell informs RapidPLUS that the values listed in Column A will be the record names in the


Records for animals-elements, field and record names.csv

	A	B	C	D	E	F
1		Age(number)	Animal(string)	Gender(string)		
2	Fluffy	1.5	cat	F		
3	Tiger	3	cat	M		
4	Fido	2.5	dog	M		
5	Cookie	4	dog	F		
6	Mozart	1	cat	M		
7	Cinnamon	2.5	dog	F		
8						

TheTXT file contains element values, field names and types, and record names.

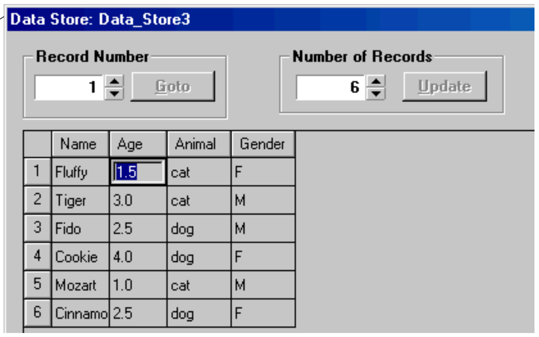
The empty space+tab at the beginning of the file informs RapidPLUS that the values listed in Column A will be the record names in the data store.


Records for animals-elements, field and record names.txt - Notepad

```
        Age(number)     Animal(string)     Gender(string)
Fluffy  1.5       cat     F
Tiger   3         cat     M
Fido    2.5       dog     M
Cookie  4         dog     F
Mozart  1         cat     M
```

The CSV or TXT file imported into a data store.

Notice that the Name column contains the values that appear in the first column of the CSV and TXT files.


Data Store: Data_Store3

Record Number: 1

Number of Records: 6

	Name	Age	Animal	Gender
1	Fluffy	1.5	cat	F
2	Tiger	3.0	cat	M
3	Fido	2.5	dog	M
4	Cookie	4.0	dog	F
5	Mozart	1.0	cat	M
6	Cinnamo	2.5	dog	F

The data store above shows a data store that received all of its values from an imported file.

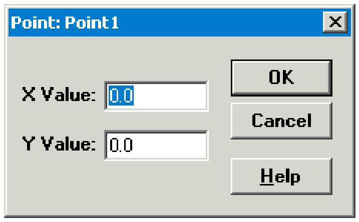
Point

The point object is a variable that holds a RapidPLUS coordinate (x@y). You can use the point object to move dynamic graphic objects. It is especially useful when your application contains several modes and you have an object that moves to different positions in each of the modes. It is also useful when you want to place several objects in the same position.

In addition, you can use the point object to resize dynamic, active primitive objects. You can assign its value to the:

- *size* property (for frame, imported bitmap, and title text objects).
- *radius* property (for circle objects).
- *start* and *end* properties (for line objects).

The Point dialog box opens when you add or edit a point object.



The dialog box is used to assign or edit a point object's initial values. It also opens when you define a point property for an active primitive object or a user property for a user-defined object.

Example

A dynamic circle (Circle1) is located at (10@10) and the value of Point1 is (20@20). If you build the entry activity, **Circle1.position := Point1**, the circle will appear at (20@20) each time the application enters that mode.

Advanced C Code Generation Options

(Applies to RapidPLUS CODE only)

The sizes of string, data store, and one- and two-dimensional array objects can change during runtime. You can specify the maximum sizes of these data objects as part of the application design. The sizes are specified globally for all of these objects, but these sizes can be changed for individual objects in their Advanced dialog boxes.

In the context of code generation, RAM must be allocated for these generated objects at the startup of the embedded system. Specifying their maximum sizes helps optimize these RAM allocations.

Also, setting an integer object to be generated as a primitive data type can contribute to RAM optimization.

Global Size Definitions

By default, RapidPLUS assigns the following maximum default sizes:

- Strings: 32,752 bytes (equivalent to 16,376 characters for double-byte and Unicode). The maximum length also applies to string elements of string-type arrays, string fields in data stores, and string fields in message structures.
- Arrays: 65,535 elements.
- Data stores: 65,535 records.

You can change these defaults in the Code Generation Preferences dialog box.

To specify global maximum sizes:

1. Open the Code Generation Preferences dialog box (by choosing Code Generator|Code Generation Preferences in the Application Manager).
2. Select the Data Sizes tab and set the sizes as necessary.

Each **new** string, array, and data store that you add to the application automatically uses these global sizes. However, you can override the default maximum length or size for a specific object via its Advanced dialog box. Also, previously added objects retain their specific sizes in their Advanced dialog boxes.

Example

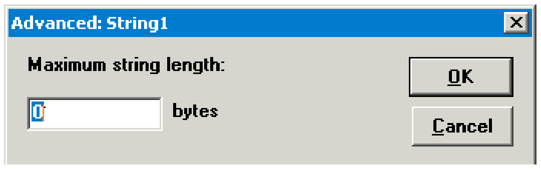
If you had already defined a string object with an initial value of “Hello World” and you then change the default string length to 10 (that is, less than the length of the string's initial value), the string object's dialog box will hold the maximum string length of 11.

Size Definitions for Individual String Objects

You can set the maximum size of a string object in its Advanced dialog box.

To change the maximum length of a string object:

1 In the String dialog box, click the Advanced button. The Advanced dialog box opens:



Maximum string length: 0 bytes

2 Type in the maximum string length in bytes. Typing a zero will cause the object to use the global size set in the Code Generation Preferences dialog box.

  If the initial string exceeds the maximum length, a warning will prompt you to either truncate the initial text or increase the limit to accommodate the text.

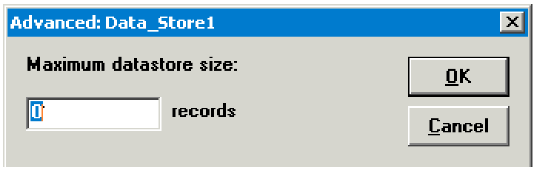
The maximum length of string objects also applies to string elements of string-type arrays, string fields in data stores, and string fields in message structures.

Size Definitions for Individual Data Store Objects

You can set the maximum size of a data store object and/or each of its **string** fields in its Advanced dialog box.

To change the maximum size of a data store object:

1 In the Data Store dialog box, click the Advanced button. The Advanced dialog box opens:



2 Type in the maximum number of records. Typing a zero will cause the object to use the global size set in the Code Generation Preferences dialog box.

If the initial record size exceeds the size limit, a warning will prompt you to either truncate the data store or increase the limit.

To change the maximum length of a string field:

1 In the Add/Edit Field dialog box, click the Advanced button.

2 Type in the maximum length in bytes. Typing a zero will cause the object to use the global size set in the Code Generation Preferences dialog box.

If the initial string exceeds the length limit, a warning will prompt you to either truncate the initial text or increase the limit.

Size Definitions for Individual Array Objects

You can set the maximum size of a one or two-dimensional array in its Advanced dialog box.

To change the default maximum size of a one or two-dimensional array:

1 In the Array dialog box, click the Advanced button.

2 Type in the maximum size of elements. Typing a zero will cause the object to use the global size set in the Code Generation Preferences dialog box.

If the initial string exceeds the length limit, a warning will prompt you to either truncate the initial text or increase the limit.

If the array is a string array, you can also type in a maximum length that applies to all the array's elements. If the array is an integer array, you can set the data type for its elements, as described in the following section.

Element Data Types for Individual Integer Arrays

In the integer array's Advanced dialog box, you can decrease the size of the C code that is generated for each element by selecting a primitive data type: long (32 bit), short (16 bit), or char (8 bit). By default, the elements are generated with a set structure for a Rapid integer (described below in the "Definitions for Individual Integer Objects" section.

Using Integer Arrays with Primitive Element Types in the Logic

Integer arrays cannot be dynamically resized during runtime, and functions that modify the array size are not available.

These arrays cannot be used in logic that requires a dependency on them (i.e., condition-only transitions, mode activities, or exported conditions).

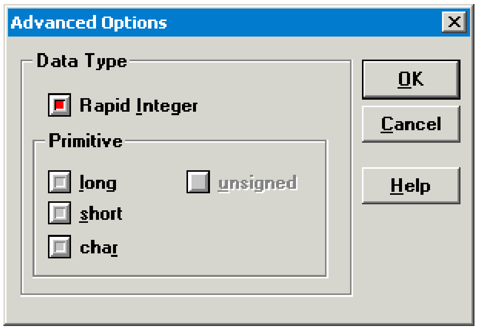
Definitions for Individual Integer Objects

You can set the size of the C code that is generated for an integer object by selecting the data type that is generated for it. By default an integer object is generated as a RapidPLUS object, which endows it with certain characteristics including an ID number and the ability to be used in logic with dependencies (i.e., condition-only transitions, mode activities, or exported conditions). The generated integer object has a structure which uses more memory than a generated primitive integer.

To reduce the memory used by the embedded system, you can generate the object as a primitive data type; however, primitive integers have less features. If you generate the object as a primitive type, you cannot set bounds for it. You also cannot use it in logic that requires dependencies (as mentioned above).

To generate an integer object as a primitive data type:

1 In the Integer dialog box, click the Advanced button. The Advanced Options dialog box opens:



[✓ Rapid Integer]
long
unsigned
short
char

2 Select either long (32 bit), short (16 bit), or char (8 bit).

3 (Optional) Select the Unsigned check box.

❖ *NOTE: This dialog box is also available for integer properties of active primitive objects and user object properties of type integer.*

Using Primitive Data Types in the Logic

Any integer type can be assigned to the object; however, information may be lost when a type with more bits is assigned to a type with fewer bits (truncation). When calculating expressions with integers and advanced integer types, the calculation of the expression will always be done using 32-bit precision. When assigning the result, truncation may occur.

Advanced integer data types can be passed to functions with integer type arguments or other advanced integer types, only if the argument is passed by value (that is, only the value of the object is passed). When the function is defined with an integer argument or advanced integer argument that is passed by reference (that is, the object itself is passed), the RapidPLUS compiler will only allow passing variables of the exact same type to the function (e.g., a function that receives a char argument by reference will only accept variables of char type).

TIME OBJECTS

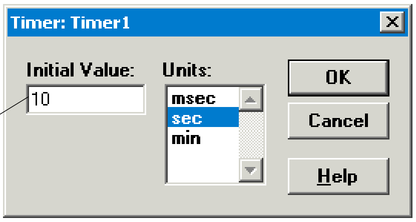
This class of nongraphic objects comprises objects that hold time data in a variable. You can display the data, use it in calculations, or base triggers on it. There are five types of time objects: timer, stopwatch, date, time, and timer tick (which is used in C code generation).

Timer

The timer object counts down from an initial value and stops when it reaches zero (generating the event, *tick*).

The timer can be paused before it reaches zero, in which case it resumes counting from where it was interrupted when started again. The timer can also be reset, in which case it starts counting from the initial value when started again. The timer also has a *restart* function, so that when it reaches zero it generates a *tick* event then starts at the initial value once again.

Use the Timer dialog box to set the initial count value and the counting units:


Timer: Timer1

Initial Value: 10

Units: msec / sec (selected) / min

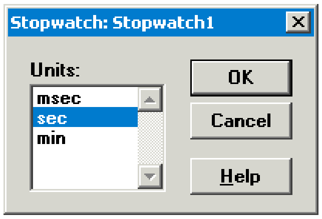
Initial counting value in the Prototyper (an integer)

Stopwatch

The stopwatch object counts up from zero in the selected time units and generates an event, *tick*, as each time unit passes by. It can be stopped then restarted from either its current time value or the initial time value. The stopwatch's value (i.e., the elapsed time) can be read at any time.

❖ *NOTE: If the stopwatch is counting in milliseconds, the tick is not generated.*

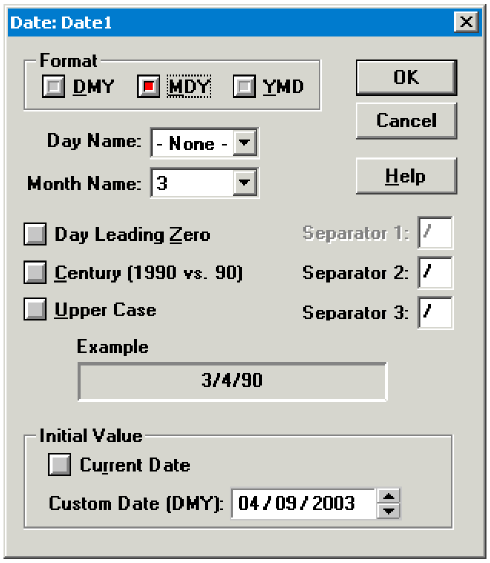
Use the Stopwatch dialog box to select the counting units:


Stopwatch: Stopwatch1

Units: msec / sec (selected) / min

Date

The date object allows you to set a date and display it in an application.



Date: Date1

Format: DMY [✓ MDY] YMD

Day Name: - None -

Month Name: 3

Day Leading Zero

Century (1990 vs. 90)

Upper Case

Separator 1: /

Separator 2: /

Separator 3: /

Example: 3/4/90

Initial Value

Current Date

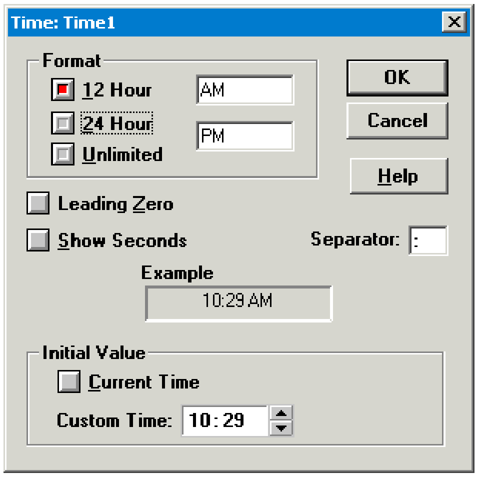
Custom Date (DMY): 04/09/2003

OPTION	DESCRIPTION
Format	Sets the format in which the date is displayed in the application, either: day-month-year, month-day-year, or year-month-day.
Day Name	Determines whether to include the day's name, and if so, in which format.
Month Name	Sets the format for the month.
Day Leading Zero	When selected, adds a zero before single-digit days, e.g., 04.
Century	When selected, displays the year with four digits, e.g., March 1, 2004 appears as Mar/1/2004.
Upper Case	When selected, all letters appear in uppercase, e.g., MAR/1/04.

OPTION	DESCRIPTION
Separators	Sets the characters that separate the day name, day, month, and year, e.g., Sun: 16/4/04. The first separator is not available when the Day Name option is set to None.
Initial Value	Sets the date to either the current system date or to a manually selected date.

Time

The time object allows you to set a time and display it in an application.


Time: Time1

Format
[✓ 12 Hour] AM
24 Hour PM
Unlimited

Leading Zero
Show Seconds
Separator: :

Example
10:29 AM

Initial Value
Current Time
Custom Time: 10:29

OPTION	DESCRIPTION
Format	Sets the format in which the time is displayed in the application. If you select 12-hour format, you can edit the AM/PM text. If you select 24-hour or Unlimited format, you can add text that will appear after the time, e.g. “hours.”
Leading Zero	When selected, adds a zero before single-digit hours, e.g., 09.

OPTION	DESCRIPTION
Show Seconds	When selected, the seconds are displayed, e.g., 8:23:00.
Separator	Sets the character that separates the hours, minutes, and seconds.
Initial Value	Sets the time to either the current system time or to a manually selected time.

TimerTick External Object

A timer tick object is a nongraphic object similar to the timer object but more economical for C code generation. Like the timer, it generates an event (*tick*) at the end of a specified period, but it does so without using a counter. It therefore consumes less RAM in the generated application, but should only be used when manipulation of the timer counter is not required.

The dialog box is used to set the period (in milliseconds) at the end of which a tick is generated. The default period is 1000 msec.

SIGNAL OBJECTS

This class of nongraphic objects comprises objects that emit some kind of signal, either:

- To the user (such as an audible beep).
- To RapidPLUS (to instruct it to carry out some operation).

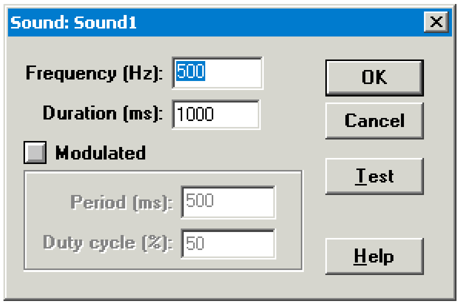
Event

The event object is used to simplify RapidPLUS logic when designing complex applications. For example, you can generate the event in one mode, and then use the event to trigger a transition in a concurrent mode.

The event object is the only nongraphic object that does not have an additional dialog box. When you add an event, the More button is disabled.

Sound

The sound object generates sound at a specified frequency, either continuously or intermittently.


Sound: Sound1

Frequency (Hz): 500
Duration (ms): 1000
Modulated
Period (ms): 500
Duty cycle (%): 50

OPTION	DESCRIPTION	DEFAULT
Frequency	Sets the object's frequency. Range: 37 – 20,000 Hz.	500
Duration	Sets the total time (in milliseconds) that the object is on.	1000 msec
Modulated	When selected, the sound is produced intermittently. **Period**: sets the length of the modulation cycle in milliseconds. **Duty cycle**: sets the percentage of the modulation cycle in which the sound is emitted.	Not selected

Example

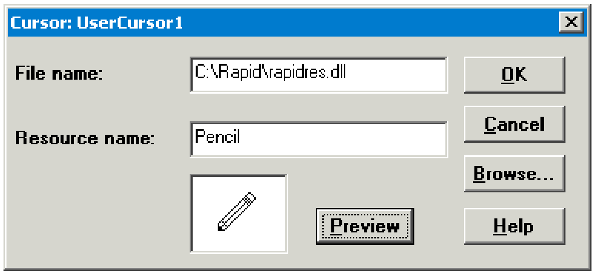
If you have a duration of 1,000 ms, a modulation period of 500 ms, and a duty cycle of 50%, the object sounds for 250 ms, is silent for 250 ms, then sounds for 250 ms, then is silent for 250 ms, after which time the object is inactive.

❖ *NOTE: From RapidPLUS 6.0 on, the sound object uses the computer's sound card, not the internal computer speakers; therefore, sounds developed in earlier versions will sound differently.*

UserCursor

The UserCursor object lets you add custom cursors to your application, to be used in the logic in conjunction with the mouse system object (see p. 10-45 for a brief description). In this way you can specify a unique cursor (other than the system cursors already supplied with RapidPLUS) that will show when the mouse is located over a certain graphic object, switch position, group, or user object.

You define a cursor by specifying a file in the UserCursor dialog box:


Cursor: UserCursor1

File name: C:\Rapid\rapidres.dll

Resource name: Pencil

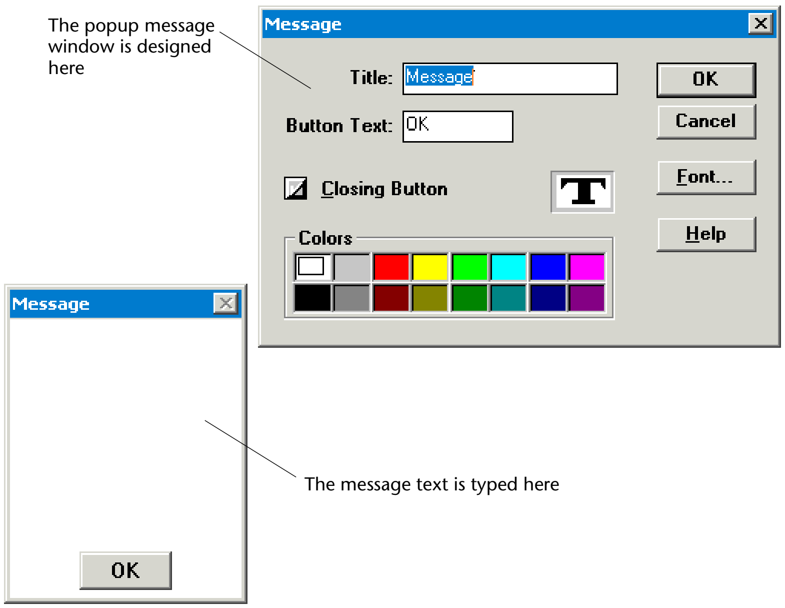
A sample UserCursor dialog box

OPTION	DESCRIPTION
File name	The name of the file containing the cursor definition, either a CUR, ANI, EXE, or DLL file. You can click the Browse button to browse to the file.
Resource name	If an EXE or DLL file is selected, the resource name must be typed in.
Preview	When clicked, this button displays a preview of the cursor.

Message

The message object displays a message in a pop-up window. In the Logic Editor, you can construct actions and/or activities that open and close the message in the Prototyper.

When you add a message object to the layout, the Message dialog box opens, together with the message window (in the upper-left corner of your screen).



To create a message window:

1 In the Message dialog box:

a. If you want to change the text that appears in the title bar, overtype “Message” in the Title box.

b. By default the message window contains a button for closing the window named “OK.” If you want to change the name of the button, overtype “OK” in the Button Text box. If you don’t want a button to appear in the window, clear the Closing Button check box.

c. The default color of the text that will appear in the message window is black. To change the color, select a different color in the palette. The new color is shown in the T preview box.

d. To change the font of the message text, click the Font button and make changes in the Font dialog box.

2 In the message window, type the text message text. If the text is too large for the window, you can resize the window.

3 Move the message window to the Object Layout and place it in the location at which you want it to appear in the Prototyper.

4 Click OK in the Message dialog box.

SYSTEM OBJECTS

RapidPLUS automatically generates the following nongraphic objects in every application: ASCII, keyboard, language, mouse, StateMachine, SystemCursor, SystemDate, and SystemTime. They are referred to as system objects. Because system objects are not added to the application in the Object Layout, they are referenced only through the Logic Palette and Logic Editor.

You cannot edit or delete the system objects.

ASCII

This object allows you to assign ASCII codes and string characters with specific ASCII values. ASCII code values 1–31 are non-printing or control character codes that are functions of the ASCII object. Code values 32–127 are keyboard characters. Code values 128–255 use the Windows ANSI character set and hold a combination of graphics and foreign-language codes.

Using the ASCII object in conjunction with the keyboard object allows you to test for when the user presses certain ASCII codes, for example, bs (backspace) and cr (carriage return).

Examples

This logic statement assigns the character whose ASCII value is 169 (the copyright symbol):

```
TextDisplay contents := ASCII withValue: 169
```

This logic statement changes a single byte “1” in the middle of a string to a double-byte “1”:

```
string[5] := ASCII withValue: (string[5].ASCIIValue + 0x8e00)
```

Keyboard

When the keyboard object is activated (*Keyboard activate*), it allows the computer keyboard to become an object that you can use during runtime. For example, you could use the keyboard to enter text into a text display or text window.

The event, *keyUp*, is generated after a keypress when a key is released.

Language

The language object enables language localization. Localization refers to switching among languages during runtime in order to display multi-lingual text strings. Localized text is appropriately displayed in the active language regardless of the computer's language settings; it requires only a font with a script that matches the respective language. Localization is currently available only for the graphic display object.

RapidPLUS's localization support relies on the multi-lingual support of the operating system. It is fully available for Unicode operating systems (Windows® 2000 and Windows® NT), but is limited to a single double-byte language for double-byte operating systems (such as Windows® 98).

In applications that feature localization, avoid the use of literals. You should also bear in mind that localization affects string-manipulation functions.

The language object has several functions that allow you to set and get the active language.

FUNCTION	DESCRIPTION
getCurrent	Returns the code page number of the current language as an integer.
set: <Integer>	Sets the code page of the current language. In the parameter, use the name of the respective language as listed in the Functions column of the Logic Palette, or the number of the code page.

FUNCTION	DESCRIPTION
	The code page number of the respective language, as follows:
Arabic	1256
Baltic	1257
Cyrillic	1251
EasternEuropean	1250
Greek	1253
Hebrew	1255
Japanese	932
Korean	949
SimplifiedChinese	936
TraditionalChinese	950
Turkish	1254
Western	1252
	The language name is a constant integer and can be used wherever an integer is required. Examples: **Language set: Language Korean** **Integer1 := Language Korean**

Example

In a cell phone application, you want to provide a choice of display languages. You first organize the various display strings in a two-dimensional array with a column for each language. Then, to switch from one language to another during runtime, you use the following logic sequence:

Display1 clearDisplay

Clears the display.

Language set: <New_Language>

Sets the new language.

Display1 fontSet: <Font_Object>

Sets the appropriate font for the new language. The font must be defined with the appropriate script for the active language.

Display1 drawText:Array1[<Lang_ID , <String_ID>] atx: 10 y: 30

Displays the string in the proper language on the specified area of the graphic display object.

This logic sequence is repeated for each language switch.

Organizing multi-lingual text strings

RapidPLUS supports multi-lingual text strings, which are typed into an array file (RAR) using an editor that is capable of saving in double byte, or has a screen font option, such as KEDIT. The text strings are then loaded into a RapidPLUS array with the *loadFromFile:* function.

e-SIM has a tool for managing multi-lingual text strings that is based on a Microsoft® Excel spreadsheet. For information about this tool, please refer to the e-SIM FTP site in the Widgets area.

Mouse

The mouse object provides two services:

- It makes the system mouse position and events available to the logic.
- It assigns cursors (either system—see below, or custom—see “UserCursor” on p. 10-40) to graphic objects and switch positions. The assigned cursor appears during runtime when the mouse is located over the object or position.

StateMachine

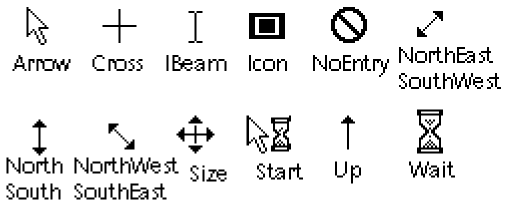
The StateMachine object makes public an aspect of the RapidPLUS state machine. The state machine responds to events by dynamically calculating the next appropriate state, and then deactivating and activating the modes required to bring the system into this state.

The StateMachine object has one condition, *has events*. This condition checks whether or not there are events located in either of two internal queues: the User generated event queue or the Logic generated event queue. (See the Code Generation Preferences dialog box for more information about these queues.)

This condition is useful for synchronizing calls of user object exported functions. Sometimes, an exported function call switches on a sequence of logical operations (transitions) inside the user object. While this sequence is being performed, the *has events* condition is true. When the event queues are empty, the *has events* condition becomes false.

SystemCursors

RapidPLUS provides twelve predefined cursors which appear in the Objects list of the Logic Palette, as a subset of the System group:



SystemDate

The SystemDate object contains the computer's real-time date. The format may be D/M/Y (default) or M/D/Y, as specified in the Windows Control Panel. The values of SystemDate can be assigned to the date object.

SystemTime

The SystemTime object contains the computer's real-time clock. Either a 12- or 24-hour (default) clock is used, as specified in the Windows Control Panel. The values of SystemTime can be assigned to the time object.

CHAPTER 11

Constant Objects

Constant objects are read-only RapidPLUS data objects, that is, their size and values, set in the Object Layout at design time, cannot be changed by the logic during runtime. There are five constant objects:

- Constant integer
- Constant number
- Constant string
- Constant array
- Constant set

The primary use for constant objects is in the context of C code generation (RapidPLUS CODE only). Constant integers, numbers, strings, and sets are generated as #defines; constant arrays are generated as consts. By default, they are generated in the application's *.h* file, but you can specify that they be generated in a separate *.h* file in order to make them available to external applications.

This chapter presents:

- When to use constant objects.
- How to add constant objects in the Object Layout.
- How to duplicate constant objects.
- How to use constant objects in the Logic Editor.
- How to generate constant objects (for RapidPLUS CODE only).

USING CONSTANT OBJECTS

Constant objects are defined in the Object Layout. For all constant objects (other than constant sets), their values cannot be changed by the logic during runtime. Constant integer, constant number, and constant string objects are used the same way that you would use any integer, number, or string object in RapidPLUS. Constant array objects behave like any array object in RapidPLUS.

In the constant set object, you define a set of integer constants (like a C *enum* specifier). In the Logic Palette, each constant in the set appears as a read-only integer property of the object. The values of these integer properties cannot be changed by the logic during runtime.

The main advantages of constant objects are in the context of C code generation (for RapidPLUS CODE only). In the context of simulation only, you could use constant objects whenever you require an integer, number, or string value that is not subject to change during runtime. By using a constant object, you can give this literal value a meaningful name, thereby enhancing the readability of the application logic.

ADDING CONSTANT OBJECTS

In the Object Palette, all of the constant data objects can be found in the Constant Data class.

To add a constant integer, number, or string object:

1 Click the Constant Data class button, then select an object button:

Constant integer

Constant number

Constant string

2 Edit the object’s name as desired and click More to open its dialog box.

3 Specify the value of the object. Remember that this value cannot be changed during runtime.

4 Click OK; the object is added to the Constant Data class in the Nongraphic Objects dialog box, where you can edit or delete it like any nongraphic object.

❖ *NOTE: You can duplicate a constant data object either as a new constant object or as a regular (variable) RapidPLUS data object. For details, see "Duplicating Constant Objects" on p. 11-6.*

To add a constant array object:

1 Click the Constant Data class button, then click the Constant Array button.

2 Define the constant array as you would define a normal RapidPLUS array. For more information on arrays see pp. 5-11 to 5-14 in the *Rapid User Manual*.

❖ *NOTE: A constant array can be of integer, number, or string type. It cannot, however, be an array of objects.*

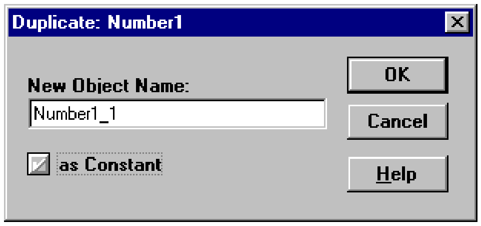
Using the Duplicate Operation to Add a Constant Object

You can duplicate an existing data object (that is, integer, number, string, or array) and turn it into a constant object.

To add a constant object by duplicating a data object:

1 Open the Nongraphic Objects dialog box.

2 Select the integer/number/string/array object and click Duplicate. The Duplicate dialog box opens:


Duplicate: Number1

New Object Name: Number1_1

☑ as Constant

Duplicating a number object—example

3 Assign a name to the new constant object and select the “as Constant” check box. If the “as Constant” check box is not selected, the new object is a number (string, integer, or array) object, just like the original.

4 Click OK; the new object is added to the Constant Data class in the Nongraphic Objects dialog box.

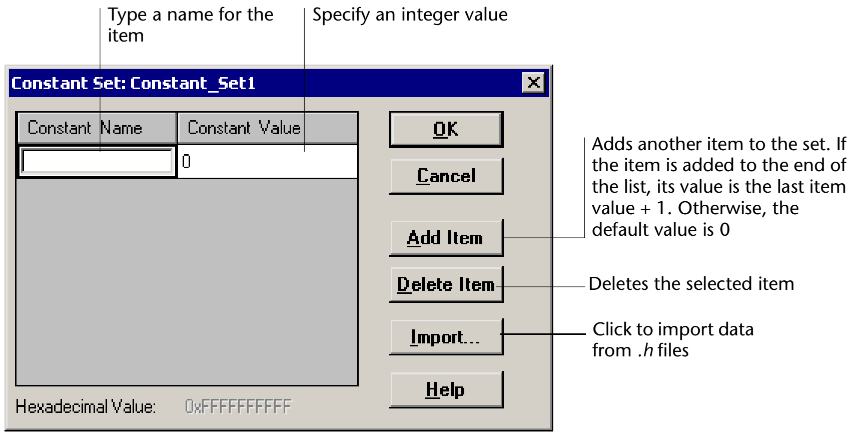
Adding a Constant Set Object

To add a constant set object:

1 Click the Constant Set button and edit the name as desired.

2 Click the More button to open the dialog box in which you define the constant integer items.

3 Click the Add Item button to enable the area in which you provide names and values for the constant integer items, as follows:


Type a name for the item
Specify an integer value
Constant Set: Constant_Set1
Constant Name
Constant Value
0
OK
Cancel
Add Item
Delete Item
Import...
Help
Hexadecimal Value:
0xFFFFFFFFFF
Adds another item to the set. If the item is added to the end of the list, its value is the last item value + 1. Otherwise, the default value is 0
Deletes the selected item
Click to import data from *.h* files

A maximum of 999 integer constants can be added to a constant set object.

❖ *NOTE: If an item in the list is selected when you click Add Item, the new item is added after the selected item. If no item is selected, the new item is added to the end of the list.*

Importing Data to a Constant Set Object

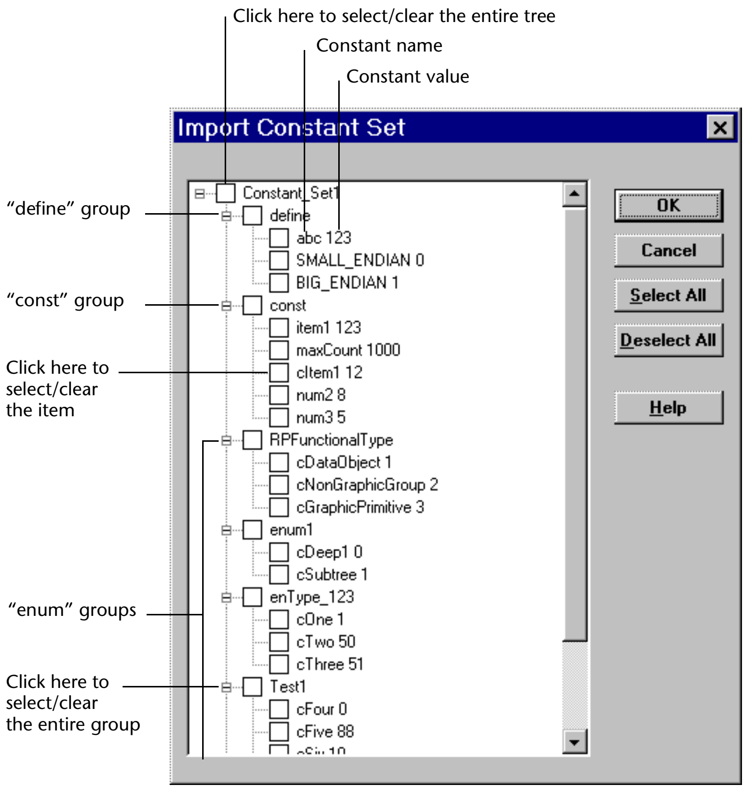
You can import data into a constant set object from one or more *.h* files. The import operation applies to the following *.h* file data types: #define, const (integer types only), and enum. The imported data replaces the items currently in the constant set.

To import data from *.h* files:

1. In the constant set More dialog box, click Import.
2. In the Import Constants dialog box, select the *.h* source file(s), and click Open; the Import Constant Set dialog box opens, listing all the items that can be imported. See a sample list in the following illustration.

   The items are listed in a three-level tree, and are grouped as follows:

   - All the #define items are grouped under the "define" heading.
   - All the const items are grouped under the "const" heading.
   - The items of each enum form a separate group under the enum name when available, or under the generic name "enum" followed by a consecutive number.
   - The items of each enum form a separate group under the enum name when available, or under the generic name "enum" followed by a consecutive number.


Click here to select/clear the entire tree
Constant name
Constant value
"define" group
"const" group
Click here to select/clear the item
"enum" groups
Click here to select/clear the entire group
Import Constant Set
OK
Cancel
Select All
Deselect All
Help

Constant_Set1
define
abc 123
SMALL_ENDIAN 0
BIG_ENDIAN 1
const
item1 123
maxCount 1000
cItem1 12
num2 8
num3 5
RPFunctionalType
cDataObject 1
cNonGraphicGroup 2
cGraphicPrimitive 3
enum1
cDeep1 0
cSubtree 1
enType_123
cOne 1
cTwo 50
cThree 51
Test1
cFour 0
cFive 88

3 Select the items to import and click OK; all existing items are cleared from the constant set, and only the imported items appear in the constant set More dialog box.

❖ *NOTE: Clearing all the items in a group automatically clears the group.*

DUPLICATING CONSTANT OBJECTS

In the Nongraphic Objects dialog box, you can:

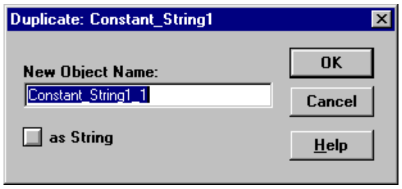
- Duplicate an existing constant integer, number, string, or array object as the equivalent data object.
- Duplicate an existing constant set as an exported property.

Duplicating Constant Integer, Number, String, and Array Objects

To duplicate a constant data object:

1 Open the Nongraphic Objects dialog box.

2 Select the constant integer/number/string/array object and click Duplicate. The Duplicate dialog box opens:



Duplicating a constant string object—example

3 Assign a name to the new object and select the “as String/as Integer/as Number/as Array” check box.

4 Click OK; the new object is added to the Data class in the Nongraphic Objects dialog box.

❖ *NOTE: If “as String (as Integer/as Number/as Array)” is not selected, the new object is a constant string (integer, number, or array) object, just like the original.*

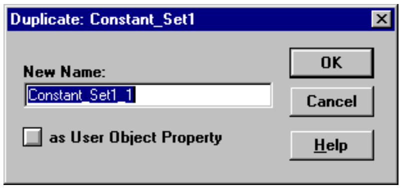
Duplicating Constant Set Objects

You can duplicate a constant set and turn it into a user object property.

To duplicate a constant set as an exported property:

1 Open the Nongraphic Objects dialog box.

2 Select the constant set object you want to duplicate and click Duplicate. The Duplicate dialog box opens:



3 Assign a name to the new constant set object and select the “as User Object Property” check box.

4 Click OK. The new constant set property is added to the User Object Properties dialog box.

❖ *NOTE: The new constant set property has no connection to the original constant set object. Changes to the original does not affect the property and vice versa.*

For information about using constant set properties, see p. 27-13.

USING IN THE LOGIC EDITOR

In the Object column of the Logic Palette, constant objects appear under the Constant Data class. In general, the constant objects do not support functions that allow you to assign values to it or resize it.

All the items added to a constant set object appear in the Properties column of the Logic Palette as read-only properties of the associated constant set object. The supported functions for these read-only properties are the same as for a constant integer object.

❖ *NOTE: There are no functions for the self property of the constant set object.*

Examples

Assume that we have defined two constant objects:

- A simple constant integer object named MY_MESSAGE, with a value of 3.
- A constant set object named MESSAGE_TYPE, with the following constant integer items:

CONSTANT NAME	CONSTANT VALUE
MESSAGE_FROM_TASK1	0
MESSAGE_FROM_TASK2	3
MESSAGE_FROM_TASK3	4

Also assume that we have defined a non-constant RapidPLUS integer object named Count.

You could use the constant objects in conditions, as follows:

& Count = MESSAGE_TYPE.MESSAGE_FROM_TASK1

or

& Count = MY_MESSAGE

You could also use them to assign their value to another (read/write) RapidPLUS object in actions or activities, as shown below:

Count := MESSAGE_TYPE.MESSAGE_FROM_TASK3
Count := MY_MESSAGE

❖ *NOTE: In the application logic, you can use the Find and Replace utility to replace constant objects with variable objects of the same type, and vice versa. For detailed instructions about the Find and Replace utility, refer to Chapter 8: "Find and Replace."*

GENERATING CONSTANT OBJECTS

When you generate C code for your application, the following definitions are generated from the constant objects:

`#define`: constant integer, constant number, constant string, constant set

`const`: constant array

By default, only one C header file is generated for the entire application. You can generate a separate file for the constant object *#define* and *enum* definitions by selecting the "Separate file for #define" option in the General tab of the Code Generation Preferences dialog box, as explained in the *Generating Code for Embedded Systems* manual.

❖ *NOTES: :*
At code generation, the const definitions are always placed in the application's source file.

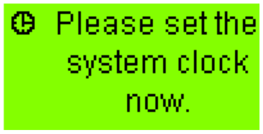
When generating code for the constant set object, the Code Generator checks for uniqueness of its property names among all the RapidPLUS object names. If the Code Generator finds a name conflict, it changes the enum item name from itemName to enumName_itemName.

CHAPTER 12

Graphic Displays

Graphic display objects simulate display screens of devices such as televisions, cell phones, or digital watches. The graphic display is comprised of a matrix of pixels that change color according to the functions used in the object’s logic.

This sample graphic display presents text and an image:



There are two types of graphic displays:

- Graphic displays, which support up to 256 colors.
- True color graphic displays, which support over 16 million colors.

This chapter presents:

- A brief summary of the steps necessary for defining a graphic display.
- How to add and define a graphic display.
- The logic used to change colors during runtime.
- The logic used to display text, images, lines and shapes on a graphic display.
- The logic used to manipulate graphic displays during runtime.
- A Function Reference table.

THE BASICS OF USING GRAPHIC DISPLAYS

Graphic displays simulate display screens. They can display text, images, and/or shapes depending on the logic and supporting objects used. Below is a brief description of how you define a graphic display to display text, images, and shapes.

Graphic displays and true color graphic displays are basically the same except that graphic displays support from 2 to 256 colors and true color graphic displays support 24-bit color. Throughout this chapter, instructions apply to both types of graphic displays. Where additional differences exist, they are mentioned.

The following table presents a summary of the steps involved in working with graphic displays. The steps to be performed depend on what you want the object to display. Page references lead you to detailed instructions.

STEP	DESCRIPTION
Add a graphic display and define its appearance	1. In the Object Layout, add the graphic display to the work area (see p. 12-4). 2. Define display size, cell size, cell color, and grid size (see p. 12-6 to 12-7). 3. (Optional) Define buffers for the display. A buffer is a temporary storage area that can be used to hold and display graphic elements (see p. 12-12).
Define the graphic display's supporting objects	If the graphic display will be used to display text, add one or more font objects (see "Font Object" on p. 13-11). If the graphic display will be used to display images, add one or more bitmap/image objects (see "Bitmap Object" on p. 13-2 and "Image Object" on p. 13-4).
Define logic to display images	For an image to appear on the display, its name and location on the display must be specified. The *drawBitmap:atx:y:* and *drawBitmap:atx:y:-transparentColor:* functions are used with bitmap/image objects to position images (see "Displaying Images" on p. 12-25).

STEP	DESCRIPTION
Define logic to display text	For text to appear on the display, two things must be specified: the font(s) that will be used and the position where the text will start. The *fontSet*: function is used in conjunction with font objects to specify the display's font (see "Specifying a Font Using a Font Object" on p. 12-21). The *drawText:atx:y:* and *draw-TransparentText:atx:y:* functions are used to position text (see "Displaying Text" on p. 12-21).
Define logic to display shapes	The following elements can be drawn on a display: filled and empty rectangles, filled and empty circles and ellipses, lines, and arcs. The functions used to draw these elements are discussed on pp. 12-26 to 12-31.
Define logic to change display colors	During runtime, the following colors can be changed: draw, background, grid, single pixels, and palette (see "Working with Colors" on p. 12-15 to "Changing a Pixel's Color" on p. 12-19).
Control the display	Several functions control when elements are updated on the display and how graphic elements are displayed (see pp. 12-31 to 12-36).
Clear the display	Three functions are available for clearing the display (see p. 12-20).
Define logic for buffers	Many of the functions that determine the appearance of a graphic display during runtime can also determine the appearance of buffers. In addition, there are functions that determine buffer performance. For details about buffers, see "Working with Buffers" on pp. 12-44 to 12-51 and "Saving and Restoring Status" on p. 12-36 to 12-42.

ADDING AND DEFINING A GRAPHIC DISPLAY

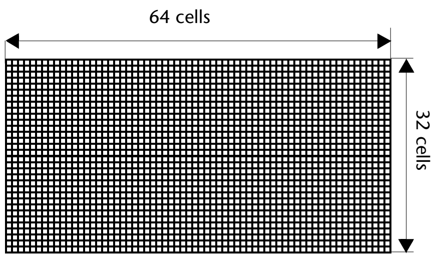
The values that you set in the graphic display's dialog boxes determine the initial appearance of the graphic display, while the display's graphic content is manipulated using the functions available in the Logic Editor. (See "Defining the Logic" starting on p. 12-15.)

To add a graphic display to the layout:

1 Select the Display Objects class.

2 Select either the True Color Graphic Display button or the Graphic Display button, then click on the layout frame.

The graphic display is added at its default size:



The default graphic display is a matrix of 64 × 32 white cells. Each cell measures 2 × 2 pixels, and the lines (grid) separating the columns and rows are black and one pixel wide.

❖ *NOTE: A project can contain multiple graphic displays; although each component in a project should not contain more than one.*

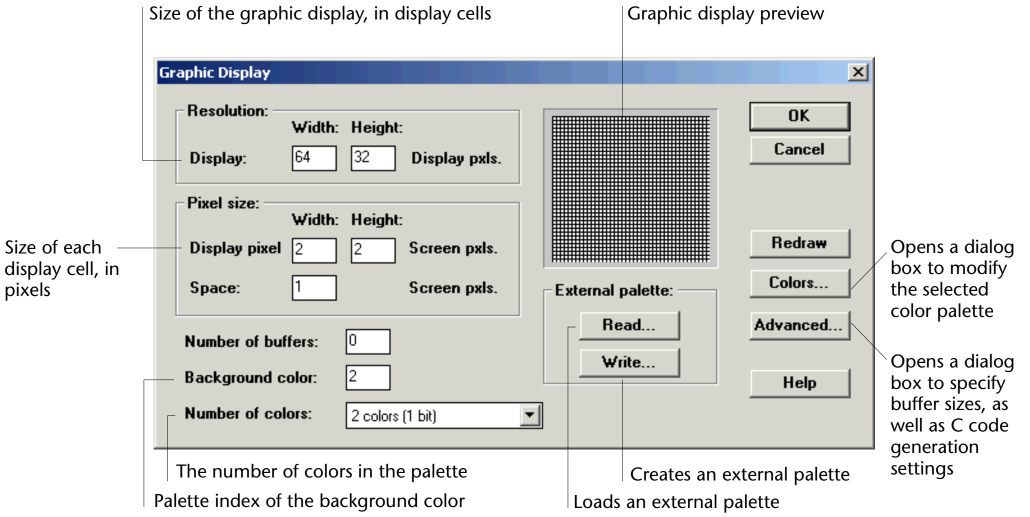
The Graphic Display Parameters

Use the Graphic Display or True Color Graphic Display dialog boxes to define:

- The size of the object, as a matrix of cells.
- The size of each cell in pixels.
- The width of the grid.
- The background color (i.e., the color for the cells).
- The number of buffers and their sizes.

The dialog boxes for the graphic displays are shown below. Each illustration points out the fields that are specific to the dialog box and some of the fields that they have in common.

Graphic Display dialog box


Size of the graphic display, in display cells

Graphic display preview

Size of each display cell, in pixels

Opens a dialog box to modify the selected color palette

Opens a dialog box to specify buffer sizes, as well as C code generation settings

The number of colors in the palette

Palette index of the background color

Creates an external palette

Loads an external palette

Graphic Display

Resolution:

	Width:	Height:	
Display:	64	32	Display pxls.

Pixel size:

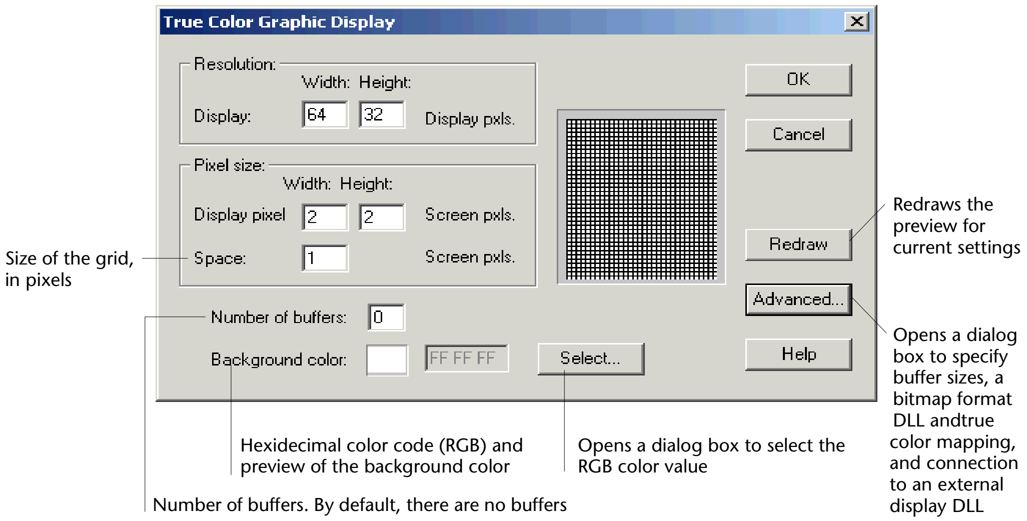
	Width:	Height:	
Display pixel	2	2	Screen pxls.
Space:	1		Screen pxls.

Number of buffers: 0

Background color: 2

Number of colors: 2 colors (1 bit)

True Color Graphic Display dialog box


Size of the grid, in pixels

Redraws the preview for current settings

Opens a dialog box to specify buffer sizes, a bitmap format DLL andtrue color mapping, and connection to an external display DLL

Hexidecimal color code (RGB) and preview of the background color

Opens a dialog box to select the RGB color value

Number of buffers. By default, there are no buffers

True Color Graphic Display

Resolution:

	Width:	Height:	
Display:	64	32	Display pxls.

Pixel size:

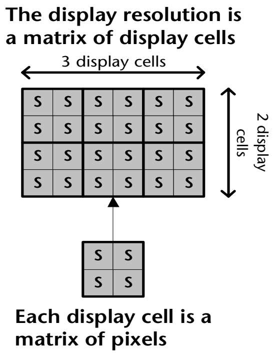
	Width:	Height:	
Display pixel	2	2	Screen pxls.
Space:	1		Screen pxls.

Number of buffers: 0

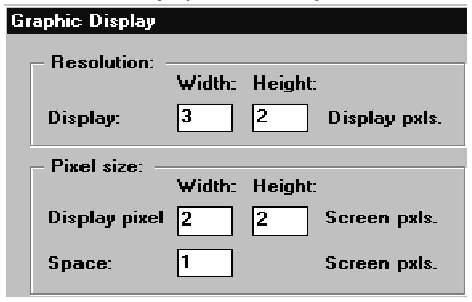
Background color: FF FF FF

Setting the Size and Grid

The following illustrations show the relationship between screen pixels, display cells, and display resolution.


The display resolution is a matrix of display cells
3 display cells
2 display cells
S
Each display cell is a matrix of pixels

Settings in Graphic Display More dialog box



Graphic Display

Resolution:

	Width:	Height:	
Display:	3	2	Display pxls.

Pixel size:

	Width:	Height:	
Display pixel	2	2	Screen pxls.
Space:	1		Screen pxls.

The size of the graphic display is the product of the number of cells (i.e., display pixels) multiplied by the size of each cell. The size of the graphic display is also affected by the grid width; the wider the grid lines, the larger the graphic display.

To define the number of cells in the graphic display:

- In the Resolution group, enter the desired width and height in cells.

To determine the size of each display cell:

- In the Pixel size group, enter the desired width and height, in pixels.

To define the grid line width:

- In the Space box, enter the desired width, in pixels. To eliminate the grid lines from the display, enter zero. To change the color of grid lines, see “Changing the Grid Color” on p. 12-7.

Graphic display size

If you resize the graphic display in the Object Layout, **the number of cells (i.e., the display resolution) remains constant**, and only the size of the individual cells is affected.

At runtime, any elements that exceed the size of the graphic display on which they are displayed are clipped.

Changing the Grid Color

The grid color is the color of the lines that separate display pixels as set in the Space field. The default color is black.

To define the grid color:

1 Select the graphic display/true color graphic display.

2 Open the Colors Edit dialog box (Edit|Colors), and change the line color.

❖ *NOTES: Some colors assigned to grid lines affect the way the background color appears in the Object Layout and Prototyper; however, these colors do not actually change the background color. You will not see this effect in the object's dialog box because the grid color in the Preview window is black.*

You can change the grid color during runtime via the gridColor property. See "Changing the Grid Color" on p. 12-18.

Selecting a Background Color

The color of the graphic display provides the background color for the graphic elements displayed on it. The default background color is white. Its palette index value varies according to the palette: in a 256-color palette it is 256, in a 16-color palette it is 16, in true color it is FFFFFF.

❖ *NOTE: You can change the background color at runtime by using the function setBackgroundColor:. However, the new color will be visible only when a function that uses background color (such as drawText or clear) is activated—and then only for the area referenced by the function.*

To set the background color for a true color graphic display:

1. With the True Color Graphic Display dialog box open, click the Select button; the standard Windows Color dialog box opens.
2. Either select one of the Basic colors or define a Custom color in the extended dialog box.
3. Click OK. The color's hexidecimal color code is added to the Background color box, together with a preview of the color. The hexidecimal code is determined by the color's RGB values.

To set the background color for a graphic display:

1. In the Background color box, enter the palette index of the desired color. (The available index numbers depend on the selection in the Number of colors box. See the following section for details.)
2. (Optional) If you are unsure of a color's index, click the Colors button to open a dialog box that displays the selected palette and corresponding index numbers.

Defining the Palette for a Graphic Display

This section applies to graphic displays and not to true color graphic displays.

Selecting the Palette

The graphic display can use from 2 to 256 colors. You determine the number of colors by choosing the number of bits per pixel (bpp), from a minimum of one to a maximum of eight.

❖ *NOTE: Code generation supports only color depths of 1, 2, 4, & 8 bits per pixel.*

To set the palette size:

- Select the size from the list in "Number of colors."

Setting the Palette Colors

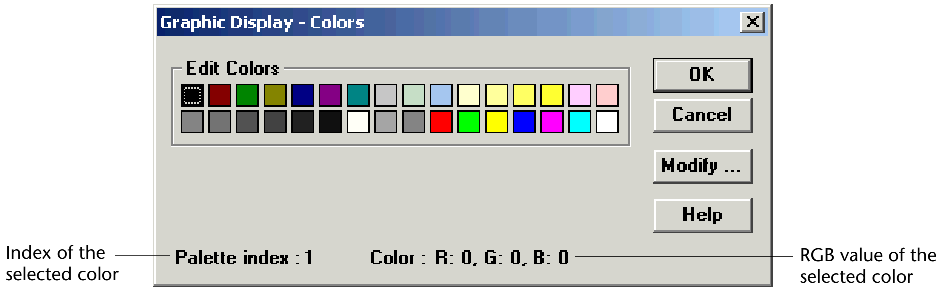
There is a default palette for each palette size. The default colors for the 2, 4, 8, and 16 color palettes are:

PALETTE SIZE	DEFAULT COLORS
2 colors (1 bpp)	black, white
4 colors (2 bpp)	black, dark gray, light gray, white
8 colors (3 bpp)	black, dark red, dark green, olive, blue, magenta, cyan, white
16 colors (4 bpp)	black, dark red, dark green, olive, dark blue, purple, teal, light gray, dark gray, red, green, yellow, blue, magenta, cyan, white

The 32- (5 bpp), 64- (6 bpp), 128- (7 bpp), and 256- (8 bpp) color palettes use RGB (Red, Green, Blue) values to determine their respective default colors.

To modify the graphic display's default color palette:

1 In the Graphic Display dialog box, click the Colors button. The Graphic Display – Colors dialog box (shown below for a 32-color palette) displays the default color settings for the selected palette size:



Palette index : 1

Color : R: 0, G: 0, B: 0

2 Select the palette color you want to change and click Modify. The standard Windows Color dialog box opens.

3 Either select one of the Basic colors or define a Custom color in the extended dialog box.

❖ *NOTE: You can change the palette colors at runtime by using the functions setPaletteIndex:toRed:green:blue:, updatePalette, and* *resetPalette. See "Changing Palette Colors During Runtime" on p. 12-19 for details.*

Color by number

Each color displayed in the Graphic Display – Colors dialog box has a palette index that is used by RapidPLUS to reference the color. The colors are numbered from left to right, top to bottom, starting with 1. When you select a color, its index (and RGB value) are shown at the bottom of the dialog box.

In the object's logic functions, you reference palette colors by their respective indexes. You also use the palette index to set the object's background color in the Graphic Display dialog box.

Creating a Color Palette

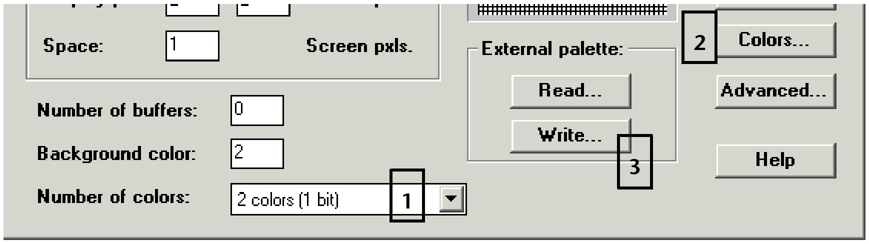
This section applies to graphic displays and not to true color graphic displays.

You can create a palette for a graphic display and export it so that you can use it in the graphics tool you use to create your bitmaps.

❖ *NOTE: The graphic display palette is independent of the RapidPLUS color palette.*

To create a palette in RapidPLUS:

1 In the Number of colors box, select the palette size:



Space: 1 Screen pxls.

Number of buffers: 0

Background color: 2

Number of colors: 2 colors (1 bit)

2 Click the Colors button to modify the palette. For instructions, see "Defining the Palette for a Graphic Display" on p. 12-8.

3 Click the Write button located in the External palette group. The Save Palette File As dialog box opens.

4 Either accept the default location (the RapidPLUS folder) and file name (*gdo.pal*) or change them.

Importing an External Palette

This section applies to graphic displays and not to true color graphic displays.

You can create a palette outside of RapidPLUS through any program that produces a Windows PAL file, or by writing the RGB values directly into the file, and then importing it into RapidPLUS.

If you are a designer of embedded systems, you can ensure color matching with the target graphic display device. Just set the palette of the graphics tool to match the colors of the graphic device in your embedded system, then import this palette into the graphic display dialog box.

To import an external palette:

1 In the Graphic Display dialog box, click the Read button located in the External palette group; the Select Palette dialog box opens.

2 Select a palette file and click OK. The default palette is replaced by the selected external palette.

❖ *NOTE: The number of colors in the external palette determines the number of colors in the graphic display. Therefore, when you import an external palette, the number of colors in the Graphic Display dialog box is automatically adjusted to match the number of colors in the imported palette.*

Externally created palette files

Externally created palettes must have the PAL file format, and the color format must be RGB.

To write a palette file, use the following example that shows a 16-color file. Each color line (lines 4 through 19) consists of three values, R(ed), G(reen), and B(lue) respectively, that together represent a single color.

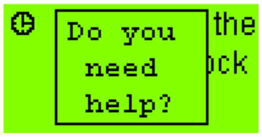
The first two lines are the file header and version. When used in RapidPLUS, these two lines can be omitted. When used in a graphics tool, the first two lines must be compatible with that tool. In the example, the first two lines are compatible with a Paint Shop Pro palette file.

```
JASC-PAL        (Header)
0100            (Version)
16              (Number of colors)
0 0 0           (First color)
128 0 0
0 128 0
128 128 0
0 0 128
```

```
128 0 128
0 128 128
192 192 192
128 128 128
255 0 0
0 255 0
255 255 0
0 0 255
255 0 255
0 255 255
255 255 255   (Last color)
```

Defining Buffers

Buffers are temporary storage areas that store display elements. The popup message in this sample graphic display is stored in a buffer:



Every graphic display has a main buffer the size of the graphic display itself. This main buffer is called the “intermediate buffer.” Each element to be displayed on the graphic display is first placed on the intermediate buffer. The intermediate buffer is an inherent property of each graphic display, and is not included in the number of buffers in the dialog box.

A zero (0) setting in the Number of buffers box means that there are no buffers other than the intermediate buffer.

To define additional buffers:

1 Open the Graphic Display/True Color Graphic Display dialog box.

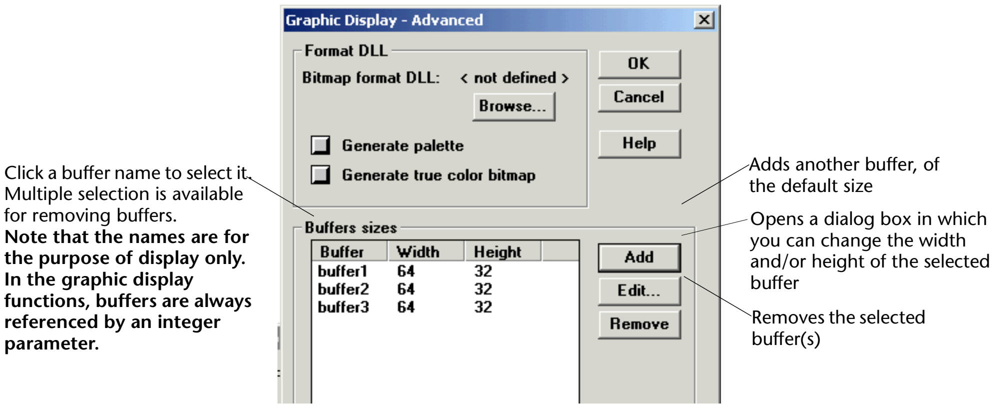
2 In the Number of Buffers box, enter a number.

By default, each additional buffer is a matrix of pixels of the same size as the graphic display.

To add, edit, and remove buffers:

1 Click the Advanced button to open the object’s Advanced dialog box.

For the true color graphic display, click the Buffers tab. Both types of graphic display have the same buffer functionality.


Graphic Display - Advanced
Format DLL
Bitmap format DLL: < not defined >
Browse...
OK
Cancel
Help
Generate palette
Generate true color bitmap
Buffers sizes
Add
Edit...
Remove

Buffer	Width	Height
buffer1	64	32
buffer2	64	32
buffer3	64	32

Click a buffer name to select it. Multiple selection is available for removing buffers. **Note that the names are for the purpose of display only. In the graphic display functions, buffers are always referenced by an integer parameter.**

Adds another buffer, of the default size

Opens a dialog box in which you can change the width and/or height of the selected buffer

Removes the selected buffer(s)

2 To change the width and height of a buffer, select the buffer and then click the Edit button, which opens a dialog box for editing the size.

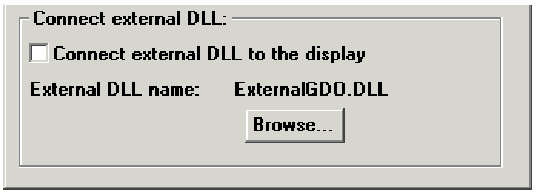
You can use a constant set to give meaningful names to the integer indexes used to reference buffers in the Logic Editor functions. See Chapter 11: "Constant Objects" for information about constant sets.

CONNECTING AN EXTERNAL DLL TO A GRAPHIC DISPLAY

Output of a graphic display can be drawn to an external device while the simulation is running in the Prototyper. This output includes notification from RapidPLUS when the graphic display's contents change, as well as the contents of the changed graphic display. This communication is achieved by specifying an external DLL file in the graphic display's Advanced dialog box and by implementing certain functions in the external DLL.

To connect a graphic display to an external DLL:

1 Open the graphic display/true color graphic display dialog box, and click the Advanced button. For the true color graphic display: in the Advanced dialog box, click the External Display tab.


Connect external DLL:
Connect external DLL to the display
External DLL name: ExternalGDO.DLL
Browse...

2 Select the “Connect external DLL to the display” check box, then click the Browse button to select the appropriate DLL file.

To enable the external DLL to receive output from a graphic display:

The DLL should implement the following API functions:

displayOpened

This function is called when the Prototyper starts, for each graphic display that is connected to the external DLL.

Syntax:

```
BOOL displayOpened(int uniqueID, const char* name, BITMAPINFO
info, void* bits)
```

Parameters:

uniqueID	Identifier for the graphic display. It is guaranteed to be unique for all graphic displays in the current session (a session is defined as the period between starting and stopping the Prototyper.)
name	Name of the graphic display in the application.
info	BITMAPINFO structure that holds the graphic display’s definitions (size, color depth, etc.)
bits	Pointer to the contents of the graphic display’s rectangular representation.

Return value:

The DLL should return TRUE if it wants notifications about the display.

displayContentsChanged

This function is called whenever RapidPLUS updates an area in the graphic display. It will be called once at startup, with the entire display area in the RECT argument. Afterwards, it will be called only for changed areas.

Syntax:

```
void displayContentsChanged(int uniqueID, RECT area, void* bits)
```

Parameters:

uniqueID	Unique identifier for the graphic display.
area	RECT structure that holds the size and position of the changed area.
bits	Pointer to the graphic display bits. (This parameter points to the entire graphic display, not only to the changed area.)

displayClosed

This function is called when the Prototyper is stopped, or when the graphic display is destroyed (for dynamic objects).

Syntax:

```
void displayClosed(int uniqueID)
```

DEFINING THE LOGIC

The values that you set in the dialog boxes determine the initial appearance of the graphic display. The functions available through the object's logic allow you to dynamically change and control its graphic elements, that is, text strings, bitmaps, or shapes.

❖ *NOTE: For every function that uses "atx: y:" for graphic display coordinates, the x coordinate is the number of pixels from the left and the y coordinate is the number of pixels from the top. The upper-left graphic pixel is coordinate x:0 y:0.*

Working with Colors

You can control the background color of the graphic display and the colors of any graphic element displayed on it.

For a graphic display object, the number of color choices available depends on the number of colors you selected in the Graphic Display dialog box. When you want to use a specific color, the color's index corresponds to its index in the object's color palette. By default, the first color in the palette is black (1) and the last color is white (2, 4, 8, 16, 32, 128, or 256).

For a true color graphic display, the color corresponds to the color's RGB value: 0x0 to 0xFFFFFF (0 to 16777215). The first color is black (0x0/0) and the last color is white ()xFFFFFF/16777215).

Changing the Draw Color

The default draw color for graphic displays is black. This color can be changed during runtime using the *setDrawColor:* function. The draw color is used for:

- Displaying text characters (*drawText:atx:y:*).
- Showing the borders of empty shapes (*drawCircleAtcx:cy:radius:, drawEllipseAtcx:cy:horizRadius:vertRadius:*, *drawRecAt:width:height:*).
- Drawing a pixel (*drawPixelAtx:y:)*.
- Drawing lines (*drawArcAtcx:cy:radius:fromX:fromY:toX:toY:, drawLineFromx:y:toX:toY:*, *lineTox: y:*).

Example

A cell phone's LCD displays text and graphic elements in white:

LCD1 setDrawColor: 4
where white is the fourth color in the graphic display's 4-color palette.

Reversing the Color of a Specified Area

The *reverseFromx:y:width:height:* function allows you to define a specific area of the graphic display that will be represented in a reverse color.

To determine which color to use for the reversed area, the graphic display:

i. Identifies the current RGB values of each pixel in the specified area.

ii. Determines the reverse color for each pixel. The reverse color RGB values are derived by subtracting each of the current RGB values from 255.

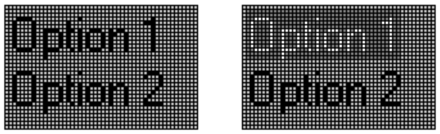
iii. For graphic displays: checks the object's color palette for the closest color available. For true color graphic displays: uses the new RGB values.

For example, a graphic display object has two colors in its palette: black and red, where black is the background color (RGB values 0,0,0). With the *reverseFromx:y:width:height:* function, you specify an area of pixels within which the colors are to be reversed. The object determines that white (RGB values 255,255,255) is the reverse of the black background color. However, white is not present in the graphic display's color palette. Thus, the background of the reverse area is drawn in red.

Example

A cell phone's LCD provides a visual cue when a user selects an option. It does so by displaying the option name in reverse color. Assume that the graphic display object has four colors in its palette and the string was originally written at the x@y coordinates of 1@1. The logic for this function is:

LCD1 reverseFromx: 1y: 1 width: (LCD1 fontStringWidth: 'Option1') height: (LCD1 fontHeight)



Normal **Reverse**

For instructions about calculating the string width and font height, see "Getting the Font Height and Text String Width" on p. 12-24.

❖ *HINT: A more precise way of controlling the background color is to draw a rectangle in XOR drawing mode while specifying the draw color. See "attributeSetXOR" on p. 12-35 for details about XOR mode.*

Changing the Background Color During Runtime

Use the *setBackgroundColor:* function to specify a background color for both the graphic display and the background pixels of text strings. This background color becomes effective only when a function using the background color is activated.

❖ *NOTE: This function does* ***not*** *refresh the graphic display, i.e., it does not change the background color of the graphic display or of graphic elements on the display.*

The functions that use the background color are: *drawText:atx:y:*, *clearDisplay*, and *clearAreaAtx:y:width:height*:.

To change the graphic display's entire background color during runtime:

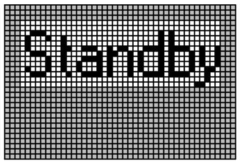
- Use the following functions in the logic:

  LCD1 setBackgroundColor: <color palette index/RGB value>
  LCD1 clearDisplay

The first function specifies the new background color to be used and the second function draws every pixel with this color.

Example

A cell phone's LCD displays the text string "Standby" when the power source is activated. The text string appears with a white background for enhanced visibility.



The logic for this function is:

LCD1 setBackgroundColor: 4
LCD1 drawText: 'Standby' atx:2 y:2

where white is the fourth color in the graphic display object's 4-color palette. The other graphic display pixels retain the background color specified in the Graphic Display dialog box.

❖ *NOTE: A font object must be specified in the logic for the text string to be displayed. For details, see "Displaying Text" on p. 12-21.*

Changing the Grid Color

Use the *gridColor* property to change the color of the grid lines that separate display pixels. The color choices are listed as functions in the Logic Palette.

Example

Use the following logic to change the grid color from black, the default color, to white:

LCD1.gridColor white

❖ *NOTE: The thickness of the grid lines is determined in the object's dialog box (see p. 12-6).*

Changing a Pixel's Color

To change the color of a single pixel on a graphic display, use the *drawPixel-Atx:y:* function. The color that the single pixel will use is either black (the default draw color) or the color specified by the *setDrawColor:* function.

Example

A cell phone's LCD must give a visual indication that it is activated and ready to receive or transmit calls. The visual cue is a two-pixel-high bar that scrolls across the top two rows of the display. The logic for this operation is:

DESTINATION	TRIGGER	ACTION
internal	**Timer1 tick**	**LCD1 setDrawColor: 1** **LCD1 drawPixelatx: int_X y:0** **LCD1 drawPixelatx: int_X y:1** **int_X changeBy: 1**

where *Timer1* is a one-second timer that has been activated by the *startRepeat* function, and
int_X is a wraparound integer from 0 to the display width minus 1

At each timer tick, a pixel at the same horizontal position in each of the LCD screen's two upper rows is drawn in the color specified by the *setDrawColor:* function and *int_X* is incremented by one. The effect is a two-pixel bar scrolling across the top of the LCD screen.

Changing Palette Colors During Runtime

(This section applies to graphic display objects, not to true color graphic displays.)

Use the *setPaletteIndex:toRed:green:blue:* function to change the color of any entry in the graphic display object's palette during runtime. The palette entry is referenced by its palette index (see "Color by number" on p. 12-10), and the color is specified by the values of its RGB components.

Palette color changes become visible on the display only after the *updatePalette* function is run. This function updates the RGB values of the colors in the palette, and then redraws the display exactly as the *updateAll* function does. The *updatePalette* function does **not** redraw the display when there was no modification of palette colors. For details about the *update* functions, see "Setting the Update Mode" on p. 12-31.

❖ *NOTE: Without running the updatePalette function, palette color changes will not affect the display even when it is in updateImmediately mode or the updateAll function has been called.*

Example

When your defined palette contains standard menu colors, but a custom color is required to display a bitmap, use this logic:

```
LCD1 setPaletteIndex: 3 toRed: 255 green: 192 blue: 255
LCD1 updatePalette
```

To restore the color palette defined in the Graphic Display dialog box, use the *resetPalette* function. This function also redraws the graphic display, making color and all other changes immediately visible.

Clearing the Graphic Display

There are three functions for clearing a graphic display.

FUNCTION	DESCRIPTION
clearDisplay	Clears the graphic display of all graphic elements, by setting all the pixels to the current background color. When used with *setBackgroundColor:*, it changes the entire background color (see p. 12-17).
clearDisplayUsingColor:	Clears the graphic display by redrawing all of its pixels in the specified color. ❖ *NOTE: This function does **not** change the object's current background color.*
clearAreaAtx:y:width: height:	Clears the rectangular area specified by the *x, y, width,* and *height* parameters, using the current background color.

Example

To clear the top half of a graphic display:

```
LCD1 clearAreaAtx: 0 y: 0 width: (LCD1 getWidth) height: (LCD1 getHeight) / 2
```

Checking Display Height or Width

The following two functions allow you to get a graphic display's height or width during runtime:

FUNCTION	DESCRIPTION	EXAMPLE
getHeight	Returns the height of the graphic display, in display pixels.	**height_int := GDO1 getHeight**
getWidth	Returns the width of the graphic display, in display pixels.	**width_int := GDO1 getWidth**

Displaying Text

For text to appear on the graphic display, you must:

STEP	DESCRIPTION
1. Add one or more font objects.	For details, see "Font Object" on p. 13-11.
2. Specify the font(s) that will be used.	Use the graphic display's *fontSet*: function to specify the display's font.
3. Specify the text that will be displayed and the position where the text will start.	Use the graphic display's *drawText:atx:y:* or *drawTransparentText:atx:y:* functions to specify the text and to position it.

Specifying a Font Using a Font Object

Use the *fontSet:* function to specify the font object whose characteristics will be applied to subsequent text strings drawn on the display. A font object **must** be specified for text strings to appear in the graphic display.

Using the *fontSet:* function with different font objects allows you to change the fonts and styles during runtime.

❖ *NOTE: If a Microsoft® Windows font defined in the font object is not found on a user's system during runtime, RapidPLUS uses the closest matching font* *available. This substitution may produce unexpected results in the displayed text string due to width and height variances between fonts.*

Example

A cell phone's LCD screen generally displays text in MS Sans Serif bold, 8 point. "No Connection" messages, however, are displayed in Courier, 10 point. The logic for this is:

```
LCD1 fontSet: Courier_Font
LCD1 drawText: 'No Connection' atx:10 y:10
```

where *Courier_Font* is a font object whose settings are Courier, regular, 10 point.

To revert to the LCD's default font style, use another instance of the *fontSet:* function that uses the font object "msSansSerif," whose font settings are MS Sans Serif, bold, 8 point.

Drawing Text on the Graphic Display

Use the *drawText:atx:y:* function to specify a text string and determine its placement on the graphic display. The text string must be enclosed by single quotes in the function. The position specified is the string's upper-left corner.

❖ *NOTE: Text that exceeds the object's size is clipped. The graphic display does not wrap text to the next line.*

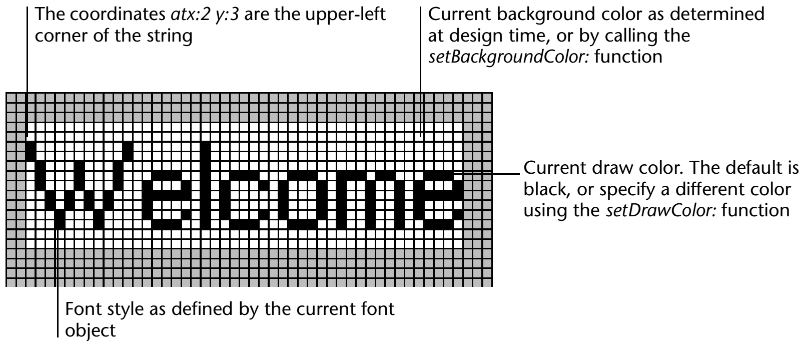
The text is drawn in the current draw color, which is black by default. The draw color can be changed during runtime (see "Changing the Draw Color" on p. 12-16).

The background pixels are drawn in the current background color, which is white by default. The background color can be set during design time (see "Selecting a Background Color" on p. 12-7) or changed during runtime (see "Changing the Background Color During Runtime" on p. 12-17).

Example

A cell phone's LCD display shows a welcome message when it is activated. The logic for this is:

LCD1 drawText: 'Welcome' atx:2 y:3


The coordinates *atx:2 y:3* are the upper-left corner of the string
Current background color as determined at design time, or by calling the *setBackgroundColor:* function
Welcome
Current draw color. The default is black, or specify a different color using the *setDrawColor:* function
Font style as defined by the current font object

Parsing a String

When displaying a long string on a graphic display, it is often necessary to divide (or parse) the string into substrings that fit the width of the display. For a discussion and usage examples of the font object functions that enable parsing, see p. 13-14.

Drawing Text with a Transparent Background

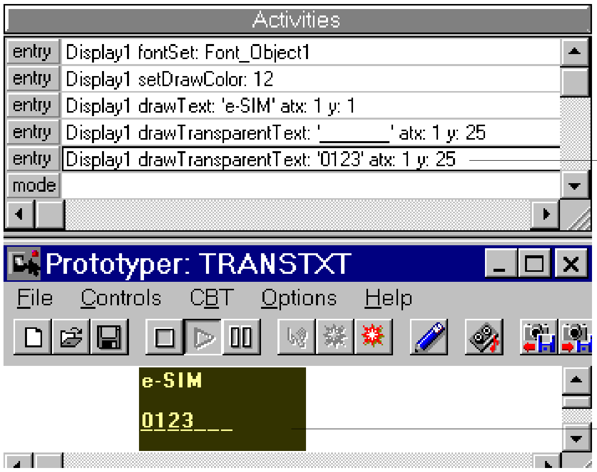
The *drawText* function draws text in label format, i.e., a rectangular box where the characters are in the draw color and the rest of the box is in the background color. The *drawTransparentText* function makes the background color transparent, so the effect is like writing on paper, i.e., only the characters are drawn.

❖ *NOTES: When the text background color is the same as the display background color, the distinction between the two functions is visible only when one text string is imposed on another.*

The runtime performance of the drawTransparentText function is significantly slower than the drawText function; therefore, the drawTransparentText function should be used only when necessary.

Example

In a cell phone application, you want to display a string of underscores (to mark the positions of the digits in the phone number) with a string of digits above them (when the user enters the phone number). Both strings have the same x, y coordinates. If you use the *drawTransparentText* function for the second string, the underscores continue to be visible even when digits are inserted above them:


Activities

entry	Display1 fontSet: Font_Object1
entry	Display1 setDrawColor: 12
entry	Display1 drawText: 'e-SIM' atx: 1 y: 1
entry	Display1 drawTransparentText: '_______' atx: 1 y: 25
entry	Display1 drawTransparentText: '0123' atx: 1 y: 25
mode	

Prototyper: TRANSTXT

File Controls CBT Options Help

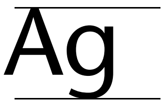
e-SIM

0123___

With the *drawTransparentText* function...
...the underscores remain visible

Getting the Font Height and Text String Width

The *fontHeight* function returns the maximum character height for the current font object, in display pixels.



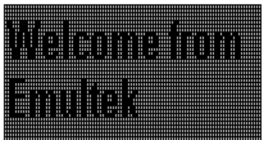
The font height is measured from the top of A to the bottom of g.

The *fontStringWidth*: function calculates, in display pixels, the width of a specified text string according to the current font object.

Getting the font height and/or text string width is necessary in instances when a text string is to be displayed below or next to a text string that is already displayed.

Example

You want to display the following text, one word at a time:



The logic activities to create this display are:

```
LCD drawText: 'Welcome' atx: 1 y: 1
LCD drawText: 'from' atx: ((LCD fontStringWidth: 'Welcome')+ 4)  y: 1
LCD drawText: 'Emultek' atx: 1 y: (LCD fontHeight)
```

Displaying Images

For images to appear on the graphic display, you must:

STEP	DESCRIPTION
1. Add one or more bitmap/image objects.	For details, see "Bitmap Object" on p. 13-2 and "Image Object" on p. 13-4.
2. Specify the bitmap that will be displayed and its position.	Use the graphic display's *drawBitmap:atx:y:* or *drawBitmap:atx:y:transparentColor:* functions to specify the object and its position. The *x,y* coordinates describe the bitmap's upper-left corner.

As with text strings, a bitmap object that exceeds the graphic display's size is clipped.

Each color used in the bitmap is translated by the graphic display to the closest available color in the object's color palette (see "Defining the Palette for a Graphic Display" on p. 12-8). The result is that the bitmap is not displayed in the color depth in which it was drawn. It uses the available colors, defined in the graphic display's palette.

Example

A cell phone's LCD shows a message icon when there is a message waiting. The logic for this is:

```
LCD1 drawBitmap: Bitmap1 atx: 10 y: 10
```

Drawing a Bitmap with a Transparent Color

The *drawBitmap:atx:y:* function draws every pixel of the bitmap rectangle, blocking out the entire display area the bitmap covers. The *drawBitmap:atx:y:-transparentColor:* function ignores the pixels in the transparent color, so that the corresponding pixels of the display remain visible.

Example

You want to show an icon that appears on the display over other content and disappears at a specific point in a sequence of events. If you use *draw-Bitmap:atx:y:* to draw the icon, the display will show a super-imposed icon that blocks out everything beneath it. If you use *drawBitmap:atx:y:transparent-Color: <ColorAroundIcon>*, the display will show only the icon itself. The logic for this is:

LCD1 drawBitmap: Bitmap1 atx: 10 y: 10 transparentColor: 16

❖ *NOTE: The transparent color for a bitmap defined in the Object Layout (Edit|Colors), and the transparent color defined in the drawBitmap function have no effect on one another. The transparent color defined in the Object Layout cannot be changed at runtime, while the transparent color specified in the function applies only to the draw operation the function performs.*

Drawing Empty and Filled Rectangles

There are two functions for drawing rectangles on the graphic display. In each function you specify a coordinate on the graphic display for the rectangle's upper-left corner and a size for its area.

To draw a rectangle as a border:

- Use the *drawRecAtx:y:width:height:* function.

  The border is one display pixel thick and its color is the current draw color (by default, black). The pixels inside the rectangular frame are transparent, that is, any graphic elements underneath are visible.

To draw a filled rectangle:

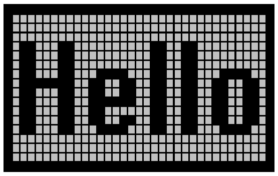
- Use the *drawFilledRecAt:width:height:* function.

  The entire rectangle (border and fill) are drawn using the current draw color (by default, black).

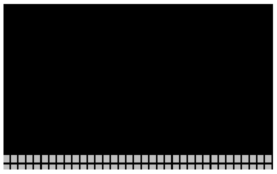
Examples

The following examples use the two different *drawRec* functions, with black as the draw color and the text “Hello” displayed at coordinates 1@1.

LCD fontSet: Font1
LCD drawRecAtx: 0 y: 0 width: ((LCD fontStringWidth: 'Hello') + 2) height: ((LCD fontHeight) + 2)
LCD drawText: 'Hello' atx:1 y:1



LCD fontSet: Font1
LCD drawFilledRecAtx: 0 y: 0 width: ((LCD fontStringWidth: 'Hello') + 2) height: ((LCD fontHeight) + 2)



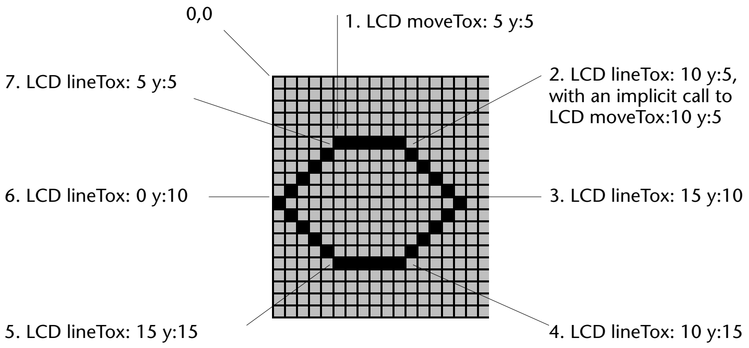
Drawing Lines

Lines are drawn in the graphic display’s draw color (by default, black). There are two methods for drawing lines on a graphic display. The first is to draw a line segment by defining the coordinates of its start and end points. This method uses the *drawLineFromx: y: toX: toY:* function. For example, to draw a diagonal line, the logic would look similar to this:

LCD drawLineFromx: 5 y: 5 toX: 15 toY: 15

❖ *NOTE: The drawn line* ***includes*** *the specified start- and end-point pixels.*

The second method is especially useful for drawing polygons, and it makes use of the *moveTox: y:* and *lineTox: y:* functions. The illustration below shows the sequence of function calls that you would use to draw a hexagon.



The first step initializes the drawing session by bringing an imaginary draw pointer to the start position. No line is actually drawn.

❖ *NOTE: By default, the draw pointer is located at 0,0.*

The subsequent steps draw lines from the draw pointer's current position up to (but **not including**) the pixel specified in the *lineTox: y:* function. Each call to this function also implies a call to *moveTox: y:* with the same coordinates (see Step 2 in the illustration). In other words, the last pixel of the line segment just drawn becomes the new position of the draw pointer. In this way you can draw connected line segments without having to explicitly specify each segment's start point.

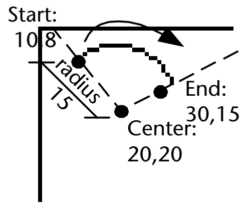
Drawing Arcs

Arcs are drawn in the graphic display's draw color (by default, black). You can draw arcs on a graphic display using a function that takes the arc's center point, radius, start point, and end point as parameters. Imaginary radial lines are drawn from the center point through the start and end points. The arc is then drawn between the radial lines in a clockwise direction—**from** the position on the start point radial line determined by the radius parameter, **to** the end point radial line.

In the following illustration, the imaginary radial lines are represented as dashed lines and the center, start and end points as small filled circles.

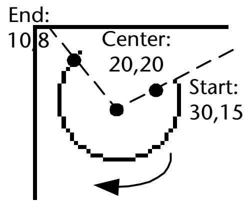
GDO1 drawArcAtcx: 20 cy: 20 radius: 15 fromX: 10 fromY: 8 toX: 30 toY: 15

Result:



GDO1 drawArcAtcx: 20 cy: 20 radius: 15 fromX: 30 fromY: 15 toX: 10 toY: 8

Result:



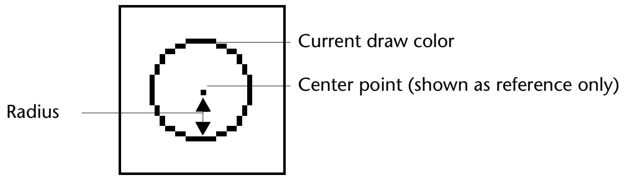
❖ *NOTE: The start and end points are only for drawing the imaginary radial lines, and do not have to coincide with the points where the arc begins and ends. The points where the arc begins and ends are those where the circle—drawn with the specified center point and radius—intersects the imaginary respective radials. In the top illustration the arc's end is not identical with the end point parameter, while in the bottom illustration the arc's beginning does not coincide with the start point parameter.*

Drawing Empty and Filled Circles and Ellipses

The graphic display has four functions that facilitate drawing empty or filled circles and ellipses. They are drawn in the graphic display's draw color (by default, black).

To draw an empty or filled circle:

- Use the *drawCircleAtcx: cy: radius:* or *drawFilledCircleAtcx: cy: radius:* function, specifying the circle's center point and its radius.



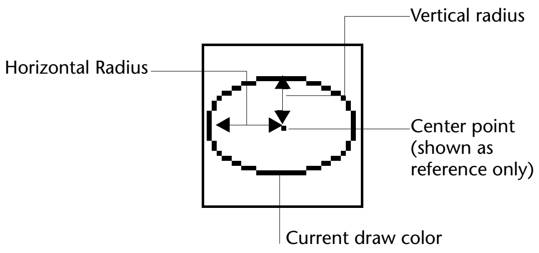
Example

The following logic statement draws a filled circle with a 20-pixel radius, that has its center point at the graphic display's 30@55 coordinate:

LCD1 drawFilledCircleAtcx: 30 cy: 55 radius: 20

To draw an empty or filled ellipse:

- Use the *drawEllipseAtcx: cy: horizRadius: vertRadius:* or *drawFilledEllipseAtcx: cy: horizRadius: vertRadius:* function, specifying the ellipse's center point and sizes.



Example

The following logic statement draws an empty ellipse with a 15-pixel horizontal radius and a 10-pixel vertical radius that has its center point at 15@15:

LCD1 drawEllipseAtcx: 15 cy: 15 horizRadius: 15 vertRadius: 10

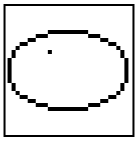
Floodfilling an Enclosed Area

Use the *floodFillAtx: y:* function to fill an enclosed area with the current draw color. By default, the draw color is black. For details about changing this color, see “Changing the Draw Color” on p. 12-16.

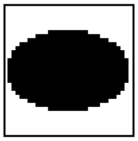
The color of the point specified by the function’s arguments becomes the reference color. In the area enclosed by pixels of a color **other** than the reference color, all the reference color pixels are set to the current draw color.

Example

LCD1 floodFillAtx: 10 y: 10



Before



After

❖ *NOTE: C code is not generated for this function.*

Setting the Update Mode

Use the *updateOnRequest* and *updateImmediately* functions to control when changes are displayed on the graphic display.

Immediate Update Mode

This is the default update mode, during which changes caused by calling the various drawing functions are immediately implemented on the display.

Update on Request Mode

After calling the *updateOnRequest* function, changes caused by calling the various drawing functions are implemented on the display’s intermediate buffer. The changes are visible on the display itself only after explicitly calling one of the following three functions:

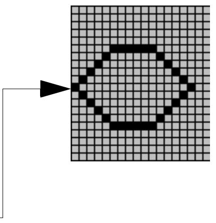
- *update*: Draws any changes that have been made since the last time the *update* function was called.
- *updateAll*: Redraws the entire intermediate buffer on the graphic display.

- *updateImmediately*: Resets the object back to its default mode and automatically updates the display.

Example

You need to draw a hexagon on the graphic display—an operation that involves drawing 6 separate lines—but you don't want the user to see it drawn line by line:

```
LCD updateOnRequest
LCD moveTox:5 y:5
LCD lineTox:10 y:5
LCD lineTox:15 y:10
LCD lineTox:10 y:15
LCD lineTox:5 y:15
LCD lineTox:0 y:10
LCD lineTox:5 y:5
LCD update
```



The hexagon is drawn as a single continuous line, instead of as a series of connecting lines

❖ *NOTE: Nothing is visible on the display until the update function is called.*

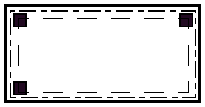
When to use *updateOnRequest*—and when not to

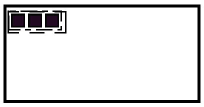
The *updateOnRequest* mode can eliminate flickering in situations when changes are being made on a relatively restricted area of the graphic display. For example, you may have a series of primitive graphic elements being drawn near each other on the graphic display. Or, you may have different user objects that draw on different buffers. In these situations, it would be good practice to put the graphic display in *updateOnRequest* mode and call the *update* function after the series of draw operations. Please refer to the following illustration.

On the other hand, if your incremental changes are widely distributed over the graphic display, the efficiency of *updateOnRequest* is seriously undermined and *updateImmediately* may give better results. The reason is that each time you call the *update* function, RapidPLUS redraws the area within the smallest possible rectangular bounding box that encloses **all** the changes made since the last update. If the changes are in opposite corners of the graphic display, for example, the redraw area is almost the entire graphic display. In this case, it would be better to work in immediate update mode, whereby RapidPLUS only redraws the small area that has changed as the result of each draw operation.

The filled circles are drawn by 3 separate calls to *drawFilledCircle*. The dashed rectangles represent the area redrawn when calling the update function.

Probably better to use immediate update mode





Good candidate for update on request mode

Setting the Drawing Mode

Use the attribute functions (*attributeSetNormal*, *attributeSetReverse*, *attribute-SetXOR*) to specify how the graphic display draws the following elements:

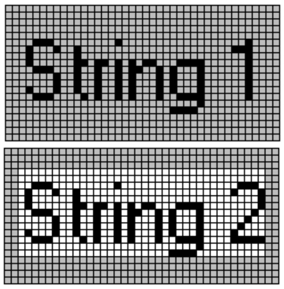
- Text characters.
- Empty and filled rectangles.
- Empty and filled circles.
- Empty and filled ellipses.
- Individual display pixels (using the *drawPixelAtx:y:* function).

attributeSetNormal

The *attributeSetNormal* function is the graphic display's default setting.

In this display setting, graphic elements are displayed in the current drawing color and are drawn on top of each other if they are placed in the same area.

Example



Using the *drawTextAtx:y:* function, “String 1” is drawn on the graphic display. Then, “String 2” is drawn on the graphic display using the same coordinates. String 2 is drawn on top of String 1.

❖ *NOTE: White is used as a new background color for String 2 to better illustrate how String 2 blocks out String 1.*

attributeSetReverse

Use the *attributeSetReverse* function to put the graphic display into reverse display mode. In this mode, graphic elements are displayed in the reverse color of the current draw color. The reverse color is the complement to 255 of the current draw color RGB values. If the current draw color is blue, R:0, G:0, B:255, the reverse color will be yellow, R:255, G:255, B:0. Graphic elements placed in the same area are drawn on top of each other.

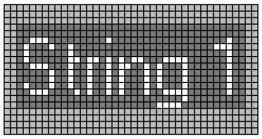
To determine the reverse draw and background colors, the graphic display:

i. Identifies the current color settings.

ii. Determines the opposite color based on the settings of the display device.

iii. For graphic displays: uses the closest color present on the object’s color palette. For true color graphic displays: uses the new RGB values.

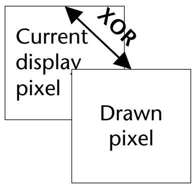
Example



Appearance of ‘String 1’ when the draw color is black but the display is in reverse display mode. The background color is also reversed.

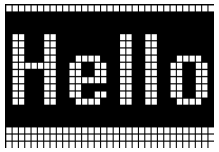
attributeSetXOR

Use the *attributeSetXOR* function to perform a logical XOR (exclusive or) operation for each pixel. This operation allows you to combine elements on the display, and then return the display to its initial state. When the graphic display is in XOR writing mode, RapidPLUS performs a logical XOR operation for each graphic element pixel to be drawn on the display, as follows:



If the current display pixel and overlay pixel are:	Then the overlay pixel is drawn in:
The same color	First color in the palette, by default, black.
Different colors	A new color, which is the logical XOR of the two colors. For graphic displays: if this new color is not available in the palette, then the closest equivalent color to it.

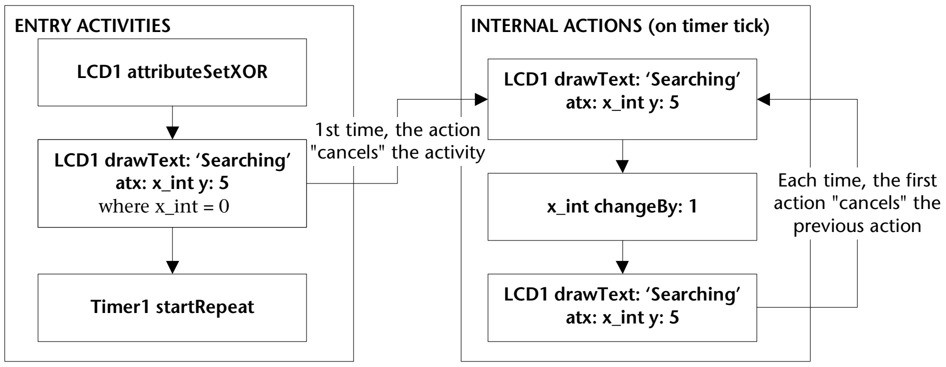
If the overlay pixel is black, then it becomes transparent when drawn on the graphic display. This transparent effect is illustrated below on a two-color graphic display, where the draw color is black and the display background color is white. Note that the text's background pixels are drawn in black because the text's background color and the display background color are the same (see the table above).



If the XOR operation is repeated a second time on the same pixels, the display returns to its original colors. Repeated drawing operations in XOR mode alternate between the two sets of colors. XOR mode can be used for moving an image over a display without deleting the original display.

Example

Assume that you want to move a text string across a display, without disturbing graphic elements that already appear. You could accomplish this effect with the following logic:


ENTRY ACTIVITIES
LCD1 attributeSetXOR
LCD1 drawText: 'Searching' atx: x_int y: 5 where x_int = 0
Timer1 startRepeat
1st time, the action "cancels" the activity
INTERNAL ACTIONS (on timer tick)
LCD1 drawText: 'Searching' atx: x_int y: 5
x_int changeBy: 1
LCD1 drawText: 'Searching' atx: x_int y: 5
Each time, the first action "cancels" the previous action

Saving and Restoring Status

The *save* and *restore functions* allow you to save the graphic display status to a predefined buffer (see "Defining Buffers" on p. 12-12), and then restore the status. The graphic display status comprises the following settings:

- Writing mode (normal, reversed, XOR)
- Update mode (onRequest or immediately)
- Draw color
- Background color
- Font
- Pen position

❖ *NOTE: A runtime error occurs (and the function is not performed) if you call any of the save or restore functions when no buffers have been defined.*

saveStatus

Stores the status in the first buffer (*buffer1)*. Each time you call this function, you overwrite any status information previously stored in this buffer.

Example

```
GDO1 saveStatus
```

restoreStatus

Restores the graphic display status according to the settings in *buffer1*. When created at design time, a buffer is initialized with the default status settings of the graphic display itself. If you call this function on a buffer to which no status has been saved, these initial status settings are applied.

Example

```
GDO1 restoreStatus
```

saveStatusIn:

Saves the graphic display status in the specified buffer, overwriting any previously-stored status information in that buffer. A runtime error occurs if you specify a buffer that does not exist.

Example

```
GDO1 saveStatusIn: BUFFERS_set.Warning
```

restoreStatusFrom:

Restores the graphic display status according to the settings in the specified buffer. A runtime error occurs if you specify a buffer that does not exist.

Example

```
GDO1 restoreStatusFrom: 3
```

Saving and Restoring Area

The *saveArea* and *restoreArea* functions allow you to save a rectangular area on the graphic display to a buffer, and then restore the saved image to the graphic display.

These functions are particularly useful for achieving a windowing effect, such as overlaying a message window on top of the main graphic display.

❖ *NOTE: A runtime error occurs (and the function is not performed) if you call any of the save or restore functions when no buffers have been defined.*

saveAreaAtx:y:width:height:

Saves the specified rectangular area to the first buffer (*buffer1*).

Example

GDO1 saveAreaAtx: 0 y: 0 width: 60 height: 5

restoreArea

Restores the image saved by the last call to *saveAreaAtx:y:width:-height:*, using the same x, y coordinates. When created at design time, a buffer's restoreArea dimensions and location are initialized at 0 (zero). Thus, if you call this function on a buffer to which no area has been saved, nothing happens.

Example

GDO1 restoreArea

restoreAreaAtx:y:

Restores the image saved by the last call to *saveAreaAtx:y:width:-height:*, using the same x, y coordinates. When created at design time, a buffer's restoreArea dimensions and location are initialized at 0 (zero). Thus, if you call this function on a buffer to which no area has been saved, nothing happens.

Example

GDO1 restoreAreaAtx: 10 y: 10

saveAreaAtx:y:width:height:in:

Saves the specified rectangular area to the buffer specified by the *in:* argument. A runtime error occurs if you specify a buffer that does not exist.

Example

GDO1 saveAreaAtx: 0 y: 0 width: 60 height: 5 in: 2

restoreAreaFrom:

Restores the image saved in the specified buffer, at the coordinates specified when the area was saved.

Example

GDO1 restoreAreaFrom: 2

restoreAreaAtx:y:from:

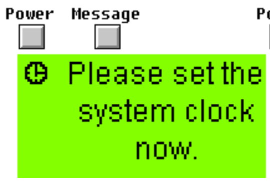
Restores the image saved in the buffer specified by the *from*: parameter, at the specified x, y coordinates.

Example

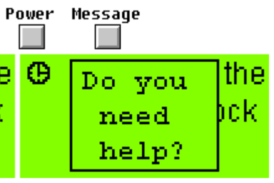
GDO1 restoreAreaAtx: 0 y: 0 from: 2

SaveArea and RestoreArea Usage Example: Pop-Up Overlay

This section presents an example of how you would use save and restore functions, as well as font object string parsing functions, in order to overlay a pop-up message on a graphic display, as illustrated below.



Initial message on the graphic display



Pop-up message overlaid on the graphic display

❖ *NOTE: If you installed the example applications, this application (popup.rpd) is located in the \\Examples\Graphic_Display_Object\Popup_Message folder. Otherwise, you can find it in the same location on the RapidPLUS CD-ROM.*

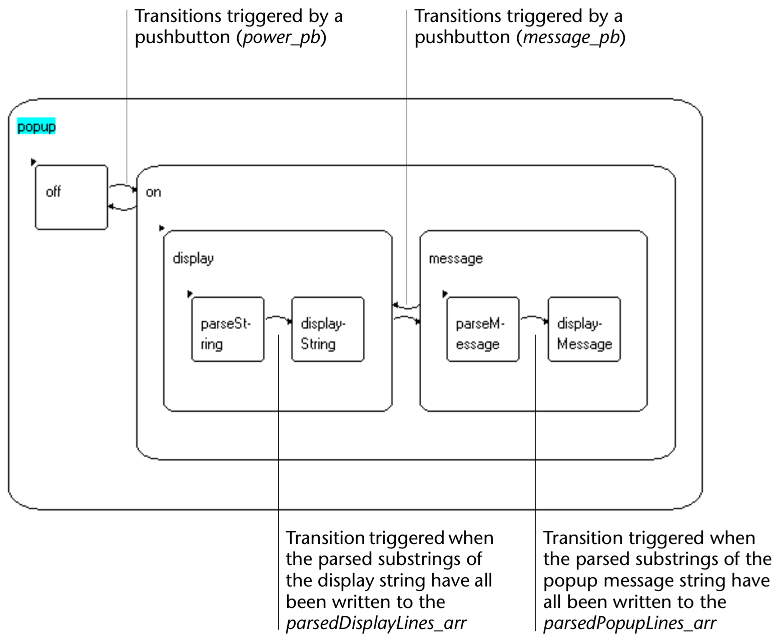
Overview

The key objects involved in the example application are:

- Two string objects:
  display_str, the display string with an initial value of ‘Please set the system clock now.’
  popup_str, the pop-up message string with an initial value of ‘Do you need help?’
- A graphic display (*Display1*) with a width of 100 display pixels.
- Two font objects:
  arial_font, Arial 9 regular, used for the display string.
  courier_font, Courier New 8 regular, used for the pop-up message string.
- One integer object (*numOfLines_int*) to hold the number of substrings, another (*arrayIndex_int*) to serve as the index parameter and a number object (*yPos_num*) to manage the text’s vertical location.

Two one-dimensional string arrays (*parsedPopupLines_arr* and *parsedDisplayLines_arr*) to hold the parsed substrings for the pop-up message string and the display string, respectively.

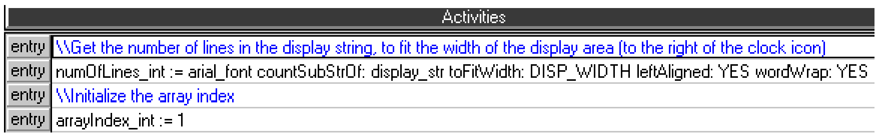
The application state chart looks as follows:


Transitions triggered by a pushbutton (*power_pb*)
Transitions triggered by a pushbutton (*message_pb*)
popup
off
on
display
message
parseSt-ring
display-String
parseM-essage
display-Message
Transition triggered when the parsed substrings of the display string have all been written to the *parsedDisplayLines_arr*
Transition triggered when the parsed substrings of the popup message string have all been written to the *parsedPopupLines_arr*

Parsing a String

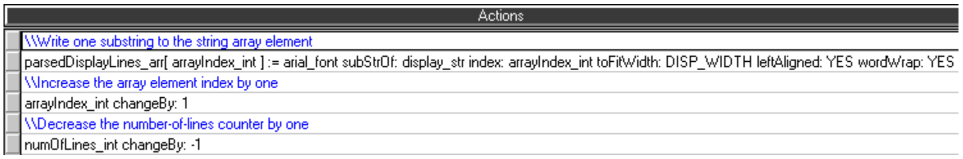
In the *parseString* and *parseMessage* modes, the display and popup message strings are broken down (or parsed) into substrings that fit a specified width (in display pixels) for a particular font object. So that the substrings can then be displayed in the *displayString* and *displayMessage* modes, each substring is written to an element of a one-dimensional string array.

Thus, for example, upon entry to the *parseString* mode, the appropriate font object function is called in order to set the *numOfLines_int* counter to the number of substrings in *display_str*:



Activities	
entry	\\Get the number of lines in the display string, to fit the width of the display area (to the right of the clock icon)
entry	numOfLines_int := arial_font countSubStrOf: display_str toFitWidth: DISP_WIDTH leftAligned: YES wordWrap: YES
entry	\\Initialize the array index
entry	arrayIndex_int := 1

Then, on an internal transition, as long as the counter *numOfLines_int* is not zero, the actions shown below are performed to write the substrings to the array.


Actions

```
\\Write one substring to the string array element
parsedDisplayLines_arr[ arrayIndex_int ] := arial_font subStrOf: display_str index: arrayIndex_int toFitWidth: DISP_WIDTH leftAligned: YES wordWrap: YES
\\Increase the array element index by one
arrayIndex_int changeBy: 1
\\Decrease the number-of-lines counter by one
numOfLines_int changeBy: -1
```

When *numOfLines_int* reaches 0, that is, there are no more substrings to be written to the array, the transition is made to the mode where the substrings are displayed.

Saving and Restoring a Graphic Display Area

The ability to save and restore areas of the graphic display to a buffer (that is, temporary memory) makes it very easy to create a windowing effect in your application. In the example application, it is accomplished by two transition actions—saving an area on the transition from *display* mode to *message* mode and restoring the area on the way back to *display* mode.

The saving transition action looks as follows:

Display1 saveAreaAtx: ((LCD_WIDTH / 2) - (POPUP_WIDTH / 2)) y: 2
width: POPUP_WIDTH height: 45 in: 1
where:
the area's x, y coordinates and width-height dimensions specify the area to be overlaid by the pop-up message window,
and
in: specifies in which buffer to store the area (in this case, buffer1).

The restoring transition action looks as follows:

Display1 restoreAreaFrom: 1
where:
the area's x, y coordinates and width-height dimensions are unspecified, indicating that these parameters should be taken from the last call to *saveAreaAtx:y:width:height:*,
and
From: specifies from which buffer to take the display the area (in this case, the same buffer1 in which we saved the area of interest).

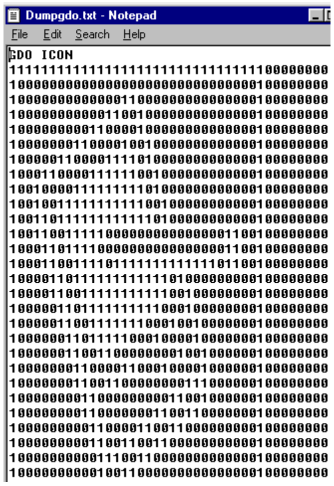
Using the *dump* Function

The *dump* function allows you to dump the display to a text file during runtime. It can be useful in debugging the application. When the *dump* function is first used, it creates the file *dumpgdo.txt* in the application folder.

Each time the function is called, the graphic display map is added to the end of this file. The function's string parameter provides a label that appears in the file above the dumped contents.

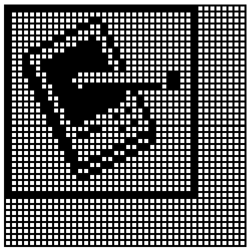
Use this parameter to identify a specific output in the dump file. For example, in an application that contains a two-color graphic display, the activity, **GDO1 dump: 'GDO ICON':**

Adds this text to Dumpgdo.txt (partial view)



```
GDO ICON
1111111111111111111111111111111000000000
1000000000000000000000000000001000000000
1000000000000110000000000000001000000000
1000000000011001000000000000001000000000
1000000001100001000000000000001000000000
1000000110000100100000000000001000000000
1000011000011110100000000000001000000000
1000110000111110010000000000001000000000
1001000011111111010000000000001000000000
1001001111111111001000000000001000000000
1001101111111111101000000000001000000000
1001100111110000000000000011001000000000
1000110111110000000000000011001000000000
1000110011101111111111111011001000000000
1000011011111111111010000000001000000000
1000011001111111111001000000001000000000
1000001101111111110001000000001000000000
1000001100111111000100100000001000000000
1000000110111100010000100000001000000000
1000001100110000000010010000001000000000
1000000011000110001000010000001000000000
1000000110011000000001110000001000000000
1000000001100000000110010000001000000000
1000000001100000011001100000001000000000
1000000001100001100110000000001000000000
1000000001100110011000000000001000000000
1000000000111001100000000000001000000000
1000000000100110000000000000001000000000
```

When the display is:



❖ *NOTE: Java code is not generated for this function.*

WORKING WITH BUFFERS

The graphic display has a *buffer* property in the Logic Palette. The *buffer* property functions can be divided into two categories:

- **Standard graphic display functions for a specified buffer**:
  You use these functions to set a buffer's drawing and/or update mode, clear the buffer or an area, draw graphic elements, set the font, set the colors, and get information on the current font, display width and height, current colors, etc. A typical function in this category looks as follows:

  ```
  GDO1.buffer clearDisplayForBuffer: <Integer>
  ```

❖ *NOTE: The buffer integer index must be greater than 0 (zero) and equal to or less than the total number of buffers defined.*

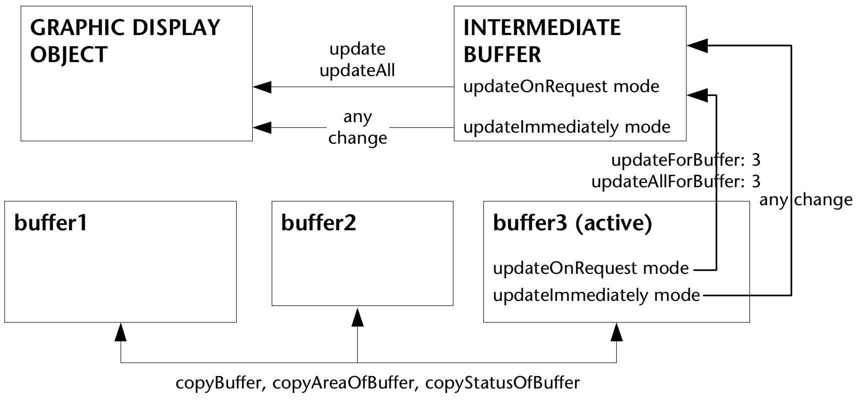
- **Unique *buffer* property functions**:
  You use these functions to perform logic that is unique to buffers, such as copying a buffer's contents or status to another buffer.

This section presents:

- How buffers interrelate with the graphic display.
- How to use the unique *buffer* property functions.
- Examples of how you can use buffers to achieve different effects, such as a moving map, windowing, animation, and an array of bitmaps.

The Whole Picture

The following schematic illustrates the interrelationships among the graphic display, the intermediate buffer, and any defined buffers:



❖ *NOTE: Changing the active buffer (see "Setting and Getting the Active Buffer" on p. 12-46), resizing the buffer's clipping rectangle or relocating the clipping rectangle on the buffer or on the graphic display (see "Clipping Rectangles" on p. 12-47) also initiate an update of the intermediate buffer.*

- **Intermediate buffer**: This buffer exists for every graphic display. It is always the same size as the graphic display. All changes to the graphic display appearance are implemented first on the intermediate buffer.

  If the graphic display is in **updateImmediately** mode, the changes to the intermediate buffer appear automatically and immediately on the graphic display itself. If the graphic display is in **updateOnRequest** mode, changes to the intermediate buffer appear on the graphic display only after calling one of the *update* functions shown in the schematic.

- **User-defined buffers (buffer1, buffer2, buffer3)**: These buffers exist because they were defined in the graphic display's More and/or Advanced dialog boxes (see "Defining Buffers" on p. 12-12). They can differ in size from the graphic display (as shown in the schematic). The buffer's entire bitmap or an area of it can be copied to another buffer. In the same way, a buffer's status (as defined on p. 12-36) can be copied to another buffer.

- **Active buffer**: Either no buffers can be active or one buffer can be active. Any changes made to the active buffer are transferred to the intermediate buffer according to the update status of the active buffer.

If the active buffer is in **updateImmediately** mode, the changes are transferred automatically and immediately to the intermediate buffer. If the active buffer is in **updateOnRequest** mode, the changes to the buffer are transferred to the intermediate buffer only after calling one of the *updateForBuffer:* functions shown in the schematic.

❖ *NOTE: A change to the active buffer's clipping rectangle (see "Clipping Rectangles" on p. 12-47) also initiates an update of the intermediate buffer.*

- **Non-active buffers**: You can make changes to the non-active buffers independently and concurrently. The non-active buffers are not dependent on the graphic display, on the intermediate buffer, or on each other. When one of the non-active buffers becomes active, its bitmap image is then transferred to the intermediate buffer according to the rules outlined above for the active buffer.

❖ *NOTE: You can determine a buffer's location on the intermediate buffer, as described in "Buffer Clipping Rectangle" on pp. 12-47. If—due to location and/or size—the active buffer's bitmap exceeds the dimensions of the intermediate buffer, it is clipped (like any bitmap or graphic element drawn on the graphic display).*

Buffers and the drawing mode

You can set a buffer's drawing mode to normal, reverse, or XOR, as described in "Setting the Drawing Mode" on pp. 12-33 to 12-36. However, the drawing mode only affects how graphic elements are drawn on the buffer itself. All transfers between buffers or between the active buffer and the intermediate buffer are implemented in the normal drawing mode.

Setting and Getting the Active Buffer

To set the active buffer:

- Use the *setDisplayBuffer:* function, as follows:

```
GDO1.buffer setDisplayBuffer: 3
```

❖ *NOTE: Using 0 (zero) as the parameter makes the intermediate buffer the active buffer.*

To get the active buffer:

- The *getDisplayBuffer* returns the index of the active buffer, as follows:

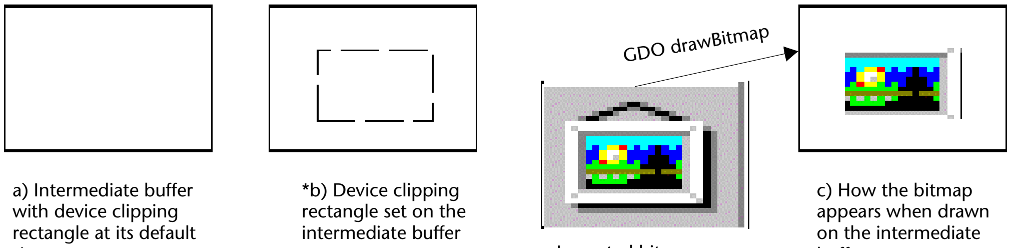
  Int1 := GDO1.buffer getDisplayBuffer

Clipping Rectangles

The graphic display and each of its user-defined buffers have clipping rectangles. The functionality of the clipping rectangles differ depending on whether the clipping rectangle is defined for the graphic display or for a user-defined buffer.

Device Clipping Rectangle

The graphic display's clipping rectangle is referred to as the device clipping rectangle. It determines the location that is valid for drawing text and graphics on the graphic display's intermediate buffer. It can be the size of the entire graphic display—which is the device clipping rectangle's default size—or it can be set to a smaller size. The device clipping rectangle determines how much of a graphic or text will appear on the graphic display. In other words, if an imported bitmap is larger than the device clipping rectangle, only the portion of the bitmap that intersects with the clipping rectangle will be displayed. The following illustrations show how the displayed area of a bitmap is determined:



a) Intermediate buffer with device clipping rectangle at its default size

*b) Device clipping rectangle set on the intermediate buffer

Imported bitmap

c) How the bitmap appears when drawn on the intermediate buffer

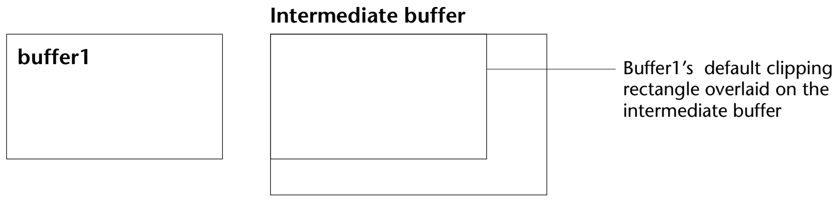
* The device clipping rectangle borders are for illustration purposes only; they do not appear on the graphic display.

❖ *NOTE: The graphic display's clipping rectangle is referred to as the device clipping rectangle because its attributes are stored in the graphic display's device context, which is an internal graphics device interface (GDI) structure. The device context governs the display of text and graphics on the graphic display.*

Buffer Clipping Rectangles

Every user-defined buffer has a clipping rectangle, which functions like a viewport. This clipping rectangle determines the location and extent of the image transferred to the intermediate buffer. By default, a buffer's clipping rectangle is the same size as the buffer.

A user-defined buffer's clipping rectangle is, by default, overlaid on the intermediate buffer at the intermediate buffer's 0, 0 coordinate. Thus, if you do not change the clipping rectangle's size or location, the entire buffer bitmap is copied, starting at the upper-left corner of the intermediate buffer, as shown in the following illustration:

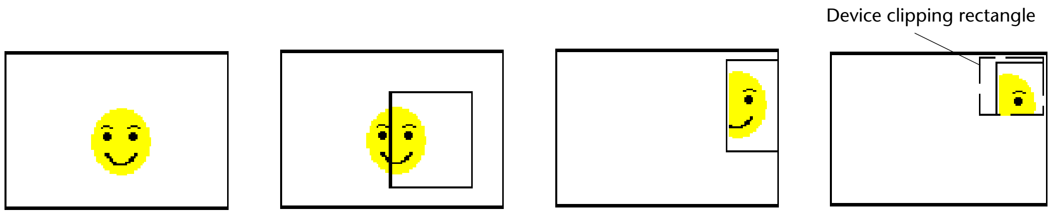

Intermediate buffer
buffer1
Buffer1's default clipping rectangle overlaid on the intermediate buffer

Default positioning of a buffer's clipping rectangle on a graphic display

You do not have to use the default settings of the clipping rectangle. There may be situations in which you want to copy only part of a buffer bitmap to the intermediate buffer—and/or you want to place the buffer bitmap at a specific location on the intermediate buffer.

The following illustrations show a) a drawing on Buffer1 whose upper-left corner is at x:40 y:20; b) a clipping rectangle that is much smaller than the buffer and is located at x:62 y:20; and c) the relocation of the clipping rectangle on the intermediate buffer a x:100 y:0. Notice that a part of the clipping rectangle is outside the intermediate buffer.

The fourth illustration shows how much of the bitmap is drawn on the intermediate buffer which has a non-default setting for its device clipping rectangle.



a) Buffer1 with a bitmap drawn on it

*b) Clipping rectangle set for Buffer1

*c) Buffer1's clipping rectangle positioned on the intermediate buffer (no device clipping rectangle was set)

*d) The bitmap will be drawn in the area in which Buffer1's clipping rectangle intersects with the device clipping rectangle

* The buffer and device clipping rectangle borders are for illustration purposes only; they do not appear on the graphic display.

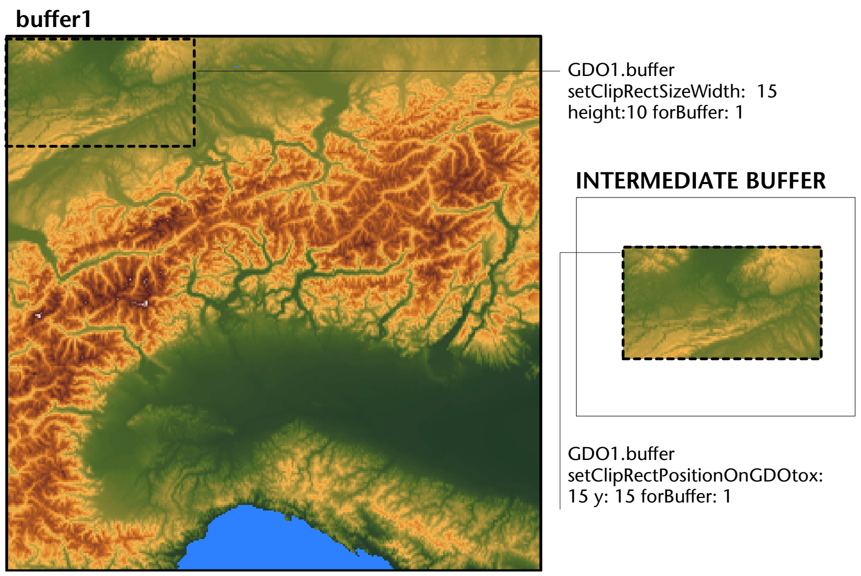
Buffer Usage Examples

This section presents ideas of how you can use buffers to achieve various effects. You can find these ideas implemented in the example applications that are located in the \\Examples folder.

Moving Map

You could achieve the effect of a moving map by creating a buffer that contains a bitmap of the entire map. You would then adjust the buffer's clipping rectangle to the size of the area of interest to be shown on the graphic display. In the same way, you would position the buffer's clipping rectangle on the graphic display in the location where you want the map segment to appear. Note that the device clipping rectangle is set at its default size.

Refer to the following illustration:



During runtime, you would move the clipping rectangle over the buffer in order to change the map segment visible on the graphic display.

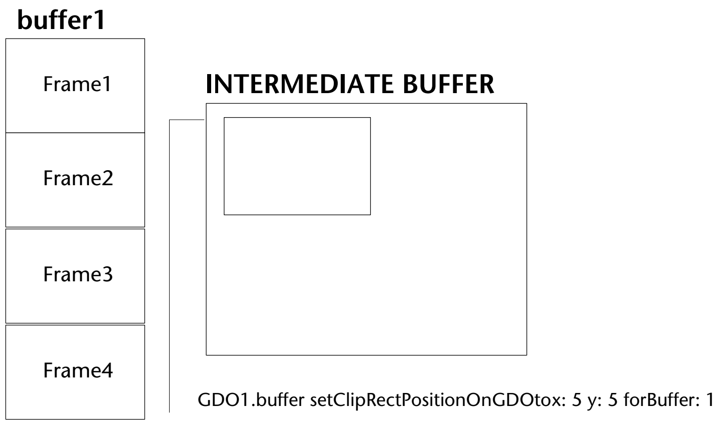
Animation

On a buffer, you draw the animation frames as one complex bitmap or as a series of bitmaps.

❖ *NOTE: Take care to size the buffer properly to accommodate the required bitmap(s). The buffer's default size is the size of the graphic display; any bitmaps you draw on the buffer that exceed its size are clipped.*

You then size the clipping rectangle to the dimensions of a single frame and initialize its position on the buffer so that it encloses the first animation frame. You position the clipping rectangle on the intermediate buffer at the location where the animation is to be displayed. Note that the device clipping rectangle is set at its default size.

Refer to the following illustration:


buffer1
Frame1
Frame2
Frame3
Frame4
INTERMEDIATE BUFFER
GDO1.buffer setClipRectPositionOnGDOtox: 5 y: 5 forBuffer: 1

Other objects required:

- An index wrap-around integer (*frame_int*), whose lower bound is 0 and upper bound is the number of frames minus 1. An entry activity initializes it to 0.
- A constant integer (*FRAME_HEIGHT*) that holds the height of the frames.

During runtime, you would:

1 Make *buffer1* the active buffer (GDO1.buffer setDisplayBuffer: 1).

2 On an internal transition, use a timer tick to trigger the following actions:

```
GDO1.buffer setClipRectPosX: 0 posY: frame_int * FRAME_HEIGHT forBuffer: 1
    frame_int changeBy: 1
```

The same approach could be used to create an array of bitmaps to implement animation.

❖ *NOTE: Although the above example illustrates the use of buffers in the graphic display, there are more efficient ways to achieve animation effects. See the Animator widget located in RapidPLUS's Widgets folder.*

Windowing

If an application uses a number of windows, you can achieve a windowing effect by creating a buffer of an appropriate size for each window and setting the buffer's location on the graphic display at the appropriate position. You can then draw bitmaps, text, or other graphic elements on each window "in the background," making the appropriate window buffer active as required by the application logic.

CHAPTER 13

Bitmap, Image, and Font Objects

Bitmaps and images can be used to enhance the visual appeal of your simulations and make them more realistic. In simulations that include graphic displays, bitmaps and images—together with text strings and font objects—play an essential part; they constitute the content to be presented on the graphic display.

While bitmaps can be used in simulations that do not include a graphic display, the font object is relevant only where a graphic display is present. Without a font object, text strings cannot be displayed on the graphic display.

This chapter presents:

- How to define bitmap, image, and font objects in the Object Layout.
- How to use bitmap, image, and font objects in the Logic Editor.

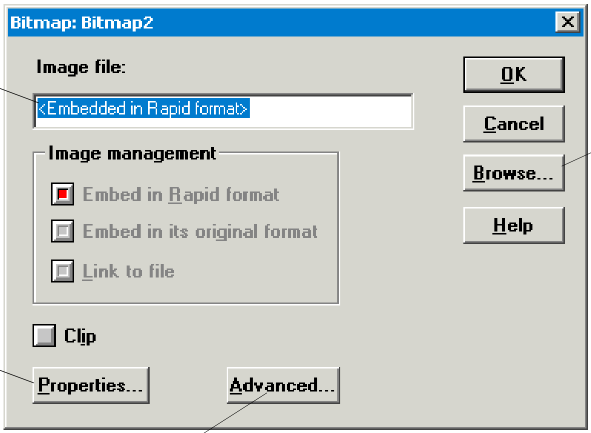
BITMAP OBJECT

The bitmap object supports the following features:

- A wide range of image formats: BMP, DIB, PNG, JPG, ICO, MSP, PCX, PSD.
- Importing (during design time) an image by specifying a file.
- Choice between image embedding and image linking.
- Image clipping.

In the Object Palette, the bitmap object is located in the Bitmap objects class.

A bitmap object's default size is 30 × 30 pixels. Its dialog box is used to select and manage an image file:



Name of the image file to be loaded. Selected by either typing the file name and path or browsing to the file

Browse to the desired file

Opens the object's Properties dialog box

Relevant for C code generation only. Opens a dialog box where you choose whether to generate code for the object

The bitmap object will automatically resize to accommodate the image (up to the size of the Object Layout).

❖ *NOTE: You can also open this dialog box for any named bitmap object in the Object Layout, that is, a bitmap pasted via the Clipboard (Edit|Paste Bitmap), a bitmap imported via File|Import bitmap, a primitive object edited in the Object Editor, or a bitmap created in the Object Editor via File|New Object.*

The Image Management and Clip options are:

OPTION	DESCRIPTION
Embed in Rapid format	The default option. The image is embedded in the application, in a native RapidPLUS format.
Embed in original format	The image is embedded in the application in its original format. ❖ *NOTE: This option is useful for saving space in the application file. If you import and embed a PNG image, for example, it is stored in the compact PNG format, and not the BMP format normally used by RapidPLUS.*
Link to file	The image is external to the application and is loaded dynamically at runtime. The image retains its name in the dialog box. ❖ *NOTES: If distributing the application, you must package the image file.* *If you do not specify an image file path, RapidPLUS searches in the usual directories (see Appendix A.) A runtime error occurs if the file is not found.*
Clip	When not selected, the image resizes with the object. When selected, if the object is made smaller, the image is clipped at the opposite ends from its 0@0 coordinates

❖ *NOTE: To change an image from embedded to linked or from linked to embedded, you must first re-import it.*

Performance considerations

Linking an image to file may slow down an application's runtime performance. An image that is embedded in its original format must be converted to the native RapidPLUS format when the Prototyper is started. Once converted, however, the bitmap performs just like a bitmap embedded in the native RapidPLUS format.

Performance is also affected by the file type. JPEG files, for example, take longer to render than PNG files.

IMAGE OBJECT

An image object is similar to a bitmap object with expanded manipulation options. The image object supports the following features:

- A wide range of image formats: BMP, DIB, PNG, JPG, ICO, MSP, PCX, PSD.
- Importing (during design time) an image by specifying a file.
- Choice between image embedding and image linking.
- Image clipping.
- Choice of modes for processing runtime manipulations.
- Manipulation of the object during runtime, including replacing the specified file; repositioning, resizing, or clipping the object; adjusting its RGB values; flipping, rotating, inverting, or mirroring it; and adjusting brightness and contrast.

In the Object Palette, the bitmap object is located in the Bitmap objects class.

A bitmap object's default size is 30 × 30 pixels. Its dialog box is used to select and manage an image file:

Upper section of the Image dialog box

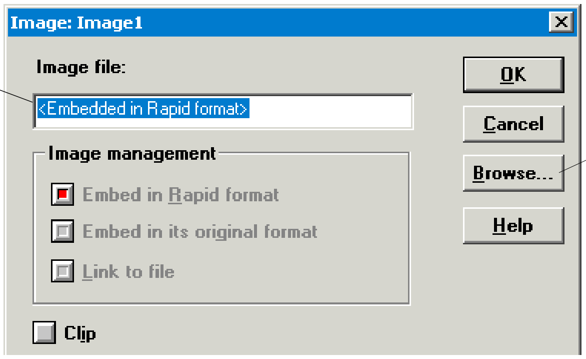


Image: Image1
OK
Cancel
Browse...
Help
Name of the image file to be loaded. Selected by either typing the file name and path or browsing to the file
Browse to the desired file

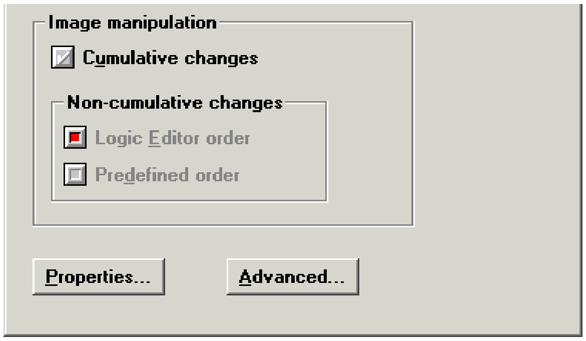
Image file: <Embedded in Rapid format>

Image management
- [✓] Embed in Rapid format
- [ ] Embed in its original format
- [ ] Link to file

[ ] Clip

The Image Management and Clip options are described on the previous page.

Lower section of the Image dialog box



Setting the Image Manipulation Mode

The default manipulation mode is **Cumulative changes**. In this mode each manipulation changes the image, and redraws it in its modified state. **Each** additional **manipulation is performed on the last redrawn image**. In other words, the very first manipulation modifies the original image, the second manipulation modifies the modified image, the third manipulation modifies the modified image resulting from the second manipulation, and so on.

There are also two **non-cumulative manipulation** modes. In these modes, **manipulations are** always **performed on the original image**. The original image is kept intact as well as a list of all the relevant preceding manipulations. This list is updated by each additional manipulation, as explained in the next paragraph. Each time the list changes, RapidPLUS applies all the manipulations on the list to the original image, then redraws the resulting image.

The list of manipulations is updated differently for the quantitative functions (*set*, *change,* and *rotate*) and the state functions (*flip*, *mirror,* and *invert*). With quantitative functions, each new instance of the function replaces the current list instance. With state functions, each new instance reverses the current list state. Thus, if there have been three instances of contrast manipulation, only the last one is kept on the list. If there have been four instances of mirroring, the image is mirrored prior to the fourth instance (mirror “on”) and not mirrored (mirror “off”) following it.

In cumulative manipulation, RapidPLUS performs a single manipulation before each redrawing of the image. In non-cumulative manipulation, RapidPLUS usually performs several manipulations before each redrawing of the image. The order in which the manipulations are applied may affect the appearance of the redrawn image. Each of the two non-cumulative manipulation modes uses a different order.

The two order types are:

Logic Order	The manipulations are applied to the original image by the order of logic.
Predefined Order	The manipulations are applied to the original image in the following order: (i) Color component changes a. *set* functions b. *change<Color Component>By* functions c. *change<Color Component>ByPercent* functions (ii) Brightness and contrast functions (iii) Invert (iv) Mirror (v) Flip (vi) Rotate

To perform manipulations on the modified image:

- Select the “Cumulative changes” check box; the Non-cumulative options are unavailable.

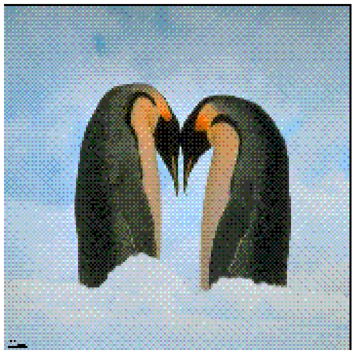
To perform manipulations on the original image:

1. Clear the “Cumulative changes” check box; the Non-cumulative options are available.
2. Select either the Logic Editor order or the Predefined order.

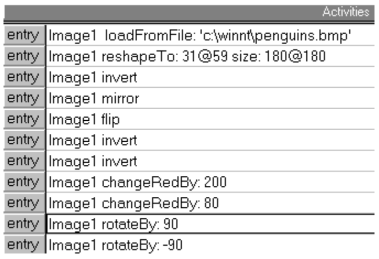
Examples of Usage

The following examples illustrate the differences among the three image manipulation modes. The same block of logic produces different results when applied to the same image. The result varies according to the selected manipulation mode.

This is the original image.



This block of logic is applied to the image.

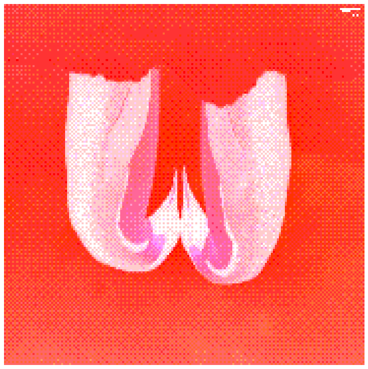


Activities

```
entry  Image1  loadFromFile: 'c:\winnt\penguins.bmp'
entry  Image1 reshapeTo: 31@59 size: 180@180
entry  Image1 invert
entry  Image1 mirror
entry  Image1 flip
entry  Image1 invert
entry  Image1 invert
entry  Image1 changeRedBy: 200
entry  Image1 changeRedBy: 80
entry  Image1 rotateBy: 90
entry  Image1 rotateBy: -90
```

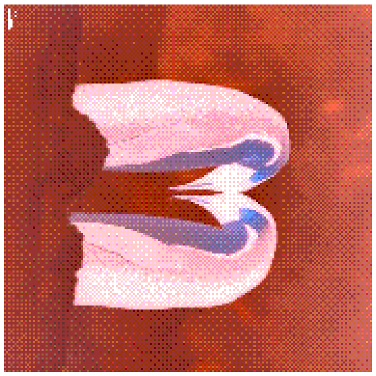
Cumulative changes manipulation

In this mode, each manipulation is applied directly to the image, so the original image ceases to exist as soon as the first manipulation has been applied. Each manipulation adds on to the current image. So, since the image was rotated 90°, and then -90°, it ends up non-rotated. Note that our image is flipped, but not rotated.



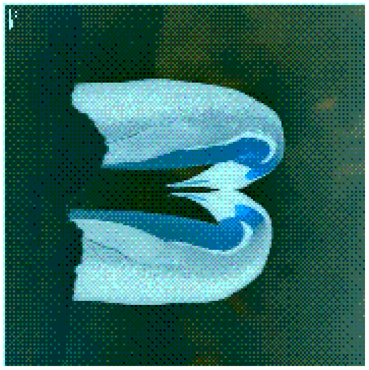
Non-cumulative changes|Logic Editor order manipulation

In this mode, all manipulations are always applied to the original image. When there are several instances of the same quantitative function, only the last instance applies. So, of the two rotations only the last one applied, and the image is flipped, and then rotated -90°.   The color difference, compared with the previous image, is due to the same reason.



Non-cumulative changes|Predefined order manipulation

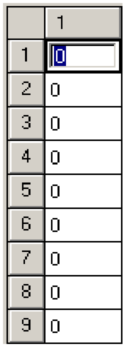
In this mode too, all manipulations are always applied to the original image, but in a different order. In this order, the color inversion manipulation is performed **after** the red color changes, producing different coloring compared with the previous image. The different order does not affect the positioning of the image, which is therefore the same as in the previous one.



Using the setColorForRGB_Ranges: function

This function provides color control by allowing you to select the pixels to which the color change applies, and set different RGB values for different pixel groups. The pixels are selected if all three of their color-component values fall within the specified range for each color component.

The color component ranges as well as the RGB values of the target color are defined in a nine-element, two-dimensional array that the function uses as an argument. The array must be in the following format:



	1	
1	0	Lower limit of R component
2	0	Upper limit of R component
3	0	Lower limit of G component
4	0	Upper limit of G component
5	0	Lower limit of B component
6	0	Upper limit of B component
7	0	Target R component value
8	0	Target G component value
9	0	Target B component value

Example

A cellular phone displays an image whose background color changes for incoming calls. The logic to simulate the color change would be similar to:

The original image

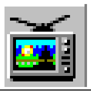
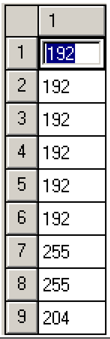
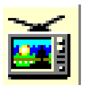


Image1 setColorForRGB_Ranges: Array1

Array1



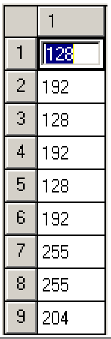
	1
1	192
2	192
3	192
4	192
5	192
6	192
7	255
8	255
9	204



During runtime, the pale gray background color changes to pale yellow. The change affects only the pixels with RGB values 192,192,192.

Image1 setColorForRGB_Ranges: Array2

Array2



	1
1	128
2	192
3	128
4	192
5	128
6	192
7	255
8	255
9	204

During runtime, the pale gray and the dark gray change to pale yellow. The change affects all pixels with RGB values in the ranges 128-192,128-192,128-192.

You can achieve a different color effect by adding another column to the array, and defining different target colors for the two shades of gray.

Using Transparent or Semi-Transparent PNG Images

When a PNG image file is loaded into an image object, its alpha channel is used to make the image transparent or semi-transparent in the Object Layout and Prototyper. Use of the alpha channel enables the PNG image to be blended with any objects placed under it and with the application background.

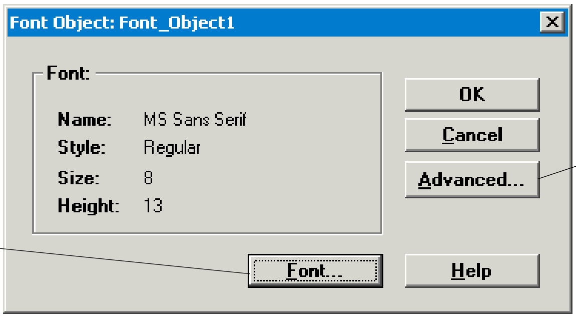
If an image object has a transparent color defined (in its Colors Edit dialog box), this transparent definition will take precedence over the alpha channel value. An image object's alpha channel can be set during runtime using the *setAlpha*: function.

❖ *NOTES: The drawing of transparent PNG images is available from RapidPLUS 8.0. PNG images used in earlier versions of RapidPLUS will look differently in version 8.0.*

This feature is not supported for code generation; however, you can write code to support it in a customized format driver or replace the supplied graphics library.

FONT OBJECT

In the Object Palette, the font object is located in the Display object class. It is a nongraphic object that makes it possible to display text in a graphic display. The font object is used in the Logic Editor to define the active font for the graphic display. Without an active font object, you cannot display text in a graphic display. The Font Object dialog box is used to select the font and its attributes. The default font definition is MS Sans Serif Regular 8.

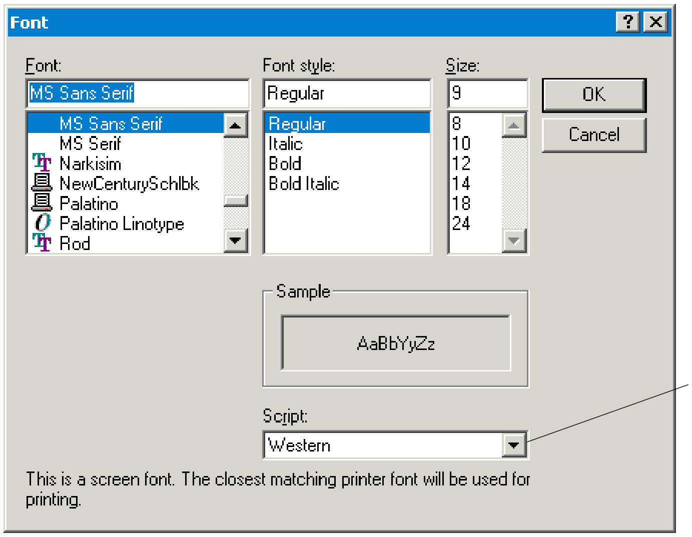

Font Object: Font_Object1
OK
Cancel
Advanced...
Font...
Help
Change font settings
Opens the Advanced dialog box for setting C code generation options (see p. 13-12)

Font:

Name: MS Sans Serif
Style: Regular
Size: 8
Height: 13

To change the font settings:

1 In the Font Object dialog box, click Font; a standard Windows font dialog box opens:



Font: MS Sans Serif
Font style: Regular
Size: 9
Script: Western

This is a screen font. The closest matching printer font will be used for printing.

2 Select the font, style, size, and script for the font object and click OK. The Font Object dialog box displays the new settings.

❖ *NOTE: Selection of an appropriate script is essential for multi-lingual support. See “Language” on p. 10-43 for details.*

Creating a font gallery

If you intend to use a variety of fonts in your graphic displays, either within a single language or because you plan to switch among languages, you may want to consider creating a nongraphic user object that acts as a font gallery. It would work something like this:

1 In the Object Layout, add a graphic display (to be deleted later) and then create a font object for each required language and/or font style.

2 In the Function Editor, create an exported function for each font object. The purpose of the function is to set the font object as the active font for any graphic display. For example, if you added a font object called ArialBold10, you would then create an exported function called **setArialBold10For: <Graphic_Display:Display1>** whose logic is:

<Display1> fontSet: ArialBold10

3 After you have finished creating the series of exported functions, go back to the Object Layout and delete the graphic display.

4 In the top panel More dialog box, click Registration and register the user object in the display objects group.

5 In any RapidPLUS application, register the user object (locate the user object in the objects folder).

Now you can add the user object to any application and use its exported functions to set the active font for any graphic display in the application.

Advanced Font Object Settings

(This section applies to RapidPLUS CODE only.)

By default, the font’s entire range of characters is included in the font object. There may be situations, however, when you would want to save resources by defining one or more ranges of characters for a font. When a font is not being used in its entirety, RapidPLUS defines a default substitute character to be used if a string contains a character that is not in the active font’s defined range.

In the Advanced dialog box, you can:

- Specify whether the font object is to be excluded from code generation.
- Change the range of characters to be included in the font object.
- Define the default character.

Single- and double-byte fonts

The character range is the number of characters available in a font. Each character is indexed in the font by ASCII values. For example, in most fonts the ASCII value for the character ‘A’ is 65.

Single-byte fonts, used mostly for Latin-based languages, are limited to 256 characters. Double-byte fonts are used in languages that require more than 256 characters, such as Chinese, Japanese, and Korean. In double-byte fonts, each character after the first 256 characters is represented by two bytes which are one unit and cannot be separated. The first byte is called the lead byte and the second byte is the character’s index within the lead byte range.

Generating a Font Object

By default, font objects are generated during code generation.

To exclude a font object from code generation:

- Select the Simulation Only option.

Changing a Font Object’s Character Range

To change a font object’s character range:

❖ *NOTE: The dialog box is the same for single- and double-byte fonts. In single-byte fonts, there is only one range and the lead byte of 0x00 is a placeholder.*

1. Clear the Use Entire Font check box; the character range line is available.
2. Click the From and/or To cells, and edit their content.

To add a character range:

1 Clear the Use Entire Font check box.

2 Click the Insert range button; a new character range is added to the list. The new range duplicates the range that is selected when you click the Insert range button, and is added to the list immediately under the selected line.

3 Change the From and/or To values in the added range.

To delete a character range:

1 Clear the Use Entire Font check box.

2 Select the character range you want to delete, then click the Delete range button. Multiple selection is available.

❖ *NOTE: You must keep at least one range for each lead byte. If you select all the ranges of a lead byte, the Delete button becomes unavailable.*

Changing a Font Object's Default Character

When a font is not used in its entirety, RapidPLUS defines a default character to substitute for characters that are not in the active font's defined range.

To change the default character:

- In the Default Character edit box, enter the ASCII value of a character that is within one of the font's character ranges.

Parsing a String

When displaying a long string on a graphic display, it is often necessary to divide (or parse) the string into substrings that fit the width of the display. Since the active font object has an impact on string width, the font object has two functions through which you:

- Count the number of substrings a string would be divided into in order for each substring to fit within the graphic display width (given in display pixels).
- Retrieve a specified substring of appropriate length from a string.

In each case, you must specify if the substrings are counted or retrieved from the beginning of the string (that is, *leftAligned*), or from the end. You must also specify if the parsing is by complete words (that is, *wordWrap*) or by character.

Example (see also the popup overlay example on p. 12-40)

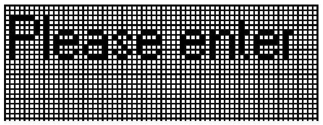
In the following example, *Font1* is Arial 8 regular, the width of GDO1 is 64 pixels, and the value of *Str1* is ‘Please enter the telephone number now:’. The result of the substring count (assigned to an integer object) is 4:

```
Int1 := Font1 countSubStrOf: Str1 toFitWidth: (GDO1 getWidth) leftAligned: 1
wordWrap: 1
```

To display the first substring, you could use the following logic:

```
GDO1 drawText: (Font1 subStrOf: Str1 index: 1 toFitWidth: (GDO getWidth)
leftAligned: 1 wordWrap: 1)  atx: 0 y: 0
```

and the result is:



CHAPTER 14

Touch Screen Object

A touch screen is a display screen topped by a touch-sensitive transparent panel. The panel is composed of a matrix of cells that transmit information to the software.

A person using a touch screen relies on touching the screen with a finger or stylus, rather than using a mouse or light pen. Since RapidPLUS presents a simulation and not an actual touch screen, the finger/stylus interaction with the touch screen is imitated by the mouse.

This chapter presents:

- How to add and define a touch screen object in the Object Layout.
- How to define its logic.
- Touch screen object reference.

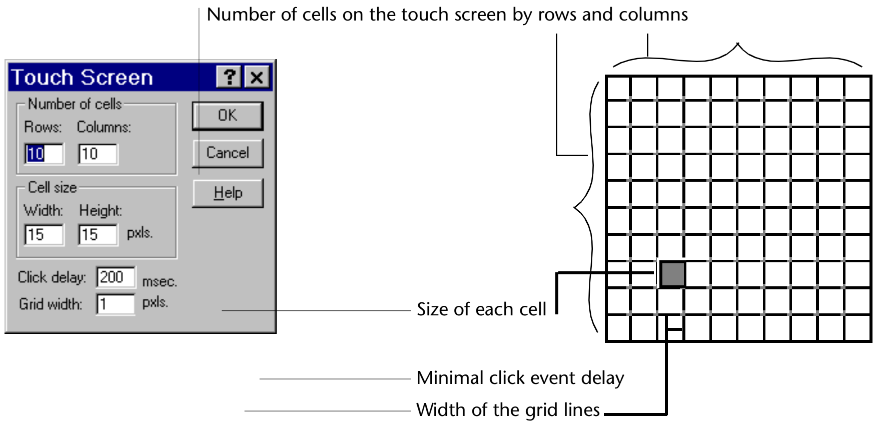
ADDING IN THE OBJECT LAYOUT

To add a touch screen object to the Object Layout:

1 The touch screen object is located in the Displays class. Select it from either the Object Palette or the New Objects list.

2 Use the Touch Screen dialog box to define:

- The size of the object, as a matrix of cells.
- The size of each cell in screen pixels.
- The width of the lines that form the grid.
- The minimal delay between pressing and releasing the mouse button that constitutes a “Click” event.


Touch Screen
Number of cells
Rows: 10 Columns: 10
Cell size
Width: 15 Height: 15 pxls.
Click delay: 200 msec.
Grid width: 1 pxls.
OK
Cancel
Help
Number of cells on the touch screen by rows and columns
Size of each cell
Minimal click event delay
Width of the grid lines

Hiding Grid Lines

You can use either of the following ways to hide the grid lines:

- Set the “Grid width” to 0:

  Or

- In the touch screen’s Colors Edit dialog box, select the Transparent check box, and set the same color in Line, Shading and Transparent.

DEFINING THE LOGIC

A touch screen is sensitive to the following operations: touch, drag, and pressure. In the simulation, these operations are imitated by the mouse. For each operation, there is a distinct mouse activity counterpart.

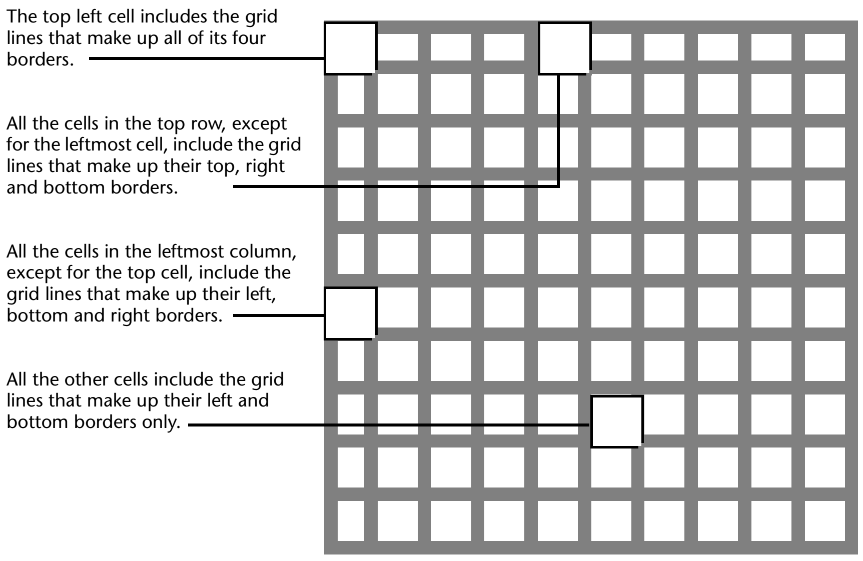
Pressing the mouse left button constitutes touch, and is supported in the logic by the *touched* and *released* events.

Keeping the left mouse button pressed—while moving the mouse—constitutes drag, and is supported by the *touchedDragged* event.

Clicking the mouse (pressing its left button at least for the Click delay period, then releasing without having moved it) constitutes pressure, and is supported by the *clicked* event.

❖ *NOTES: Numeration of the columns and rows in the touch screen object's matrix starts with one, so that the left-most column is the first column and the uppermost row is the first row.*

All horizontal grid lines except for the top border are included within the row immediately above them. The top border is included in the top row. All vertical grid lines except for the left border are included within the column immediately to their left. The left border is included in the first column. The relationship between grid lines and cell area is illustrated in the following graphic.


The top left cell includes the grid lines that make up all of its four borders.
All the cells in the top row, except for the leftmost cell, include the grid lines that make up their top, right and bottom borders.
All the cells in the leftmost column, except for the top cell, include the grid lines that make up their left, bottom and right borders.
All the other cells include the grid lines that make up their left and bottom borders only.

CHAPTER 15

Database Access Object

The database access object is used for linking the RapidPLUS application to any database that uses the ODBC (Open Database Connectivity) driver (version 2.0 or higher).

Once linked to a database, the data is available through the object to the RapidPLUS application. The data can be used in any RapidPLUS logic and the database can be updated from the RapidPLUS application.

The database access object also allows you to build and run SQL (Structured Query Language) query statements. Use SQL clauses to determine which fields are to be retrieved from the specified database, to establish filters for the data to be retrieved from the fields, and to determine the field order in the retrieved record set.

This chapter presents:

- How to define database access objects.
- How to configure an SQL query.
- How to define logic for database objects, including navigating among records, changing records, performing queries dynamically, and sending non-query SQL statements.
- How to handle errors.

ADDING IN THE OBJECT LAYOUT

❖ *NOTE: An ODBC v. 2.0 (or higher) driver must be installed on your system to use this object in your application.*

To add a database access object:

1. The database access object is located in the Communication class. Select it from either the Object Palette or the New Objects list. The DBAccess Object dialog box opens.
2. To define the object, click More.

DEFINING THE DATABASE ACCESS OBJECT

The DBAccess dialog box has three tabs: Selection, Advanced, and SQL. Use the tabs as described in the following table:

TAB	DESCRIPTION
Selection	Defines the database linked to the object and which table(s) and field(s) the object accesses within the selected database.
Advanced	Defines: • Whether or not the database is read-only. • The SQL filter (WHERE) and sort (ORDER BY) clauses. • Whether or not the query type is dynamically linked.
SQL	The definitions that you specify in the Selection and Advanced tabs are the basis for the SQL query statement that RapidPLUS sends when the application starts. The SQL tab displays the SQL statement.

Accessing a Database

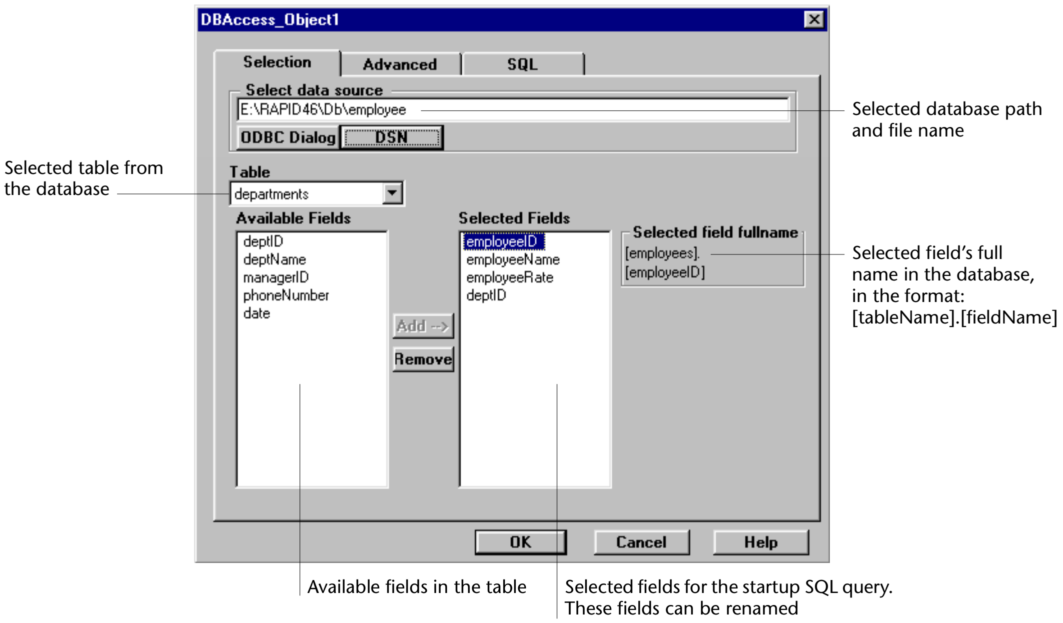
There are various ways of accessing data sources, depending on your system's driver, operating system, and the database type (Microsoft Access, Excel, Oracle, etc.) you want to access. For specific information, refer to the ODBC documentation.

In the DBAccess dialog box, Selection tab (and Advanced tab), there are two buttons for accessing data sources:

BUTTON	DESCRIPTION
ODBC Dialog	Used to select an ODBC driver description and then a data source file. This method may include a file path, which must be present on the system.
DSN	Used to select a data source name.

❖ *NOTE: The selected file or DSN must be present on the system when editing and when running the application in the Prototyper or Reviewer.*

Below is an example of a database object that contains a database:


DBAccess_Object1
Selection
Advanced
SQL
Select data source
ODBC Dialog
DSN
Table
Available Fields
Selected Fields
Selected field fullname
Add -->
Remove
OK
Cancel
Help
Selected database path and file name
Selected table from the database
Selected field's full name in the database, in the format: [tableName].[fieldName]
Available fields in the table
Selected fields for the startup SQL query. These fields can be renamed

Select data source: E:\RAPID46\Db\employee

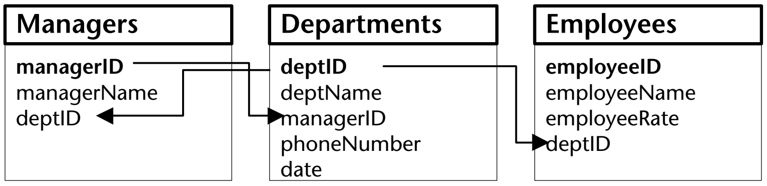
Table: departments

Available Fields: deptID, deptName, managerID, phoneNumber, date

Selected Fields: employeeID, employeeName, employeeRate, deptID

Selected field fullname: [employees].[employeeID]

The database shown above refers to a small Microsoft Access 97 database called *Employees.mdb* that is on the RapidPLUS CD-ROM (\Examples\Objects\DB). This database is used as an example throughout the chapter. It consists of the following tables and fields:



Tables and fields in the *Employess.mdb* database

Selecting Tables and Fields Database

❖ *NOTE: These instructions apply to databases other than Microsoft Excel databases. See p. 15-9 for instructions about working with Excel spreadsheets.*

To select tables and fields for the startup SQL query:

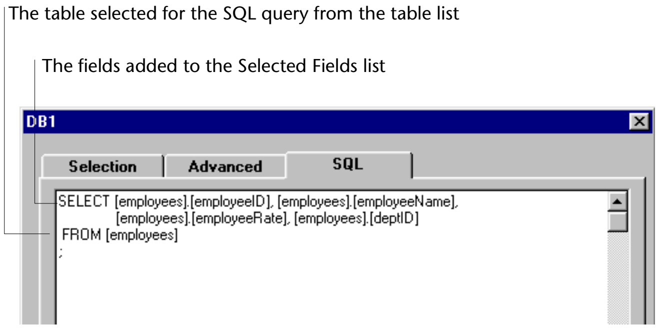
1 From the Table list, select a table that the object will access.

2 The Available Fields list displays all the fields of the selected table. Choose the field or fields to be included in the application's startup query and click Add.

3 Repeat Steps 1 and 2 for all tables and fields that you want to include in the startup query.

❖ *NOTE: A database access object can only be linked to one database. You cannot select tables and fields from two databases in a single database access object.*

As you select tables and fields, the object builds an SQL statement that you can view by selecting the SQL tab. This tab contains a non-editable text pad displaying the SQL query statement. For example:


The table selected for the SQL query from the table list
The fields added to the Selected Fields list
DB1
Selection
Advanced
SQL

```
SELECT [employees].[employeeID], [employees].[employeeName],
          [employees].[employeeRate], [employees].[deptID]
 FROM [employees]
;
```

To remove a field from the Selected Fields list:

- In the Selection tab, select the field(s) and click Remove.

The SQL statement changes accordingly as you remove fields from the list.

To rename a field in the Selected Fields list:

- In the Selection tab, select a field and type in another name.

❖ *NOTE: Renaming the field in the Selected Fields list does not affect the selected field's full name, as described in the illustration on* p. 15-6.

Configuring the Query

The Advanced page in the database object dialog box allows you to configure complex SQL query options as you add fields to the Selected Fields list. These options include the sort order of the fields and any conditional statements that the field contents must meet to be included in the query.

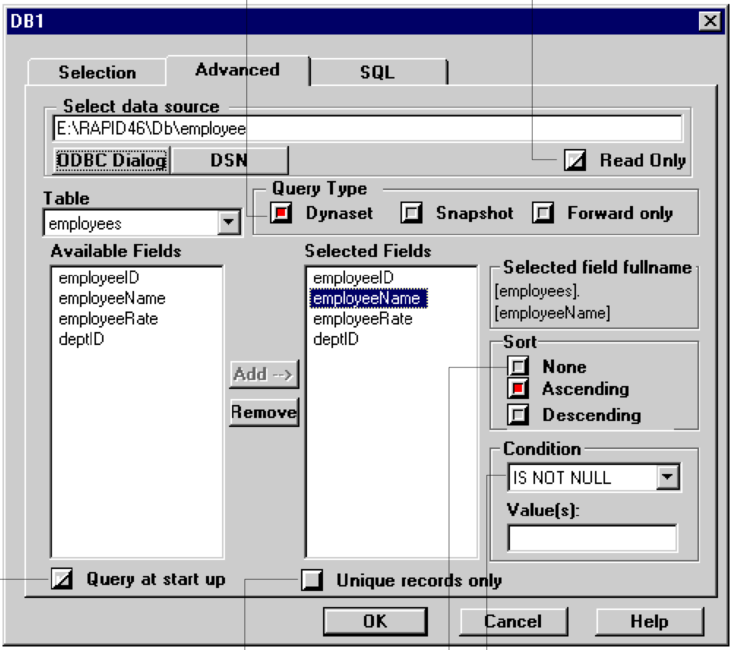
In this tab you also specify whether or not:

- The database is read only.
- To run the SQL query when the application starts in the Prototyper.
- To exclude records whose fields contain the same value.
- The query result set can be changed, when those changes are visible, and whether you can scroll both backwards and forwards through the records.

See the following sample database.

Choose the desired query type. The options are described in the table on the following page

When selected, you cannot add to or edit the database during runtime



Select data source: E:\RAPID46\Db\employee

[✓ Read Only]

Table: employees

Query Type: [✓ Dynaset] Snapshot Forward only

Available Fields: employeeID, employeeName, employeeRate, deptID

Selected Fields: employeeID, employeeName, employeeRate, deptID

Selected field fullname: [employees].[employeeName]

Sort: None [✓ Ascending] Descending

Condition: IS NOT NULL

Value(s):

[✓ Query at start up]

Unique records only

When selected, the SQL query runs when the RapidPLUS application is started in the Prototyper

When selected, records with duplicate field values are not included in the query result

Select an operator from the list and enter a value in order to restrict the records included in the result of the SQL query. The operators are described under “Conditions” on the following page

The data in the selected field is sorted in the order found in the data source (none), from the lowest value to highest value (ascending), from the highest value to the lowest value (descending)

Query Type

To define the query type:

- Choose among the following options:

Type	Query Result Link to the Database	Scrolling
Dynaset	Dynamically linked. You can change the data; the changes are only visible the next time the record is accessed.	Bidirectional
Snapshot	Not dynamically linked. You can change the data; the changes are visible when you rerun the SQL query.	Bidirectional
Forward only	Not dynamically linked; no changes allowed to the data.	Forward only

Condition

To set a filter for the selected field:

- Choose an SQL operator from the Condition list and enter a value in the Value edit box, as follows:

if you use this operator	A record will be included in the query result if the field's value is
IS NULL, IS NOT NULL	Null/not null. A value is null if it is missing, unknown, or not relevant.
<, <=, <>, =, >, >=	Less than, less than or equal to, not equal to, equal to, greater than, or greater than or equal to the integer or number value specified in the Value box. ❖ *NOTE: You can use the logical operators AND, OR, and NOT to create compound conditions.* *For example, the SQL clause:* **WHERE [employees.employeeRate] >= 5.1 AND [employees.employeeRate] <= 8.7;** *retrieves those records where the* ***employeeRate*** *field of the* ***employees*** *table is between 5.1 and 8.7 (inclusive).*

if you use this operator	**A record will be included in the query result if the field's value is**
BETWEEN	Between the specified integer or number values in the Value box. For example, the SQL clause: **WHERE [employees.employeeRate] BETWEEN 5.1 AND 8.7;** only includes records whose *employeeRate* field value in the *employees* table are between 5.1 and 8.7. ❖ *NOTE: Compare this with the example used above for the relational operators.*
IN, NOT IN	Included/not included in the list of strings specified in the Value box. For example, the SQL clause: **WHERE [departments.deptName] IN ('SPORTS', 'CLOTHING');** only picks out records where the value of the *deptName* field in the *departments* table is SPORTS or CLOTHING.
LIKE, NOT LIKE	The same/not the same as the string specified in the Value box. ❖ *NOTE: In the Value box, you can use an underscore (_) as a single-character wildcard or a percentage sign (%) as a substring wildcard (where the substring can be of zero length). For example, the SQL clause* **WHERE [dictionary.phrase] LIKE 'E%R_' ;** *will include records where the* ***phrase*** *field value in the* ***dictionary*** *table is "ERA," or "ENQUIRY."*

❖ *NOTES: To remove any filters from the selected field, select <no condition> in the Condition list.*

To create a parameterized value for a condition operator, enter a question mark (?) in the Value box. You can then use the field's ***setParameter:*** *function to specify the value dynamically during runtime. For more information, see "Setting Parameterized Values" on p. 15-13.*

Working with Microsoft Excel Spreadsheets

If you are working with Excel spreadsheets, you should use the following procedure:

1 In the DBAccess dialog box, Advanced tab, open the database (see p. 15-3 for information about accessing databases).

2 Add the relevant fields to the Selected Fields list.

3 Make sure the "Query at startup" check box is not selected.

4 The query must be written manually. In the Logic Editor, add the following logic:

```
<Database object name>.dbSQL := 'SELECT L1,L2 FROM "<sheet name>$"'
<Database object name> runQuery
```

DEFINING THE LOGIC

Navigating Among the Records

The database access object has a number of functions that allow you to navigate easily among the records in the query result table.

Moving to Records

To move to the beginning or end of the query result table:

- Use the *moveFirst* or *moveLast* function.

To move to a specific record:

- Use the *moveTo: <integer>* function, specifying the record in the integer argument. A runtime error occurs if the function attempts to move to a record that does not exist.

Scrolling to Records

To scroll backward or forward one record at a time:

- Use the *moveNext* or *movePrev* function. If you are on the last record and call *moveNext,* or on the first record and call *movePrev*, a runtime error occurs. Similarly, if the query type is “Forward only” (defined in the Advanced tab) and you call *movePrev*, a runtime error occurs.

To scroll backward or forward by a specified number of records:

- Use the *moveBy:* function, specifying the number of records to advance or go back (by using a negative value). A runtime error occurs if the function attempts to move to a record that is beyond the end-of-file or beginning-of-file boundaries.

Using Bookmarks

To move to a specific record:

1 First, move to the record that you want to bookmark (for example, the employee with the highest rate) and use the *getBookmark* function to get a read-only integer marker for the record. The logic would look something like:

```
maxRate_int := DB1 getBookmark
```

2 To jump to a bookmarked record, use the *moveToBookmark:* function, specifying the bookmark returned by the *getBookmark* function. For example (in continuation of the example shown in Step 1):

```
DB1 moveToBookmark: maxRate_int
```

❖ *NOTE: Bookmarks are not supported for the Forward only query type.*

Changing Database Records

If the query type (as specified in the Advanced tab) has **not** been defined as Forward only, and if the database link is **not** read only (see the Note below), then you can use the functions described in this section to add/delete records in the linked database and/or assign values to database fields.

❖ *NOTE: A database link will be read only if the Read-only option is selected in the Advanced tab, or according to criteria specific to your ODBC driver. For example, if you are using the Microsoft Access ODBC driver and your query joins tables,* *the database link is automatically read only. You can check if the link is read only via the object's* ***is readOnly*** *condition.*

To add a record to the database:

- Use the *add* function. A new record, with null field values, is added after the last record. The database access object points to the new record and you can change the field values as described in Steps 3 and 4 of the "To change field values in the database" procedure below.

To delete the current record from the database:

- Use the *delete* function. The database access object points to the previous record.

To change field values in the database:

1. Use one of the navigation functions, as described in "Navigating Among the Records" on p. 15-9, to go to the record that you want to change.
2. Call the object's *edit* function to prepare the database for record changes.
3. Use the field assignment function to make the desired changes to the record.
4. Call the object's *update* function to transfer the changes made in Step 3 to the database (or to the transaction buffer, if using the transaction functions as described in "Performing Transactions" on p. 15-12).
5. Repeat Steps 1 through 4 for as many changes as you would like to make.

Example

Let's assume a query that links the database access object to the employeeID, employeeName, and deptID fields of the EMPLOYEES table. You want to change the department for John Smith from Sports to Appliances. The following series of activities would make the desired change (assuming that you are pointing to the appropriate record):

```
DB1 edit

DB1.deptID := 'APPLIANCES'

DB1 update
```

When will changes be visible?

Assuming that you are displaying the database data in one of the RapidPLUS display objects, you may be confused by the fact that the changes you make are not immediately visible. How you see the changes depends on the query type defined in the DBAccess dialog box, Advanced tab (see the illustration on p. 15-6 and the table on p. 15-7).

If the query type is Dynaset, the changes are visible the next time you access the record. If the query type is Snapshot, the query must be run again in order to see the changes.

Performing Transactions

An ODBC driver that supports transactions has a transaction buffer to store changes made to the database and only implements those changes upon a specific command. As illustrated on the following page, the database access object has three functions that control the transaction buffer:

- *transactionBegin*: opens a link to the database's transaction buffer.
- *transactionCommit*: implements all the database changes made since the last call to *transactionBegin* and empties the buffer.
- *transactionRollback*: discards all changes made since the last call to *transactionBegin* and empties the buffer.

A runtime error occurs if you try to call *transactionBegin* if the previous transaction was not terminated by either *transactionCommit* or *transactionRollback*. In the same way, a runtime error occurs if you call either *transactionCommit* or *transactionRollback* without a matching *transactionBegin* function.

❖ *NOTE: To confirm that your database supports transactions, use the* ***has transactions*** *condition.*

For detailed information on transaction procedures, you should consult the documentation of your ODBC driver. For example, the Microsoft Access driver requires you to call *transactionBegin* **before** running the query. In this case, therefore, you would have to clear the "Query at startup" check box (in the Advanced tab), and call *transactionBegin* before calling *runQuery*.

Modifying Queries Dynamically

There are two ways in which you can modify the SQL query statement dynamically:

- Modifying the *dbSQL*, *dbFilter,* and/or *dbSort* properties.
- Setting parameterized values for the statement's WHERE clause.

Modifying the *dbSQL, dbFilter,* and/or *dbSort* Properties

The database access object's *dbSQL* property holds the SQL statement used to query the database. The SQL statement at startup is the one that was built via the object's dialog box. If the "Query at startup" check box is selected, the query is run automatically when you start the Prototyper.

Through the logic, however, you can change the entire SQL statement or its component clauses by assigning values to the *dbSQL*, *dbFilter,* and/or *dbSort* properties. You would then run the modified query by calling the *runQuery* function.

To change the entire SQL statement:

- Assign a string to the *dbSQL* property. Assigning a value to the *dbSQL* property automatically sets both the *dbFilter* and *dbSort* properties to empty strings.

To change the query's filter:

- Assign a string to the *dbFilter* property. This assignment automatically changes the WHERE clause in the *dbSQL* property.

To change the query's sort order:

- Assign a string to the *dbSort* property. This assignment automatically changes the ORDER BY clause in the *dbSQL* property.

Setting Parameterized Values

In the Advanced tab, you build the SQL statement's WHERE clause by defining a condition operator and value for the selected field—one field at a time. This procedure is described in detail on p. 15-7.

If you enter a question mark (?) as the value, it becomes a parameterized value, allowing you to set the value dynamically during runtime. Before running the query, you provide the value by calling the field's *setParameter:*

function. You must call the *setParameter:* function for each parameterized value in the WHERE clause, in the order that they appear.

Example

Let's assume the following SQL query for our database access object:

```
SELECT  DISTINCT [employees].[employeeID], [employees].[employeeName],
   [employees].[employeeRate], [employees].[deptID]
FROM [employees]
WHERE [employees].[employeeName] IN ?   AND
   [employees].[deptID] = ?
;
```

Before running this query, you must provide a parameter for the *employee-Name* and *deptID* fields, as follows:

DB1.employeeName setParameter: '('Travolta, John','Dean, James')'
DB1.debtID setParameter: 'ACCOUNTING'
DB1 runQuery

In this case, the WHERE clause of the query becomes:

```
WHERE
 [employees].[employeeName] IN ('Travolta, John', 'Dean, James')AND
 [employees].[deptID] = ACCOUNTING
```

and the query result will include all employees named John Travolta and James Dean in the accounting department.

Sending Non-Query SQL Statements

You might want to send a non-query SQL statement in order to, for example, create, insert, or delete a database table during runtime. To support this capability, use the following function of the database access object's *self* property: *executeSQL*: <*string*>, where the <string> argument is any SQL statement enclosed in single quotes.

❖ *NOTE: This function operates on the database itself—**not** on the record set.*

ERROR HANDLING

There are two types of errors handled by the database access object:

- Database errors
- RapidPLUS runtime errors

Many different database errors can occur when accessing databases via an ODBC driver. The types of errors are specific to the database being accessed. Whenever a database error occurs, the ODBC error message is assigned to the *dbErrorMessage property* and the *dbError* event is generated.

Two specific database errors are login and query errors, that is, unsuccessful attempts to connect to and query a database. Use the *setLoginTimeout*: and *setQueryTimeout*: functions to specify a timeout period after which these errors are returned by the ODBC driver. The default is 15 seconds.

Runtime errors are generated when the RapidPLUS logic is incorrect. For example, you call *transactionRollback* without having called *transactionBegin*, or you try to assign a value to a field without having called the *edit* function.

❖ *NOTE: Most database errors do not result in runtime errors so they can go unnoticed. To avoid this situation, you can either open an Inspector window on the database access object and look at the dbErrorMessage property or catch the dbError event in your logic.*

❖ *NOTE: With the navigation functions (moveFirst, moveLast, moveNext, movePrev, moveBy:, and moveTo:), a runtime error occurs if you try to move beyond the beginning or the end of the record set.*

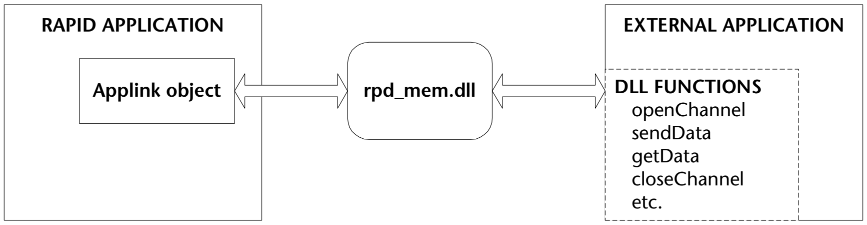
CHAPTER 16

Applink Object

The Applink object enables RapidPLUS applications to communicate with external applications via shared memory. The advantage of using Applink objects over other communication methods (such as DDE) is that shared memory enables fast communication.

RapidPLUS provides a shared memory DLL, *rpd_mem.dll*, which contains functions that open channels of communication between applications and manages the transfer of data.

In RapidPLUS, *rpd_mem.dll* is accessed through the Applink nongraphic object. In an external application, *rpd_mem.dll* is accessed by calling its functions.



How data is exchanged via shared memory

This chapter presents:

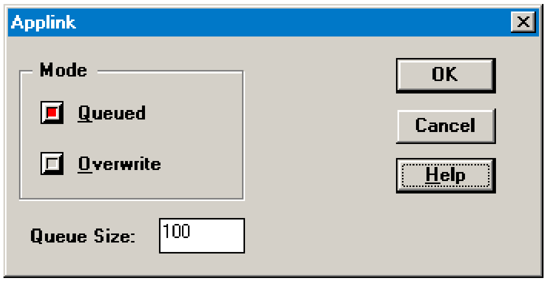
- How to define the Applink object so that it sends and receives data.
- How to use *rpd_mem.dll* in an external application.

ADDING AN APPLINK OBJECT IN THE OBJECT LAYOUT

To add an Applink object:

1 The Applink object is located in the Communications class. Select it from either the Object Palette or the New Objects list. The Applink dialog box opens.

2 Click More to set the object's mode of data transmission:



Mode

[✓ Queued]

Overwrite

Queue Size: 100

Mode of Transmission—Queued vs. Overwrite

Data transmitted from either application is sent to *rpd_mem.dll*.

- In **Queued mode**, all sent messages are stored in a queue in *rpd_mem.dll*. The messages are read in the order in which they entered the queue (that is, first in, first out). The default mode is Queued.
- In **Overwrite mode**, there is no queue; each message is sent directly to *rpd_mem.dll,* and the next message sent overwrites the previous message. In this mode, a data element can be overwritten before it is read.
- The **Queue size** range is 0–1,000,000. The default size is 100.

You can also change the transmission mode in the logic using the *setQueuedMode* and *setOverwriteMode* functions.

USING THE APPLINK OBJECT

The main tasks you will want to accomplish using the Applink object are:

- Sending data to the external application.
- Receiving data from the external application.

Before you can do either of these tasks, you **must** open a channel of communication between RapidPLUS and the external application.

❖ *NOTE: The memory-sharing DLL, rpd_mem.dll, can contain up to 20 channels.*

Opening and Closing a Channel

Before RapidPLUS can communicate with another application, a channel of communication must be opened. The channel **must** have the same name in RapidPLUS and in the external application. Each Applink object can open one channel at a time.

When you have finished transferring data, you should close the channel.

To open a channel:

- Use the *open: <channelName>* function.

<channelName> is the name that the external program will also use to open the channel from its side.

For example,

```
Applink1 open: 'channel1'
Applink1 open: 'Name_List'
```

❖ *NOTES: If your application contains more than one Applink object, each object's channel must have a unique name. However, if you are using Applink objects that will communicate with each other, they can use the same channel name.*

As stated above, an application can contain two Applink objects that communicate with each other via one channel. However, if you try to open this application in a second RapidPLUS window (while it is open in the first RapidPLUS window), an error will occur in the second RapidPLUS.

To close a channel:

- Use the *close* function. For example,

```
Applink1 close
```

Sending Data

To send data to the external application:

- Use the *sendData: '<string>' :id:* function.
  where

'<string>'	is a RapidPLUS string (any string, object, or property that accepts string values).
<id>	is an integer that identifies the type of data being sent. The integer value for this parameter is set by you and the person writing the outside application. For example, if you are sending data to include in an employee list (parameters such as name, address, phone number), you would assign ID numbers to each parameter (such as name=1, address=2, phone number=3) In the examples above, the ID for the name is 1. If you do not want to designate the data type, use a zero for the *id* parameter. For example, **sendData : '07/09/91' id: 0**

Using Constant Set Objects

If you want to send more than one type of data, you may want to use a constant set object to define the types of data. For example:

sendData AddressList_Constant_Set.name id: 2
sendData AddressList_Constant_Set.streetAddress id: 3

❖ *NOTE: The maximum size for sending data is 32,000 bytes.*

Notification That the Data Was Received

When the external application receives data from RapidPLUS, the application reads the data and then generates an *acknowledged* event back to RapidPLUS. This event is important when the RapidPLUS application needs to know that the data was received before it sends the next data string.

The *acknowledged* event can be used in a trigger in RapidPLUS. For example,

Applink1 acknowledged

Receiving Data

When data is sent to RapidPLUS:

i. A *dataReceived* event is generated:

ii. The string is placed in the Applink object's *data* property; and

iii. The *getData* function can retrieve the data.

The Applink object continues to receive data as long as the mode containing the *getData* function is active. Once that mode becomes inactive, the Applink object cannot receive new data.

One way to restart the process of receiving data is to use the *checkForData* function. This function checks if there is data in the shared memory. If so, it generates a *dataReceived* event and the string is placed in the Applink object's *data* property. You can then use the *getData* function to retrieve the data.

(To see how these logic items are used, refer to "Logic Examples" on p. 16-6.)

To receive data from the shared memory:

- Use the *getData* function in an activity or action.

For example,

Applink_Chan1 getData
(The data is placed in *Applink_Chan1.data*.)

To display the data or assign it to another object:

- Use the *data* property.

For example:

TextDisplay1.contents := Applink_Chan1.data
ArrayOfData[index] := Applink_Chan1.data

To check for additional data in the shared memory:

- Use the *checkForData* function.

For example,

Applink_Chan1 checkForData

LOGIC EXAMPLES

The first example illustrates how an Applink object sends data to an external application; the second example illustrates how an Applink object receives data from an external application.

Example 1: Sending Data to an External Application

In the Object Layout

The RapidPLUS application contains the following objects to facilitate the sending of data:

- One **Applink object**, “Applink_PhoneNumber,” set to queued mode.
- An **array object**, “Arr_PhoneNumbers,” containing 10 phone numbers.
- An **integer object**, “Counter,” used to increment the array elements. Its initial value is 1.

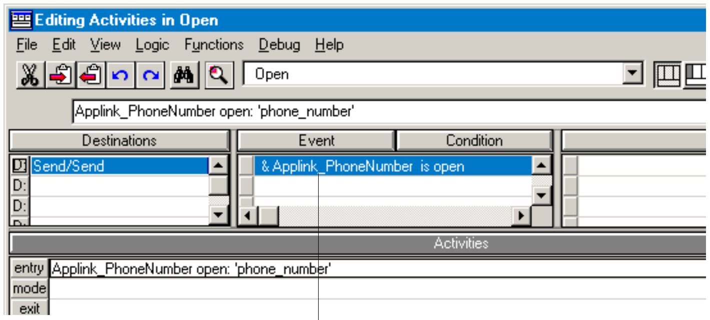
In the Mode Tree

There are three modes: **Open**, **Send**, and **Close**.

In the Logic Editor

Open mode:

Open mode contains an entry activity that opens a channel:


Editing Activities in Open
File Edit View Logic Functions Debug Help
Open
Destinations
Event
Condition
Activities

Applink_PhoneNumber open: 'phone_number'

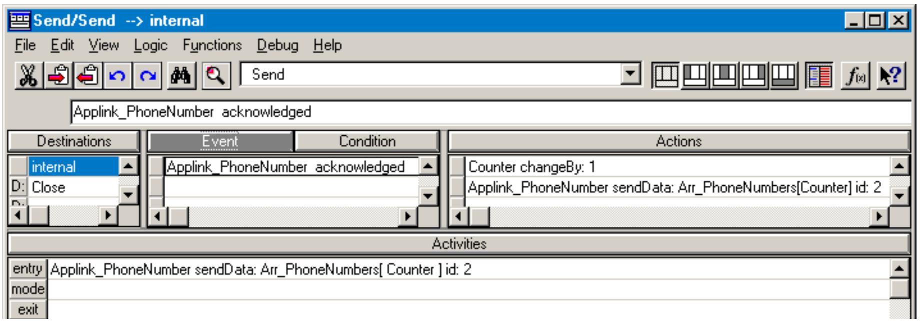
D:	Send/Send
Event	& Applink_PhoneNumber is open
entry	Applink_PhoneNumber open: 'phone_number'
mode	
exit	

This condition makes sure that the channel is open

Send mode:

In Send mode, there are two transition destinations:

- An internal transition.
- A transition to Close mode.



Applink_PhoneNumber acknowledged

Destinations	Event	Condition	Actions
internal	Applink_PhoneNumber acknowledged		Counter changeBy: 1
Close			Applink_PhoneNumber sendData: Arr_PhoneNumbers[Counter] id: 2

Activities

entry	Applink_PhoneNumber sendData: Arr_PhoneNumbers[Counter] id: 2
mode	
exit	

i. When Send mode becomes active, the entry activity is executed, sending the first element in the array to the shared memory.

ii. After the external application reads the data and sends an *acknowledged* event back to RapidPLUS, RapidPLUS uses the *acknowledged* event in an internal transition.

iii. There are two actions. The Counter integer increments the array element by 1; the Applink object sends the second element in the array to the shared memory.

iv. This process continues until all 10 array elements have been sent. The condition:

& Counter > 9

triggers the transition to Close mode.

Close mode:

Close mode contains:

- An entry activity that closes the channel:

Applink_PhoneNumber close

Example 2: Receiving Data from an External Application

The second example mirrors the first, that is it contains similar objects, but this time they are used for receiving data rather than sending it.

In the Object Layout

The application contains the following objects to facilitate receiving data:

- One **Applink object**, “Applink_List_PhoneNumber,” set to queued mode.
- A **data store object**, “Employee_List,” that contains several fields: employee name, phone number, mailing address, and E-mail address.
- An **integer object**, “Counter,” used to increment the data store fields. Its initial value is 0.

In the Mode Tree

There are four modes: **Open**, **Receive**, **Add_to_Employee_List**, and **Close**.

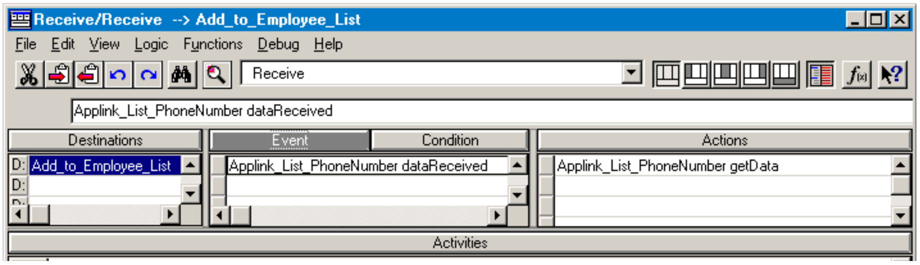
In the Logic Editor

Open and Close modes:

As in the first example, these modes open and close the channel.

Receive mode:

In Receive mode, RapidPLUS waits for the external application to send data.


Receive/Receive --> Add_to_Employee_List
File Edit View Logic Functions Debug Help
Receive
Destinations
Event
Condition
Actions
Activities

Applink_List_PhoneNumber dataReceived

D: Add_to_Employee_List

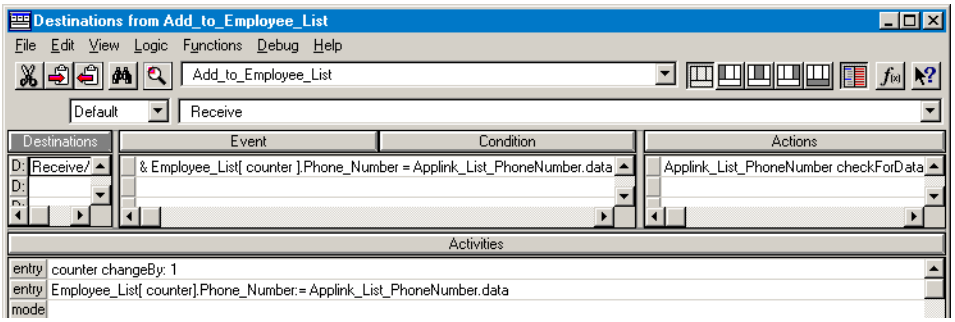
Applink_List_PhoneNumber dataReceived

Applink_List_PhoneNumber getData

i. When data is sent to RapidPLUS, the *dataReceived* event is generated. (The data is also stored in the Applink object’s *data* property.) This event is used to trigger a transition to Add_to_Employee_List mode.

ii. The *getData* function is used in an action to retrieve the data from shared memory.

Add_to_Employee_List mode


Destinations from Add_to_Employee_List
File Edit View Logic Functions Debug Help
Destinations
Event
Condition
Actions
Activities

Add_to_Employee_List

Default

Receive

D: Receive/

& Employee_List[counter].Phone_Number = Applink_List_PhoneNumber.data

Applink_List_PhoneNumber checkForData

entry counter changeBy: 1

entry Employee_List[counter].Phone_Number:= Applink_List_PhoneNumber.data

i. When Add_to_Employee_List mode becomes active, the entry activities are executed: the value of Counter is incremented by 1. The data contained in the *data* property is assigned to a field in the data store object.

ii. Once the data is stored, the contents of Applink_List_PhoneNumber.data is equivalent to the contents of Employee_List's selected field. The event:

& Employee_List[counter].Phone_Number = Applink_List_PhoneNumber.data

is used to trigger a transition back to Receive mode.

iii. The action:

Applink_List_PhoneNumber checkForData

checks for additional data in the shared memory.

USING RPD_MEM.DLL IN AN EXTERNAL APPLICATION

The file *rpd_mem.dll* is located in the Rapidxx folder. For the external application to access it, either: the external application must be located in the Rapidxx folder; *rpd_mem.dll* must be moved to the Windows system32 folder; or *rpd_mem.dll* must be located in the PATH environment variable of the system or user. A subfolder, Rapidxx\rpd_mem, contains a header file and link libraries for Visual C++ and Borland, which enable you to link to the Applink object from C.

The tasks that the external application can perform are:

- Opening a channel of communication.
- Sending data to the Applink object.
- Receiving data from the Applink object.
- Closing the channel.
- Setting and getting the transmission mode (queued or overwrite).
- Setting and getting the size of the queue.

Opening and Closing the Channel

Before the external application can communicate with RapidPLUS, a channel of communication must be opened. The channel **must** have the same name in RapidPLUS and in the external application.

When the communication process has been completed, you should call the *closeChannel* function.

❖ *NOTE: Up to 20 channels can be opened.*

Opening a Channel

- Use the rpd_openChannel function. When a channel is opened, its transmission mode is Queued.

Syntax

```
long rpd_openChannel(const char* channelName, void(*dataArrived)
(int), void(*acknowledged)(int))
```

Parameters

channelName	Name of the channel; must be the same name used by the Applink object.
dataArrived	Address of the callback function, *dataArrived*. The syntax for *dataArrived* is: **void dataArrived(int channelId)**
acknowledged	Address of the callback function, *acknowledged*. **void acknowledged(int channelId)**

Return values

`channelId`	No error, the value of the channel's ID.
`RPD_ER_ALREADY_OPEN`	The channel is already open.
`RPD_ER_FULL_TABLE`	Twenty channels are already open.

Closing a Channel

- Use the rpd_closeChannel function.

Syntax

```
long rpd_closeChannel (int channelId)
```

Parameter

channelID	The channel's ID.

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_ALREADY_CLOSE`	The channel is already closed.
`RPD_ER_CHANNEL_NOT_OPEN`	A channel was not opened.

Sending Data

To send data to the Applink object:

- Use the rpd_sendData function.

Syntax

```
long rpd_sendData(int channelId, int type, const char* data,
   int  size)
```

Parameters

channelID	The channel's ID.
type	Data type.
data	Data to be sent.
size	Length of the data in bytes.

❖ *NOTE: The maximum size for sending data is 32,000 bytes.*

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_CHANNEL_NOT_OPEN`	The channel is not open.
`RPD_ER_DATA_LARGE`	The sent data is too large for buffer.
`RPD_ER_FULL_QUEUE`	The queue is full.

Getting Data

There are two functions that get data from the shared-memory file: rpd_getData and rpd_checkForData. rpd_getData actually gets the data; rpd_checkForData checks if data is located in the shared-memory file.

To get data from the shared-memory file:

- Use the rpd_getData function.

Syntax

```
long rpd_getData(int channelId,int* type, char* data, int* size)
```

Parameters

channelId	The channel’s ID.
type	Output: pointer to data type.
data	Pointer to the buffer in which received data is placed.
size	Input: length of buffer in bytes; output: size of data in bytes.

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_CHANNEL_NOT_OPEN`	The channel is not open.
`RPD_ER_BUFFER_SMALL`	The buffer size is too small.
`RPD_ER_NO_DATA`	The buffer is empty.

To check if there is more data in the shared-memory file:

- Use the rpd_checkForData function.

Syntax

```
long rpd_checkForData(int channelId)
```

Parameters

channelId	The channel’s ID.

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_CHANNEL_NOT_OPEN`	The channel is not open.

Setting and Getting the Transmission Mode

To set or get the transmission mode:

- Use the rpd_setMode and rpd_getMode functions.

Syntax

```
int rpd_setMode(int channelId, int mode)
int rpd_getMode(int channelId)
```

Parameters

channelId	The channel's ID.
mode	Queued or overwrite.

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_CHANNEL_NOT_OPEN`	The channel is not open.

Setting and Getting the Size of the Queue

To set or get the queue size:

- Use the rpd_setQueueSize and rpd_getQueueSize functions.

Syntax

```
long rpd_setQueueSize(int channelId, long size)
long rpd_getQueueSize(int channelId)
```

Parameters

channelId	The channel's ID.
size	Size of the queue. The maximum size is 1,000,000.

Return values

`RPD_SUCCESS`	No error.
`RPD_ER_CHANNEL_NOT_OPEN`	The channel is not open.
`RPD_LARGE_QUEUE_SIZE`	The size set is larger than the maximum queue size.

Examples of Code

Using *rpd_mem.dll*

In this example, a channel named RapidPLUS is opened. The data type, Applink_PHONE (a phone number) is used in the *sendData* function.

❖ *NOTE: The channel name **must** be the same name as in the RapidPLUS application.*

```
res = rpd_openChannel("Rapid", dataArrived, acknowledged);
if (res==RPD_SUCCESS)
{
   //send data
   rpd_setMode("RAPID", cQueued);
   res=rpd_sendData("Rapid", Applink_PHONE,  data,  size);
}
```

Using the dataArrived Callback Function

In this example, the following data types are used:

Data Type	**Description**
Applink_PHONE	A phone number
Applink_DATE	A date
Applink_TIME	A time

```
void dataArrived(int channelId)
{
 //Get data
 int type;
 char buf[1024];
 int size =1024;
 res = rpd_getData((channelId, type,  buf,  &size);
 if (res == SUCCESS)
 {
   switch(type)
   {
      case  Applink_DATE;
         func1(buf,size);
      break;
      case Applink_TIME;
         func2(buf,size);
      break;
      case Applink_PHONE;
         func3(buf,size);
      break;
   }
 }
}
```

Using Polling

You can use polling in place of the callback function for retrieving data.

```
while(true)
{
 res = rpd_getData((channels[i].channelId,type,data,size);
 if((res > 0) // the buffer is not empty and no error occurs.
   func(type,data,size);
}
```

C H A P T E R 17

Using ActiveX Controls

ActiveX® is Microsoft‘s brand name for its technologies that allow software components to interact with each other on Windows operating systems, regardless of the language in which they were built. ActiveX technologies are based on Microsoft’s Component Object Model (COM), that is, a group of conventions and supporting libraries that facilitates interaction between different software modules in a consistent, object-oriented way.

ActiveX controls are reusable components that incorporate ActiveX technology. Once added to a program, they appear to be a normal part of the program. Some familiar ActiveX controls are user interface components such as buttons, scroll bars, check boxes, and list boxes.

In RapidPLUS, you can incorporate any ActiveX control installed on your computer as an object in your application. RapidPLUS translates the control’s COM-based interface into RapidPLUS events, properties, and functions available in the Logic Editor. This chapter describes how you add or register an ActiveX control in the Object Layout and how you determine its runtime behavior.

❖ *NOTE: In order to use an ActiveX control effectively in RapidPLUS, it is important that you be thoroughly familiar with its specific interface elements.*

ADDING OR REGISTERING ACTIVEX CONTROLS IN RAPIDPLUS

There are two ways to add an ActiveX control to an application:

- Adding it straight from a file, without registering it.
- Registering it and then adding it like any other object. When you register a user object, it is added to the Object Palette and New Objects dialog box.

Adding an ActiveX Control

Adding an ActiveX control—without registering it—means that it is added to the application's layout, but not to the Object Palette.

To add an ActiveX control:

1 Choose Objects|Add ActiveX. A dialog box opens with a list of all ActiveX controls currently installed on your computer.

2 Select a control from the list and click OK. If the control is graphic, you place it on the work area as you would any RapidPLUS graphic object. If the control is nongraphic, it is added to the Nongraphic Objects dialog box.

❖ *NOTES: RapidPLUS checks that the selected control is a valid ActiveX control before adding it to the layout. For example, it's possible that the control appears in the Windows registry but its executable file is no longer located in the expected path. In such cases, you are notified that the control is invalid and cannot be added.*

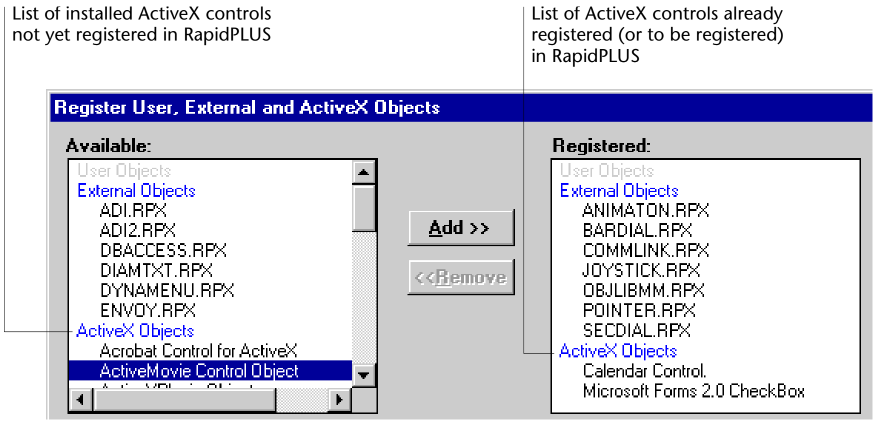
Due to the design of the control itself, a nongraphic control (such as a timer) might have a graphic representation in the Object Layout. At runtime in the Prototyper, however, the control will not be visible.

Registering an ActiveX Control in RapidPLUS

Registering an ActiveX control in RapidPLUS adds it to the Object Palette and New Objects dialog box. Each time you open RapidPLUS, the ActiveX control is available, like any other native RapidPLUS object.

To register ActiveX controls in the Object Palette:

1 Choose Objects|Register; the Register dialog box opens:



List of installed ActiveX controls not yet registered in RapidPLUS

List of ActiveX controls already registered (or to be registered) in RapidPLUS

Register User, External and ActiveX Objects

Available:

User Objects
External Objects
ADI.RPX
ADI2.RPX
DBACCESS.RPX
DIAMTXT.RPX
DYNAMENU.RPX
ENVOY.RPX
ActiveX Objects
Acrobat Control for ActiveX
ActiveMovie Control Object

Registered:

User Objects
External Objects
ANIMATON.RPX
BARDIAL.RPX
COMMLINK.RPX
JOYSTICK.RPX
OBJLIBMM.RPX
POINTER.RPX
SECDIAL.RPX
ActiveX Objects
Calendar Control
Microsoft Forms 2.0 CheckBox

2 In the Available list, select the ActiveX control you want to register and click Add. Repeat this step for all the ActiveX controls you want to register.

3 Click OK; the Object Palette is updated. RapidPLUS adds the ActiveX objects class icon to the left column (if it does not yet exist) and the control's icon to the right column. If a control does not have an icon of its own, RapidPLUS uses a default icon.

Why doesn't an ActiveX control appear in the list?

If an ActiveX control name does **not** appear in the Add ActiveX or Register User, External and ActiveX Objects dialog boxes, then the control is not registered in the system registry.

To manually register an ActiveX control in the system registry:

1 From the Windows Start menu, select Run.

2 In the Open edit box, type: **regsvr32 "<full path to the ActiveX file>"** For example:

regsvr32 "c:\ActiveX_controls\myActiveX.ocx"

You should get a message confirming successful registration. If you get an error message, there is a problem with the ActiveX control.

❖ *NOTE: To unregister an ActiveX control, type* **regsvr32 /u <full path>**. *To get a full description of regsvr32 switches, type* **regsvr32** *without any parameters.*

Distributing RapidPLUS Applications with ActiveX Controls

If you are packaging your application for distribution, do not forget to include all required control files (usually OCX or DLL) and instruct the end-user to copy the file(s) anywhere in the RapidPLUS search path (as explained in "Defining a Search Path" on p. 1-14). The first time the application is opened in the Reviewer, the ActiveX control(s) are automatically registered.

❖ *NOTES: Just in case a problem arises with automatic registration of an ActiveX control, you may also want to give the end-user instructions on manual registration via the Windows regsvr32 utility, as described in "Why doesn't an ActiveX control appear in the list?" above.*

RapidPLUS is tested on all the current Windows versions, and RapidPLUS simulations can be moved from computer to computer without problem. However, third-party ActiveX controls used in RapidPLUS simulations may not have been written or tested for portability—and may not function properly when moved to another platform. If your simulation is required to run on multiple platforms, please check that its ActiveX controls also meet this requirement.

ACTIVEX CONTROLS IN THE OBJECT LAYOUT

Changing Parameters

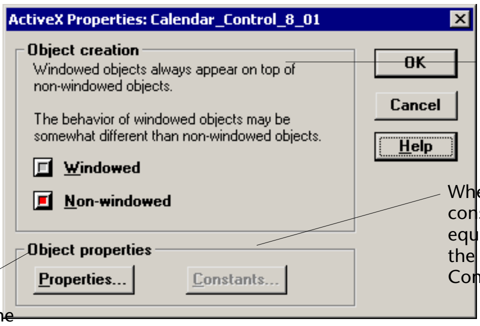
Some ActiveX controls have parameters that can be changed during design time.

To change an ActiveX control's parameters:

1 In the Object Layout, open the control's parameter pane as you would for any graphic object. Change its name, size, location, and parent as desired.

2 Click More to open the following dialog box:

A typical ActiveX control More dialog box



ActiveX Properties: Calendar_Control_8_01

Object creation

Windowed objects always appear on top of non-windowed objects.

The behavior of windowed objects may be somewhat different than non-windowed objects.

☐ Windowed

☒ Non-windowed

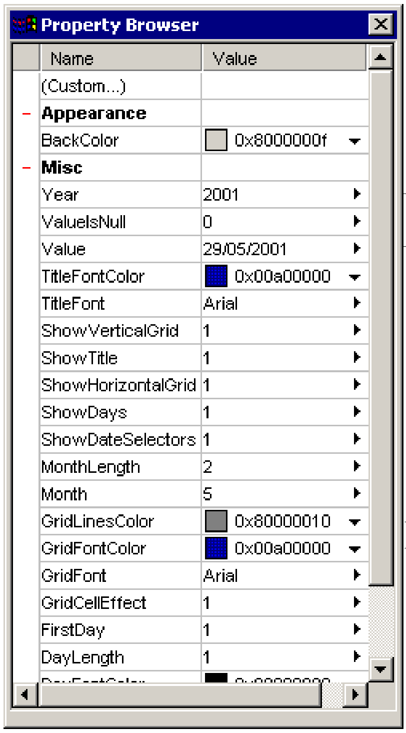
Object properties

For an explanation of these options, see "ActiveX Control Windowing and Stack Order (Z-Order)" on p. 17-7

When available, click to view the control's constant sets (enumerations) and create equivalent RapidPLUS constant sets for use in the Logic Editor. See"Viewing and Creating Constant Sets" on p. 17-6 for details

Click to open the Properties Browser

3 Click the Properties button to open the Property Browser:



Property Browser

	Name	Value
	(Custom...)	
−	**Appearance**	
	BackColor	⬜ 0x8000000f ▾
−	**Misc**	
	Year	2001 ▸
	ValueIsNull	0 ▸
	Value	29/05/2001 ▸
	TitleFontColor	🟦 0x00a00000 ▾
	TitleFont	Arial ▸
	ShowVerticalGrid	1 ▸
	ShowTitle	1 ▸
	ShowHorizontalGrid	1 ▸
	ShowDays	1 ▸
	ShowDateSelectors	1 ▸
	MonthLength	2 ▸
	Month	5 ▸
	GridLinesColor	▨ 0x80000010 ▾
	GridFontColor	🟦 0x00a00000 ▾
	GridFont	Arial ▸
	GridCellEffect	1 ▸
	FirstDay	1 ▸
	DayLength	1 ▸

Click the right arrow to open the respective property's dialog box. Several properties may open the same dialog box

Click the down arrow to open a list of values for the respective property

Change the values of the various properties according to your needs. A right arrow indicates an additional dialog box. A down arrow indicates a list of values.

Getting help on an ActiveX control

If there is online help for the control, clicking the Help button in its Properties dialog box accesses its context-sensitive information.

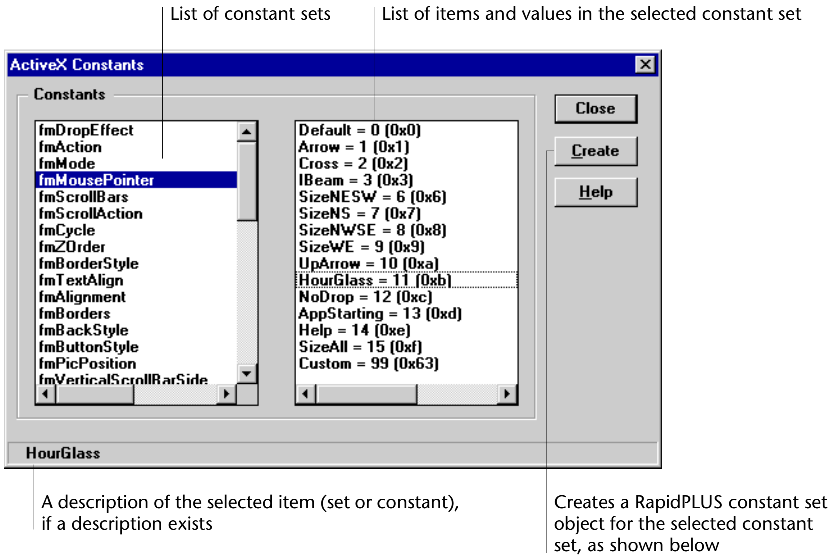
You can also get context-sensitive help on its functions in the Logic Palette, as you would for any RapidPLUS object function.

Viewing and Creating Constant Sets

An ActiveX control may have constant sets of predefined possible values for one or more of its properties (or for function and/or event parameters).

To view a control's constant sets and create RapidPLUS equivalents:

- Click the Constants button in its More dialog box (as shown on the previous page). The following dialog box opens:



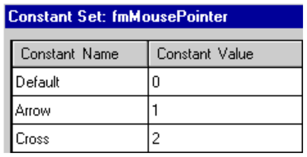
fmDropEffect
fmAction
fmMode
fmMousePointer
fmScrollBars
fmScrollAction
fmCycle
fmZOrder
fmBorderStyle
fmTextAlign
fmAlignment
fmBorders
fmBackStyle
fmButtonStyle
fmPicPosition
fmVerticalScrollBarSide

Default = 0 (0x0)
Arrow = 1 (0x1)
Cross = 2 (0x2)
IBeam = 3 (0x3)
SizeNESW = 6 (0x6)
SizeNS = 7 (0x7)
SizeNWSE = 8 (0x8)
SizeWE = 9 (0x9)
UpArrow = 10 (0xa)
HourGlass = 11 (0xb)
NoDrop = 12 (0xc)
AppStarting = 13 (0xd)
Help = 14 (0xe)
SizeAll = 15 (0xf)
Custom = 99 (0x63)

HourGlass

A description of the selected item (set or constant), if a description exists

Creates a RapidPLUS constant set object for the selected constant set, as shown below


Constant Set: fmMousePointer

Constant Name	Constant Value
Default	0
Arrow	1
Cross	2

Use the constant set in the logic as follows:
CheckBox1.MousePointer := fmMousePointer.Arrow

ACTIVEX CONTROL WINDOWING AND STACK ORDER (Z-ORDER)

In the Object Layout, you control the stack order of graphic ActiveX controls like any other graphic object (for more details, see “Changing Stack Order in the Object Layout” on p. 21-2). During runtime, however, there is a difference in stack order behavior between windowed and non-windowed ActiveX controls.

The stack order of **non-windowed** controls (that is, controls that run directly in the client’s window—in our case, the Prototyper) can be controlled exactly like that of any other graphic object, as explained on p. 21-2.

Windowed controls (that is, controls that run in their own window) are always drawn on top of non-windowed RapidPLUS graphic objects and non-windowed ActiveX controls—even if the non-windowed object is a child of the windowed control. You can, however, control the stack order **among** windowed objects.

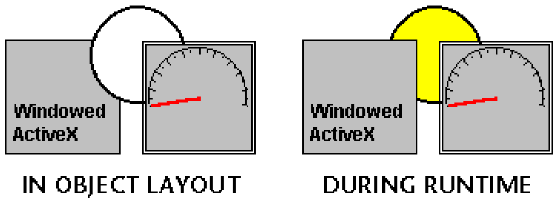


Illustration of the stack order behavior of windowed objects

❖ *NOTE: All RapidPLUS graphic objects are non-windowed, except for the text window, message, and graphic multimedia objects, such as digital video.*

Changing Non-Windowed Objects to Windowed

In addition to the impact on stack order, a control's window status (windowed vs. non-windowed) can affect other aspects of its runtime behavior.

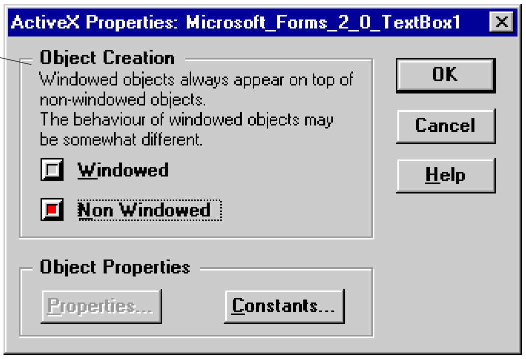
Example

The Microsoft Office Textbox control is, by definition, a non-windowed object. When run in the RapidPLUS Prototyper, selected text is not highlighted on a reversed background. If you change the control to a windowed object, the selected text is properly highlighted.

To change a non-windowed control to a windowed control:

- In the control's More dialog box, select the Windowed option:

These options are only enabled if the control is non-windowed by definition


ActiveX Properties: Microsoft_Forms_2_0_TextBox1

Object Creation
Windowed objects always appear on top of non-windowed objects.
The behaviour of windowed objects may be somewhat different.

Windowed [✓ Non Windowed]

❖ *NOTE: Some ActiveX controls present themselves to the container as non-windowed, even though they are not. Thus, the windowing options will be available in the above dialog box but the selection has no effect during runtime. You can test for this type of situation by placing the supposedly non-windowed ActiveX control behind a RapidPLUS graphic object in the Object Layout and observing if it maintains that stack order during runtime.*

SUPPORTED ACTIVEX DATA TYPES

ActiveX controls use a set of custom types for properties, function parameters, and return values. The following table summarizes the equivalent RapidPLUS data type for each ActiveX data type.

ACTIVEX TYPE	RAPID TYPE	COMMENTS
Integers, unsigned integers, currency	Integer	
Date	Date	See "New RapidPLUS Data Types" on pp. 17-11 to 17-15.
Float	Number	
Boolean	Integer	where 0 = false and 1 = true
String (BSTR)	String	
Color	RapidPLUS color	Like the *lineColor* or *fillColor* properties
Pointer to picture	RapidPLUS picture	See "New RapidPLUS Data Types" on pp. 17-11 to 17-15.
Pointer to font	RapidPLUS font	See "New RapidPLUS Data Types" on pp. 17-11 to 17-15.

ACTIVEX TYPE	RAPID TYPE	COMMENTS
Pointer	Integer (if pointer to integer); otherwise, see details in Comments	For properties: to font or picture only. For event parameters: all types, up to one level, i.e., does not support a pointer to a pointer. For functions: not supported.
Character	Character	where character = an element of a string. Thus, in the Logic Editor, the assignment function for an element of the Text string property expects a Character argument, as follows: **textbox1.Text[3] := <Character>**
Variant	Variant, a system object that is added to an application when an ActiveX object is added	The variant object enables RapidPLUS to assign string, number, integer, or character values to variant properties. For example: **ActiveX1_param1: <variant> param2: <variant> param3: <variant>** can be written as: **ActiveX1_param1: (Variant byte: 12) param2: (Variant string: 'world') param3: (Variant long: 100)** The variant object interacts with these data objects to enable the property to receive values directly; therefore the logic can be written as: **ActiveX1_param1: 12 param2: 'world' param3: 100**
IDispatch, IUnknown	IDispatch is supported as a function argument. Both IDispatch and IUnknown can be manipulated through the *getProperty* and *setProperty* functions of the RapidActiveXHelper object. See p. 17-20.	

New RapidPLUS Data Types

The following properties have been added to RapidPLUS in order to support ActiveX objects that require them:

- Picture
- Font
- Date

❖ *NOTE: These objects are only available as ActiveX properties in the Logic Editor, and have no relation to the existing bitmap, font, and date objects in RapidPLUS.*

Picture

FUNCTION	DESCRIPTION	EXAMPLE
:=	Allows the assignment of one picture property to another.	**Image1.picture := Image2.picture**
loadFromFile: <string>	Loads a picture from the specified image file. File types supported: BMP and ICO. ❖ *NOTE: If you do not specify a path, RapidPLUS searches in the RapidPLUS search paths (as described in "Defining a Search Path" on p. 1-14).*	**Image1.picture loadFromFile: 'c:\images\mouse.ico'**
saveToFile: <string>	Saves the picture to the specified file. If you do not specify a path, it saves to the current directory (usually the RapidPLUS directory). File type supported: BMP.	**Image1.picture saveToFile: 'c:\images\mouse.bmp'**
clear	Clears the picture.	**Image1.picture clear**
width	Returns the picture width, in pixels.	**Int1 := Image1.picture width**
height	Returns the picture height, in pixels.	**Int1 := Image1.picture height**

Font

FUNCTION	DESCRIPTION	EXAMPLE
:=	Assigns the attributes of one font property to another font property.	**SActiveX1.font := ActiveX2.font**
=	Returns TRUE if the font properties have the same properties.	**& ActiveX1.font = ActiveX2.font**
boldGet	Returns 1 if the bold attribute is set, 0 if not.	**Int1 := ActiveX1.font boldGet**
boldSet: <integer>	Sets the font to bold (1) or non-bold (0).	**ActiveX1.font boldSet: ActiveX2.font boldGet**
charsetGet	Returns the font character set, according to the following enumeration:	**Int1 := ActiveX1.font charsetGet**

ANSI_CHARSET	0	JOHAB_CHARSET	130
DEFAULT_CHARSET	1	HEBREW_CHARSET	177
SYMBOL_CHARSET	2	ARABIC_CHARSET	178
SHIFTJIS_CHARSET	128	GREEK_CHARSET	161
GB2312_CHARSET	129	TURKISH_CHARSET	162
HANGEUL_CHARSET	134	THAI_CHARSET	222
CHINESEBIG5_CHARSET	136	EASTEUROPE_CHARSET	238
RUSSIAN_CHARSET	204	MAC_CHARSET	77

FUNCTION	DESCRIPTION	EXAMPLE
charsetSet: <integer>	Sets the font's character set, according to the enumeration shown above.	**ActiveX1.font charsetSet: 161**
italicGet	Returns 1 if the italic attribute is set, 0 if not.	**& ActiveX1.font italicGet = 1**
italicSet: <integer>	Sets the font to italic (1) or non-italic (0).	**ActiveX1.font italicSet: 0**
nameGet	Returns the font name, as a string.	**Str1 := ActiveX1.font nameGet**

FUNCTION	DESCRIPTION	EXAMPLE
nameSet: <string>	Sets the font name to the specified string.	**ActiveX1.font nameSet: 'Arial bold'**
sizeGet	Returns the font size, in points.	**Number1 := ActiveX1.font sizeGet**
sizeSet: <number>	Sets the font size, in points.	**ActiveX1.font sizeSet: 7.5**
strikethroughGet	Returns 1 if the font attribute is strikethrough, 0 if not.	**Int1 := ActiveX1.font strikethroughGet**
strikethroughSet: <integer>	Sets the font attribute to strikethrough (1) or not strikethrough (0).	**ActiveX1.font strikethroughSet: 1**
underlineGet	Returns 1 if the font attribute is underline, 0 if not.	**Int1 := ActiveX1.font underlineGet**
underlineSet: <integer>	Sets the font attribute to underline (1) or not underline (0).	**ActiveX1.font underlineSet: ActiveX2.font underlineGet**
weightGet	Returns the font weight (usually 400 for non-bold or 700 for bold).	**Int1 := ActiveX1.font weightGet**
weightSet: <integer>	Sets the font weight, as above.	**ActiveX1.Font weightSet: 700**

Date

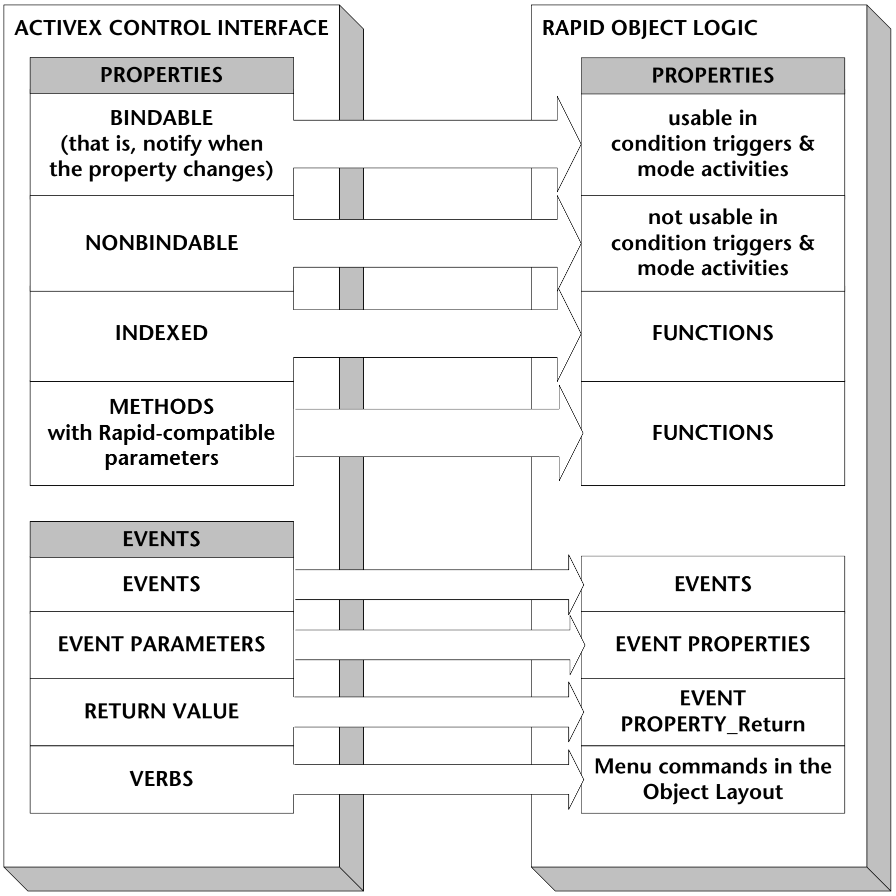
FUNCTION	DESCRIPTION	EXAMPLE
:=	Assigns the values of one date property to another date property.	**MonthView1.date := MonthView2.date**
asFloat	Returns the date as an encoded float value. This function is useful for calculating the number of days between two days.	**daysPassed := MonthView1.date asFloat - MonthView2.date asFloat**
asString	Returns the current date and time as a fixed length string in the format: 'Sun Sep 16 01:03:52 1998'.	**Display1.contents := MonthView.date asString**
dayGet	Returns the day of the month as an integer.	**Int1 := MonthView.date dayGet**
daySet: <integer>	Sets the day of month to the specified integer.	**MonthView.date daySet: 9**
hourGet	Returns the hour of the day as an integer.	**Int1 := MonthView.date hourGet**
hourSet: <string>	Sets the hour of the day to the specified integer.	**MonthView.date hourSet: 14**
isValid	Returns 1 if the property contains a valid date and time. Otherwise, returns 0.	**& MonthView.date isValid**
minuteGet	Returns the minutes of the hour as an integer.	**minutesDisp1.contents := MonthView.date minuteGet**
minuteSet: <integer>	Sets the minutes of the hour to the specified integer.	**MonthView.date minuteSet: 45**
monthGet	Returns the month of the year as an integer.	**& MonthView.date monthGet > 6**
monthSet: <integer>	Sets the month of the year to the specified integer.	**MonthView.date monthSet: 6**

FUNCTION	DESCRIPTION	EXAMPLE
now	Sets the date and time to the current date and time.	**MonthView.date now**
secondGet	Returns the seconds of the minute as an integer.	**Int1 := MonthView.date secondGet**
secondSet: <integer>	Sets the second of the minute to the specified integer.	**MonthView.date secondSet: MonthView2.date secondGet**
yearGet	Returns the year as a 4-digit integer.	**& MonthView.date yearGet = 1998**
yearSet: <integer>	Sets the year to the specified integer.	**MonthView.date yearSet: 2000**

HOW ACTIVEX INTERFACES ARE CONVERTED TO RAPIDPLUS LOGIC

When you register or add an ActiveX control to RapidPLUS, its interface of properties, methods (that is, functions) and events is translated into RapidPLUS logic equivalents. Its custom commands, or verbs (if any), are translated into menu commands in the Object Layout.

The following diagram summarizes the translation process:


ACTIVEX CONTROL INTERFACE
PROPERTIES
BINDABLE (that is, notify when the property changes)
NONBINDABLE
INDEXED
METHODS with Rapid-compatible parameters
EVENTS
EVENTS
EVENT PARAMETERS
RETURN VALUE
VERBS
RAPID OBJECT LOGIC
PROPERTIES
usable in condition triggers & mode activities
not usable in condition triggers & mode activities
FUNCTIONS
FUNCTIONS
EVENTS
EVENT PROPERTIES
EVENT PROPERTY_Return
Menu commands in the Object Layout

Properties

There are three types of ActiveX control properties:

- Bindable, that is, they notify the container (in our case, RapidPLUS) when their value has changed.
- Nonbindable, that is, changes to their values are not broadcast to the container.
- Indexed, that is, an array-like property which uses indexes to retrieve a specific value. Every indexed property is converted to a pair of RapidPLUS functions:

  <propertyName>Get_index: <integer> Returns the value in the specified index.

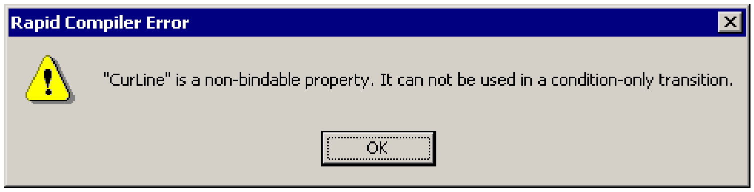
  <propertyName>Set_index: <integer> value: <value> Writes the specified value in the specified index.

Other than the indexed properties, all ActiveX control properties of a type supported by RapidPLUS become object properties that appear in the logic palette's Properties column when you select the ActiveX object.

For a complete list of ActiveX data types that are supported by RapidPLUS, see "Supported ActiveX Data Types" on pp. 17-9 to 17-15.

Bindable vs. nonbindable properties in condition-only triggers and mode activities

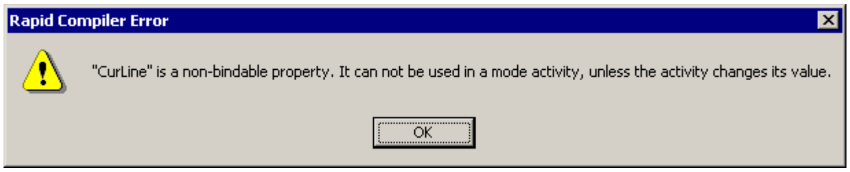
Although all properties are available in the Logic Palette for inclusion in condition-only triggers, you should only use bindable properties. If you include a nonbindable property in a condition-only trigger, you get the following error message:



"CurLine" is a non-bindable property. It can not be used in a condition-only transition.

Nonbindable properties are available for inclusion in mode activities, but should only be used to have their value changed by the activity (and **not** to assign their value to a data object).

Thus, assuming that Microsoft Forms 2.0 TextBox is an ActiveX control and its *CurLine* property is nonbindable, the mode activity **Mcrosoft_Forms_2_0_TextBox1.CurLine := Int1** is valid; the mode activity, **Int1 := Microsoft_Forms_2_0_TextBox1.CurLine changed**, however, causes the following error message to appear:


Rapid Compiler Error

"CurLine" is a non-bindable property. It can not be used in a mode activity, unless the activity changes its value.

Functions

ActiveX methods that use the following types in their parameters become the functions of the object's *self* property in RapidPLUS:

- Integer
- Number
- String
- Color
- Variant (converted to a string)

A method that uses a pointer to an integer as a parameter, for example, will **not** appear in the Functions column of the logic palette when the object's *self* property is selected.

❖ *NOTE: For a complete list of ActiveX types that are supported by RapidPLUS, see "Supported ActiveX Data Types" on pp. 17-9 to 17-15.*

Events

The ActiveX control events become RapidPLUS object events. When a control event is triggered, the control calls a function that, in turn, triggers the RapidPLUS event.

Unlike RapidPLUS events, however, ActiveX control events can also have parameters and a return value. These are handled as described below.

Event Parameters

An example of event parameters would be a *Click* event that has two integer parameters named "X" and "Y." These parameters are assigned the mouse position coordinates whenever the event takes place. The parameters are read-only, unless they're pointers (see "When are event properties not read-only?" below). Their values remain unchanged until the next event occurrence.

Event parameters become specialized RapidPLUS properties, with the following syntax:

ev_<eventName>_<parameterName>

In the example given above, therefore, the event parameters would appear in the Properties column of the logic palette as *ev_Click_X* and *ev_Click_Y.*

❖ *NOTE: Event properties are valid only after the event has occurred. You get a runtime error if you attempt to read an event property's value without its event having been triggered.*

When are event properties not read-only?

The exception to the rule of event properties being read-only are those cases where the event parameter is a pointer. Some events use pointer parameters to get a return value from RapidPLUS. For example, an ActiveX control might have the event:

BeforeUpdate(short *Cancel)

The pointer parameter *Cancel*, whose default value is '0' (or FALSE), appears in RapidPLUS as the event parameter *ev_BeforeUpdate_Cancel*. If you assign a value of '1' (that is, **ev_BeforeUpdate_Cancel := 1**) **before** the *BeforeUpdate* event is triggered, then the *BeforeUpdate* event is canceled and the control is not updated. The *BeforeUpdate* event remains “blocked” until you reassign ‘0’ to the *ev_BeforeUpdate_Cancel* pointer parameter.

Event Return Value

For every event with a return value, a new property is added to the ActiveX properties in the logic palette. The property type (such as integer or number) depends on the return value type. Its format is:

ev_<eventName>_Return

If you assign a value to this property before the event occurs, the value is returned to the ActiveX control when the event is triggered.

❖ *NOTE: Event return values are write-only. Thus, for example, it would not make sense to base a condition trigger on evaluating an event return value.*

Verbs

ActiveX verbs are custom design-time commands that you can perform on the control, such as open a properties dialog box. The verb list is specific to each ActiveX control, and a control may have no verbs at all. When an ActiveX control has verbs to display, RapidPLUS adds them as menu commands to the object’s pop-up menu.

RapidActiveXHelper Object

The RapidActiveXHelper object is a nongraphic ActiveX object that expands the functionality of ActiveX controls in RapidPLUS. It enables placement of ActiveX controls in focus as well as manipulation of their properties.

In addition, the RapidActiveXHelper object makes it possible to manipulate nested properties. The term “nested properties” refers to properties of properties. Some ActiveX controls have properties which in turn have their own properties. Nested properties are not accessible through the ActiveX control itself, but they can be manipulated via the RapidActiveXHelper object.

Nested properties of ActiveX controls are not visible in the Logic Palette. A good working knowledge of the relevant ActiveX control is therefore necessary for successful manipulation of its nested properties via the RapidActiveXHelper object.

A RapidActiveXHelper object is added/registered like any other ActiveX control.

The RapidActiveXHelper object has three functions: *setFocus*, *getProperty*, and *setProperty*. All three functions require an ActiveX control argument.

FUNCTION	DESCRIPTION	EXAMPLE
getProperty_object: <ActiveX_Object> name: <String>	Returns the current value of the specified ActiveX control's property as a string.	**String1 := ActiveXHelper getProperty_object: Calendar_Control_8_01 name: 'Year'**
setFocus_object: <ActiveX_Object>	Places the specified ActiveX control in focus.	**ActiveXHelper setFocus_object: Calendar_Control_8_01**
setProperty_object: <ActiveX_Object> name: <String> value: <String>	Sets the value of the specified ActiveX control's property.	**ActiveXHelper setProperty_object: Calendar_Control_8_01 name: 'Month' value: '10'**

Manipulating Properties of Activex Controls

The *getProperty_object:name:* and *setProperty_object:name:value:* functions allow you to obtain and/or change the values of specified properties of ActiveX controls. These functions are especially useful when access to the specified property is not available in the ActiveX control itself.

Example 1

You have an application with twelve buttons of which only four can be concurrently displayed (due to the limited size of the graphic display). You use the two Automotive ActiveX controls ButtonContentList and ListManager to change the buttons' objects as needed, using the following logic:

Rapid ActiveXHelper setProperty_object: ButtonContentList name: 'ListManager' value: (Rapid ActiveXHelper getProperty_Object: ListManager name: '')

The above logic line is equivalent to the following Visual Basic statement:

```
ButtonContentList.ListManager = ListManager.Object
```

Example 2

You have an application that uses the Microsoft Office Chart 9.0 ActiveX control in an application. One of the properties of this object is *Interior*. *Interior* is an object-type property with several properties, none of which are accessible through the Office Chart control itself.

These nested properties can however be manipulated through the RapidPLUS ActiveXHelper object.

To get the value of the color property of *Interior*, you use the following logic line:

```
Display1.contents := Rapid ActiveXHelper getProperty_object:
Microsoft_Office_Chart_9_01 name: 'Interior.Color'
```

You can use the *setProperty_object:name:value:* similarly to assign a value to a nested property.

❖ *NOTE: Nested properties are not visible in the Logic Palette. In order to successfully manipulate nested properties through the ActiveXHelper object, you must have a good working knowledge of the ActiveX control.*

ACTIVEX CONTROLS FOR THE AUTOMOTIVE INDUSTRY

RapidPLUS supports the Microsoft Windows CE for Automotive ActiveX controls. Once installed on your computer, these controls are listed among the available ActiveX objects.

ACTIVEX INCOMPATIBILITY

RapidPLUS as an ActiveX container conforms rigorously to Microsoft's Component Object Model (COM) conventions and requirements. However, you may come across ActiveX controls that are incompatible with RapidPLUS. Symptoms of this incompatibility are displaying an error message when:

- Running the application in the Prototyper.
- Adding the control and it either does not appear or does not draw properly in the Object Layout.
- Clicking the Properties button in the object's More dialog box.
- Resizing or repositioning the object in the Object Layout.

To verify that the control is properly installed on your system, try using it in other applications, such as Microsoft® Word.

In versions 5–6.6 of RapidPLUS, each ActiveX control was identified by its control name, which could be different between versions of the ActiveX control, or in different languages. This difference could cause a RapidPLUS application that was created on one system to fail to load on another system—if the ActiveX on the second system had a different control name.

From version 7.0, RapidPLUS identifies each ActiveX control by its class ID, which is the same ID for all operating systems, languages, and versions of the ActiveX control.

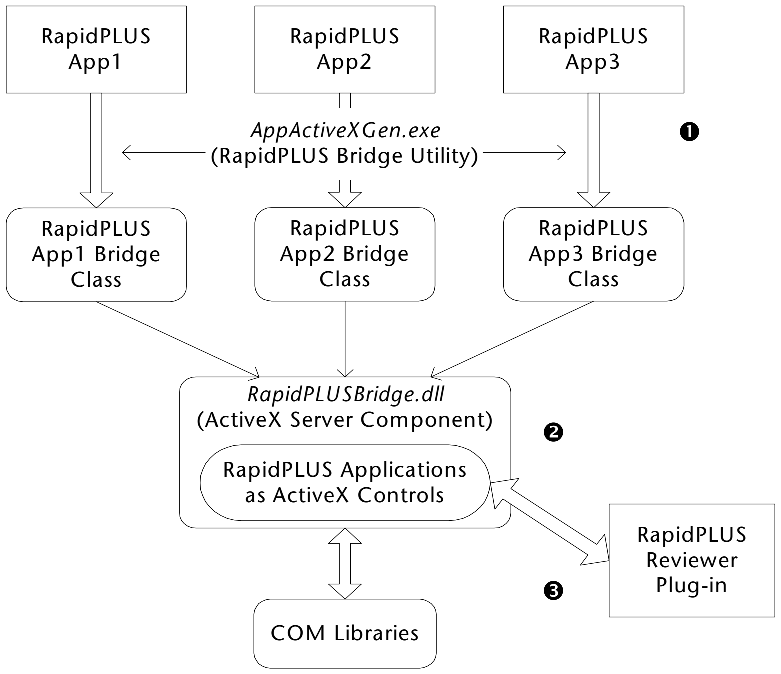
Old applications can be fixed by opening them on the system in which they were originally created and in the current version of RapidPLUS, then saving all the application files.

RAPIDPLUS ACTIVEX BRIDGE UTILITY

The ActiveX bridge utility wraps a RapidPLUS application as a unique ActiveX control. The application's exported properties and events become ActiveX interface properties and events. You can insert the ActiveX control (e.g., in Microsoft Office applications), and you can program the control (e.g., through Visual Basic, Visual C, and MATLAB).

To generate a registered RapidPLUS ActiveX control, you will use the supplied bridge utility, *AppActiveXGen.exe,* with the RapidPLUS application (RPD format, only). This utility generates an application bridge class that describes the properties and events in a type library (TLB) file. The bridge class, together with an ActiveX server component, *RapidPLUSBridge.dll,* exposes the application functionality to the container application, and opens communication with the RapidPLUS Reviewer plug-in.

The relationship between these parts is shown in the following diagram:


RapidPLUS App1
RapidPLUS App2
RapidPLUS App3
AppActiveXGen.exe
(RapidPLUS Bridge Utility)
❶
RapidPLUS App1 Bridge Class
RapidPLUS App2 Bridge Class
RapidPLUS App3 Bridge Class
RapidPLUSBridge.dll
(ActiveX Server Component)
❷
RapidPLUS Applications as ActiveX Controls
RapidPLUS Reviewer Plug-in
❸
COM Libraries

❶ The RapidPLUS bridge utility, *AppActiveXGen.exe*, generates a registered bridge class, *RapidPLUS_<AppName>_Bridge.tlb,* in the same folder as the RapidPLUS application.

❷ The ActiveX server component, *RapidPLUSBridge.dll,* is a registered ActiveX control (registered during RapidPLUS installation). This component uses the type information to expose the application functionality, as an ActiveX control, to the container application.

❸ *RapidPLUSBridge.dll* opens communication with the RapidPLUS Reviewer plug-in for each instance of the ActiveX control.

Generating a RapidPLUS ActiveX Control

To generate a RapidPLUS ActiveX control:

1 At a command prompt, run *AppActiveXGen.exe* (located in the main Rapidxx folder) using the following syntax:

```
AppActiveXGen.exe [path]MyApp.rpd [/c:CLSID] [/p:ProgID]
```

❖ *NOTE: Details about the class ID (CLSID) and programmatic identifier (ProgID) are in the following section, "AppActiveXGen.exe Command-Line Options."*

A RapidPLUS application bridge class is generated, and the ActiveX control is registered.

2 Add the ActiveX control to a container application as you would any other ActiveX control.

Registering RapidPLUS COM Libraries

The RapidPLUS COM libraries, *RapidControl.dll* and *RapidPLUSBridege.dll* (both located in the Rapidxx folder), are automatically registered during RapidPLUS installation. If these components become unregistered for any reason, you will need to register them again.

To register the RapidPLUS COM libraries:

• With the Windows tool, *regsvr32.exe,* use the following syntax at a command prompt:

```
regsvr32 [path]RapidControl.dll [path]RapidPLUSBridge.dll
```

AppActiveXGen.exe Command-Line Options

The complete command-line syntax for *AppActiveXGen.exe* is as follows:

```
AppActiveXGen.exe [path] MyApp.rpd [[/u] | [[/c:{clsid}] [/p:<progid>]]]
```

The path in the command cannot contain spaces and you can use a full path, or a path that is relative to *AppActiveXGen.exe*.

/u Option (Unregister)

This option is used to unregister a RapidPLUS ActiveX bridge control.

Example

```
AppActiveXGen.exe ..\applics\MyApp.rpd /u
```

/c:{CLSID} Option

This option specifies a class ID (CLSID). The CLSID is a globally unique identifier that enables the container to link to the embedded objects.

The CLSID is a 128-bit hexidecimal number enclosed in braces. If left empty, a new CLSID will be assigned automatically.

You can find the CLSID in the Windows Registry Editor at:
`HKEY_LOCAL_MACHINE\SOFTWARE\Classes\CLSID\{CLSID}`

❖ ***CAUTION: Do not make changes to the Windows registry.*** *Only use this information for copying and pasting into the command line.*

Example

The following command generates an ActiveX control and assigns the specified CLSID. A ProgID will be assigned automatically.

```
AppActiveXGen.exe ..\applics\MyApp.rpd
 /c:{E2F91AB8-E570-4a28-AEC6-5C40F3452F45}
```

/p:<ProgID> Option

This option specifies a unique programmatic identifier (ProgID), a string value that identifies the RapidPLUS ActiveX control. If left empty, a new ProgID will be assigned automatically. The automatically generated format is *RapidAXBridge.RapidPLUS<AppName>Bridge.*

The ProgID must comply with the following requirements:

- Start with a letter.
- Not exceed 39 characters.
- Not contain spaces or punctuation (including underscores), **except** for periods.

You can find the ProgID in the Windows Registry Editor at:
`HKEY_LOCAL_MACHINE\SOFTWARE\Classes\<ProgID>`

❖ ***CAUTION: Do not make changes to the Windows registry.*** *Only use this information for copying and pasting into the command line.*

Example

The following command generates an ActiveX control and assigns the specified ProgID. A CLSID will be assigned automatically.

```
AppActiveXGen.exe ..\applics\MyApp.rpd
 /p:RapidAXBridge.RapidPLUSMyAppBridge
```

Updating the ActiveX Control

If you update the exported properties or events in the RapidPLUS application, you will need to update the ActiveX control. You can either generate a new one, or if you are already using the control in a container application, then you will want to overwrite the previous one.

To update the ActiveX control in a container application:

1. Use the RapidPLUS bridge utility, *AppActiveXGen.exe*, with the /c and /p options. Be sure to use the **same** CLSID and ProgID as the previous version of the control (see the previous section for information about these parameters).

   Steps 2–5 apply to **Microsoft Office container applications,** only.

2. When you insert an ActiveX control into a Microsoft Office application, the application automatically creates extender (EXD) files. The EXD files cache the control information so that it takes less time to insert the control again. After you update the ActiveX control, you need to delete the EXD files and reinsert the control.

   First, exit all Microsoft Office applications.

3 Locate the Windows\Temp folder (by default C:\Windows\Temp). The folder should contain one or more subfolders for corresponding applications. By default, these folders are:

- Excel8.0
- Word8.0
- Ppt10.0
- Vbe

4 Delete the control extender files *RAPIDBRIDGEUTILELib.exd* and *RAPIDBRIDGELib.exd* from the appropriate folders.

5 Open the application, remove and reinsert the control. New and updated EXD files will be created automatically.

CHAPTER 18

Hosting RapidPLUS Simulations in Windows Programs

The Rapid Reviewer can be linked to or embedded in another Windows program using the Rapid Simulator ActiveX control. This ActiveX control not only allows a RapidPLUS application to be imported into another Windows program, but it also enables the Windows program to manipulate and control the RapidPLUS application.

In Microsoft® Office programs such as Word and PowerPoint®, Visual Basic® macros can be used to transfer data to and from the RapidPLUS application and control the events that are generated in it. In Microsoft Internet Explorer (4.x or higher) and Netscape® Communicator (4.08–4.x), JavaScript is used. In computer-based training (CBT) programs, such as Authorware and ToolBook, program-specific tools are used to achieve the same results.

In all these programs (referred to as “host applications”), the Properties dialog box of the Rapid Simulator object enables you to import a RapidPLUS application, set the appearance of the RapidPLUS application, determine the routing mode, and set control features.

This chapter presents:

- How to add a RapidPLUS simulation to a host application.
- How to transfer data between the RapidPLUS simulation and host application.
- How to enable the host application to send actions to the simulation.

- How to enable the host application to monitor user actions that occur in the RapidPLUS simulation (monitor mode).
- How to enable the host application to control user actions that occur in the RapidPLUS simulation (reroute mode).

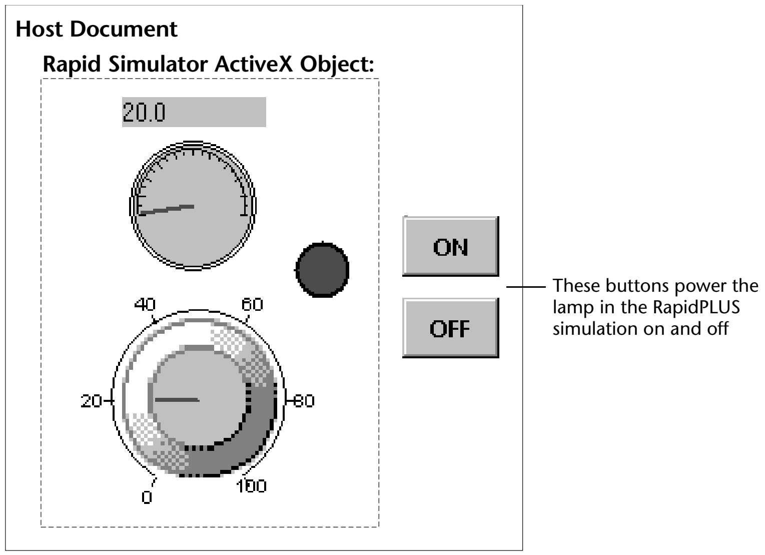
USING A RAPID SIMULATOR OBJECT

A Rapid Simulator ActiveX object (referred to as the “Rapid Simulator”) is a container for a RapidPLUS application (referred to as the “RapidPLUS simulation”). However, it is not only a container, but has its own properties and logic as well.

A Rapid Simulator that has been embedded in another Windows program document (referred to as the “host document”) can:

- Run independently of the host document.
- Transfer data to and from the host document.
- Have its events controlled by the host document.

In the following illustration, the host document powers the RapidPLUS simulation on and off. Once the simulation is powered on, it runs independently of the host document.


Host Document
Rapid Simulator ActiveX Object:
20.0
40
60
20
80
0
100
ON
OFF
These buttons power the lamp in the RapidPLUS simulation on and off

Procedure for Adding a Rapid Simulator

1. Add the Rapid Simulator.
2. Select the RapidPLUS application to be simulated.
3. Configure the Rapid Simulator's properties.

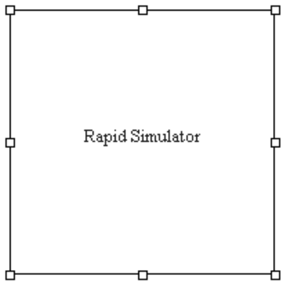
These steps are described below.

Adding the Rapid Simulator

Programs that use ActiveX controls have procedures for adding and manipulating the controls. Please follow the appropriate procedures.

To add the Rapid Simulator:

- Add the Rapid Simulator according to the host program's procedures for adding an ActiveX control. The object will look similar to:



Selecting the RapidPLUS Application to Be Simulated

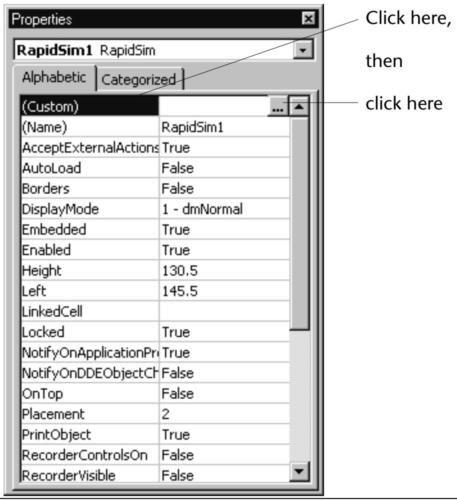
You select the RapidPLUS application in the Rapid Simulator's Properties dialog box. The RapidPLUS application can be in any of the following file formats: RPD, RVR, UDO, RDO, or ZRP (zipped application). It can also be the URL of a zipped application.

To select a RapidPLUS application:

1. Open the Rapid Simulator Properties dialog box according to the program's procedures. Please refer to the following table:

In Microsoft Office programs

You reach it from the ActiveX Properties list:



Properties

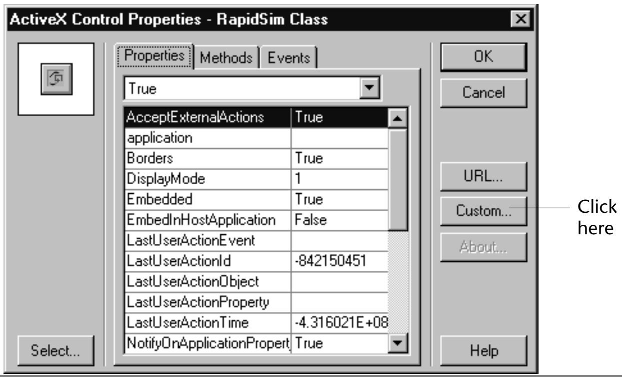
RapidSim1 RapidSim

Alphabetic | Categorized

(Custom)	...
(Name)	RapidSim1
AcceptExternalActions	True
AutoLoad	False
Borders	False
DisplayMode	1 - dmNormal
Embedded	True
Enabled	True
Height	130.5
Left	145.5
LinkedCell	
Locked	True
NotifyOnApplicationPr	True
NotifyOnDDEObjectCh	False
OnTop	False
Placement	2
PrintObject	True
RecorderControlsOn	False
RecorderVisible	False

In Macromedia Authorware

You reach it from the ActiveX Control Properties dialog box:

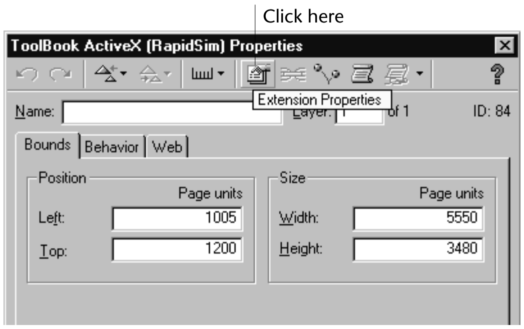


True

AcceptExternalActions	True
application	
Borders	True
DisplayMode	1
Embedded	True
EmbedInHostApplication	False
LastUserActionEvent	
LastUserActionId	-842150451
LastUserActionObject	
LastUserActionProperty	
LastUserActionTime	-4.316021E+08
NotifyOnApplicationPropert	True

In ToolBook

You reach it from the ActiveX Control Properties dialog box:



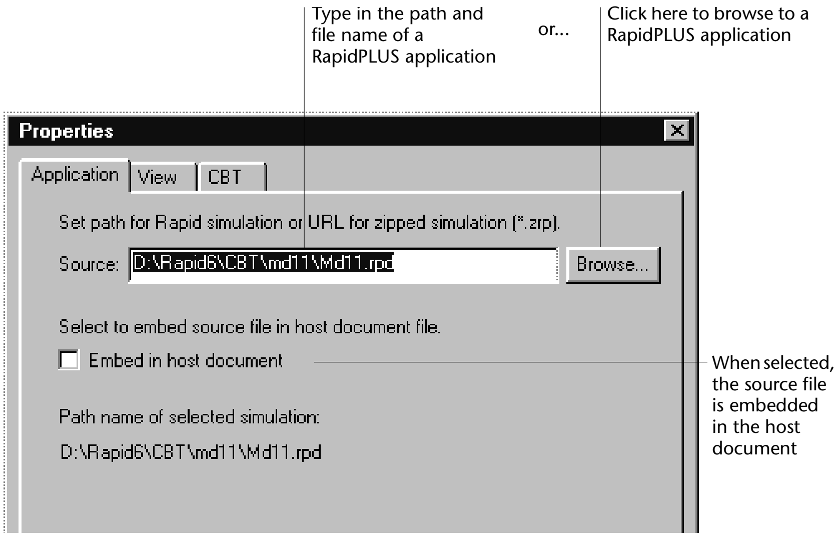
Name: Layer: 1 of 1 ID: 84

Position (Page units): Left: 1005; Top: 1200

Size (Page units): Width: 5550; Height: 3480

2 In the Rapid Simulator's Properties dialog box, enter the path and file name of a RapidPLUS simulation.

You can open a RapidPLUS application in any of the following file formats: RPD, RVR, UDO, RDO, or ZRP (zipped application). It can also be the URL of a zipped application.


Type in the path and file name of a RapidPLUS application
or...
Click here to browse to a RapidPLUS application
When selected, the source file is embedded in the host document
Properties
Application
View
CBT
Browse...
Embed in host document

Set path for Rapid simulation or URL for zipped simulation (*.zrp).

Source: D:\Rapid6\CBT\md11\Md11.rpd

Select to embed source file in host document file.

☐ Embed in host document

Path name of selected simulation:

D:\Rapid6\CBT\md11\Md11.rpd

3 If you want to embed the RapidPLUS simulation in the host document, select the "Embed in host document" check box. When selected, the source file (but not its supporting files) will be saved as part of the host document when the host document is saved.

❖ *NOTES: If you want the RapidPLUS simulation's supporting files to be embedded as well, you must create a ZRP file.*

In Authorware, you cannot embed a RapidPLUS simulation that is larger than 60 KB.

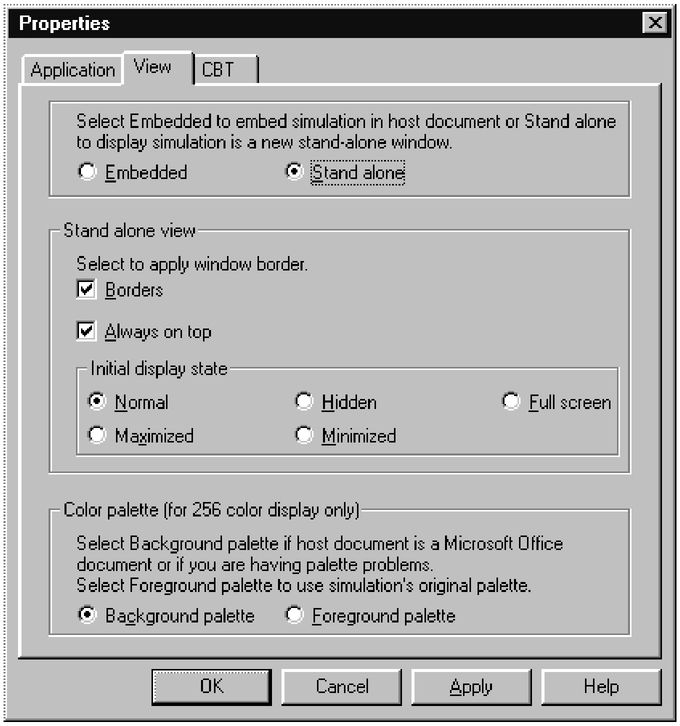
If the "Embed in host document" check box is not selected, the RapidPLUS simulation will be linked to the host document.

Configuring the RapidPLUS Simulation

You can choose how the simulation appears in the host document in the Rapid Simulator's Properties dialog box.

To configure the simulation:

1 Click the View tab.


Properties

Application | View | CBT

Select Embedded to embed simulation in host document or Stand alone to display simulation is a new stand-alone window.
Embedded [✓ Stand alone]

Stand alone view

Select to apply window border.
[✓ Borders]

[✓ Always on top]

Initial display state
[✓ Normal] Hidden Full screen
Maximized Minimized

Color palette (for 256 color display only)

Select Background palette if host document is a Microsoft Office document or if you are having palette problems.
Select Foreground palette to use simulation's original palette.
[✓ Background palette] Foreground palette

OK | Cancel | Apply | Help

2 Select either Embedded view or Stand alone view.

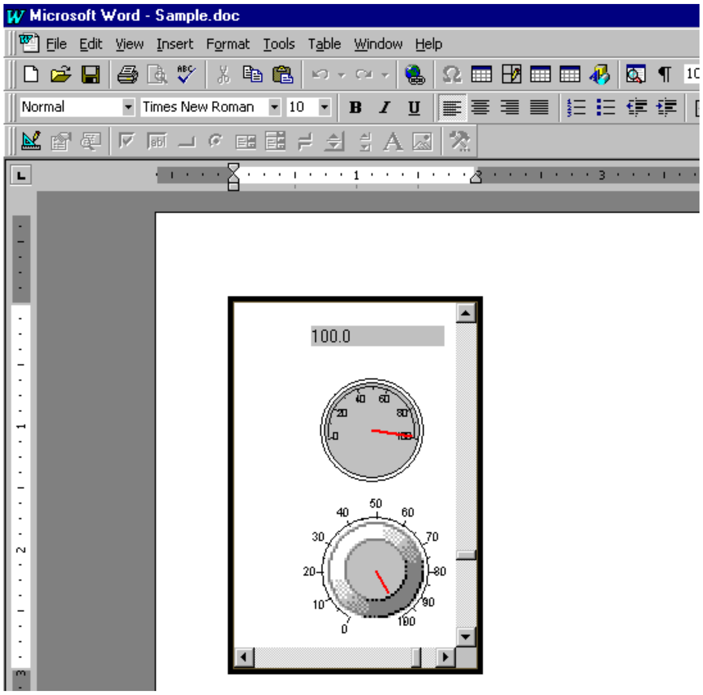
Embedded view

The simulation is displayed within the Rapid Simulator. If the simulation is larger than the Rapid Simulator, scroll bars are added.

Stand alone view

The simulation is displayed in a Reviewer window. The Reviewer's initial appearance depends on the stand-alone view options selected in Step 3.

The illustration below shows a sample embedded RapidPLUS simulation (RPD) running in a Word document:


Microsoft Word - Sample.doc
File Edit View Insert Format Tools Table Window Help
Normal
Times New Roman
10
100.0

Sample of a RapidPLUS simulation (RPD) running in a Word document—in Embedded view

3 Set these options only if you selected Stand alone view:

Borders check box

If you select this check box, the Reviewer window has a border frame and can be manipulated using the Reviewer's Control menu. For details about the Reviewer window, see Chapter 21: "The Reviewer" in the *Rapid User Manual*.

Initial display state

Select one of the display options. If you select Normal, the Reviewer window is displayed at its actual size.

4 If your Windows environment uses 256 colors, select the Color Palette type.

Foreground palette

When selected, the RapidPLUS simulation's original palette is used. If Foreground palette causes flickering problems, switch to Background palette.

Background palette

When selected, the system palette is used. If the host document is a Microsoft Office program, use Background palette.

Viewing the RapidPLUS Simulation

To view the RapidPLUS simulation:

HOST DOCUMENT	PROCEDURE
Microsoft Word	Exit Design mode.
Microsoft PowerPoint	Run the slide show.
Authorware	Run in the Presentation window.
ToolBook II	Run in the Viewer.

Viewing the RapidPLUS Simulation in a Browser

- In the RapidPLUS Document Manager, generate the simulation as an HTML file and then view it (by choosing File|View). The simulation will open in your default browser.

  Refer to the *Generating Documents* manual for details about working with the Document Manager.

Resizing the RapidPLUS Simulation

There are several ways to resize the simulation.

During Design Mode

Using the sizing handles

1 Re-enter Design mode (the simulation does not appear in Design mode).

2 Use the sizing handles to change the object's size.

Using the ActiveX Properties list

- If the host application has Height and Width properties for its ActiveX controls, use them to resize the RapidPLUS simulation.

Using the host document's programming language

- Use the following properties in the host document's programming language (e.g., Microsoft Visual Basic):

```
WindowHeight

WindowWidth
```

These properties are for resizing a Rapid Simulator in stand-alone view during runtime.

During Runtime

You can only resize the window during runtime when the simulation is in Stand-alone view—with borders—so that you see the Reviewer window.

- Use the sizing handles

  or

- The Reviewer window's Control|Size command

  or

- The *WindowHeight* and *WindowWidth* properties described above.

OVERVIEW OF COMMUNICATION OPTIONS

The following options are available to host documents:

OPTION	RapidPLUS SIMULATION	HOST DOCUMENT
Get data	Exported properties pass data to the Rapid Simulator.	Rapid Simulator properties and events pass data from the RapidPLUS simulation to the host document.
Send data	Exported properties receive data from the Rapid Simulator.	Rapid Simulator functions pass data to the RapidPLUS simulation.
Send user actions	The RapidPLUS simulation accepts external user actions.	The host document sends user actions to the RapidPLUS simulation.
Monitor user actions	User actions flow both internally within the RapidPLUS simulation and externally to the host document.	The Rapid Simulator is set to Monitor mode. The host document observes user actions taking place in the RapidPLUS simulation
Control user actions	User actions flow externally to the host document. The RapidPLUS simulation waits for “permission” to perform them.	The Rapid Simulator is set to Reroute mode. The host document either “acknowledges” or “denies” a user action.

❖ *NOTE: Throughout this chapter, scripting examples are presented in Visual Basic for Applications format.*

HOW THE HOST DOCUMENT GETS DATA FROM THE SIMULATION

When an exported property is added to the RapidPLUS simulation, the host document is able to get data from the Rapid Simulator. A host document gets data from the RapidPLUS simulation in two ways:

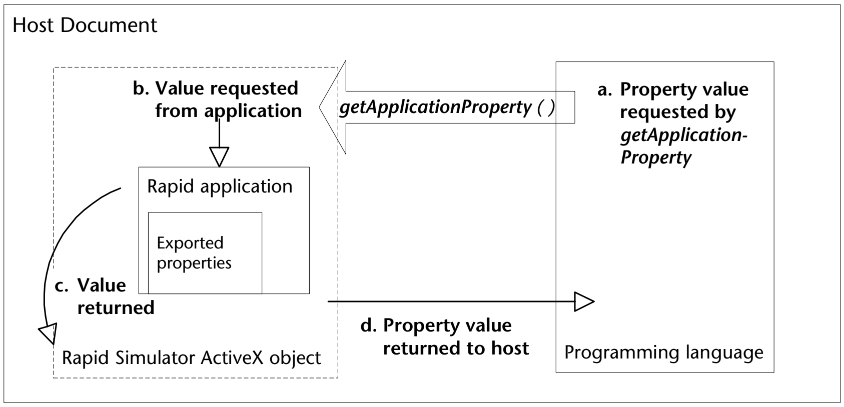
- **Initiated by the host document:** the host document sends a request for an exported property’s value to the RapidPLUS simulation via the Rapid Simulator.

- **Initiated by the RapidPLUS simulation:** when the value of an exported property changes, the RapidPLUS simulation notifies the Rapid Simulator, which then sends the value to the host document.

Both of these methods are explained below, together with procedures for setting up the host document and RapidPLUS simulation to get data.

GETTING DATA—INITIATED BY THE HOST DOCUMENT

The following illustration shows how the host document sends a request for the value of an exported property to the RapidPLUS simulation via the Rapid Simulator object:


Host Document
b. Value requested from application
getApplicationProperty ( )
a. Property value requested by getApplication-Property
Rapid application
Exported properties
c. Value returned
Rapid Simulator ActiveX object
d. Property value returned to host
Programming language

i. In the host document’s programming language, the GetApplication-Property(<property name>) method is written to get the current value from Rapid Simulator. For example, in Visual Basic:

```
RapidSim1.GetApplicationProperty("<exported property name>")
```

ii. Through an internal mechanism, the Rapid Simulator requests the value of the named exported property from the RapidPLUS application.

iii. Through the same internal mechanism, the RapidPLUS simulation returns the value of the exported property. The value is always a string.

iv. The exported property’s value is returned to the host document which can then use the value.

Procedure for Getting Data—Initiated by the Host Document

1 Add an exported property to the RapidPLUS simulation. (For details about adding an exported property, refer to Chapter 19 of the *Rapid User Manual*, "Adding User Properties..." p. 19-6.)

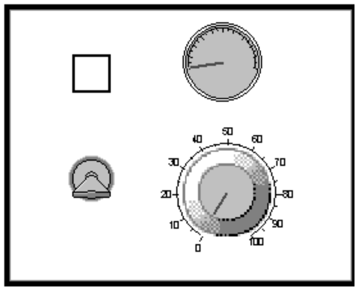
   For example, an exported number property could hold the value that the host document will get.

2 In the host document's programming language, use a method (GetApplicationProperty) to get the current value of the exported property. For example,

```
RapidSim1.GetApplicationProperty("<property name>")
```

Example of Getting Data—Initiated by the Host Document

The following example shows how to enable the host document to get data from a Rapid Simulator ActiveX object. It is based on a Rapid Simulator that is embedded in a Word document:



All of the simulation's logic is internal; that is, no exported properties or exported events were used. The following activities were used in "On" mode to power on the lamp and rotary potentiometer:

Entry activity: **Lamp1 on**
Mode activity: **Indicator1.reading := Potentiometer1.value**

The host document can display the RapidPLUS simulation in runtime, but cannot read the indicator's value or the lamp's state.

Setup for getting data from the RapidPLUS simulation

In the RapidPLUS application

- In the Object Layout, two exported properties are added: a number property called “DialReading” and a string property called “LampState.”
- In the Logic Editor, two activities are added:

Entry activity: **App.LampState := ‘On’**
Mode activity: **App.DialReading := Indicator1.reading**

In the Rapid Simulator

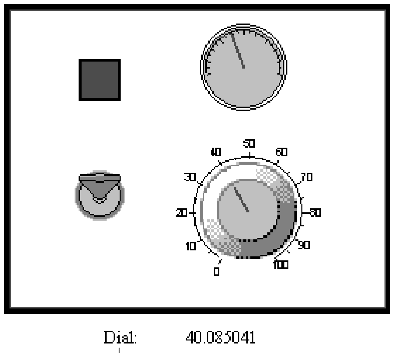
By default, the “Notify on application property change” check box is selected.

In the host document

- Two Label control objects are added to the document that will display the values of LampState and DialReading.
- The following script is added in Visual Basic:

```
Private Sub ReadingLabel1_Click()
' Called when user clicks on the Dial label
' Update label value
 ReadingLabel1.Caption = RapidSim1.GetApplicationProperty
 ("DialReading")
End Sub
```

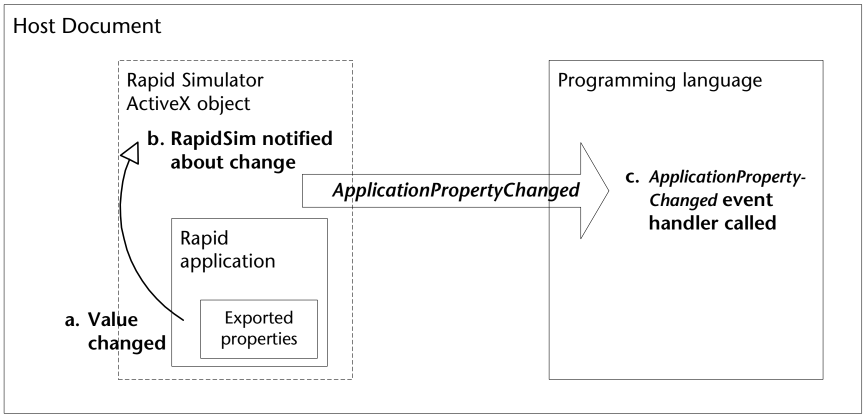
In the RapidPLUS simulation, as the potentiometer value changes, so does the dial reading. In the host document, each time the Dial label is clicked, the Rapid Simulator gets the current value of the dial:



When the Dial label is clicked, the GetApplicationProperty method gets the current value of the dial

GETTING DATA—INITIATED BY THE RAPIDPLUS SIMULATION

The following illustration shows how a change in the value of an exported property is sent to the host document:


Host Document
Rapid Simulator ActiveX object
b. RapidSim notified about change
Rapid application
Exported properties
a. Value changed
ApplicationPropertyChanged
Programming language
c. ApplicationProperty-Changed event handler called

i. An exported property's value changes.

ii. The Rapid Simulator object is notified of the change.

   (The type of notification can either be set in the object's Properties dialog box or in the host document's programming language. These notification types are explained in "Automatic notification" on p. 18-16.)

iii. In the host document's programming language, an event handler, ApplicationPropertyChanged, is written to get the property name and value from the Rapid Simulator.

   The host document can then use the value. For example it could display the value in another ActiveX control, such as a Form label.

Procedure for Getting Data—Initiated by the RapidPLUS Simulation

1. Add an exported property to the RapidPLUS application. (For details about adding an exported property, refer to Chapter 19 of the *Rapid User Manual*, “Adding User Properties...” p. 19-6.)

   For example, an exported number property could hold the value that the host document will get.

2. Make sure the Notify on application property change check box is selected in the Rapid Simulator Property dialog box (see “Automatic notification” below for details).

3. In the host document’s programming language, use an event handler (ApplicationPropertyChanged) for the Rapid Simulator to get the exported property’s value. For example,

```
RapidSim1_ApplicationPropertyChanged(ByVal <propertyName> As String,
 ByVal value As Variant)
```

When the Simulation Contains More than One Exported Property

When the simulation contains more than one exported property, you must check for the actual property name. For example:

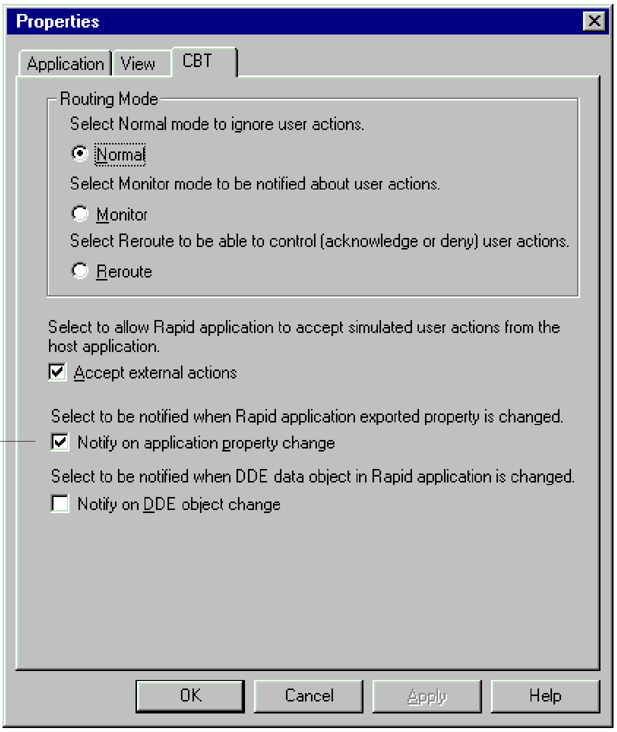
```
Private Sub RapidSim1_ApplicationPropertyChanged(ByVal propertyName
As String, ByVal value As Variant)
' Called when RapidPLUS application property changes
' Handle Application property changes
 If propertyName = "<Property1>" Then
        Object1.Caption = value
 Else:
     If propertyName = "<Property2>" Then
            Object2.Caption = value
     End If
 End If
End Sub
```

Automatic Notification

You can make the RapidPLUS simulation automatically notify the Rapid Simulator each time an exported property's value changes. That is, every time an exported property's value changes, the event handler for the ApplicationPropertyChanged event is called.

To choose automatic notification:

1. Open the Rapid Simulator Properties dialog box, CBT tab.
2. Select the "Notify on application property change" check box.



Routing Mode

Select Normal mode to ignore user actions.

[✓ Normal]

Select Monitor mode to be notified about user actions.

Monitor

Select Reroute to be able to control (acknowledge or deny) user actions.

Reroute

Select to allow Rapid application to accept simulated user actions from the host application.

[✓ Accept external actions]

Select to be notified when Rapid application exported property is changed.

[✓ Notify on application property change]

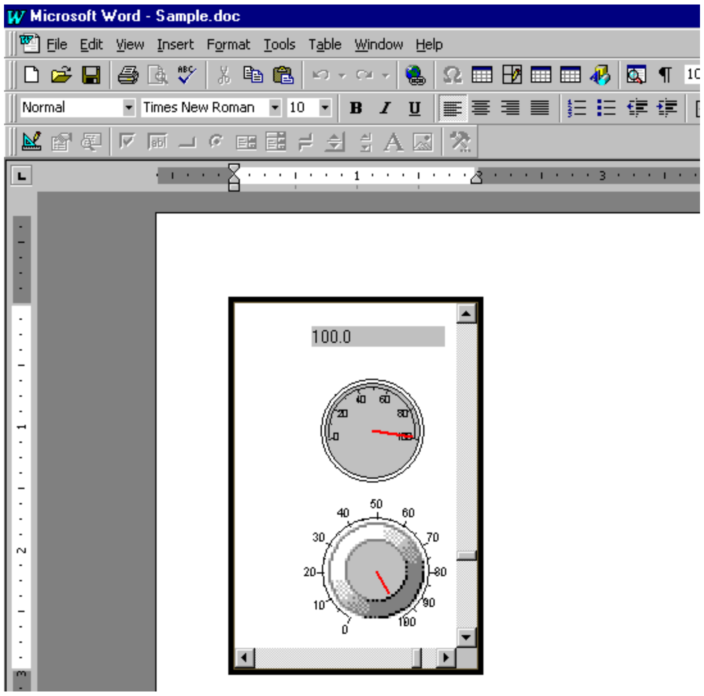
Select to be notified when DDE data object in Rapid application is changed.

Notify on DDE object change

Select to automatically notify the Rapid Simulator object when an exported property's value changes

Example of Getting Data—Initiated by the RapidPLUS Simulation

This example shows how to enable the host document to get data from a Rapid Simulator. It is based on a Rapid Simulator that is embedded in a Word document:


Microsoft Word - Sample.doc
File Edit View Insert Format Tools Table Window Help
Normal
Times New Roman
10
100.0

All of the simulation’s logic is internal; that is, no exported properties or exported events were used. The following mode activities were used to display the rotary potentiometer’s value on the round dial indicator and text display:

Indicator1.reading := Potentiometer1.value

Display1.contents := Potentiometer1. value

The host document can display the RapidPLUS simulation in runtime, but cannot read the indicator’s value.

Setup for getting data from the RapidPLUS simulation

In the RapidPLUS application

- In the Object Layout, an exported number property is added, called "DialReading."
- In the Logic Editor, a mode activity is added:

  App.DialReading := Indicator1.reading

In the Rapid Simulator object

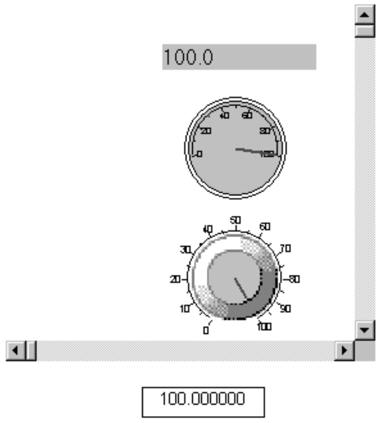
By default, the "Notify on application property change" check box is selected.

In the host document

- A Label control object is added to the document that will display DialReading's value.
- The following event handler is added in Visual Basic.:

```
Private Sub RapidSim1_ApplicationPropertyChanged(ByVal
   propertyName As String, ByVal value As Variant)
   Label1.Caption = value
End Sub
```

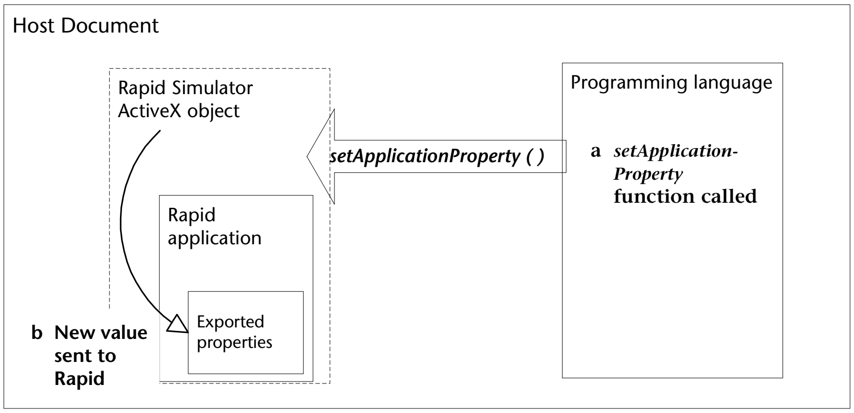
The ApplicationPropertyChanged event handler enables the label to display the dial indicator's value:



SENDING DATA TO THE RAPIDPLUS SIMULATION

When an exported property or exported event is added to the RapidPLUS application, the host document is able to send data to the RapidPLUS simulation object. The host document calls a method that sets the exported property's value or event's triggers via the Rapid Simulator object.

The following illustration shows how a host document changes the value of an exported property:


Host Document
Rapid Simulator ActiveX object
Programming language
setApplicationProperty ( )
a setApplication-Property function called
Rapid application
Exported properties
b New value sent to Rapid

i. In the host document's programming language, the SetApplication-Property("<property name>", "<value>") method sets the exported property's value in the RapidPLUS simulation.

ii. Through an internal mechanism, the Rapid Simulator sends the value to the RapidPLUS application.

Procedure for Sending Data

1 Add an exported property or exported event to the RapidPLUS application. (For details about adding exported properties and events, refer to Chapter 19 of the *Rapid User Manual*, "Adding User Properties..." p. 19-6.)

Examples

- An exported number, integer, or string property could hold the value that the host document will send.

- An exported event could be used to trigger a lamp on and off.

2 In the host document, add another ActiveX control whose value will be sent to the simulation.

Examples

- A Scroll Bar control object could be used to control the value sent to the exported number property.
- A Button control object could be used to trigger an exported event.

3 In the host document's programming language, use methods and events to send data.

Examples

- The SetApplicationProperty method could set the exported property's value.

```
RapidSim1.SetApplicationProperty "<property name>", <value>
```

- The TriggerApplicationEvent method could trigger the exported event.

```
RapidSim1.TriggerApplicationEvent <"event name">
```

4 In the RapidPLUS application, add logic to read the data sent from the host document.

Examples

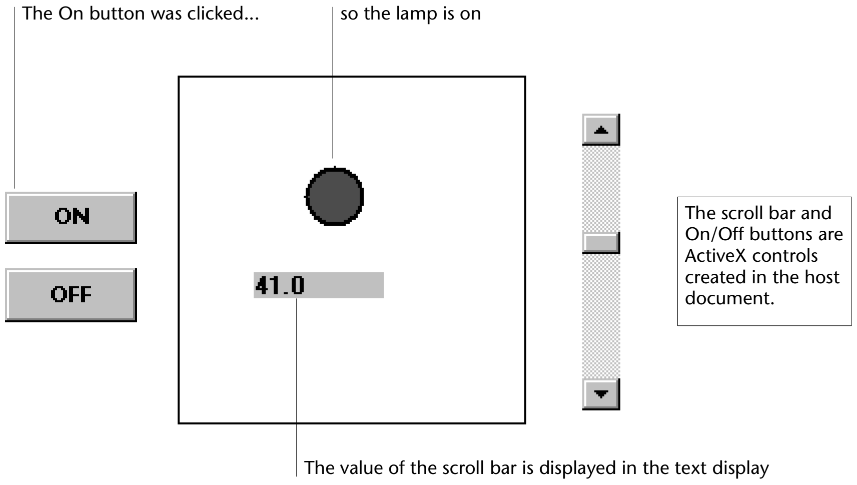
- A mode activity could read the value of the exported property.
- The triggered event could have a resulting action.

Example of Sending Data

This example shows how to enable the host document to send data to a RapidPLUS simulation. It is based on a Rapid Simulator in a Word document where:

- The RapidPLUS application contains a lamp and a text display.
- The Rapid Simulator is in embedded view.
- The host document contains an On button, an Off button, and a scroll bar.

The example already contains the elements needed for the host document to send data to the RapidPLUS simulation:


The On button was clicked...
so the lamp is on
ON
OFF
41.0
The scroll bar and On/Off buttons are ActiveX controls created in the host document.
The value of the scroll bar is displayed in the text display

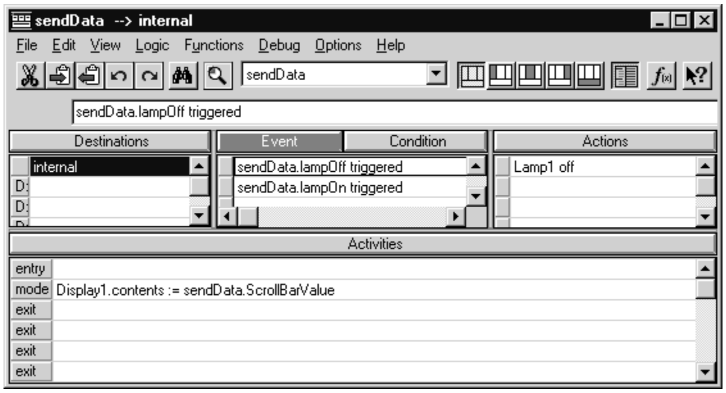
Setup for Sending Data to the RapidPLUS Simulation

In the RapidPLUS application

In the Object Layout:

- There is one exported property: a number property called "ScrollBarValue."
- There are two exported events: "lampOn" and "lampOff."

In the Logic Editor, the following logic is added:



sendData.lampOff triggered

Destinations: internal

Event: sendData.lampOff triggered; sendData.lampOn triggered

Actions: Lamp1 off

entry	
mode	Display1.contents := sendData.ScrollBarValue
exit	
exit	
exit	
exit	

In the host document

- Two Button objects control the state of the lamp. A Scrollbar object controls the value displayed in the text display.
- The following script is added in Visual Basic:

```
Private Sub OnButton_Click()
    RapidSim1.TriggerApplicationEvent "lampOn"
End Sub

Private Sub OffButton_Click()
    RapidSim1.TriggerApplicationEvent "lampOff"
End Sub

Private Sub ScrollBar1_Change()
    RapidSim1.SetApplicationProperty "ScrollBarValue",
    ScrollBar1.Value
End Sub
```

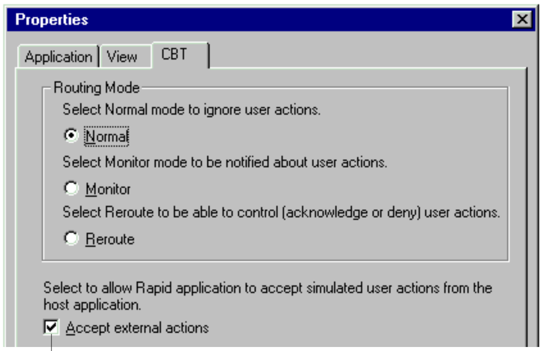
SENDING EXTERNAL ACTIONS TO THE RAPIDPLUS SIMULATION

In order to send external actions, both the Rapid Simulator and the host document must be modified.

The host document can generate user actions in the simulation only when the Rapid Simulator is set up to accept external actions. An example of an external action is: pressing a Button object in the host document that causes a switch in the simulation to move to the Up position.

Modifying the Rapid Simulator to Accept External Actions

1 Open the Rapid Simulator Properties dialog box, CBT tab.



Routing Mode

Select Normal mode to ignore user actions.

● Normal

Select Monitor mode to be notified about user actions.

○ Monitor

Select Reroute to be able to control (acknowledge or deny) user actions.

○ Reroute

Select to allow Rapid application to accept simulated user actions from the host application.

☑ Accept external actions

Select this check box so the simulation can accept external actions from the host document

2 Select the “Accept external actions” check box.

❖ *NOTE: The Rapid Simulator can accept external actions in any of the routing modes (see “Setting the Routing Mode” on p. 18-25 for details about the modes).*

Modifying the Host Document to Send External Actions

The host document sends an external action to the simulation via an ActiveX control object that uses the SimulateUserAction method.

The method’s syntax (in Visual Basic) is:

```
RapidSim1.SimulateUserAction "<objectName>", "<propertyName>",
"<eventName>"
```

where

`<objectName>` is the name of the object to which the action is sent (e.g., Switch1, Lamp1).

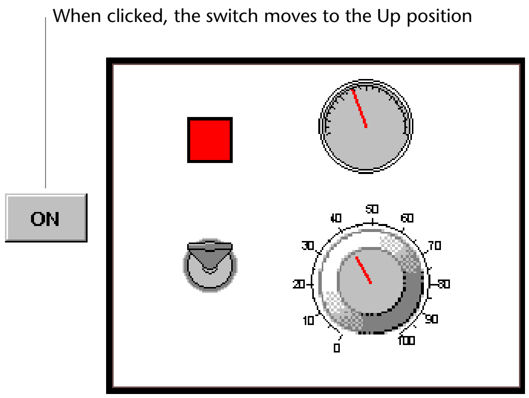
`<propertyName>` is the object’s property (e.g., up, blinkPeriod. If none, then enter “$self”).

`<eventName>` is the event (e.g., make. If the event is the assignment of a value, such as “:= 8.5,” only the value “8.5” is included in the argument).

Example

A Button object is added in the host document, then the following method is added:

```
OnButton1_Click()
  RapidSim1.SimulateUserAction "Switch1", "up", "make"
```



Example of a host document that contains two ActiveX controls: a Button and a Rapid Simulator

SETTING THE RAPID SIMULATOR'S ROUTING MODE

The Rapid Simulator's routing mode determines how user actions are handled by the simulation. As in the Simulation Manager object, the three modes are:

ROUTING MODE	DESCRIPTION
Normal	User actions flow internally in the simulation without any link to the host program.

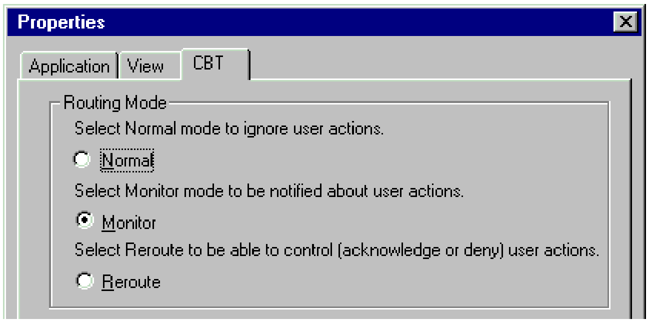
ROUTING MODE	DESCRIPTION
Monitor	User actions flow both internally within the simulation and externally to the host program via an internal mechanism (see p. 18-26 for details about Monitor mode).
Reroute	User actions generated in the simulation flow to the host program via an internal mechanism, and the simulation waits for the host to send a response. If the host "acknowledges" the user action, RapidPLUS responds to the user action as it would normally. If the program "denies" the user action, RapidPLUS does not respond to it, and sends the next user action in the queue, if more than one user action occurred (see p. 18-29 for details about Reroute mode).

Setting the Routing Mode

The routing mode can be set during design time in the Rapid Simulator Properties dialog box or at runtime via the host document's script.

Using the Rapid Simulator Properties Dialog Box

1 Open the dialog box, CBT tab.


Properties

Application | View | CBT

Routing Mode

Select Normal mode to ignore user actions.

Normal

Select Monitor mode to be notified about user actions.

[✓ Monitor]

Select Reroute to be able to control (acknowledge or deny) user actions.

Reroute

2 Select a routing mode.

❖ *NOTE: In Microsoft Office programs, the routing mode can also be set in the ActiveX Properties list.*

Using the Host Document's Programming Language

- Use the following code:

```
<RapidSim>.RoutingMode = rm<Mode>
```

or

```
<RapidSim>.RoutingMode = <Value>
```

where value is, 0: Normal, 1: Monitor, 2: Reroute.

For example:

```
RapidSim1.RoutingMode = rmMonitor
```

MONITORING USER ACTIONS IN THE RAPIDPLUS SIMULATION

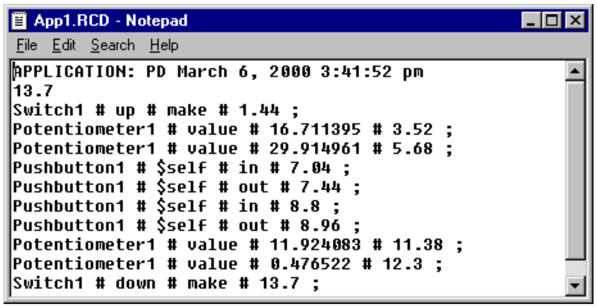
The host document can observe user actions taking place in the simulation when the Rapid Simulator is in monitor mode. In monitor mode, user actions flow both internally within the simulation and externally to the host application.

Monitor mode is especially useful in computer–based training (CBT). An instructor can monitor a student's actions.

Getting User Actions from the Simulation

When the Rapid Simulator is in monitor mode, it automatically receives each user action that is generated in the simulation. In other words, when an object is clicked in the simulation, the Rapid Simulator receives information that includes which object was clicked, the object's property that was affected, and the event itself.

To understand how user actions are generated in RapidPLUS, look at the following Recorder file. Notice that every line in the body of the file contains one recorded user action. Each line contains four fields that are separated by a hash sign (#):



```
APPLICATION: PD March 6, 2000 3:41:52 pm
13.7
Switch1 # up # make # 1.44 ;
Potentiometer1 # value # 16.711395 # 3.52 ;
Potentiometer1 # value # 29.914961 # 5.68 ;
Pushbutton1 # $self # in # 7.04 ;
Pushbutton1 # $self # out # 7.44 ;
Pushbutton1 # $self # in # 8.8 ;
Pushbutton1 # $self # out # 8.96 ;
Potentiometer1 # value # 11.924083 # 11.38 ;
Potentiometer1 # value # 0.476522 # 12.3 ;
Switch1 # down # make # 13.7 ;
```

- The first field is the object's name as it appears in the application (e.g., Switch1).
- The second field is the name of the object's property that was affected by the user action (e.g., up).
- The third field is the name of the event (e.g., make).
- The fourth field contains the time stamp: the time elapsed (in seconds) since the start of the recording.

  The information held in these four fields is passed to the host document when the Rapid Simulator is in monitor mode. Additional information that is passed to the host document includes an ID number and a response number.
- ID is the ID number of the user action. This value can be used when the Rapid Simulator is set to reroute mode to acknowledge or deny the action.
- Response is a placeholder for the response flag to be set by the host when the event handler is called to generate an immediate response to the action.

Modifying the Host Document to Monitor User Actions

In order to monitor user actions, both the Rapid Simulator and the host document must be modified.

To monitor user actions:

1 Set the Rapid Simulator's routing mode to Monitor (see p. 18-25 for instructions).

2 In the script, add the UserActionFired event handler:

```
RapidSim1_UserActionFired(ByVal objectName As String, ByVal
propertyName As String, ByVal eventName As String, ByVal time As
Single, ByVal id As Long, response As Long)
```

This event handler gets user actions as they occur in the simulation. As you can see from the script, the information includes the object's name, property, event, time stamp, ID number, and place holder for response.

All this information must appear in the event handler, but it does not all have to be used. For example, you could use only the first three values: objectName, propertyName, and eventName.

Displaying User Actions in the Host Document

A Label object (or other ActiveX object) can be used to display user actions that take place in the RapidPLUS simulation. The Label can display the entire user action string, or parts of it.

To display the entire user action string:

- Use the following method:

```
Label1.Caption = objectName + " " + propertyName + " " + eventName
" " + time  + id " " + response
```

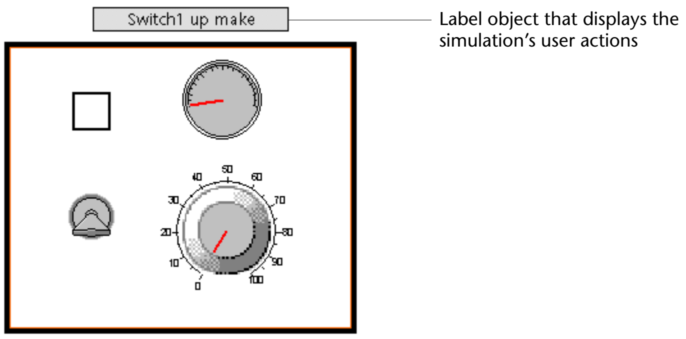
(The `" "` adds one space between each part.)

Example

In this example, the following script is used to display each user action's object, property, and event.

```
Private Sub RapidSim1_UserActionFired(ByVal objectName As String,
ByVal propertyName As String, ByVal eventName As String, ByVal time
As Single, ByVal id As Long, response As Long)
 actionLbl.Caption = objectName + " " + propertyName + " " +
eventName
 'actionLbl.Caption = RapidSim1.LastUserActionObject + " " +
propertyName + " " + eventName
End Sub
```

The result of this script is illustrated below:



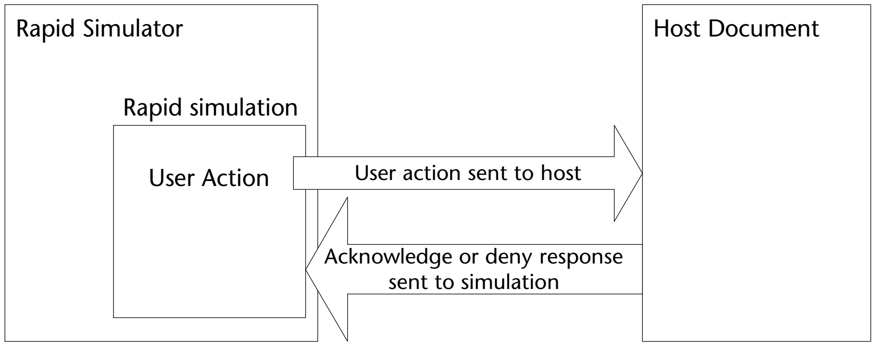
Example of a host document that contains two ActiveX controls: a Label and a Rapid Simulator

REROUTING USER ACTIONS

When the Rapid Simulator is in reroute mode, the simulation sends all of the user actions it generates to the host document and **waits for the host document to send a response**.

If the host document "acknowledges" the user action, the simulation responds to the user action as normal. For example, if the user action is to rotate a dial, then the dial is rotated. If the host document "denies" the user action, the simulation does not respond to it.

A user action is placed in a queue awaiting a response (either an acknowledge or a deny event). For example, if a student has pressed a switch in the RapidPLUS simulation, and the host document detects that it is the wrong switch for the given task, the host document will deny the user action. This means that, from the student's point of view, the switch does not respond to his or her mouse click. The host document could also provide some form of message, such as a beep or an error message.



Flow of user actions in reroute mode

When the queue contains one or more actions, the simulation does not send notifications about additional user actions until the first action receives a response.

Modifying the Host Document to Respond to User Actions

In order to respond to user actions, both the Rapid Simulator and the host document must be modified.

1. Set the Rapid Simulator's routing mode to Reroute (see p. 18-25 for instructions).
2. In the script, add the UserActionFired event and a response value:

```
RapidSim1_UserActionFired(ByVal objectName As String, ByVal
propertyName As String, ByVal eventName As String, ByVal time As
Single, ByVal id As Long, response As Long)

response = <Acknowledge (1)/Deny (2) /Hold (0)>
```

Example

```
Private Sub RapidSim1_UserActionFired(ByVal objectName As String,
ByVal propertyName As String, ByVal eventName As String, ByVal time
As Single, ByVal id As Long, response As Long)
' The user did something...
    If objectName = "Switch1" Then
        response = 1'Acknowledge
    Else
        ' User did something other then changing switch1
        actionLbl.Caption = "Wrong action! you should turn the
          switch on."
        response = 2   'Deny
    End If
End Sub
```

Using the SendAcknowledge and SendDeny Methods

Some host applications do not let the user change the Response field. In these applications, use the SendAcknowledge and SendDeny methods.

Example

```
Private Sub RapidSim1_UserActionFired(ByVal objectName As String,
ByVal propertyName As String, ByVal eventName As String, ByVal time
As Single, ByVal id As Long, response As Long)
If objectName = "Switch1" Then
        RapidSim1.SendAcknowledge Id  'Acknowledge action
        identified by Id
    Else
        ' User did something other then changing switch1
        actionLbl.Caption = "Wrong action! you should turn the
          switch on."
        RapidSim1.SendDeny    'Deny last action
 End If
End Sub
```

Controlling the Rapid Recorder

The simulation's Recorder can be displayed and manipulated within the host document **during runtime**. For details about using the Recorder, refer to Chapter 20: "The Proptotyper" in the *Rapid User Manual*.

To display the Rapid Recorder during runtime:

- In the ActiveX Properties list, set the RecorderVisible property to True.

To control the Rapid Recorder during runtime:

1 In the ActiveX Properties list, set the RecorderControlsEnabled property to True.

2 Use the following functions:

FUNCTION	DESCRIPTION
RecorderRecord	Instructs the Recorder to begin recording.
RecorderPlay	*Instructs the Recorder to play the recording.*
RecorderStop	*Instructs the Recorder to stop the current play or record operation.*
LoadRecorderFile	Loads a recorder file (RCD).
SaveRecorderFile	Saves a recorder file.
RecorderCue	Instructs the Recorder to play at fast speed.
RecorderRewind	Instructs the Recorder to rewind the recording to the start.
RecorderStep	Instructs the Recorder to step (that is, play one event at a time).

These functions are described in more detail in the "Properties, Methods, and Events" section that starts on p. 18-34.

Controlling the RapidPLUS Simulation's State

You can save the current state of the simulation at any point while it is running. For details about controlling the simulation's state, refer to Chapter 20: "The Proptotyper" in the *Rapid User Manual*.

To save the simulation's state:

- Use the SaveState method.

To load a state file:

- Use the LoadState method.

The loaded state becomes the starting point each time you start the simulation.

To reset the state:

- Use the ResetState method.

The simulation is reset to the initial state.

Communicating with DDE Objects

Although the DDE (Dynamic Data Exchange) protocol is still supported by RapidPLUS, its use is not recommended because the current methods for exchanging data between applications are quicker and more reliable than DDE.

The following logic items are available in RapidPLUS 6.0 to support backward compatibility: NotifyOnDDEObjectChange, RequestDataFromDDEObject, PokeDataToDDEObject, and DDEObjectChanged. They are described in the "Properties, Methods, and Events" section that starts on p. 18-34.

PROPERTIES, METHODS, AND EVENTS

This section describes the Rapid Simulator's properties, methods, and events:

Properties

The properties described in this section are also defined in the Rapid Simulator's Properties dialog box and/or ActiveX Properties list. They determine how the Rapid Simulator behaves when it is run in the host document.

AcceptExternalActions

Sets the simulation to accept external actions. Default value: True.

Application

Returns the full path of the application currently loaded in the Rapid Simulator, read only.

Borders

Defines the appearance of the Reviewer in stand-alone view.

DisplayMode

Defines the appearance of the Reviewer in stand-alone view.

Valid Values

0: Hidden
1: Normal (default)
2: Minimized
3: Maximized
4: FullScreen

Embedded

Displays the simulation either in embedded view or stand-alone view.

If True, the simulation is embedded, i.e., displayed within the Rapid Simulator. When the application is larger than the simulation window, scroll bars are added.

If False, the simulation is in stand-alone view, i.e., displayed in a Reviewer window.

EmbedInHostApplication

Determines whether the source application is embedded in the host document or linked to it.

If True, the source file (but not its supporting files) are saved as part of the host document when the host document is saved.

❖ *NOTE: To embed the RapidPLUS simulation's supporting files as well, you must create a ZRP file.*

If False, the RapidPLUS simulation will be linked to the host document.

LastUserActionEvent

Returns a string containing the name of the event that was involved in the last user action that took place in the simulation.

LastUserActionId

Returns an integer containing the event ID of the last user action that took place in the simulation.

LastUserActionObject

Returns a string containing the name of the object that was involved in the last user action that took place in the simulation.

LastUserActionProperty

Returns a string containing the name of the property that was involved in the last user action that took place in the simulation.

LastUserActionTime

Returns a float number containing the time stamp of the last user action that took place in the simulation.

NotifyOnApplicationPropertyChange

If True, notifies the Rapid Simulator each time an exported property value changes in the simulation. That is, every time an exported property's value changes, the event handler for the ApplicationPropertyChanged event is triggered.

NotifyOnDDEObjectChange

If True, notifies the Rapid Simulator each time a DDE object's value changes in the simulation. That is, every time a DDE object's value changes, the event handler for the DDEObjectDataChanged event is triggered.

OnTop

Sets the Rapid Simulator window to always-on-top mode.

Palette

(For 256-color display only.)

Determines the palette to be used by the simulation. Foreground uses the simulation's original palette. Background uses the system palette.

The Background palette should be used whenever the host program is a Microsoft Office program; it should also be used if the Foreground palette causes flickering problems.

Values

0: Foreground
1: Background (default)

RecorderControlsEnabled

Enables the Recorder controls during runtime only. Default value: True.

RecorderVisible

Shows or hides the Recorder during runtime only. Default value: False.

RoutingMode

Determines how user actions are handled by the simulation.

Values

0: rmNormal
1: rmMonitor
2: rmReroute

Source

Designates the RapidPLUS source file or the URL that is loaded into the Rapid Simulator.

The RapidPLUS application can be in any of the following file formats: RPD, RVR, UDO, RDO, or ZRP (zipped application). It can also be the URL of a zipped application.

WindowLeft

Returns an integer value that is the x-position of the Rapid Simulator window's upper-left corner. This property can be used during runtime to change the position of a stand-alone window.

WindowHeight

Returns an integer value that is the height of the Rapid Simulator window. This property can be used during runtime to change the size of a stand-alone window.

WindowTop

Returns an integer value that is the y-position of the Rapid Simulator window's upper-left corner. This property can be used during runtime to change the position of a stand-alone window.

WindowWidth

Returns an integer value that is the width of the Rapid Simulator window. This property can be used during runtime to change the size of a stand-alone window.

Methods

The methods are used to send various commands to the RapidPLUS simulation or to change the characteristics of the Rapid Simulator during runtime. These methods are available in the host application's programming language.

GetApplicationProperty

Gets the current value of an exported property in the simulation.

Syntax

```
GetApplicationProperty("<property name>")
```

Parameters

propertyName	Name of the exported property (a string).

Return Value

The value of the property (a string).

LoadRecorderFile

Loads the recorder file specified in the argument.

Syntax

```
loadRecorderFile <file name>
```

Parameters

file name	Name of the recorder file (RCD).

Return Value

None

LoadState

Loads the state file specified in the argument.

Syntax

```
LoadStateFile <file name>
```

Parameters

file name	Name of the state file (RST).

Return Value

None

Pause

Pauses the simulation.

Syntax

```
Pause
```

Parameters

None

Return Value

None

PokeDataToDDEObject

Sends the data string value to the RapidPLUS DDE object that is represented by "Application–Topic–Item" string arguments.

Syntax

```
PokeDataToDDEObject (<application name>, <topic name>, <item name>,
<value (as string)>
```

Parameters

Application-topic-item	As defined for the DDE object in the application.
value	Value of the data string.

Return Value

None

RecorderCue

Instructs the Recorder to play at fast speed.

Syntax

```
RecorderCue
```

Parameters

None

Return Value

None

RecorderPlay

Instructs the Recorder to play the recording.

Syntax

```
RecorderPlay
```

Parameters

None

Return Value

None

RecorderPlayCase

Instructs the Recorder to play a use/test case from the loaded file.

Syntax

```
RecorderPlayCase <case number>
```

Parameters

case number	Number of the use/test case (the number that appears in the case header).

Return Value

None

RecorderRecord

Instructs the Recorder to begin recording.

Syntax

```
RecorderRecord
```

Parameters

None

Return Value

None

RecorderRewind

Instructs the Recorder to rewind to the start.

Syntax

```
RecorderRewind
```

Parameters

None

Return Values

None

RecorderStep

Instructs the Recorder to step (i.e., play one event at a time).

Syntax

```
RecorderStep
```

Parameters

None

Return Value

None

RecorderStop

Instructs the Recorder to stop any playing or recording operation.

Syntax

```
RecorderStop
```

Parameters

None

Return Value

None

RequestDataFromDDEObject

Returns a data string from the RapidPLUS DDE object that is represented by "Application–Topic–Item" string arguments.

Syntax

```
RequestDataFromDDEObject (<application name>, <topic name>, <item
name>)
```

Parameters

Application-topic-item	As defined for the DDE object in the application.

Return Values

Value of the DDE object (as a string)

ResetState

Resets the state.

Syntax

```
Reset
```

Parameters

None

Return Value

None

Resume

Resumes ("un-pauses") the paused simulation.

Syntax

```
Resume
```

Parameters

None

Return Value

None

SaveRecorderFile

Saves the recording to the recorder file specified in the argument.

Syntax

```
SaveRecorderFile <file name>
```

Parameters

file name	Name of the recorder file (RCD).

Return Value

None

SaveState

Saves the state to the state file specified in the argument.

Syntax

```
SaveStateFile <file name as string>
```

Parameters

file name	Name of the state file (RST).

Return Value

Name

SendAcknowledge

The host document acknowledges (i.e., returns to the RapidPLUS simulation) a rerouted event, identified by its eventID.

Syntax

```
SendAcknowledge (ID)
```

Parameters

ID	ID of the user action.

Return Value

None

SendDeny

The host document denies (i.e., does not return to the RapidPLUS simulation) a rerouted event.

Syntax

```
SendDeny
```

Return Value

None

SetApplicationProperty

Sets the value of an exported property in the simulation.

Syntax

```
SetApplicationProperty(<property name>, <value>)
```

Parameters

propertyName	Name of the exported property.
value	New value for the exported property (a string).

Return Value

None

SimulateUserAction

Sends an external user action to the RapidPLUS simulation using information supplied in the argument. The argument string must contain three words.

Syntax

```
SimulateUserAction(<objectName>,<property name>, <value>)
```

Parameters

objectName	Object's name as it appears in the application.
propertyName	Name of the object's property that was affected by the user action (e.g., up, $self–if none).
eventName	Name of the event (e.g., make).

Return Value

None

Start

Starts the simulation.

Syntax

```
Start
```

Parameters

None

Return Value

None

Stop

Stops the simulation.

Syntax

```
Stop
```

Parameters

None

Return Value

None

TriggerApplicationEvent

Triggers an exported event in the simulation.

Syntax

```
TriggerApplicationEvent(<eventName>)
```

Parameters

eventName	Name of the exported event.

Return Value

None

Events

ApplicationEventTriggered

Notifies the Rapid Simulator when an exported event in the simulation is triggered.

Syntax for event handler (in Visual Basic)

```
ApplicationEventTriggered(ByVal eventName As String)
```

Parameters

eventName	Name of the exported event, a string.

Return Value

None

ApplicationPropertyChanged

Notifies the Rapid Simulator when the value of an exported property in the simulation changes.

Syntax for event handler (in Visual Basic)

```
ApplicationPropertyChanged(ByVal propertyName As String, ByVal value
As Variant)
```

Parameters

propertyName	Name of the exported property, a string.
value	Value of the exported property, as a variant (converted to a string in some host programs).

Remarks

The notification occurs only if the NotifyOnApplicationPropertyChanged property is True.

Return Value

None

DDEObjectChanged

Notifies the Rapid Simulator about a change in a simulation's DDE object.

Syntax (in Visual Basic)

```
DDEObjectChanged(ByVal application As String, ByVal topic As String,
ByVal item As String, ByVal data As Variant)
```

Parameters

application-topic-item	As defined for the DDE object in the application.
data	Current value of the item, as a variant (converted to a string in some host programs).

Return Value

None

UserActionFired

Notifies the Rapid Simulator about a user action that took place in the simulation.

Syntax for event handler (in Visual Basic)

```
UserActionFired(ByVal objectName As String, ByVal propertyName As
String, ByVal eventName As String, ByVal time As Single, ByVal id As
Long, response As Long)
```

Parameters

objectName (string)	Object's name as it appears in the application.
propertyName (string)	Name of the object's property that was affected by the user action (e.g., up).
eventName (string)	Name of the event (e.g., make).
time (float)	Time stamp: the time elapsed (in seconds) since the simulation started running.
ID (integer)	Action ID: can be used by the "sendAcknowledge" method to acknowledge the action.

response (integer)	Placeholder for the response flag to be set by the host when the event handler is called to generate an immediate response to the action. Relevant only in reroute mode. The legal values are: 1: Acknowledge 2: Deny

Return Value

None

WindowPosChanged

Called when the user moves a stand-alone simulation window.

Syntax for event handler (in Visual Basic)

```
WindowPosChanged(ByVal Left As Long, ByVal Top As Long)
```

Parameters

left	The x-coordinate of the new upper-left corner.
top	The y-coordinate of the new upper-left corner.

Return Value

None

WindowSizeChanged

Called when the user resizes a stand-alone simulation window.

Syntax for event handler (in Visual Basic)

```
WindowSizeChanged(ByVal Width As Long, ByVal Height As Long)
```

Parameters

width	The new width, in pixels.
height	The new height, in pixels.

Return Value

None

CHAPTER 19

Using JavaBeans in RapidPLUS

JavaBeans™ component architecture, developed by Sun Microsystems, is an architecture for the Java environment. JavaBeans (also known as "Beans") are self-contained, re-usable components that can be deployed in a network on any operating system.

In RapidPLUS, you can incorporate JavaBeans as objects in your application. Graphic JavaBeans can be used for user interface components or special effects to enhance the user experience. Nongraphic JavaBeans can be used to implement complex application logic in Java. RapidPLUS translates the JavaBean interface into RapidPLUS events, properties, and functions available in the Logic Editor.

This chapter presents:

- How to add or register JavaBeans in the Object Layout.
- How to use JavaBean objects in RapidPLUS logic.
- How to determine the runtime behavior of JavaBean objects.
- How to debug JavaBean objects.

❖ *NOTE: In order to use a JavaBean object effectively in RapidPLUS, we recommend that you be thoroughly familiar with its specific interface elements. We also recommend that you be familiar with Java programming, especially if you want to develop your own JavaBeans.*

INTEGRATING JAVABEAN OBJECTS INTO RAPIDPLUS

There are two ways to add a JavaBean to an application:

- Add it straight from a file, without registering it.
- Register it, and then add it like any other object. When registered, a JavaBean object is added to the Object Palette and New Objects dialog box.

Before you can add or register a JavaBean in RapidPLUS, you must make sure that it is located in an appropriate folder as described in the next section.

The Search Path for JavaBean Objects

JavaBeans are stored in JAR files. Each JAR file contains one or more JavaBeans. The JAR file also contains a manifest file whose contents enable RapidPLUS to find and use the JavaBeans stored in the file.

When adding or registering a JavaBean, RapidPLUS searches for JAR files in:

- The application folder and its subfolders.*
- The RapidPLUS *objects* folder.
- The RapidPLUS *applics* folder.
- The RapidPLUS folder (wherever *Rapidxx.exe* is located).
- A search path specified by the user in the Define Search Path dialog box (Application Manager|Options|Search Path).

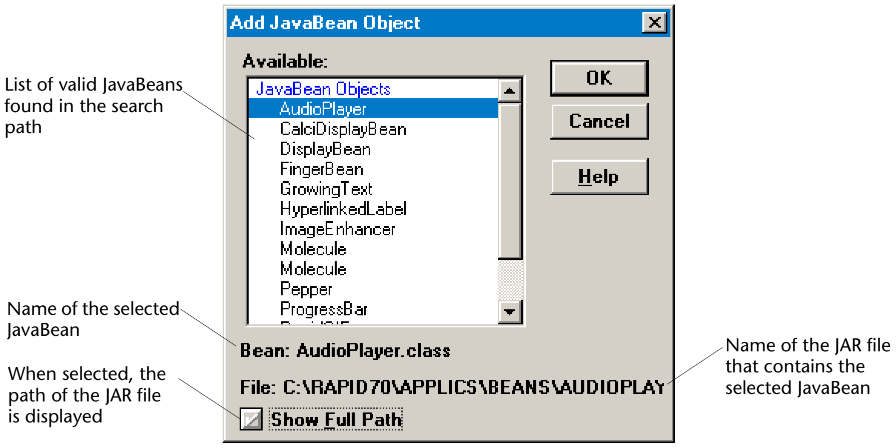
* RapidPLUS searches in the application folder and its subfolders only when the JavaBean is being added, not when it is being registered.

Adding a JavaBean to RapidPLUS

Adding a JavaBean—without registering it—means that it is added to the application's layout frame, but not to the Object Palette.

To add a JavaBean:

1 Choose Objects|Add JavaBean Object. A dialog box opens listing all the JavaBeans found.


List of valid JavaBeans found in the search path
Name of the selected JavaBean
When selected, the path of the JAR file is displayed
Name of the JAR file that contains the selected JavaBean
Add JavaBean Object
Available:
OK
Cancel
Help
Show Full Path

JavaBean Objects
AudioPlayer
CalciDisplayBean
DisplayBean
FingerBean
GrowingText
HyperlinkedLabel
ImageEnhancer
Molecule
Molecule
Pepper
ProgressBar

Bean: AudioPlayer.class

File: C:\RAPID70\APPLICS\BEANS\AUDIOPLAY

A sample Add JavaBean Object dialog box

2 Select a JavaBean object from the list and click OK. If the object is graphic, you place it on the layout frame as you would place any RapidPLUS graphic object. If the object is nongraphic, it is added to the Nongraphic Objects dialog box.

Sometimes a graphic JavaBean object will appear as an empty rectangle because it cannot draw itself while in design mode. During runtime, it will appear appropriately.

Registering a JavaBean in RapidPLUS

Registering a JavaBean in RapidPLUS adds it to the Object Palette and New Objects dialog box.

To register JavaBeans:

1. Choose Objects|Register; the Register dialog box opens.
2. In the Available list, scroll down to the JavaBean Objects section and select the JAR file you want to register, then click Add. All the JavaBeans within this JAR file are registered.

   Repeat this step for all the JAR files you want to register.
3. Click OK; the Object Palette is updated. RapidPLUS adds the JavaBean objects class icon to the left column (if it does not yet exist) and the specific icon to the right column. If a JavaBean does not have an icon of its own, RapidPLUS uses a default icon. The JavaBean object is also added to the list in the New Objects dialog box.
4. (Optional) If you want the JavaBean object to be a permanent part of the Object Palette and New Objects dialog box, save your settings (using either Options|Save Settings Now or Save Settings on Exit in the Application Manager); the registration will be saved in the *Rapidxx.ini* file.

Windowed vs. Non-Windowed JavaBean Objects

A **windowed** JavaBean object (also known as a heavyweight component) runs in its own window. A **non-windowed** JavaBean object (also known as a lightweight component) runs in the RapidPLUS window.

In general, when a JavaBean object is added to the layout frame, its inherent Java definition determines whether it is windowed or not windowed in RapidPLUS. A windowed JavaBean object cannot be changed to non-windowed; however, non-windowed JavaBean objects can be made windowed (although some may not work correctly).

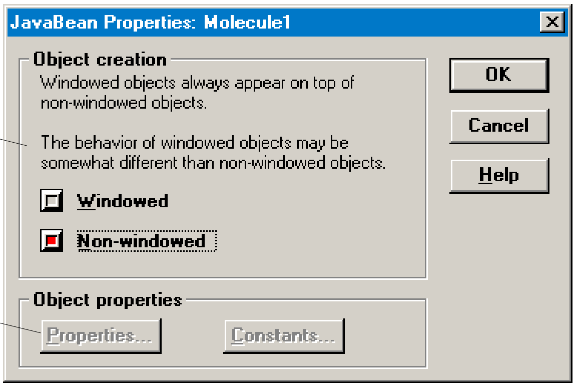
❖ *NOTE: If Java code is generated for an application, windowed and non-windowed JavaBean objects are generated according to their inherent Java definitions, regardless of settings in RapidPLUS.*

To change a non-windowed JavaBean object's window definition:

- In a JavaBean object's parameter pane, click the More button to open the its dialog box:

These two options determine whether the object will appear in its own window or as part of the RapidPLUS window

This button is available when the object is customizable. Click it to open a properties dialog box



JavaBean Properties: Molecule1

Object creation

Windowed objects always appear on top of non-windowed objects.

The behavior of windowed objects may be somewhat different than non-windowed objects.

Windowed

[✓ Non-windowed]

A sample JavaBean object dialog box

❖ *NOTE: All RapidPLUS graphic objects are non-windowed, except for the text window object, message object, and graphic multimedia objects, such as digital video.*

In the Object Layout, you control the stack order of graphic JavaBean objects like other graphic object (for details, see "Changing Stack Order in the Object Layout" on p. 21-2). During runtime, however, there is a difference in stack order behavior between windowed and non-windowed JavaBean objects.

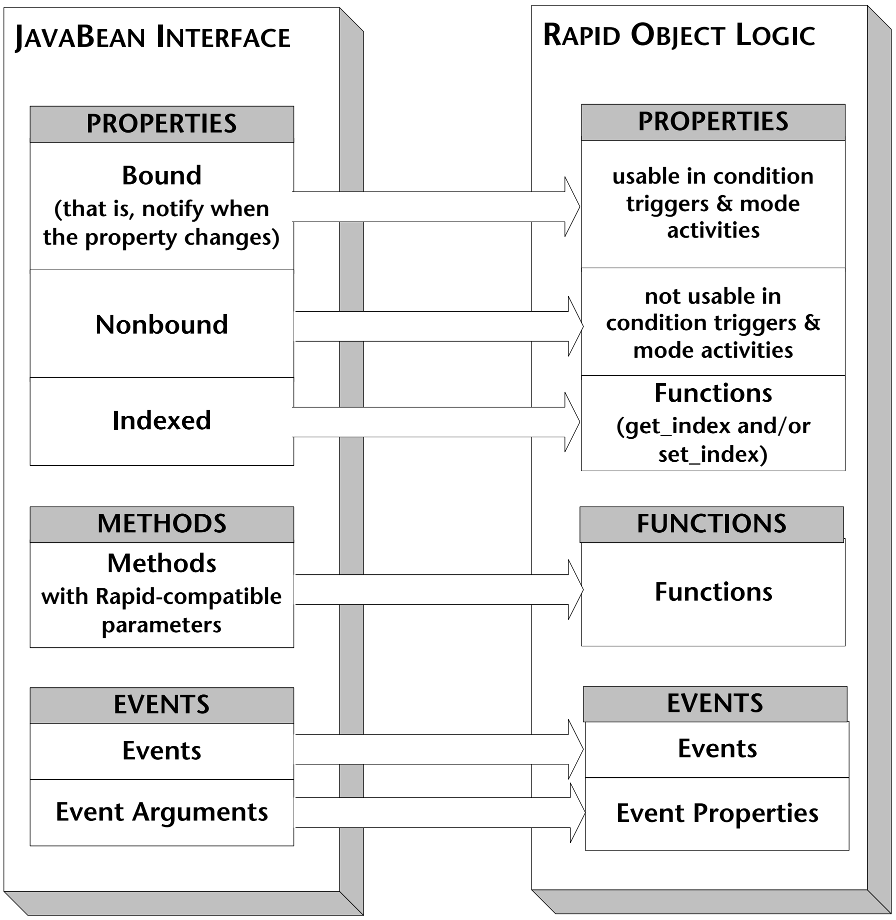
Windowed JavaBean objects are always drawn on top of non-windowed and windowed RapidPLUS graphic objects and non-windowed JavaBean objects—even if the non-windowed object is a child of the windowed object. You can, however, control the stack order among windowed JavaBean objects.

Non-windowed JavaBean objects can be transparent, semi-transparent, or non-rectangular. They maintain stack order among themselves like other RapidPLUS objects.

Windowed JavaBean objects may have slightly better graphics performance than non-windowed JavaBean objects.

LOGIC FOR JAVABEAN OBJECTS

When you register or add a JavaBean object to RapidPLUS, its properties, methods, and events are translated into RapidPLUS logic equivalents. The following diagram summarizes the translation process:


JAVABEAN INTERFACE
PROPERTIES
Bound
(that is, notify when the property changes)
Nonbound
Indexed
METHODS
Methods
with Rapid-compatible parameters
EVENTS
Events
Event Arguments
RAPID OBJECT LOGIC
PROPERTIES
usable in condition triggers & mode activities
not usable in condition triggers & mode activities
Functions
(get_index and/or set_index)
FUNCTIONS
Functions
EVENTS
Events
Event Properties

Supported JavaBean Types

JavaBean objects use Java language types for properties, function parameters, and return values. The following table summarizes the equivalent RapidPLUS data type for each Java type:

JAVA TYPE	RapidPLUS TYPE	COMMENTS
int, byte, short	Integer	
boolean	Integer	where 0 = false and 1 [or <>0] = true
float, double	Number	
String	String	
Java color (java.awt.Color)	RapidPLUS color	Like the *lineColor* or *fillColor* properties
char	Character	where character = an element of a string
Java image (java.awt.Image)	Image	
Java font (java.awt.Font)	Font	

The Java image and Java font types are special types that were added to support JavaBeans that require them. Although they are not the same as RapidPLUS image and font objects, you can assign a RapidPLUS bitmap to a JavaBean object's *image* property. For example:

JavaBean1.image := Bitmap1

This assignment capability is expensive and should be used sparingly.

Functions for the JavaBean object's *image* and *font* properties are described in the following tables.

Image

FUNCTION	DESCRIPTION	EXAMPLE
:=	Allows the assignment of one *image* property to another.	**Bean1.image := Image2.image**
**loadFromFile: <string>*	Loads an image from the specified file. ❖ *NOTE: If you do not specify a path, RapidPLUS searches in the RapidPLUS search path (as described on p. 19-2).*	**Bean1.image loadFromFile: 'c:\images\mouse.ico'**
**clear*	Clears the image.	**Bean1.image clear**
width	Returns the image width, in pixels.	**Int1 := Bean1.image width**
height	Returns the image height, in pixels.	**Int1 := Bean1.image height**

* These functions are not supported for Java code generation. Instead of using the *loadFromFile*: function to load an image, you can assign a bitmap object to the *image* property as described on the previous page.

Font

FUNCTION	DESCRIPTION	EXAMPLE
:=	Assigns the attributes of one font property to another font property.	**Bean1.font := Bean2.font**
=	Returns TRUE if the font properties have the same properties.	**& Bean1.font = Bean2.font**
**boldGet*	Returns 1 if the bold attribute is set, 0 if not.	**Int1 := Bean1.font boldGet**
**boldSet: <integer>*	Sets the font to bold (1) or non-bold (0).	**Bean1.font boldSet: 1**
**italicGet*	Returns 1 if the italic attribute is set, 0 if not.	**& Bean1.font italicGet = 1**

FUNCTION	DESCRIPTION	EXAMPLE
**italicSet: <integer>*	Sets the font to italic (1) or non-italic (0).	**Bean1.font italicSet: 0**
**nameGet*	Returns the font name, as a string.	**Str1 := Bean1.font nameGet**
**nameSet: <string>*	Sets the font name to the specified string.	**Bean1.font nameSet: 'Arial bold'**
**sizeGet*	Returns the font size, in points.	**Number1 := Bean1.font sizeGet**
sizeSet: <number>	Sets the font size, in points.	**Bean1.font sizeSet: 7.5**

* These functions are not supported for Java code generation.

Properties

JavaBean properties appear as properties of RapidPLUS JavaBean objects, provided that their property type is one that is supported by RapidPLUS (see p. 19-7 for a list of supported types).

JavaBean properties can be:

- **Bound**: they notify RapidPLUS when their value has changed. This type of property can be used in condition triggers and mode activities.

  Or:

  Nonbound: changes to their values are not broadcast to RapidPLUS. This type of property can not be used in condition triggers and mode activities.

- **Indexed**: an array-like property that uses indexes to retrieve a specific value. Indexed properties do not appear in the Logic Palette in the Property column; they are converted to a pair of RapidPLUS functions:

  <**propertyName>Get_index: <integer>** Returns the value in the specified index.

  <**propertyName>Set_index: <integer> value: <value>** Writes the specified value in the specified index.

  Some properties have both of these functions; some properties only have one of them.

Functions

JavaBean public methods appear as functions of RapidPLUS JavaBean objects, provided that their argument types, including return values, are supported by RapidPLUS (see p. 19-7 for a list of supported types).

Building Descriptive Functions

Sometimes, when a JavaBean method is mapped to RapidPLUS, it loses descriptive information. For example, the method:

```
public void drawCircle(int centerX, int centerY, int radius)
```

may appear in RapidPLUS as:

Bean1 drawCircle_int: <Integer> int: <Integer> int: <Integer>

This function is not descriptive and does not indicate the meaning of each parameter. It would be better if the function would appear like:

Bean1 drawCircle_centerX: <Integer> centerY: <Integer> radius: <Integer>

There are two ways to get descriptive functions:

- Compile the Java class with debug information. RapidPLUS will take the descriptive argument names directly from the Java class. If you are using JDK, just run javac with the -g flag. If you are exporting from IBM® Visual Age® for Java™, make sure you check “include debug attributes in classes.” Other tools have different ways of doing this, but it’s usually enabled by default.
- Write a BeanInfo class for the JavaBean with method descriptors for each method; however, this way is not recommended if all you want is descriptive method names. For information about the BeanInfo class, see p. 19-12.

Events

JavaBean events define a listener interface and an event object class. The listener interface includes one or more methods that are called when the event occurs. Each method gets an event object as an argument. The event object may contain additional properties that are part of the event.

JavaBean events are mapped to RapidPLUS events and appear in the Function/Event column like other RapidPLUS events.

The arguments included in the event object are mapped to specialized properties of the JavaBean object. They appear in the Properties column with the following syntax:

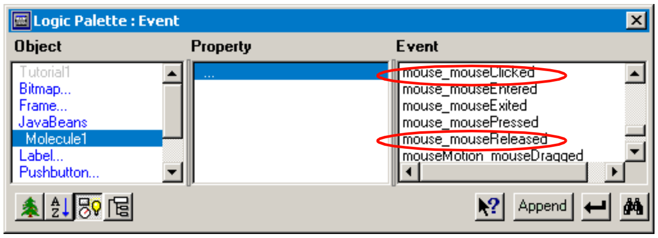
ev_<eventName>_<propertyName>

Event properties are valid only after the event has occurred. You get invalid values if you attempt to read an event property's value without its event having been triggered; therefore, they should be used only in the actions of a transition that triggers the event.

Example

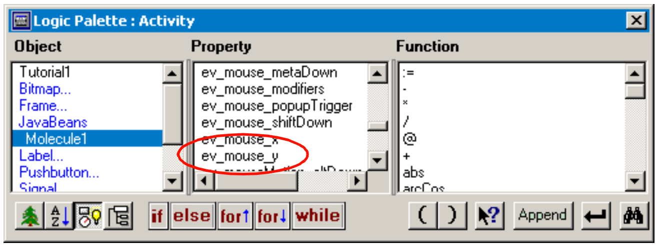
A JavaBean object has an event called "Mouse." It defines a listener interface called "MouseListener" which includes several methods, such as: `void mouseClicked` (MouseEvent event) and `void mouseReleased` (MouseEvent event). Each of these methods defines a different manifestation of the Mouse event. One is called when the user clicks the mouse button; the other is called when the user releases the mouse button.

In RapidPLUS, these events will be events of the *self* property:



The event, *mouse_mouseClicked* is triggered when the user clicks the mouse button in the Prototyper; the event, *mouse_mouseReleased*, is triggered when the user releases the mouse button.

The Mouse event object has properties. In RapidPLUS, these properties will be specialized properties of the JavaBean object:



The properties circled above provide the location (x and y integer values) of the mouse when the event occurs.

Using the BeanInfo Class to Define the Logic Interface of JavaBeans

The JavaBean interface to the RapidPLUS logic (properties, events, and functions) is derived from its Java class definition. By default, Java uses a process called introspection to look at the Bean public class methods and derive the JavaBean interface from there. When this process is used, usually the JavaBean object in RapidPLUS will have many properties, events, and functions, not all of them relevant for the RapidPLUS user.

The JavaBean specification allows using a BeanInfo class to define the exact interface the JavaBean will have. This interface will also appear in the RapidPLUS logic. If you are using commercial JavaBeans, most likely they will contain BeanInfo classes to specify the exact interface of the bean in Java GUI design tools, and this interface will also appear in RapidPLUS.

If you are developing your own JavaBeans, you can use the BeanInfo class to control exactly which functions, properties, and events will appear in the RapidPLUS logic. This gives you the same control you have when developing other RapidPLUS objects like RPX and user objects.

For more information on BeanInfo classes, refer to the JavaBean specification from Sun Microsystems.

CHECKING THE RUNNING STATUS OF JAVABEAN OBJECTS

JavaBean objects can be programmed to check their own running status—that is, whether they are currently in design time (Object Layout) or runtime (Prototyper or LiveManuals). This capability enables each JavaBean object to draw a default representation of itself in the Object Layout.

Step 1: Implement BeanContextChild

Each JavaBean object must implement the BeanContextChild interface (com.esim.accessibility.beans.BeanContext). This interface is part of the LiveManuals Java classes and can also be found at <Rapidxx folder>\java\jb-Wrapper\. We recommend that you place *BeanContextChild.class* inside the JavaBean object's JAR file, so that it will work in RapidPLUS, and as a standalone JavaBean.

In addition, two other class files must be placed inside the JavaBean object's JAR file: com.esim.accessibility.beans.BeanContext and com.esim.util.Light-weightCollection.

Step 2: Supply a BeanContext Object to Query Status

After the JavaBean object implements the BeanContextChild interface, RapidPLUS will call the JavaBean object's setBeanContext method and supply it with a BeanContext object. This object is used to query the JavaBean about its status—whether the object is in design time or runtime—by calling its isDesignTime method.

❖ *NOTE: We recommend that you call the isDesignTime method from the paint method.*

An example application, *CounterButton2.rpd*, is provided to demonstrate a JavaBean object that draws a default representation in the Object Layout. It also includes comments about how to implement the BeanContextChild interface (located in the \\Examples\Objects\JavaBeans\BeanContext folder).

IMPLEMENTING RECORDABLE EVENTS FOR JAVABEAN OBJECTS

In both RapidPLUS and the Scenario Authoring Tool, events (also known as user actions) performed with RapidPLUS objects can be recorded and replayed. In RapidPLUS, recorded events can be replayed in the Prototyper and in the Rapid Reviewer, and can be added as use and test cases in the Document Manager. In the Scenario Authoring Tool, recorded events become an integral part of scenarios/guided tours, which are used with LiveManuals simulations in Web browsers.

JavaBean objects can be programmed so that events performed with them can be recorded, just like other RapidPLUS objects. The required code changes are explained in this section via an example JavaBean object called "CounterButton." This JavaBean object is based on the CounterButton bean from the Sun Bean Development Kit. It comprises a simple button that has a counter displayed in the center of the button. Clicking the button increments the counter and generates an event (called an action in Java).

In our example we created a new JavaBean object, "CounterButton-Recordable" (referred to in this document as the "Bean object"), which extends the functionality of CounterButton, including changes to make its click event recordable.

❖ *NOTE: The CounterButtonRecordable JavaBean object cannot be used in production; it is only provided for instructional purposes.*

Step 1: Implement RapidAccessible

The Bean object's class must implement the RapidAccessible interface (com.esim.accessibility.interfaces.RapidAccessible). This interface is part of the LiveManuals Java classes and can also be found at <Rapidxx folder>\java\jb-Wrapper\. We recommend that you place RapidAccessible.class inside the Bean object's JAR file, so that it will work in RapidPLUS and as a standalone JavaBean.

The RapidAccessible interface defines three methods:

METHOD	DESCRIPTION
addRoutableValue-Listener	Adds/removes listeners for recordable events. A recorder (like the Scenario Authoring Tool) usually adds a listener to a JavaBean, and the JavaBean notifies it whenever the user triggers a recordable event in the JavaBean, so that it can record it.
removeRoutableValue-Listener	
injectRoutableValue	Plays back an event. It is typically called from the Scenario Player applet.

These methods are used in the following steps.

Step 2: Use the Helper Class, RapidRoutingSupport

A class file called RapidRoutingSupport (com.esim.helpers.RapidRouting-Support) helps implement recordable events in the Bean object. This class should be packed together with the Bean object's JAR file. (It's small.)

2.1 Add a RapidRoutingSupport member variable to Bean class

```
// recordable events support
protected RapidRoutingSupport routingSupport;
```

2.2 Implement addRoutableValueListener and remove RoutableValueListener

Implement addRoutableValueListener and removeRoutableValueListener. These methods are usually implemented the same way in every JavaBean object, using the RapidRoutingSupport class:

```
/**
 * Add a listener that allows notification of value changes
 * that can be recorded or routed via the extension services.
 * @param listener java.beans.VetoableChangeListener
 */
public void addRoutableValueListener(VetoableChangeListener
 listener)
{
   if (routingSupport == null)
      routingSupport = new RapidRoutingSupport(this);

   routingSupport.addRoutableValueListener(listener);
}
```

```
/**
 * Remove a listener that allows notification of value changes
 * that can be recorded or routed via the extension services.
 * @param listener java.beans.VetoableChangeListener
 */
public void removeRoutableValueListener(VetoableChangeListener
 listener)
{
   if (routingSupport == null)
    return;

   routingSupport.removeRoutableValueListener(listener);
    }
```

Now, whenever the user triggers a recordable event in the Bean object, the Bean object should notify the Recorder about it, so that the event will be recorded.

Step 3: Implement Event Recording

A recordable event consists of a textual description (string) and zero or more numeric arguments. The RapidRoutingSupport class provides several routeEvent methods that allow you to pass events to the recorder, with or without arguments.

The recorder can prevent the event from happening, by throwing a Property-VetoException. This exception is caught by the RapidRoutingSupport object and causes the routeEvent method to return FALSE. In the Bean object's code, you should check the result of routeEvent, and if it returned FALSE, the Bean object must not fire the event or change its state in any way resulting from the event. In the case of the CounterButton JavaBean object, this object fires the "action" event and increments its counter. Neither of these actions should happen if the recorder vetoed the event.

In the CounterButton JavaBean object, a button click occurs when the user presses and releases the mouse. This event is handled in the mouseReleased method:

```
public void mouseReleased(MouseEvent evt) {
   if (!isEnabled()) {
   return;
   }
   if (down) {
   down = false;
   repaint();
    fireAction();
   }
}
```

The “fireAction()” call fires the action event and increments the button counter. In that point, we need to pass the event to the recorder. Let’s call the event “clicked” (it can be given any name of course). The code is modified as follows for the Bean object:

```
public void mouseReleased(MouseEvent evt) {
   if (!isEnabled()) {
   return;
   }
   if (down) {
   / repaint the button so it would be shown in the "released" state.
   // this is done regardless if the clicked event is triggered or not
   down = false;
   repaint();

   // route event for recording
   // routeEvent will return false if the event was vetoed by some
       // listener, in this case the event should not be fired, and the
   // change in the button state as a result of the event (that is
   // incrementing the counter) should not be performed
   // the routeEvent returns true if the event was approved (router
   // may veto the event)
   // the fireAction method will also increment the counter
   if(routingSupport == null || routingSupport.routeEvent(''clicked''))
      fireAction();
   }
}
```

Note the checking of the return value of routeEvent. If routeEvent returns FALSE, it means that the recorder intercepted the event and wants to prevent it from happening. In that case, the Bean object should not trigger the event nor increment the counter.

Step 4: Implement injectRoutableValue

Now you need to implement the injectRoutableValue method in order to play back recordable events. Again, the RapidRoutingSupport class provides methods to analyze the received event. You can extract the event description and one of its arguments (if it has arguments).

In the case of Bean object, we need to check for one event type: the “clicked” event. Here is the code that checks for it:

```
/**
 * Inject a routable value. This should cause the receiver
 * to trigger a change in state, identical to that caused by
 * an event that generated the routable value.
 * A new routableValue event should not be fired.
 * @param value java.lang.Object
 */
public void injectRoutableValue (Object value)
{
    // extracts the event description
    String desc = RapidRoutingSupport.extractDescription(value);

    // handle the "clicked" event
           if (desc.equals("clicked"))
       fireAction(); // simulate push button click
 }
```

That's it! The Bean object now fully supports one recordable event: "clicked." The button is fully usable for scenario recording, just like a regular RapidPLUS button.

Step 5: Compare the Recordable and Nonrecordable JavaBean Objects

Several files are provided that demonstrate the differences between the recordable and nonrecordable JavaBean objects (located in the \\Examples\JavaBeans\RecordableEvents folder). The *counterbuttons.jar* file contains both the CounterButton and CounterButtonRecordable JavaBean objects, including source code and support classes (RapidAccessible and RapidRoutingSupport). These JavaBean objects are used in an example application, *Recordable_Events.rpd*. A sample document (created in the Document Manager) contains use cases recorded for the two JavaBean objects.

Note that when a JavaBean object does not support recordable events (does not implement the RapidAccessible interface), RapidPLUS records all mouse and keyboard events related to the JavaBean object, so it will still work but the use case will be much larger (for example, the use case for the CounterButton JavaBean object has many more events because it does not support recordable events).

DEBUGGING JAVABEAN OBJECTS

JavaBean objects can be debugged like any other RapidPLUS object, using the Debugger and Inspector. When the code of JavaBean objects needs to be debugged, a Java console is provided.

Using the Java Console

The Java console is a RapidPLUS-supplied window that displays output from Java. All output to the Java system output and error streams go to this Java console. Here is an example of Java code that outputs to the Java console:

```
System.out.println ("hello from javabean");
```

To open the Java console:

1. In the Application Manager, choose Options|Java Console.
2. The Java console opens, displaying output from Java, including debug output from the JavaBean object.

JavaBean Incompatibility

RapidPLUS works best with the Java Virtual Machine (JDK/JRE) version1.3.x. If a JavaBean is not compatible with the JVM used, the JavaBean object will either not run or will partially work. You can manually select a different JVM for RapidPLUS to use.

To select a different Java Virtual Machine:

1. In the Application Manager, choose Options|Select Java VM to Use; a dialog box opens for selecting a *jvm.dll*.
2. Select the appropriate *jvm.dll* and click Open.

   jvm.dll is located in the JDK/JRE installation folder, usually inside the jre\bin folder.
3. Close and reopen RapidPLUS so that the new JVM setting will take effect.

Debugging Java Code Running Inside RapidPLUS

In order to debug JavaBean objects running inside RapidPLUS, you must instruct the JVM to listen for Debugger connections. To do so, you must make certain modifications in the *Rapidxx.ini* file under the [RPJavaManager] section. In this section, you specify extra arguments to the JVM in the form of JVMArgumentX lines, where X is a number between 1-99. This can be used for other things, such as specifying an extra class path.

Example

In this example, the JVM is instructed to listen for Debugger connections using TCP/IP in port 25000.

```
[RPJavaManager]
JVMArgument1:-Xdebug
JVMArgument2:-Xnoagent
JVMArgument3:-Xrunjdwp:transport=dt_socket,server=y,suspend=n,
 address=25000
```

After opening an application containing JavaBean objects, you can attach to the JVM running inside RapidPLUS using any Java tool that supports remote debugging. Unfortunately, most commercial Java tools support this only in their “enterprise” edition, but you can use free tools, such as NetBeans (http://www.netbeans.org).

DISTRIBUTING APPLICATIONS WITH JAVABEAN OBJECTS

If you are packaging your application for running in the Rapid Reviewer, do not forget to include each JavaBean object’s JAR file and instruct the end-user to copy the file(s) anywhere in the RapidPLUS search path (as explained on p. 19-2).

When the end-user runs the application in the Reviewer, RapidPLUS will search for the appropriate Java Virtual Machine (JRE or JDK) version. If the end-user’s system doesn’t have this version installed, RapidPLUS will search for a suitable JRE or JDK installation. If RapidPLUS cannot find a suitable installation, the application will not run (see p. 19-19 for more information).

When you distribute JavaBeans that you developed, you can compile the Java classes without debug information and put the compiled classes in the JAR file in order to save space.

CODE GENERATION

JavaBean objects are supported in Java code generation. For information, refer to the *Generating Web Simulations* manual.

CHAPTER 20

OpenGL Object

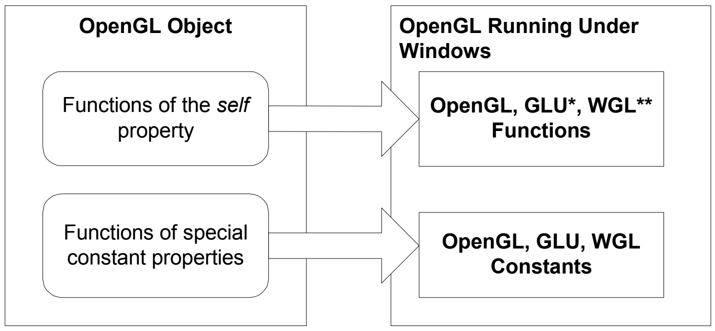
The OpenGL object interfaces with the OpenGL library (and extensions) in order to implement complex graphic objects in RapidPLUS applications. OpenGL is a platform-independent graphics library that supports the fast rendering of 2-D and 3-D graphics, including the following features:

- Rendering of graphic primitives (points, lines, polygons, curves, etc.) in 2-D or 3-D space—framed, filled, or patterned.
- Incorporation of materials, lighting, fog, reflections, and shadows in order to enhance the realism of scenes.
- Drawing bitmap images, including scaling, rotation, transparency, and other effects.
- Mapping textures (images) on complex objects.
- Transformation of an object in 3-D space, allowing animation effects such as rotating, scaling, and moving the scene.

OpenGL does not include functions for window management, user interaction, or file I/O. Each host environment (in our case, Microsoft Windows) must implement some means of handing over to OpenGL the drawing control of a window or bitmap.

OVERVIEW

The following diagram illustrates how the OpenGL object works in the RapidPLUS environment:


OpenGL Object
Functions of the *self* property
Functions of special constant properties
OpenGL Running Under Windows
OpenGL, GLU*, WGL** Functions
OpenGL, GLU, WGL Constants

* GLU is an OpenGL extension that provides a higher-level interface to complex tasks, such as perspective setting, texture mapping, and drawing complex objects.

** WGL is a Microsoft extension that allows OpenGL to run under Windows. The OpenGL object supports the WGL functions that allow you to use Windows fonts to write text with OpenGL.

The OpenGL library and its extensions (GLU and WGL) contain more than 450 functions, of which approximately 100 are supported by the OpenGL object. Most of the unsupported functions are simply overlapped functions, i.e., similar functions that take different types of arguments.

The OpenGL object may support only one version, thus simplifying the interface without sacrificing functionality. For example, of the functions *glVertex2f*, *glVertex2i* and *glVertex2s*, the OpenGL object only supports *glVerex2f*. Other unsupported functions take arguments such as void* or bit arrays—data types which RapidPLUS does not support.

Purpose of This Chapter

This chapter explains how to define and use an OpenGL object in a RapidPLUS application. It assumes that you are already familiar with the OpenGL library and its extensions.

For information on specific functions and routines, please refer to your OpenGL documentation.

ADDING AN OPENGL OBJECT TO THE OBJECT LAYOUT

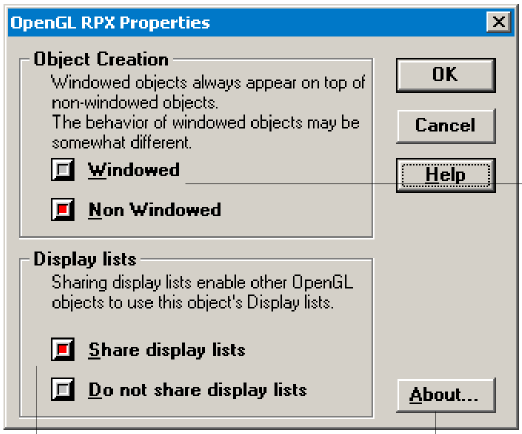
1 From the Object Palette, select the OpenGL class icon and then the OpenGL object icon.

2 Place and size the OpenGL object on the Object Layout work area as you would any graphic object.

The size of the OpenGL object determines the default dimensions (and proportions) of the viewport within which the OpenGL image is displayed during runtime.

Setting the Object's Parameters

- Click the More button in the parameter pane to open the OpenGL RPX Properties dialog box:



OpenGL RPX Properties

Object Creation

Windowed objects always appear on top of non-windowed objects.
The behavior of windowed objects may be somewhat different.

☐ Windowed

[✓ Non Windowed]

Display lists

Sharing display lists enable other OpenGL objects to use this object's Display lists.

[✓ Share display lists]

☐ Do not share display lists

Selects the window status, as explained in "Windowed vs. Non-Windowed" on p. 20-4

Selects the display list status, as explained in "Display Lists" on p. 20-4

Click to display information about the OpenGL and GLU DLLs currently installed on your computer

Windowed vs. Non-Windowed

A **non-windowed** OpenGL object runs directly in the Prototyper, like most of the RapidPLUS graphic objects. A **windowed** OpenGL object runs in its own window within the Prototyper window (like windowed ActiveX controls, the text window object, the message object and graphic multimedia objects).

The differences in behavior between non-windowed and windowed OpenGL objects can be summarized as follows:

	WINDOWED	NON-WINDOWED
Stack order (Z-order) during runtime	Can only be controlled relative to other windowed objects. ❖ *NOTE: **Any** windowed object will always be in front of **any** non-windowed object.*	Can only be controlled relative to other non-windowed objects.
Transparency	None of its colors can be made transparent.	Like any graphic object, one of its colors can be made transparent.
Performance	Depending on the platform, **may** have enhanced performance.	

❖ ***IMPORTANT:*** *Some graphic card drivers (especially old drivers) do not properly support non-windowed OpenGL. If you experience problems using the non-windowed mode, try the windowed mode. If this works, try to install the latest driver for your graphic card. Updating your Windows operating system with the latest service pack may also help.*

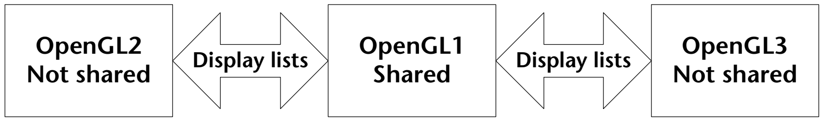
Display Lists

A display list encapsulates a set of OpenGL commands (and their results), which you can then invoke as a single routine by simply naming the display list. Display lists optimize rendering by creating a library of complex objects, each comprised of a number of OpenGL geometric and/or image primitives. The price, however, is heavier demands on memory space.

If you choose the Share display lists option for an OpenGL object, then its display lists will be available to all other OpenGL objects in the application that have the same window status (windowed or non-windowed).

❖ *NOTE: If an OpenGL object shares its display lists, then the display lists of the other OpenGL objects in the application are available to it as well, even if they do not explicitly share their display lists. However, objects that do not share their display lists have no access to each other's display lists.*

In the following illustration, for example, OpenGL2 and OpenGL3 would have no knowledge of each other's display lists.



About Your OpenGL and GLU DLLs

To view information about the OpenGL and GLU DLLs currently installed on your system:

- Click the About button in the object's More dialog box.

Editing Colors

Each OpenGL object has a fill and a background color. In the Object Layout, the fill color determines the color of the OpenGL object's label, while the rest of the object's bounding box is painted in the background color. During runtime, the fill and background colors are the object's default colors, which are changed by calling one of the OpenGL color functions.

You can change the object's fill and background colors in the Color Editor. You can also set one of the colors, or any other color, as transparent.

❖ *NOTE: During runtime, transparency is only relevant for non-windowed OpenGL objects, as described in "Windowed vs. Non-Windowed" on p. 20-4.*

Adding Quadric and Tessellator Data Objects

Some of the GLU functions that support the drawing of simple three-dimensional geometric shapes (i.e., cones, cylinders, disks, and spheres) take quadric data objects as arguments. Similarly, some of the GLU functions that support the drawing of complex polygons and surfaces take tessellator data objects as arguments.

In order to implement these functions (as explained in “Initializing and Using Quadric and Tessellator Data Objects” on p. 20-9), you must first add an instance(s) of the quadric or tessellator data object in the Object Layout.

To add a quadric or tessellator data object in the Object Layout:

- In the Object Palette, select the OpenGL class icon and then the Quadric or Tessellator object icon.

❖ *NOTE: A single quadric or tessellator data object can be shared among multiple OpenGL objects.*

IMPLEMENTING IN THE APPLICATION LOGIC

OpenGL Functions and Constants in RapidPLUS Syntax

Functions

The OpenGL RPX function names preserve the OpenGL names, with the first argument concatenated by an underscore. For example:

```
glVertex2f (Glfloat x, Glfloat y)        ➔        glVertex2f_x: y:
```

The OpenGL and GLU functions are accessed in the Logic Palette through the OpenGL object’s *self* property.

Pointer Parameters

Some OpenGL and GLU functions have pointers to arrays as parameters. RapidPLUS functions, however, cannot use pointers as arguments. Where the maximum size of the array pointer parameter is known, the OpenGL function is supported in RapidPLUS by adding arguments that set the value of each array element.

Example

The OpenGL library includes several variations of a *glLight* function for setting the light source parameters for one of the eight available light sources. One of the OpenGL function declarations is as follows:

```
void GLLightfv (GLenum light, GLenum pname, const GLfloat *params);
```

where:

light	is a constant that specifies which light source is being modified (from GL_LIGHT0 to GL_LIGHT7).
pname	is a constant that specifies which lighting parameter is being set.
* *params*	is a number array with four elements. For example, the lighting parameter GL_POSITION uses the first three elements to specify the position of the light source and the fourth to specify whether or not the light source is directional.

In RapidPLUS, this OpenGL function is implemented as follows:

```
glLightfv_light: pname: param1: param2: param3: param4:
```

Thus, if we wanted to use potentiometers to control the position (gl_POSITION) of a light source (gl_LIGHT0), the internal action or the mode activity would look something like:

```
OpenGL1 glLightfv_light: OpenGL1.cA gl_LIGHT0
pname: OpenGL1.cM gl_POSITION param1: Potentiometer1.value
param2: Potentiometer2.value param3: Potentiometer3.value param4: 1
```

Properties and OpenGL Constant Values

In addition to the *self* property, each OpenGL object has three properties through which the OpenGL and GLU constant values are made available as read-only functions. These properties are:

PROPERTY	FUNCTIONS
cA	All OpenGL constants whose names (after the GL_ prefix) begin with the letters A through L. Names that begin with non-alphabetic symbols are also included in this list.
cM	All OpenGL constants whose names (after the GL_ prefix) begin with the letters M through Z.
cGLU	All GLU and WGL constants.

❖ *NOTE: The OpenGL and GLU constant prefixes (GL_ and GLU_, respectively) are lowercase in RapidPLUS. Thus, the OpenGL constant **GL_LINE_STRIP** is **gl_LINE_STRIP** in RapidPLUS.*

Example

Calling glBegin ( ) with the constant argument GL_LINE_STRIP:

IN C	IN RapidPLUS
glBegin(GL_LINE_STRIP)	GLObj glBegin_mode: GLObj.cA gl_LINE_STRIP

Functions That Return Values

Some OpenGL and GLU functions that return a value do so through two parameters:

- *pname*: an OpenGL or GLU constant that identifies the parameter ("Pointer Parameters" on p. 20-7).
- *value*: the value returned by the function.

These functions are implemented in RapidPLUS by a single *pname* argument whose value is returned as the function result, such as:

```
glGetBooleanv_pname:
glGetFloatv_pname:
```

Initializing and Using Quadric and Tessellator Data Objects

RapidPLUS allocates memory for each quadric or tessellator data object added in the Object Layout (see “Adding Quadric and Tessellator Data Objects” on p. 20-6). Before you can use the object as an argument in a GLU function, however, you must initialize it by assigning the result of the *gluNewQuadric* or *gluNewTess* function, as follows:

```
quadric1 := OpenGL1 gluNewQuadric
tess1 := OpenGL1 gluNewTess
```

Once initialized, you can use the object in a GLU function, as follows:

```
OpenGL1 gluDisk_qObj: quadric1 innerRadius: 0.5 outerRadius: 0.8 slices: 10 loops: 5
```

❖ *NOTE: Using an uninitialized quadric or tessellator data object causes a non-fatal runtime error. Should the user choose to continue, the object is automatically initialized. The runtime error is only significant if the application is for code generation.*

You have to delete initialized quadric or tessellator objects before terminating the application, as follows:

```
OpenGL1 gluDeleteQuadric: quadric1
OpenGL1 gluDeleteTess: tess1
```

❖ *NOTE: Terminating the application without deleting an initialized object causes a non-fatal runtime error. The object is then automatically deleted. The runtime error is only significant if the application is for code generation.*

Error Handling

OpenGL essentially ignores errors generated during runtime. RapidPLUS, however, captures OpenGL errors as non-fatal runtime errors. You can then choose to continue running the application or to stop the Prototyper. You can incorporate the read-only *glGetError* function into logic like the following, in order to display the OpenGL error strings:

```
TextDisplay1.contents := OpenGL1 gluErrorString_errCode: OpenGL1 glGetError
```

Implementing Raster Images

The OpenGL object uses RapidPLUS bitmaps to implement the rendering of full-color raster images. The following table presents a summary of the five OpenGL object functions that render raster images for drawing backgrounds and applying textures.

Table 1: OpenGL Object Functions that Support Raster Images

FUNCTION	COMMENTS
glDrawPixels_width: height: format: type: pixels:	The *pixels* argument is a RapidPLUS bitmap. The *width, height, format,* and *type* arguments are set internally. Since these arguments are ignored, you can set them to zero in the Logic Editor. ❖ *NOTE: RapidPLUS changes bitmap dimensions so that they are always a power of 2 without attempting to maintain aspect ratio. This implementation may cause some bitmap images to appear distorted.*
glTexImage1D_target: level: internalformat: width: height: border: format: type: pixels: *or*	The *pixels* argument is a RapidPLUS bitmap with a height of 1 pixel. All arguments except for *pixels, level,* and *border* are set internally, and can be set to zero in the Logic Editor.
glTexImage2D_target: level: internalformat: width: height: border: format: type: pixels:	Same as above, except that the *pixels* argument is a RapidPLUS bitmap of any size.
gluBuild1DMipmaps_target: components: width: height: format: type: data: *or*	The *data* argument must be a Windows bitmap with a height of 1 pixel. The *format* and *type* arguments are set internally and can be set to zero.
gluBuild2DMipmaps_target: components: width: height: format: type: data:	Same as above, except the *data* argument is a Windows bitmap of any size.

Implementing WGL Functions

OpenGL is a graphics library, leaving issues of user interaction and window handling to the host environment. In order to allow window and user interface management in Windows, a number of functions have been added to the OpenGL API. The prefix for these functions is WGL. The OpenGL object supports the following two WGL functions:

- wglUseFontBitmaps
- wglUseFontOutlines

❖ *NOTE: These functions are not supported for code generation (see "Code Generation" on p. 20-12).*

Redrawing (Swapping Buffers)

In order to support smooth drawing or animation, Windows uses a double-buffered pixel format. In this format, a window has a front (displayed) and back (hidden) image buffer. Drawing commands are sent to the back buffer, and the Windows SwapBuffers function has to be called to copy the contents of the hidden back buffer to the displayed front buffer. The RapidPLUS OpenGL object implements buffer swapping through the *redraw* function.

❖ *NOTE: The redraw function also implicitly calls the glFinish function (causing any unexecuted OpenGL commands to be executed).*

The *redraw* function has to be called in order to make image changes visible in the application.

Drawing Text

The function *glCallLists_n: type: lists:* is used to write text. Its *lists* argument supports only unsigned bytes, represented as a RapidPLUS string. Thus, the arguments *n* (normally used to specify the size of the display list array) and *type* (normally used to specify the data type of the array stored by *lists*) are set internally and their values are ignored during runtime.

Example

```
\\Create 96 display lists, each one a character bitmap in the
specified font, starting with character 32 and ending with character
128. The ID of the first display list is 2000.
OpenGL1 wglUseFontBitmaps_name: 'Times New Roman' first: 32
count: 96 listBase: 2000
\\Set the base display list ID
OpenGL1 glListBase_base: 2000 - 32
 \\Call a series of display lists, based upon the specified string
OpenGL1 glCallLists_n: 0 type: 0 lists: 'e-SIM Ltd.'
```

CODE GENERATION

The OpenGL object is fully supported for C code generation for target platforms with OpenGL support, except for the WGL functions (see "Implementing Raster Images" on p. 20-10). An OpenGL context is created for each OpenGL object in the application. The functions of the constant properties (*cA*, *cM* and *cGLU*) are mapped to OpenGL constants using C macros.

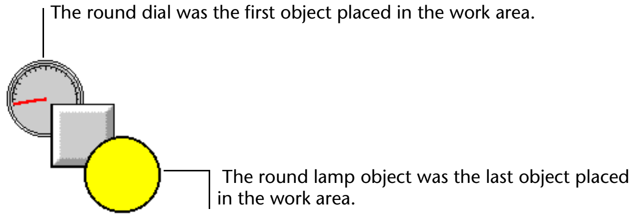
❖ *NOTE: The functions that take bitmaps as arguments (see "Implementing Raster Images" on p. 20-10) are not currently supported for code generation.*

The integrator will have to implement some initializing code, such as creating and initializing a window and implementing some platform-dependent functions such as *redraw*.

C H A P T E R 2 1

Graphic Object Stack Order

The stack order of graphic objects (including active primitive objects) determines which objects appear on top of, or behind, other graphic objects in the application. The first graphic object placed on the layout is at the bottom of the stack, and any subsequent overlapping graphic objects are superimposed on top of it.


The round dial was the first object placed in the work area.
The round lamp object was the last object placed in the work area.

Three overlapping graphic objects

❖ *NOTE: Stack order applies to graphic objects only. Nongraphic objects have no stack order.*

You can change the stack order of graphic objects and object groups in the RapidPLUS application, both in the Object Layout and dynamically, during runtime.

CHANGING STACK ORDER IN THE OBJECT LAYOUT

To change stack order:

1 Select the object(s) or object group(s) to move in the stack order.

2 Choose Layout|Order to display the stack order options, and choose one:

OPTION	DESCRIPTION
Bring to Front	Places the selected object(s) in front of all the other objects.
Send to Back	Places the selected object(s) behind all the other objects.
Bring Forward	Moves the selected object(s) forward one level.
Send Backward	Moves the selected object(s) back one level.
Bring in Front of	Places the selected object(s) in front of the object specified in the Order Objects dialog box (see “Bringing In Front Of or Sending To Back Of” on p. 21-2).
Send to Back of	Places the selected object(s) behind the object specified in the Order Object dialog box (see “Bringing In Front Of or Sending To Back Of” below.)

About Groups

If you select an object group, changing the stack order moves **all** the objects in the group. The objects within the group do not change their stack order. If an object is part of an object group, its stack order can only be changed within the object group. That is, the change in the stack order affects only the appearance of the objects within the group.

Bringing In Front Of or Sending To Back Of

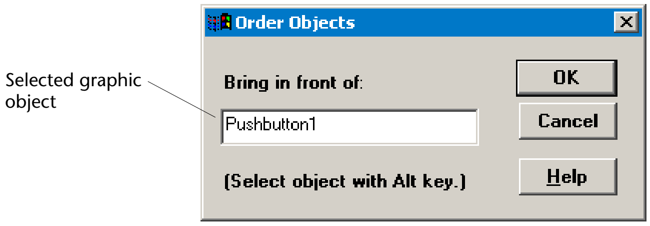
Choosing either “Bring in Front of” or “Send to Back of” opens the Order Object dialog box. In this dialog box, you specify the object that the selected objects will move in front of or in back of.

To bring object(s) in front of or send to the back of another object:

1 Select the object(s) whose stack order you want to change.

2 Choose Layout|Order|“Bring in Front of” or “Send to Back of.” The Order Object dialog box opens.

3 In the Object Layout work area, Alt-click the object that the selected object(s) will move in front of or behind. The selected object’s name appears in the dialog box:



4 Click OK; the change in the stack order is executed.

CHANGING STACK ORDER DURING RUNTIME

To change an object’s stack order during runtime, it must have been made dynamic in the parameter pane.

Moving Dynamic Graphic Objects to Front or Back

The *self* property of all dynamic graphic objects has the following functions for changing stack order during runtime:

FUNCTION	DESCRIPTION
bringToFront	Moves the object to the top of the stack order.
sendToBack	Moves the object to the bottom of the stack order.
bringInFrontOf: <graphic object>	Moves the object one position higher in the stack order than the specified graphic object.
sendToBackOf: <graphic object>	Moves the object one position lower in the stack order than the specified graphic object.

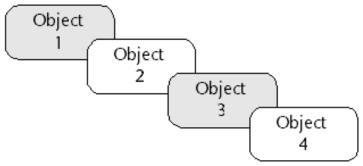
❖ *NOTE: If a graphic object is part of a group, these functions only change the object stack order within that group.*

Using the *orderPosition* Property to Change Stack Order

Dynamic graphic objects also have the *orderPosition* property. It is used to specify the dynamic object's precise stack order, in relation to the other objects in the application. This property supports every integer function.

Example

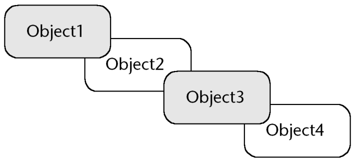
A group of dynamic objects are stacked in the following order:



The following logic is used to change the stack order of Object1 and Object3:

Object1.orderPosition := Object2.orderPosition +1
Object3.orderPosition := Object4.orderPosition +1

The result is:



Object1 and Object3 change positions in the stack order so that they are superimposed on top of the objects specified in the logic. Another way to use the stack order functions would be to use a condition trigger that reads the stack order of two objects and then changes the order if the condition is met. For example:

TRIGGER	FUNCTION
Object1.orderPosition < Object2.orderPosition	**Object1.orderPosition := Object2.orderPosition +1**

About Groups

If a dynamic object is part of a group, its stack order can only be changed within that group. A runtime error occurs if you try to assign an *orderPosition* value that is less than one or greater than the number of objects in the group.

CHAPTER 22

User Objects with Messages

In earlier versions of RapidPLUS, user objects participated in the parent application logic through exported properties, events, and functions.

❖ *NOTE: If you have never created a user object, we suggest that you read Chapter 19: "User-Defined Objects" in the Rapid User Manual.*

In version 4.5 and higher, the user object interface can also include exported messages. An exported message is, basically, data that is transferred between a parent application and its user object through an event.

However, a message is more than the data being transferred. It involves a specific framework that must be created in order to send the data. First, a union must be created. Each union contains one or more structures which, in turn, contain fields. A structure's fields can be of the following data types: string, integer, number, array, or another (nested) structure.

From either the parent application or the user object, you can assign data to a structure's fields and send the structure to the "other side," where its data can be read and processed as required. To perform an operation on a structure, it must be active. Because the structures are in a union, only one of them can be active at a time.

This chapter presents:

- How a user object message works.
- Terms basic to the user object message.
- General changes to the user object More dialog box.
- Building and editing a user object message.

- Using the user object message logic.
- Importing a structure from a header file.

❖ *NOTE: The design of messages in RapidPLUS is based on C programming. An understanding of unions and structures in C is helpful.*

HOW DOES A USER OBJECT MESSAGE WORK?

As shown in the illustration on the following page, when you add a user object to the parent application, its unions are automatically made available to the application (along with its properties, events, and/or functions, if any).

Either the parent application or the user object can assign values to structure fields or assign one like structure to another, and either side can pass a structure to the "other side" via the *send* function. The *send* function automatically triggers the *messageReceived* event on the side receiving the data.

In a union, only one structure can be active at any given time. As shown on the following page, assigning a value to a structure makes it active "locally," that is, on the side—either parent application or user object—that called the assignment activity. The value is **not** available to the other side until the structure is sent. Sending a structure makes it active on the receiving side.

❖ *NOTE: The structure must be active on the sending side before it can be sent.*

The role of the active structure

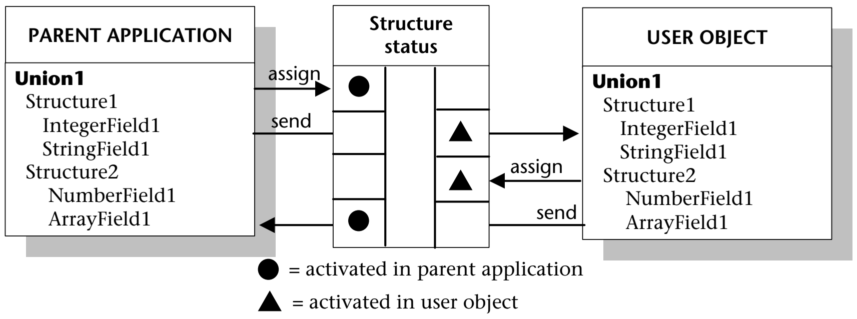
Messages are sent (from the user object to its parent application, or vice versa) in a free-form format.

The active structure defines the semantics of the message, that is, it defines how the collection of bytes currently located in the interface should be parsed: is it, for example, a string of 100 characters, or is it two integers and three arrays?

Thus, the currently active structure must be deactivated—either implicitly or explicitly, as explained below—before the user object or the parent application can place another set of data in the interface—to change it, to read it, and/or send it to the other side.

In the case of assigning a value to a structure field, RapidPLUS automatically deactivates any other structure that may be active and activates the structure involved in the assignment.

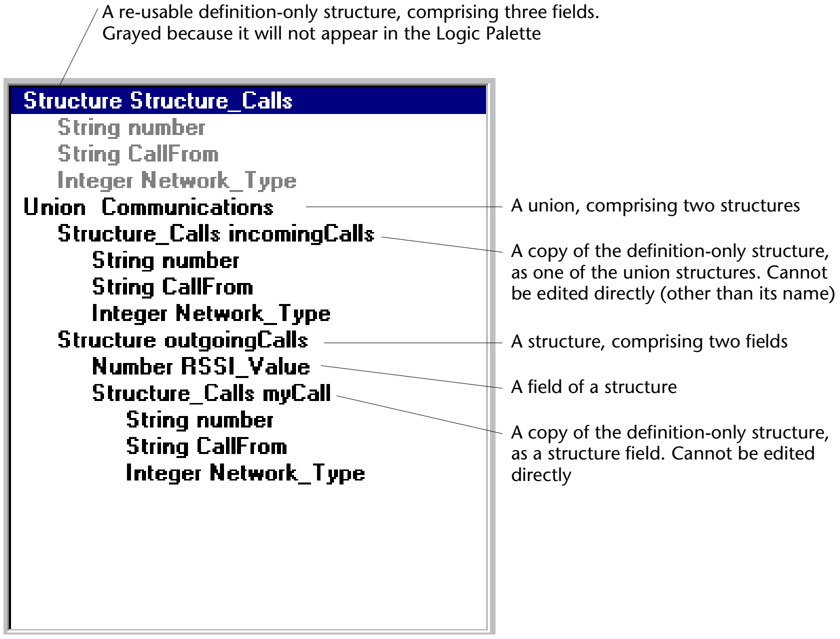
In the following example, the parent application might assign a value to Structure2 (making it active in the parent application) and send it to the user object (making it active in the user object).



❖ *NOTE: The user object message's functions and events are described in detail on pp. 22-17 to 22-19.*

USER OBJECT MESSAGE PARTS: A GLOSSARY

Before getting into the details of how to add messages to the user object interface, it is important that you understand the following terms. The illustration below shows a typical messages list and illustrates the hierarchy among the various message parts.



```
Structure Structure_Calls
    String number
    String CallFrom
    Integer Network_Type
Union  Communications
    Structure_Calls incomingCalls
        String number
        String CallFrom
        Integer Network_Type
    Structure outgoingCalls
        Number RSSI_Value
        Structure_Calls myCall
            String number
            String CallFrom
            Integer Network_Type
```

A re-usable definition-only structure, comprising three fields. Grayed because it will not appear in the Logic Palette
A union, comprising two structures
A copy of the definition-only structure, as one of the union structures. Cannot be edited directly (other than its name)
A structure, comprising two fields
A field of a structure
A copy of the definition-only structure, as a structure field. Cannot be edited directly

Union

A union is a collection of one or more structures. During runtime, only **one** of its structures can be active at a time.

Definition-Only Structure

A definition-only structure is a collection of fields that exists solely for the purpose of being reused, either as a union structure or as a structure field. It must contain at least one field.

Changes that you make to a definition-only structure are automatically propagated to its copies. Definition-only structures do **not** appear in the Logic Palette and do **not** participate directly in the application logic.

Structure

A structure is a collection of fields. It can either be a child of a union or a child of another structure (nested structure). It must contain at least one field.

There are two types of structures:

- A definition-only structure (whose purpose is to be reused). This structure type is described in the previous section.
- A single-instance structure (cannot be reused).

During runtime, you can assign a structure to a structure as long as both structures have the same number of fields and the same sequence of field data types.

Field

A field is a child of a structure. Each field has a specific data type, either:

- String
- Integer
- Number
- Array
- Structure (definition-only or single-instance)

The usual runtime functions can be used on each data type, that is, string functions on string fields, integer functions on integer fields, and so on.

ADDING MESSAGES TO A USER OBJECT

In the User Object More dialog box, Messages page, you can:

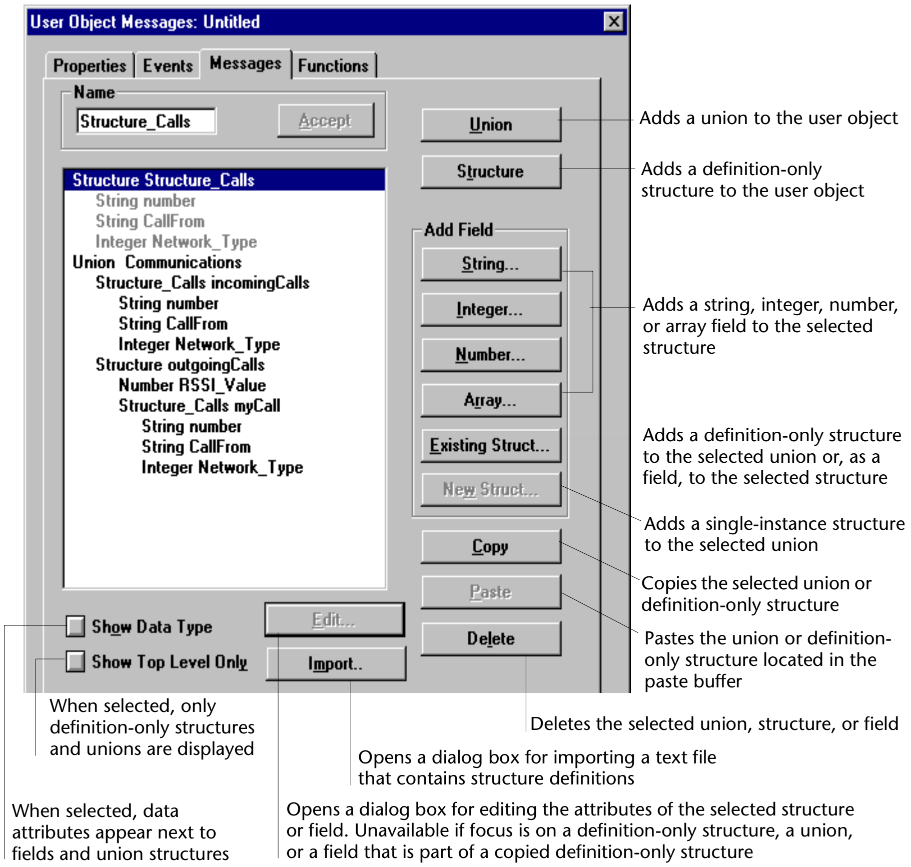
- Add and delete unions in the user object message interface.
- Add, edit, and delete definition-only structures (for re-use as union structures or structure fields).
- Add, edit, and delete single-instance structures as union structures.
- Import structure definitions from a file.

To view messages:

Open the User Object Properties dialog box, Messages tab. To do so:

1. Choose Edit|User Object Properties or double-click anywhere in the Object Layout work area (but **not** on an object).
2. Click the More button in the root object's parameter pane. The User Object Properties dialog box opens at the Properties tab.
3. Click the Messages tab.

   The following illustration shows the various message components:



Adds a union to the user object

Adds a definition-only structure to the user object

Adds a string, integer, number, or array field to the selected structure

Adds a definition-only structure to the selected union or, as a field, to the selected structure

Adds a single-instance structure to the selected union

Copies the selected union or definition-only structure

Pastes the union or definition-only structure located in the paste buffer

Deletes the selected union, structure, or field

Opens a dialog box for importing a text file that contains structure definitions

Opens a dialog box for editing the attributes of the selected structure or field. Unavailable if focus is on a definition-only structure, a union, or a field that is part of a copied definition-only structure

When selected, only definition-only structures and unions are displayed

When selected, data attributes appear next to fields and union structures

Adding Unions and Structures

Adding Definition-only Structures

To add a definition-only structure to the user object:

- Click **Structure**. A structure is added to the user object with the default name “Structure*x*” where *x* is a number that increments with each structure added. For details of how to add fields to the definition-only structure, see “Adding Fields to a Structure” on pp. 22-9 to 22-12.

To cause the definition-only structure to generate as a union:

1. Select the structure and click Edit; the Substructure dialog box opens.
2. Select the Generate as Union check box, then click OK.

❖ *NOTE: A definition-only structure should be generated as a union **only** when the embedded system requires this type of message union.*

To add a union to the user object:

- Click **Union**. A union is added to the user object with the default name “Unionx” where *x* is a number that increments with each union added.

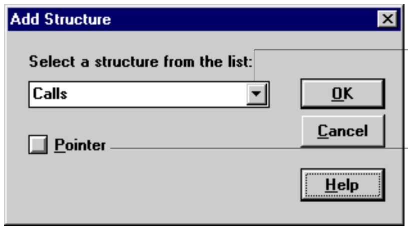
Adding a Structure to a Union

You can add two types of structures to a union:

- Definition-only structures (existing structures).
- Single-instance structures (new structures).

To add a definition-only structure to a union:

1. Select the union. In the Fields group, click **Existing Struct**; the Add Structure dialog box opens:



Displays a list of all definition-only structures in the user object

If selected, the Code Generator will expect a pointer to the field, rather than the field itself

❖ *NOTE: Only relevant in the context of code*

2. Select a structure from the list of definition-only structures.

3 The structure's default memory allocation method is the buffer method. To use the pointer method, select the Pointer check box. For an explanation of these choices, see "Defining the Memory Allocation Method" on p. 22-13.

❖ *NOTE: The memory allocation method is only relevant if you are using RapidPLUS for code generation purposes.*

4 Click OK to add the definition-only structure to the selected union. The default name is *<definition-only structure name> Structurex*, where x is an ordinal number.

❖ *NOTE: The added structure's fields cannot be edited directly in the union. You have to edit the original definition-only structure directly and those changes are propagated automatically to all instances of the definition-only structure in the message interface.*

To add a single-instance structure to a union:

1 Select the union.

2 In the Fields group, click **New Struct**; the Substructure dialog box opens.

3 The structure's default memory allocation method is the buffer method. To use the pointer method, select the Pointer check box. For an explanation of these choices, see "Defining the Memory Allocation Method" on p. 22-13.

❖ *NOTE: The memory allocation method is only relevant if you are using RapidPLUS for code generation purposes.*

4 (Optional) To cause the structure to generate as a union, select the Generate as Union check box.

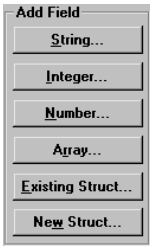
❖ *NOTE: A single-instance structure should be generated as a union* ***only*** *when the embedded system requires this type of message union.*

5 Click OK to add the structure as a child of the union. The structure's default name is *Structurex*, where *x* is a number that increments with each structure added to the user object.

When subsequent structures are added to a union, they appear under the union as follows: If the union is selected (when the structure is added), the structure is added directly below it. If another union structure was selected, the new structure is added directly below it.

❖ *NOTE: You can edit this structure's fields directly, but you cannot reuse it in another union or structure.*

Adding Fields to a Structure



There are five types of fields that can be added to a structure: string, integer, number, array, and definition-only structure (existing structure).

❖ *NOTE: An error message will appear if you try to close the User Object Properties dialog box when a structure has no fields. Empty structures are not allowed.*

To add a field to a structure:

- Select the structure and click one of the buttons in the Add Field group.

❖ *NOTE: The buttons in the Fields group are unavailable until you have added at least one structure.*

String, Integer, or Number Fields

If you add a string, integer, or number field, a field-specific dialog box opens in which you can define various data attributes. The table below summarizes the data attributes for each field type.

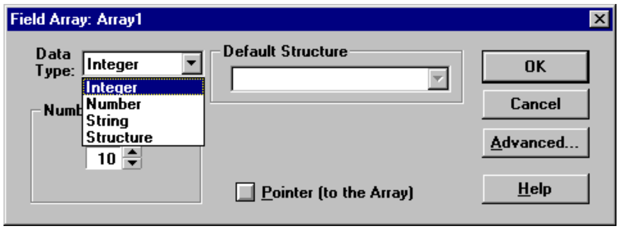
❖ *NOTE: These attributes are only relevant in the context of code generation.*

FIELD TYPE	ATTRIBUTE	COMMENTS
String	String length	Defines the size of the string, in bytes.
Integer	Size	Choose among *long*, *short*, *int*, *char*, or *bits*. If you choose *bits*, you must specify the number of bits per integer in your system.
	Sign	Integer is signed unless the check box is selected.
Number	Element size	Choose *float*, *double*, or *long double*.
String, integer, and number	Pointer	When selected, indicates that the field is a pointer to data. When not selected, indicates that the memory allocation method is the buffer type. ❖ *NOTE: If the structure's memory allocation method is pointer type, each field can be either pointer or buffer type. If the structure's memory allocation method is buffer type, each field can only be buffer type.*

Array Field

When you add an array field to the structure, a dialog box opens in which you define the array field's:

- **Data type** (integer, string, number, or structure). If there are no definition-only structures, the structure data type does not appear in the list.
- **Default structure**. If you selected a structure data type, you must choose a definition-only structure from this list. For all other data types, this element does not apply.
- **Number of elements**.
- **Memory allocation method**. For buffer type memory allocation, the array field's memory allocation method must be the same as the structure's. In other words, if the Pointer check box was not selected in the structure's dialog box, it must also not be selected here.



Sample Array Field dialog box

❖ *NOTE: You can only add one-dimensional arrays as fields in a structure.*

To set the data attributes for the integer, number, and string data types:

1 Click Advanced; the corresponding field dialog box opens.

2 Set the attributes as needed.

To set an array of structures field's memory allocation method to pointer type:

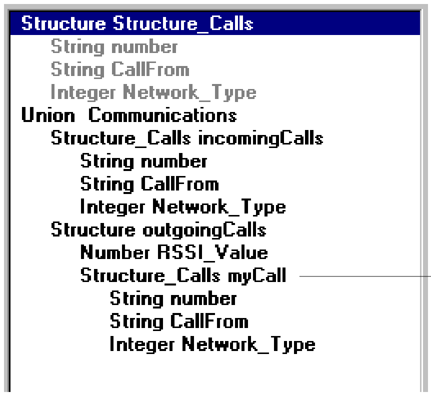
1 Click Advanced; the Default Structure dialog box opens.

2 Select the Pointer check box, then click OK.

❖ *NOTE: To learn when to use an array of structures field, see p. 22-14.*

Definition-only Structure Field (Existing Structure)

Besides adding a definition-only structure to a union, you can also add it as a field of a single-instance structure (a nested structure). In the illustration below, the definition-only structure “Calls” has been added as a field (named “myCall”) to the single-instance structure “outgoingCalls.”



```
Structure Structure_Calls
    String number
    String CallFrom
    Integer Network_Type
Union  Communications
    Structure_Calls incomingCalls
        String number
        String CallFrom
        Integer Network_Type
    Structure outgoingCalls
        Number RSSI_Value
        Structure_Calls myCall
            String number
            String CallFrom
            Integer Network_Type
```

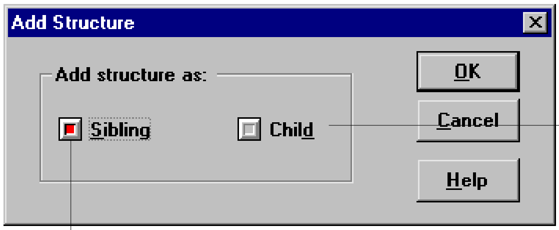
The fields of the nested structure are indented to show the hierarchy. These fields cannot be edited directly, as explained in “Editing Fields and Changing Names” on p. 22-12

To add a definition-only structure field:

1 Select a single-instance structure, then click **Existing Struct** in the Add Field group; the Add Structure dialog box opens (as shown on p. 22-7).

2 Choose a definition-only structure and, if you want the memory allocation method to be pointer type, select the Pointer check box.

3 Click OK, the Add Structure dialog box then prompts you to select whether the definition-only structure will be placed at the same level as the single-instance structure (a sibling) or at the level of a field (child).



Select to place the definition-only structure at the field level (a nested structure)

Select to place the definition-only structure at the same level as the single-instance structure

4 Click OK.

❖ *NOTE: You can add a definition-only structure* ***at the field level*** *by selecting a field of the single-instance structure, and then clicking Existing Struct.*

Editing Fields and Changing Names

Once added to the structure, you can change the field's name and/or edit its data attributes.

To change the name of a field, structure, or union:

1. Select the item.
2. Make the changes in the Name box.
3. Click Accept to apply the change.

To edit the data attributes of a field:

- Select the field and click Edit; the dialog box in which you originally defined the data attributes opens so that you can make your changes.

What happens when you edit a definition-only structure that has been added to a union or a structure

Refer to the example on p. 22-11 of a definition-only structure that was added as a field to another structure. Any changes that you make to fields in the definition-only structure "Calls" will be automatically carried over to the nested structure "myCall," which has been added as a field to the structure "outgoing Calls."

For example, if you change the name of the string field "number" to "myNumber" in "Calls," the change is automatically propagated to the same field in "myCall."

Note that when you select a field of a nested structure, the Edit and Delete buttons become unavailable. You cannot directly edit (or delete) a field of a nested structure. You must always go back to the original definition-only structure and make the changes there. The changes are then propagated to all other instances of that definition-only structure.

Deleting a Field, Structure, or Union

To delete a field, structure, or union:

- Select the item and click Delete. You are asked to confirm the delete operation.

❖ *NOTE: If you are deleting a definition-only structure, all instances of the item are deleted.*

Changing the Order of Unions, Structures, and Fields

Use Alt+🡅 (up arrow) or Alt+🡇 (down arrow) to move the selected union, structure, or field up or down among its siblings in the list. In other words, you can change the field order within a structure, the structure order within a union, and the union order within the user object—but you cannot, for example, move a field out of one structure and into another. Thus, if the focus is on the first or last union, structure or field, pressing Alt+🡅 or Alt+🡇, respectively, has no effect.

Defining the Memory Allocation Method

❖ *NOTE: This information is only relevant in the context of code generation and is mainly used for user defined interfaces (UDIs).*

Because the user object message is a union of structures, by definition all structures use the same memory space in the embedded system environment.

Memory can be allocated for a structure by one of two methods:

- **Buffer**, whereby RapidPLUS internally allocates enough memory to accommodate the largest structure. This is the default method.
- **Pointer**, whereby the user object message uses memory supplied by the underlying embedded system.

You choose the memory allocation method when you create the structure (see p. 22-7).

❖ *NOTE: Once you have designated a structure as buffer memory type, it cannot contain pointer-type string fields or another structure that contains pointer-type string fields.*

To change the memory allocation method for the selected structure:

1 Click Edit to open the Structure dialog box.

2 Select the Pointer check box for the pointer allocation method or leave it clear for the buffer method.

When to Use an Array of Structures

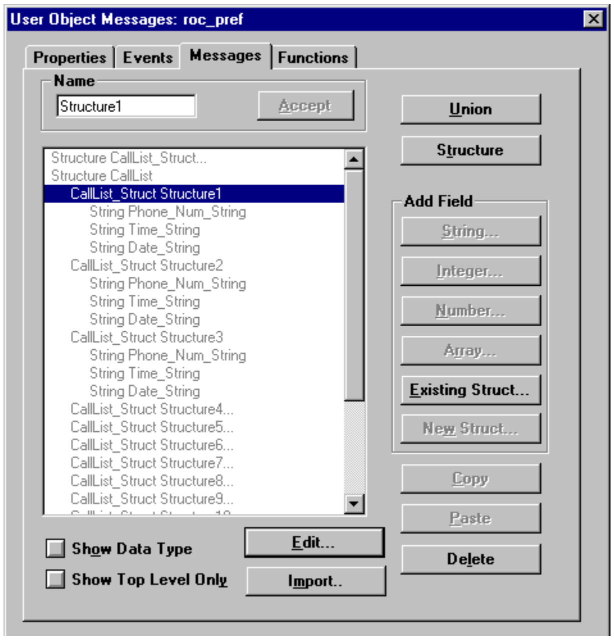
As you know, a definition-only structure is created to be reused as a union structure and as a structure field (nested structure). A definition-only structure can also be placed in an array field. The resulting array of structures can itself be used as a definition-only structure.

Why place a structure in an array?

1 Because doing so reduces the need to duplicate identical structures.

2 If the application is generated to code, the resulting code is simplified.

In the user object shown below, there is a union that contains nine identical structures. These structures contain information about the nine most frequent calls. As you can see, the building of this union required a lot of repetitive work:


User Object Messages: roc_pref

Name: Structure1

```
Structure CallList_Struct...
Structure CallList
   CallList_Struct Structure1
      String Phone_Num_String
      String Time_String
      String Date_String
   CallList_Struct Structure2
      String Phone_Num_String
      String Time_String
      String Date_String
   CallList_Struct Structure3
      String Phone_Num_String
      String Time_String
      String Date_String
   CallList_Struct Structure4...
   CallList_Struct Structure5...
   CallList_Struct Structure6...
   CallList_Struct Structure7...
   CallList_Struct Structure8...
   CallList_Struct Structure9...
```

Show Data Type [ ]
Show Top Level Only [ ]

When this union is generated to code, the generated interface looks like:

```
typedef struct tROC_PREF_R11368_CallList
  {
  ROC_PREF_R4395_CallList__Struct cSF_R12594_Structure1  ;
  ROC_PREF_R4395_CallList__Struct cSF_R3727_Structure2   ;
  ROC_PREF_R4395_CallList__Struct cSF_R11244_Structure3  ;
  ROC_PREF_R4395_CallList__Struct cSF_R2377_Structure4   ;
  ROC_PREF_R4395_CallList__Struct cSF_R9894_Structure5   ;
  ROC_PREF_R4395_CallList__Struct cSF_R1027_Structure6   ;
  ROC_PREF_R4395_CallList__Struct cSF_R8544_Structure7   ;
  ROC_PREF_R4395_CallList__Struct cSF_R16061_Structure8  ;
  ROC_PREF_R4395_CallList__Struct cSF_R7194_Structure9   ;
  } ROC_PREF_R11368_CallList:
```

By using an array of structures, the generated interface could be reduced to:

```
typedef struct tROC_PREF_R11368_CallList
  {
  ROC_PREF_R4395_CallList__Struct cSF_R12594_Structure1[9] ;
  } ROC_PREF_R11368_CallList;
```

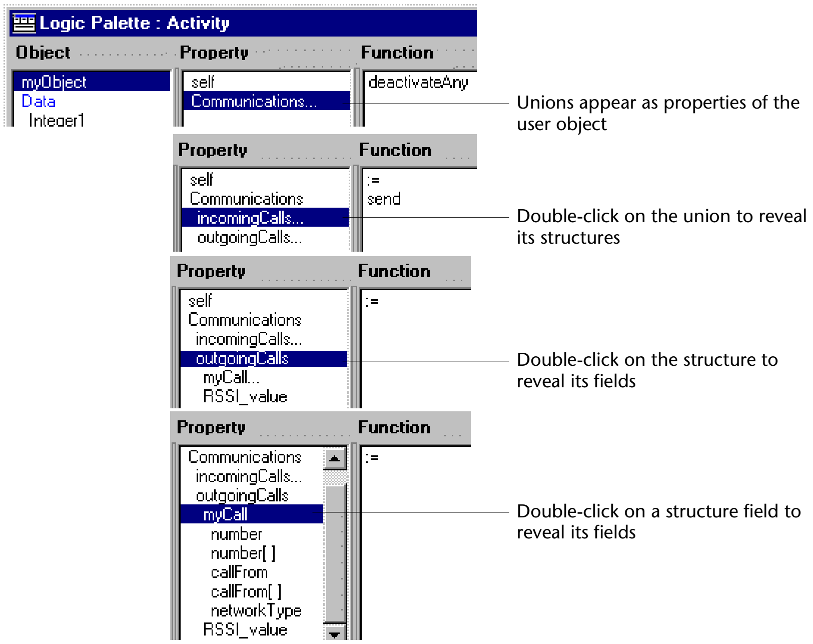
and the repetitive work involved in building the union could be avoided.

USING THE USER OBJECT MESSAGE LOGIC

The user object message has conditions, events, and functions that facilitate the sending of structures from the parent application to the user object and vice versa.

❖ *NOTE: In the context of code generation, the interface between the parent application and the user object simulates the interface between an embedded system module (represented by the user object) and the embedded RapidPLUS application (represented by the parent application).*

When you add a user object to an application, a message's unions appear as properties of the user object in the Logic Palette. See the following illustration.



❖ *NOTES: The union-structure-field hierarchy is shown through nesting.*

Double-clicking toggles between expanding and collapsing the union, structure, or structure field.

When building logic for the user object message, it is important to remember that assigning a value to a structure field makes the structure active on the side calling the assignment activity, and sending a structure makes it active on the receiving side. While a structure is active, trying to implement a read or send activity on another structure results in a runtime error. This point is illustrated on p. 22-3.

❖ *NOTE: When you assign a value to a field of an inactive structure, RapidPLUS automatically deactivates the active structure and activates the structure involved in the assignment activity.*

Message Properties, Functions, Conditions, and Events

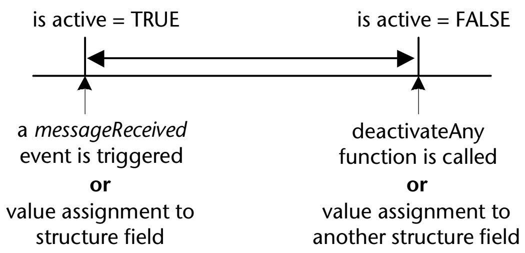
The tables below—arranged by property—summarize message functions, conditions, and events.

For the Union

PROPERTY	FUNCTION/ EVENT	COMMENTS
Any of the unions defined by the user	*deactivateAny*	An activity that deactivates any active message structure in the union; no error occurs if the function is called while there is no currently active structure. *Syntax*: **UserObject1.Union1 deactivateAny**
	anyMessage-Received	An event triggered automatically at the **union** level after every *messageReceived* event triggered at the **structure** level (see below). ❖ *NOTE: This event can be used in the code generation context to handle the arrival of unexpected structures. See the usage example on* p. 22-22. *Syntax*: **UserObject1.Union1anyMessageReceived**

For Each Structure of the User Object

PROPERTY	FUNCTION/ EVENT	COMMENTS
Any of the union structures defined by the user	:=	Assigns the contents of one structure to another, overwriting the previous contents. Both structures must have the same field types and the fields must be in the same order. Assignment between structures with pointer-type memory allocation will only work if the structures are generated as user objects (UDO) and not as interface only (UDI).
	send	An activity that copies the data to the application (if called from the user object) or to the user object (if called from the application) and then activates the structure on the receiving side in order to properly interpret the data. The *send* activity automatically triggers the *messageReceived* event on the side receiving the data. *Syntax*: **Keypad.Calls_union^OutgoingCall send**

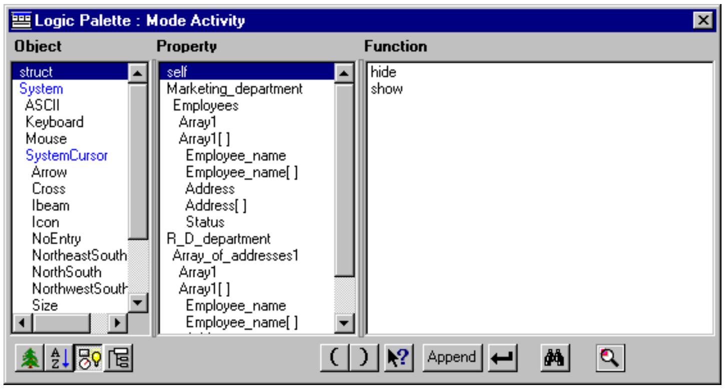
PROPERTY	FUNCTION/ EVENT	COMMENTS
	messageReceived	This event is generated whenever the *send* function is called; the user object sending to the application triggers the event in the application, and vice versa. *Syntax (in user object)*: **Keypad.Calls_union^OutgoingCall messageReceived** *Syntax (in application)*: **Keypad_UDO.Calls_union^OutgoingCall messageReceived**
	is active	This condition is true under the following conditions:  is active = TRUE is active = FALSE a *messageReceived* event is triggered **or** value assignment to structure field deactivateAny function is called **or** value assignment to another structure field

For Any Field of a Union Structure

PROPERTY	FUNCTION/ EVENT	COMMENTS
Any union structure field	All functions appropriate to the field or array element type, with the following exceptions: Integer and number: *changeBy:, resetValue* String: *append:, changeASCIIBy: at:, clear, deleteCharAt:, deleteFrom: to:, insert: at:, resetValue* String field element: *clear*	

Using Arrays of Structures in Logic

The array of structures is nested under its structure in the Logic Palette:

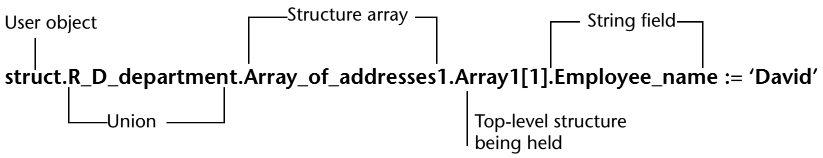


Sample Logic Palette containing arrays of structures

The array itself does not have functions, however, its elements have all the functions available to other structure fields.

Example of logic

In the following example, a string is assigned to the first element in an array of structures:



```
struct.R_D_department.Array_of_addresses1.Array1[1].Employee_name := 'David'
```

Runtime Errors

The following actions in the RapidPLUS application will produce runtime errors:

- Reading the field of a structure when another structure is active.
- Sending an inactive structure.
- Assigning a structure to another structure that contains different fields.

Examples of Usage

Message Sent from a User Object to an Application

A typical usage of a user object message interface might be a keypad user object with a union (named "keyPress") that contains one structure (named "keyIn"). The structure includes an integer field called "ScanCode." The internal logic of the user object would assign an appropriate value to the ScanCode field each time a keypad button is pressed, and then send the structure. For example:

```
Transition: internal
Trigger:    Pb_1 in
Actions:    keypad.keyPress^keyIn^ScanCode := 1
            keypad.keyPress^keyIn send
```

When this user object, and its message interface, is added to a parent application, each key press generates a *messageReceived* event in the application. You can use this trigger to activate application logic which, for example, displays the key's scan code.

```
Transition: internal
Trigger:    Keypad_UDO.keyPress^keyIn messageReceived
Actions:    Display1.contents append: Keypad_UDO.keyPress^keyIn^ScanCode
```

Message Sent from an Application to a User Object

In your cellular phone application, you may want to simulate the action of an outgoing call. For example, when the Send pushbutton is pressed in the application, a structure is sent to a user object that represents the communications task of the embedded system.

In the RapidPLUS application, you would assign values to the structure fields and then send the structure. Your logic might look something like:

```
Transition: internal
Trigger:    Pb_Snd in
Actions:    Calls_UDO.Calls_union^Call_Struct^PhoneNumber := Display1.contents
            Calls_UDO.Calls_union^Call_Struct^callType:= 0
            Calls_UDO.Calls_union^Call_Struct^Time:= systemTime
            Calls_UDO.Calls_union^.Call_Struct send
```

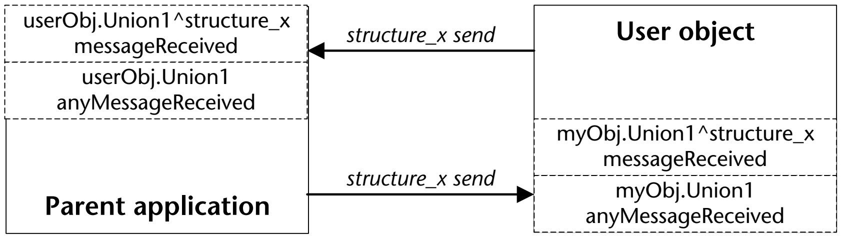
The internal logic of the user object would then appropriately process the incoming message. If the communications task responds by storing the outgoing telephone number in a temporary Redial buffer, your logic might look something like:

Transition: internal
Trigger: **Calls.Calls_union^Call_Struct messageReceived**
Actions: **Redial_array [1] := Calls.Calls_union^Call_Struct^PhoneNumber**

Using the *anyMessageReceived* Event to Handle Exceptions

❖ *NOTE: This usage example is only relevant in the code generation context.*

Each time that a structure is sent, the *messageReceived* event is triggered automatically for the equivalent structure on the receiving side and the *anyMessageReceived* event is triggered for the union, as illustrated below:


userObj.Union1^structure_x messageReceived
userObj.Union1 anyMessageReceived
Parent application
structure_x send
structure_x send
User object
myObj.Union1^structure_x messageReceived
myObj.Union1 anyMessageReceived

When designing a RapidPLUS application for code generation purposes, the user object represents a module of the underlying embedded system while the parent application represents the embedded RapidPLUS task.

USING MESSAGES AS DATA CONTAINERS

User objects with a message interface can be utilized as data containers. A **data container is a user object whose purpose is to hold data that can be shared among various project components.**

Unlike RapidPLUS data objects that are available only within their parent user object, data held in the message interface of user objects can be made accessible also to other project components through the use of holders.

Example

Imagine a mobile phone project where several components use the same array of data. One component manages calls, another manages messages, a third manages the phone book, and a fourth provides statistics. All four components use the same list of names and phone numbers. If you use a RapidPLUS array for this list, the array must be duplicated in each component that uses it.

If you use a data container instead, you define the list once in the message interface of a user object, then make it accessible to other components by defining a holder for the data container in each component that uses the list.

In the RapidPLUS simulation, where issues of memory usage are negligible, the choice of one approach over the other is a matter of preference. However, in applications designed for code generation, economical memory usage becomes a prime consideration, and a data container rather than multiple RapidPLUS arrays should be used.

General Procedure for Defining a Data Container

1 Define a user object with a message interface. Define the exact data structure required. For code generation, this user object should be flagged as a data container in the Code Generation Preferences dialog box, Components tab.

   ❖ *NOTE: When a user object is flagged for code generation as a data container, code is generated* ***only for the data*** *in its message interface. You should therefore not develop any logic inside the user object since all such logic will be deleted from the generated code. Nor should you use message functions or events (send, deactivateAny, anyMessageReceived, messageReceived, is active) since message logic is also deleted when code is generated for a data container.*

2 Allocate an instance of the user object where you can pass it to all the components that need it; the main application is a good choice.

3 In every component that needs to access the data container, define:

   a. A holder, without default, for the data container user object.

   b. An exported *init* function that will allow the main application to initialize the holder.

4 In the main application, add a call to the *init* function of each component that uses the data container, with the data container instance as a parameter.

IMPORTING STRUCTURES FROM A FILE

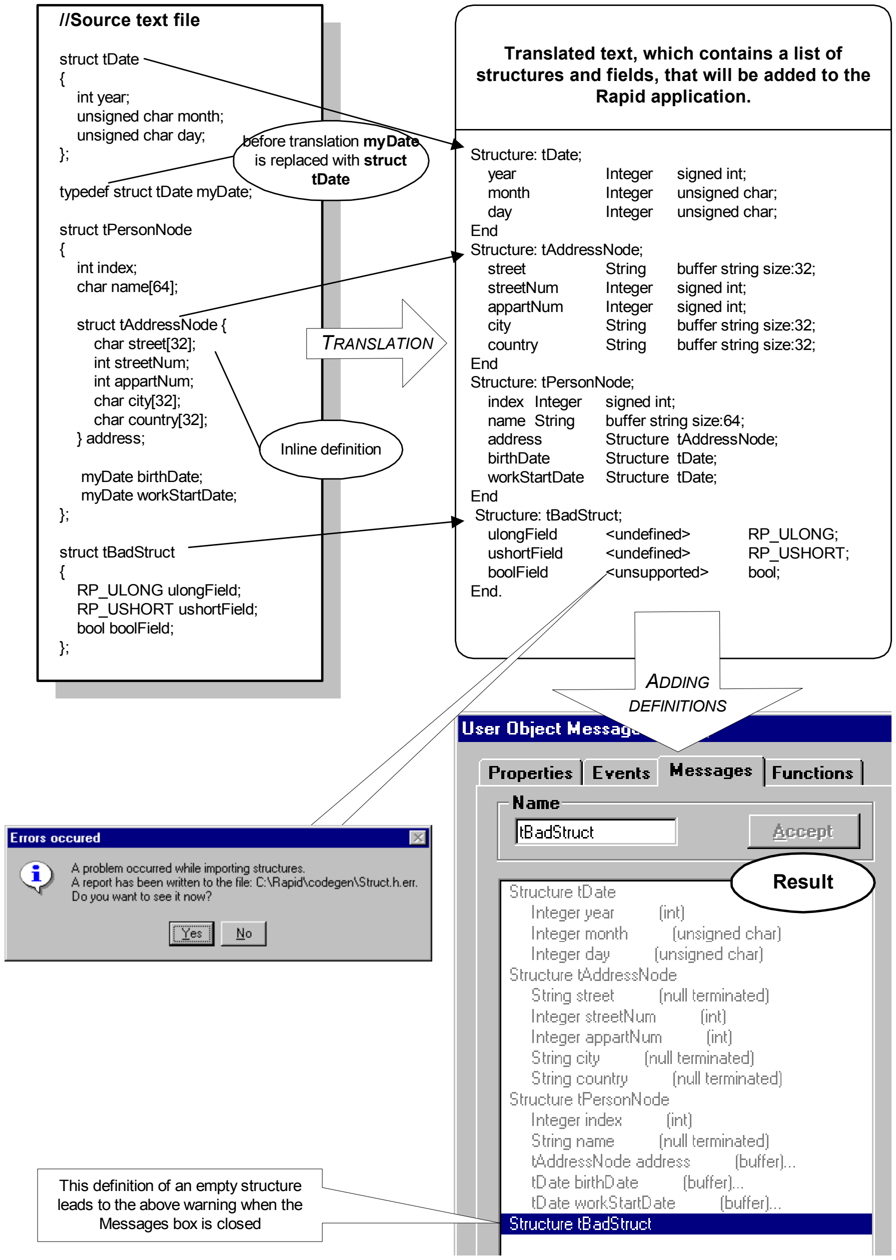
Structures can be imported from text files (usually *.h* files). However, before importing them, the files must contain certain structure definitions that RapidPLUS can translate into user object structures.

The illustration on the next page shows:

- A text file that contains the appropriate structure definitions.
- The text as translated by RapidPLUS.
- The resulting structure in a user object.
- A message about a structure that could not be imported.

❖ *NOTE: If the source text file contains preprocessor instructions (e.g., # define...), the file must be preprocessed to redefine them otherwise, those definitions cannot be imported.*

If the file contains illegal C definitions, the result may be unpredictable, but will not damage a RapidPLUS application.



```
//Source text file

struct tDate
{
    int year;
    unsigned char month;
    unsigned char day;
};

typedef struct tDate myDate;

struct tPersonNode
{
    int index;
    char name[64];

    struct tAddressNode {
        char street[32];
        int streetNum;
        int appartNum;
        char city[32];
        char country[32];
    } address;

     myDate birthDate;
     myDate workStartDate;
};

struct tBadStruct
{
    RP_ULONG ulongField;
    RP_USHORT ushortField;
    bool boolField;
};
```

Translated text, which contains a list of structures and fields, that will be added to the Rapid application.

```
Structure: tDate;
   year            Integer     signed int;
   month           Integer     unsigned char;
   day             Integer     unsigned char;
End
Structure: tAddressNode;
   street          String      buffer string size:32;
   streetNum       Integer     signed int;
   appartNum       Integer     signed int;
   city            String      buffer string size:32;
   country         String      buffer string size:32;
End
Structure: tPersonNode;
   index  Integer   signed int;
   name  String     buffer string size:64;
   address          Structure  tAddressNode;
   birthDate        Structure  tDate;
   workStartDate    Structure  tDate;
End
 Structure: tBadStruct;
   ulongField       <undefined>           RP_ULONG;
   ushortField      <undefined>           RP_USHORT;
   boolField        <unsupported>         bool;
End.
```

before translation **myDate** is replaced with **struct tDate**
TRANSLATION
Inline definition
ADDING DEFINITIONS
Result

Errors occured

A problem occurred while importing structures.
A report has been written to the file: C:\Rapid\codegen\Struct.h.err.
Do you want to see it now?

tBadStruct

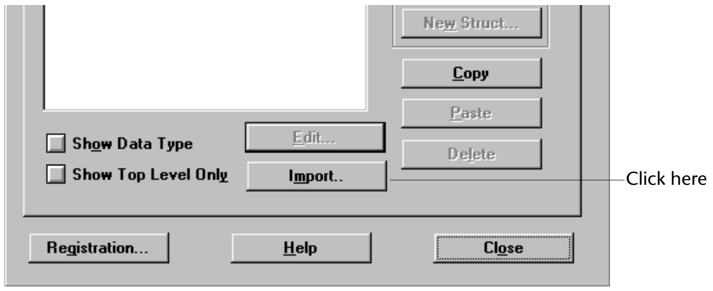
```
Structure tDate
    Integer year          (int)
    Integer month         (unsigned char)
    Integer day           (unsigned char)
Structure tAddressNode
    String street         (null terminated)
    Integer streetNum     (int)
    Integer appartNum     (int)
    String city           (null terminated)
    String country        (null terminated)
Structure tPersonNode
    Integer index         (int)
    String name           (null terminated)
    tAddressNode address  (buffer)...
    tDate birthDate       (buffer)...
    tDate workStartDate   (buffer)...
Structure tBadStruct
```

This definition of an empty structure leads to the above warning when the Messages box is closed

Importing a Structure

To import a structure:

1. Open the User Object Properties dialog box, Messages tab.
2. Click the Import button.



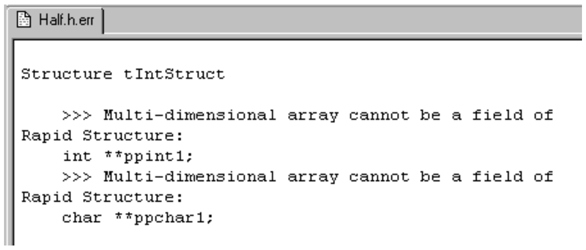
The Import structure definitions dialog box opens. Although the default file extension is *.h*, any text file can be imported.

3. Select a file and click Open. RapidPLUS translates the imported structures into the proper RapidPLUS format.

If RapidPLUS detects problems in a text file that contains structure definitions, a message box opens notifying you that there are translation problems.

To view these items, click Yes in the message box; your system's text editor opens and displays a list of items that cannot be imported, warnings, and errors.

The following illustration shows a sample error list:



```
Structure tIntStruct

    >>> Multi-dimensional array cannot be a field of
Rapid Structure:
    int **ppint1;
    >>> Multi-dimensional array cannot be a field of
Rapid Structure:
    char **ppchar1;
```

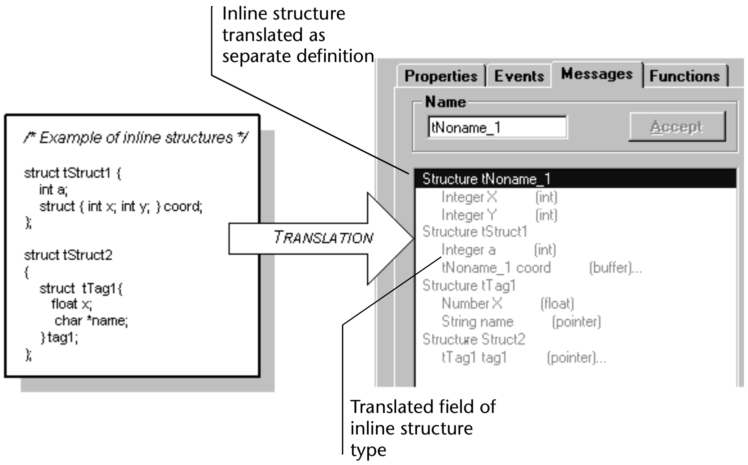
Sample of an error list

4 If there are no translation problems, the structure definitions contained in the imported file are imported into the application as definition-only structures.

However, if RapidPLUS detects an imported structure with the same name as an existing user object property or structure, the Paste Conflicts: Duplicate Elements dialog box opens. If you choose Replace, all references to the existing structure or property will be replaced, including in the logic.

How RapidPLUS Handles Various Items during Translation

- A structure defined within another structure as a field type is translated as a separate structure definition. If the definition doesn't have a tag name, the structure type is named **tNoname_N**, where N is a counter of currently translated inline structures.


Inline structure translated as separate definition
TRANSLATION
Properties
Events
Messages
Functions
Name
Accept
Translated field of inline structure type

```
/* Example of inline structures */

struct tStruct1 {
   int a;
   struct { int x; int y; } coord;
};

struct tStruct2
{
   struct  tTag1{
     float x;
     char *name;
   } tag1;
};
```

Name: tNoname_1

```
Structure tNoname_1
    Integer X        (int)
    Integer Y        (int)
Structure tStruct1
    Integer a        (int)
    tNoname_1 coord        (buffer)...
Structure tTag1
    Number X        (float)
    String name        (pointer)
Structure Struct2
    tTag1 tag1        (pointer)...
```

Arrays

- A one-dimensional signed char array (e.g., **char field1[32]**) is translated as a string allocated as a buffer field (rather than as an integer array of "char" data type).
- An unsigned char array is interpreted as an integer array.
- A two-dimensional signed char array is interpreted as a one-dimensional RapidPLUS string array. For example, **signed char array2[10][32]** is interpreted as a string array of 10 strings containing 32 characters each.
- An array of structures field is translated only when it is explicitly defined as an array field (as **struct tStruct2 starr[20]**).
- An array of structures that contains an array of structures field cannot be imported.

Pointers

- A pointer of signed char type (e.g., **char *p**) is translated as an integer, pointer field, having data type "char."
- An unsigned char pointer is translated as an integer field pointer.
- A pointer to a numeric type (e.g., **float *p**) is translated as a numeric field pointer.
- A pointer to a structure (e.g., **struct tStruct2 *p**) is translated as a structure field, allocated as a pointer.
- If a structure contains a field pointer to the same structure type, the field cannot be imported. For example:

```
{  struct tStruct1 {
 int a:
 struct tStruct1 *p;
 };
```

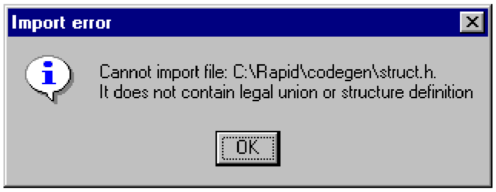
This field cannot be imported

Items That Generate Warnings

- Two-dimensional arrays of type other than signed char is not supported (e.g., **unsigned char array1[10][10]**).
- A pointer to a pointer type is not supported (e.g., **long double **arrayP**).
- A pointer field within a substructure allocated as a buffer cannot be processed.
- An array of pointers field is not supported.
- Union field definitions are ignored. Only top-level unions are translated.
- Unions, declared as fields of structure, cannot be imported.
- Non-structure fields of a top-level union are imported as fields of inline structure.
- Non-instantiated union definitions are imported as RPUnion objects. Tag of union definitions plays the role of RPUnion name. Any instance name following a union definition is ignored.

Items That Generate Error Messages

Importing a text file that contains no structure definitions generates an error message similar to:



Cannot import file: C:\Rapid\codegen\struct.h.
It does not contain legal union or structure definition

CHAPTER 23

State Matrix

A state matrix is a tool used to systematically describe and analyze a project's states. It is commonly used for testing embedded systems.

RapidPLUS also uses the state matrix as a tool for analyzing transitions between modes. Using the State Matrix command you can export logic data to Microsoft® Excel (9.0 or higher) and view the state matrix in Excel's workbook format (XLS).

In Excel, the RapidPLUS state matrix presents the mode tree as it appears in RapidPLUS, that is, the mode hierarchy is maintained. Just like in RapidPLUS—child modes are indented under their parents; exclusive modes appear in black, concurrent modes appear in blue. Also, when the RapidPLUS state matrix is first created in Excel, it is automatically saved as an XLS file. You can revise the file as necessary and save it for later use.

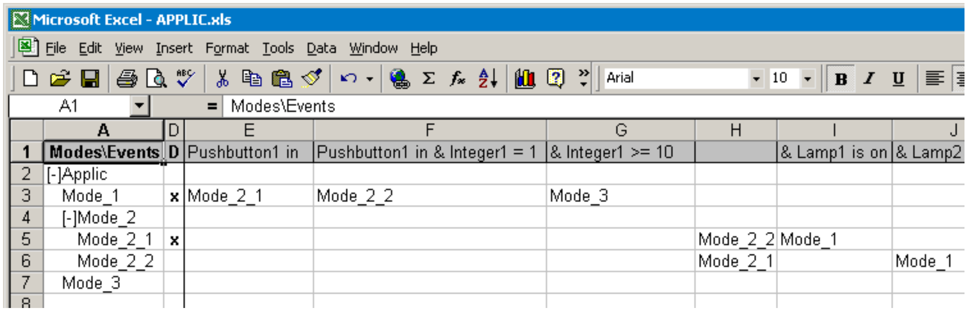
A RapidPLUS application's state matrix enables you to systematically check the application's modes, triggers, and transitions.

This chapter presents:

- An overview of the RapidPLUS state matrix.
- How to export logic data to Excel.

OVERVIEW

An exported state matrix looks like:


Microsoft Excel - APPLIC.xls
File Edit View Insert Format Tools Data Window Help
Arial
10

A1 = Modes\Events

	A	D	E	F	G	H	I	J
1	Modes\Events	D	Pushbutton1 in	Pushbutton1 in & Integer1 = 1	& Integer1 >= 10		& Lamp1 is on	& Lamp2
2	[-]Applic							
3	Mode_1	x	Mode_2_1	Mode_2_2	Mode_3			
4	[-]Mode_2							
5	Mode_2_1	x				Mode_2_2	Mode_1	
6	Mode_2_2					Mode_2_1		Mode_1
7	Mode_3							
8								

In the illustration above, the root mode was selected in RapidPLUS. The following table describes the rows and columns.

COLUMN	DESCRIPTION
A	The cells under Column A present the selected mode and its child modes in a tree format like they are presented in the Mode Tree: • Child modes are indented under their parents. • Exclusive modes appear in black, concurrent modes appear in blue. • The mode tree can be collapsed and expanded.
B and C	Used internally.
D	Denotes which modes are default modes.
E and on	The column labels present the application's events and conditions. The cells present the transition destinations that occur when the events and conditions are triggered.

❖ *NOTE: Internal transitions are not exported to Excel.*

EXPORTING LOGIC DATA

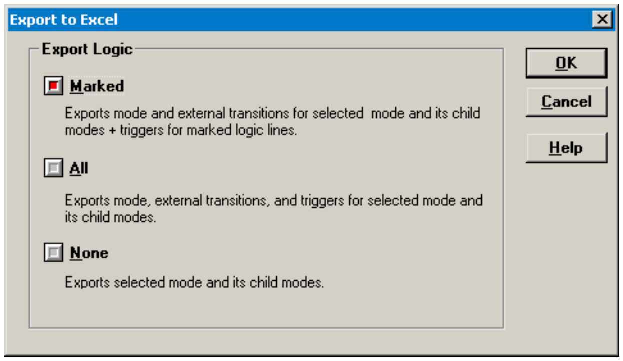
An exported state matrix can present different amounts of logic information. The amount of logic presented is defined in the Export to Excel dialog box.

To export logic data to Excel:

1. Open the application in the Mode Tree or State Chart.
2. Select the mode whose data you want to export. The selected mode **and** its child modes will be exported.
3. In the Mode Tree: choose Tree|State Matrix,
   or
   In the State Chart: choose Tools|State Matrix.

   Ctrl+Shift+P

   The Export to Excel dialog box opens:



Export to Excel

Export Logic

[✓ Marked]

Exports mode and external transitions for selected mode and its child modes + triggers for marked logic lines.

All

Exports mode, external transitions, and triggers for selected mode and its child modes.

None

Exports selected mode and its child modes.

4. Select the Export Logic format as follows:
   - **Marked** exports a state matrix that displays modes, triggers, and destination transitions for the logic lines that you marked in the Mode Tree/Logic Editor. See instructions for marking and unmarking logic lines on the following page.
   - **All** exports a state matrix that displays modes, triggers, and destination transitions for all logic lines, both marked and unmarked.
   - **None** exports a state matrix that displays modes only.
5. Click OK to export the data to Excel; Excel opens, displaying the spreadsheet. The new Excel workbook is automatically saved in the folder where the application is located.

To mark logic lines for export:

- Right-click the mode or logic line and choose Mark for Export, or:

In the Mode Tree window:

1. Select the mode.
2. Choose Tree|Mark for Export.

In the Logic Editor window:

1. Select the logic lines.
2. Choose Edit|Mark for Export.

In the Logic Editor window, the selector buttons of logic lines marked for export are colored blue. Logic lines marked for export to Excel are saved with the application.

❖ *NOTE: If a logic line is marked both as a breakpoint and for export, the breakpoint green takes precedence over the export blue. However, the line will still be exported.*

To clear marked logic lines:

- Right-click the mode or logic line and choose Unmark for Export, or:

In the Mode Tree window:

1. Select the mode.
2. Choose Tree|Unmark for Export.

In the Logic Editor window:

1. Select the logic lines.
2. Choose Edit|Unmark for Export.

Marking and unmarking logic lines for export

Marking a mode for export automatically marks all of its child modes as well; all the logic lines of the marked modes—except for triggers and actions of internal transitions—will be exported to Excel. To refine your mode marking, you will have to unmark and re-mark lower branches of the mode tree. Note that the blue, marked-for-export indicator is visible only in the Logic Editor window.

To control export at the level of individual logic lines, use the Logic Editor window rather than the Mode Tree window. Select the desired logic lines, then mark or unmark them for export. Note that marking or unmarking a logic line that is part of a logic block, automatically applies to all the lines in the block.

CHAPTER 24

Exporting State Charts to Visio

The State Chart tool provides a graphical view of an application's logical structure and flow. It shows the application's mode hierarchy and the transitions from one mode to another.

State charts can be exported to Microsoft® Visio® (Visio 5 or higher). Each exported chart follows the UML conventions for state charts. In addition to modes and transitions, the application's logic can be included in the exported chart.

Exporting the state chart to Visio makes it available for editing with all the Visio tools. However, the Visio drawing cannot be imported back into RapidPLUS.

This chapter presents:

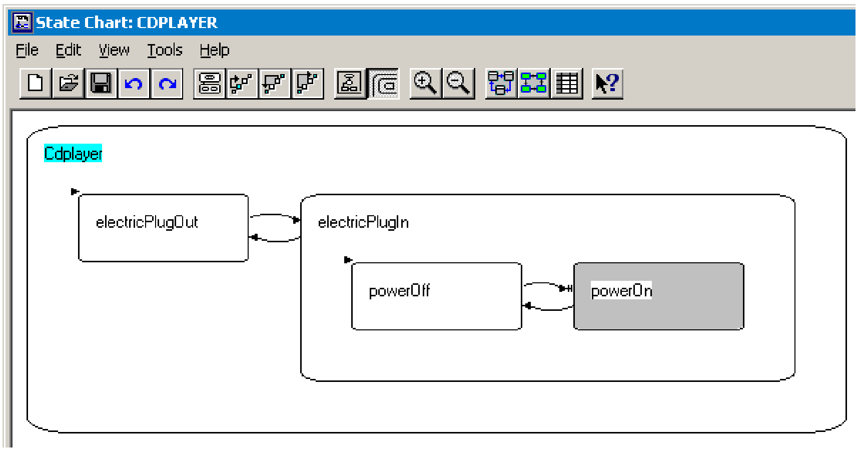
- Views of a state chart in RapidPLUS and Visio.
- How to export logic data to Visio.
- How to modify the appearance of modes in exported state charts.

OVERVIEW

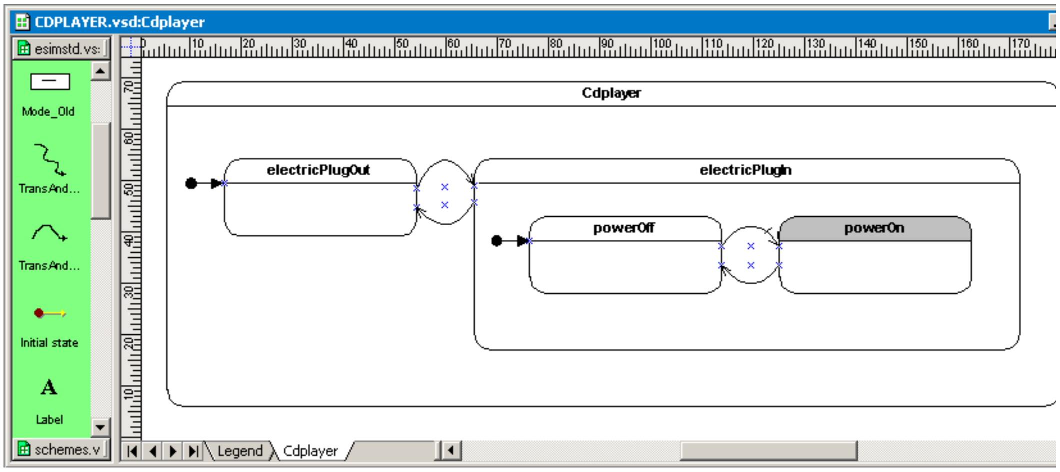
A state chart that has been exported to Microsoft Visio (Visio 5 or higher) may display only modes and external transitions, or it may include related logic lines as well.

❖ *NOTE: Internal transitions are not exported to Visio.*

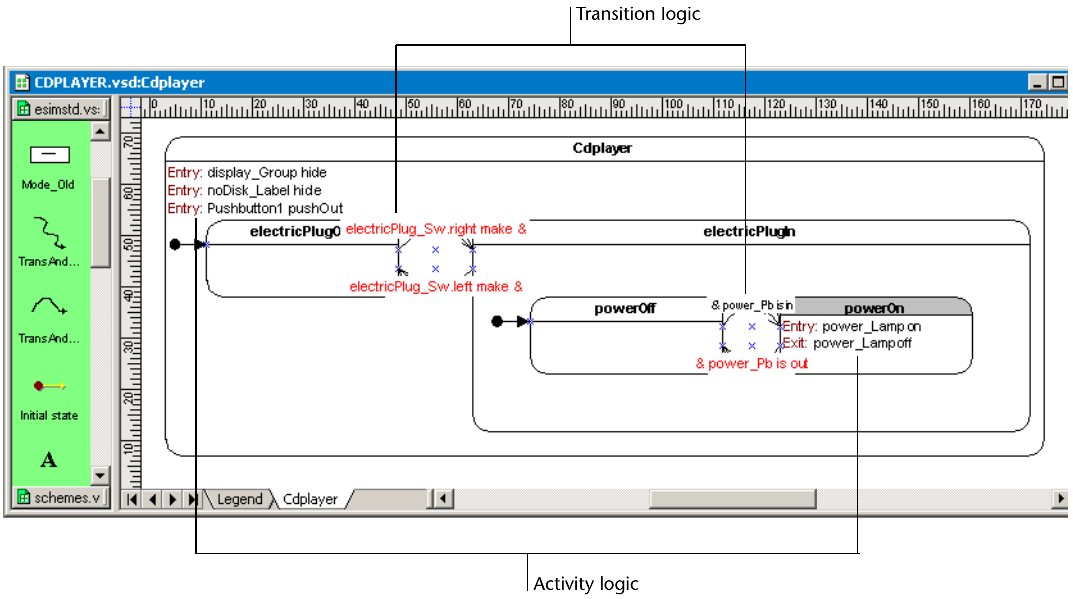
The following illustrations present three views of the same state chart.



State chart in RapidPLUS



State chart without logic in Visio



State chart with logic in Visio

EXPORTING A STATE CHART

As shown in the illustrations above, an exported state chart can include logic information. The amount of logic presented is defined in the Export to Visio dialog box.

To export a state chart that includes selected logic, you must first mark the logic to be exported (see "To mark logic lines for export to Visio:" on p. 24-5).

To export a state chart to Visio:

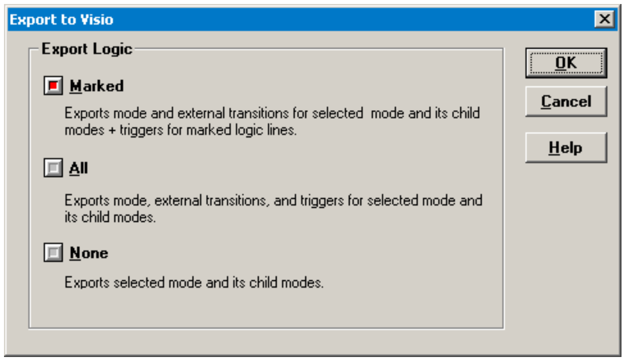
1 Open the application in the State Chart.

2 Select the mode whose state chart you want to export.

The number of levels included in the exported chart is determined by the number of levels set for the state chart in the Chart Options dialog box (Tools|Options, State Chart tab).

Ctrl+Shift+S

3 Choose Tools|Export State Chart, or click the State Chart button; the Export to Visio dialog box opens:


Export to Visio

Export Logic

[✓ Marked]
Exports mode and external transitions for selected mode and its child modes + triggers for marked logic lines.

All
Exports mode, external transitions, and triggers for selected mode and its child modes.

None
Exports selected mode and its child modes.

4 Select the Export Logic format as follows:

- **Marked** exports a chart that displays modes, external transitions and marked logic lines. See instructions for marking and unmarking logic lines on the next page.
- **All** exports a chart that displays modes, external transitions and all logic lines, both marked and unmarked.
- **None** exports a chart that displays modes and external transitions only. No logic lines are exported even when they are marked.

❖ *NOTE: Only logic lines that are associated with the displayed modes are exported. As in the RapidPLUS state chart, transition numbering replaces transition logic when the Number Transitions check box is selected in the Chart Options dialog box (Tools|Options, State Chart tab).*

5 Click OK to export the chart to Visio.

Visio opens, displaying the state chart and the RapidPLUS Visio stencil *EsimStd.vss* (this stencil is used by RapidPLUS to build the charts in Visio). The new Visio drawing is automatically saved in the folder where the application is located.

To mark logic lines for export to Visio:

- Right-click the mode or logic line and choose Mark for Export,
  or:

In the Mode Tree window:

1 Select the mode.

2 Choose Tree|Mark for Export.

In the Logic Editor window:

1 Select the logic lines.

2 Choose Edit|Mark for Export.

In the Logic Editor window, the selector buttons of logic lines marked for export are colored blue. Logic lines marked for export to Visio are saved with the application.

❖ *NOTE: If a logic line is marked both as a breakpoint and for export to Visio, the breakpoint green takes precedence over the export to Visio blue. However, the logic line will still be exported to Visio.*

To clear marked logic lines:

- Right-click the mode or logic line and choose Unmark for Export,
  or:

In the Mode Tree window:

1 Select the mode.

2 Choose Tree|Unmark for Export.

In the Logic Editor window:

1 Select the logic lines.

2 Choose Edit|Unmark for Export.

Marking and unmarking logic lines for export to Visio

Marking a mode for export to Visio automatically marks all of its child modes as well; all the logic lines of the marked modes—except for triggers and actions of internal transitions—will be exported to Visio.

To refine your mode marking, you will have to unmark and re-mark lower branches of the mode tree. Note that the blue, marked-for-export indicator is visible only in the Logic Editor window.

To control export to Visio at the level of individual logic lines, use the Logic Editor window rather than the Mode Tree window. Select the desired logic lines, then mark or unmark them for export. Note that marking or unmarking a logic line that is part of a logic block, automatically applies to all the lines in the block.

Choosing and Creating Schemes for Exported State Charts

The appearance of modes in exported state charts is determined by scheme masters provided by another RapidPLUS stencil, *schemes.vss*. In RapidPLUS, the masters are listed in the Chart Options dialog box's “Scheme” list. The master named “Default” is the basis for all predefined and new masters. You can use the supplied scheme masters or create your own.

❖ *NOTE: Only modify the Default master if you want all subsequent masters to contain these modifications.*

To select a chart scheme other than the Default scheme:

1. Open the Chart Options dialog box (Tools|Options).
2. In the Scheme list, click the arrow and select a scheme.
3. Click OK.

To create a new chart scheme:

1. Open the Chart Options dialog box (Tools|Options).
2. In the Scheme list, click the arrow and select <**New**>, then click Settings. Microsft Visio opens to a new master named “Default.<consecutive number>”. The *schemes.vss* stencil is also opened, but is not in focus.
3. Modify the textual appearance of mode names as needed.

   (Although other elements can be modified, they will not be applied to the charts. The other elements apply to exported screen transition charts.)
4. Save the new scheme. To do so:

   a. Close the master.

   b. In the Update dialog box that opens, click Yes.

c. In the *scheme.vss* stencil, right click the new master (named "Default.<number>") and choose Master Properties.

d. Edit the Master's name, then click OK.

e. Close *schemes.vss*. In the Save Changes dialog box, click Yes. By default, the new master is saved in Visio 5 format. You can choose a different Visio version.

The newly created scheme is added to the Scheme list in the Chart Options dialog box.

CHAPTER 25

Generating Reports

RapidPLUS enables you to generate detailed text or graphic reports about various aspects of your applications and projects. All of the reports can be printed, either directly from RapidPLUS or via the read-only Report Viewer. Many of the reports can be customized to present the specific amount of information you want to see. Additionally, reports containing XML code can be generated for an application and its user objects.

This chapter presents:

- An overview of the reports.
- How to work with reports in the Report Viewer.
- Reports about objects.
- Reports about modes.
- Report about user object interface.
- Reports about project components.
- Coverage test reports.
- XML reports and their API.

❖ *NOTE: This chapter replaces Chapter 24: “Generating Reports” of the Rapid User Manual.*

OVERVIEW OF THE RAPIDPLUS REPORTS

There are five main types of reportare. They are accessed from the Reports menu in the Application Managers:

TYPE	REPORT NAME	DESCRIPTION
Objects	*Object Layout*	Presents a "snapshot" of the application in the Object Layout.
	Object Tree	Presents the hierarchy of the application's objects.
	Object Data	Summarizes object information, such as parent, type, parameters, and properties.
	Prototyper Layout	Presents a "snapshot" of the application in the Prototyper.
Modes	*State Chart Plot*	Presents a "snapshot" of the application in the State Chart.
	Mode Tree	Presents a hierarchy of the application's modes.
	Mode Data	Summarizes mode information, such as parent, type, transitions, and activities.
Interface	*User Object Interface*	Summarizes information about an application's (or project's) user object interface, such as exported functions and messages.
Components	*Component Dependency Tree*	Presents a hierarchical tree of the project's user objects.
	Component List	Presents a list of the project's user objects.
	Detailed Component List	Similar to the Component List report, except that it also lists holders.
	Target Graphic Displays	Presents a list of the graphic displays that are used in the project components.

TYPE	REPORT NAME	DESCRIPTION
Coverage Test	*Coverage Test*	Presents a list of modes, transitions, triggers, user functions, or objects that are not referenced in coverage test data that is collected from the Prototyper.
XML	*Selected Application*	An XML file that presents XML code for the application.
	Application and User Objects	Same as above, except for the entire project.

WORKING WITH REPORTS IN THE REPORT VIEWER

This section applies to the following reports:

- Object Tree report
- Object Data report
- Mode Tree report
- Mode Data report
- User Object Interface report
- Component Dependency Tree report
- Component List report
- Detailed Component List report
- Coverage Test report

All of these reports are generated to the read-only Report Viewer, from which you can save and/or print them. Once a report has been saved, it can be viewed in any text editor, but it cannot be reopened in the Report Viewer.

(The Object Layout, Prototyper Layout, and State Chart Plot reports are printed directly from RapidPLUS. The XML reports are viewed and printed from a Web browser).

Viewing Reports

A generated report is displayed in the Report Viewer using a default font style. You can change the display font.

To change the display font:

1. In the Report Viewer, choose File|Set Font. The standard Microsoft Windows Font dialog box opens.
2. Change the font and/or attributes as necessary, then click OK.

Saving Reports

The first time you save a report, the default location is the \\Applics folder.

To save the report shown in the Report Viewer:

1. Choose File|Save As or click the Save button. The standard Microsoft Windows Save As dialog box opens, with the RapidPLUS report file extension (TRD) as the default file type. You can also save reports as text files (TXT).
2. Name the file, then click Save.

Printing Reports

Before you print a report, you can change the printer font.

To change the printer font:

1. In the Report Viewer, choose File|Set Printer Font. The standard Microsoft Windows Font dialog box opens.
2. Change the font and/or attributes as necessary, then click OK.

To print the report shown in the Report Viewer:

1. Choose File|Print or click the Print button. The standard Microsoft Windows Print dialog box opens.
2. Click Print.

Editing Reports

Saved report files can be viewed and edited in any text editor. By default RapidPLUS displays the files in Microsoft® Notepad. You can change the default text editor in the Report Editor dialog box.

To edit a report:

1. In the Application Manager, choose Options|Edit; the Open Report dialog box opens.
2. Select a file, then click Open; the report opens in the default text editor.

To change the default text editor:

1. In the Application Manager, choose Options|Report Editor.
2. In the Report Editor dialog box, click the Browse button to select the text editor's executable file (EXE).

OBJECT REPORTS

RapidPLUS can generate four types of reports about an application's objects:

- Object Layout report
- Object Tree report
- Object Data report
- Prototyper Layout report

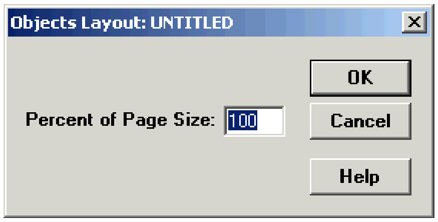
Instructions for creating these reports are presented below.

Object Layout Report

This report is a printed "snapshot" of the application in the Object Layout.

To print an Object Layout report:

1. In the Application Manager, choose Reports|Objects|Layout; the following dialog box opens:



Percent of Page Size: 100

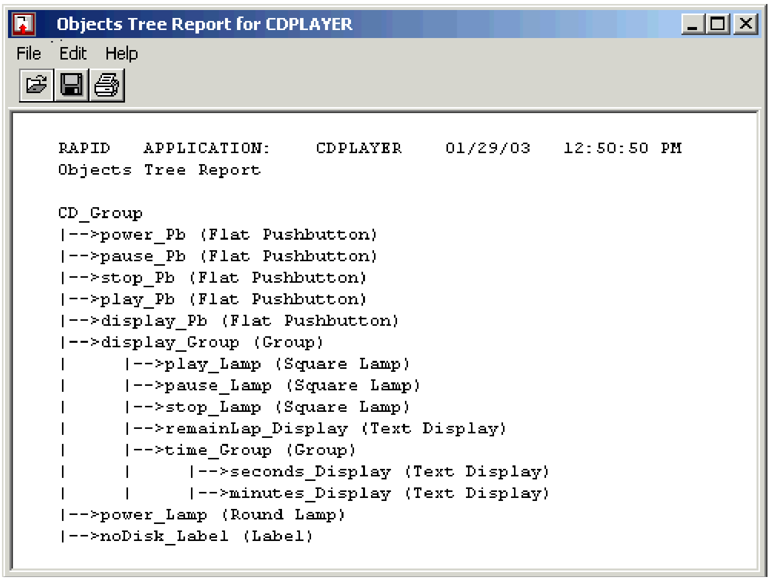
2 Either accept or change the Percent of Page Size value, then click OK.

The default size is 100%, which means that the image will be scaled to print as large as possible on a single sheet, while maintaining the same aspect ratio and orientation. The smaller the percentage value, the smaller the image, and the faster the printout. For a complex layout image, the time difference may be substantial.

3 In the standard Microsoft Windows Print dialog box, click Print.

Object Tree Report

This report is an ASCII text file that presents the hierarchy of the application's objects. A typical report (as viewed in the Report Viewer) looks like this:



```
RAPID   APPLICATION:    CDPLAYER    01/29/03    12:50:50 PM
Objects Tree Report

CD_Group
|-->power_Pb (Flat Pushbutton)
|-->pause_Pb (Flat Pushbutton)
|-->stop_Pb (Flat Pushbutton)
|-->play_Pb (Flat Pushbutton)
|-->display_Pb (Flat Pushbutton)
|-->display_Group (Group)
|      |-->play_Lamp (Square Lamp)
|      |-->pause_Lamp (Square Lamp)
|      |-->stop_Lamp (Square Lamp)
|      |-->remainLap_Display (Text Display)
|      |-->time_Group (Group)
|      |      |-->seconds_Display (Text Display)
|      |      |-->minutes_Display (Text Display)
|-->power_Lamp (Round Lamp)
|-->noDisk_Label (Label)
```

To generate an Object Tree report:

1 In the Object Layout, select the object for which you want to generate a report. If you want a report about all of the application's objects, be sure that no object is selected in the layout area.

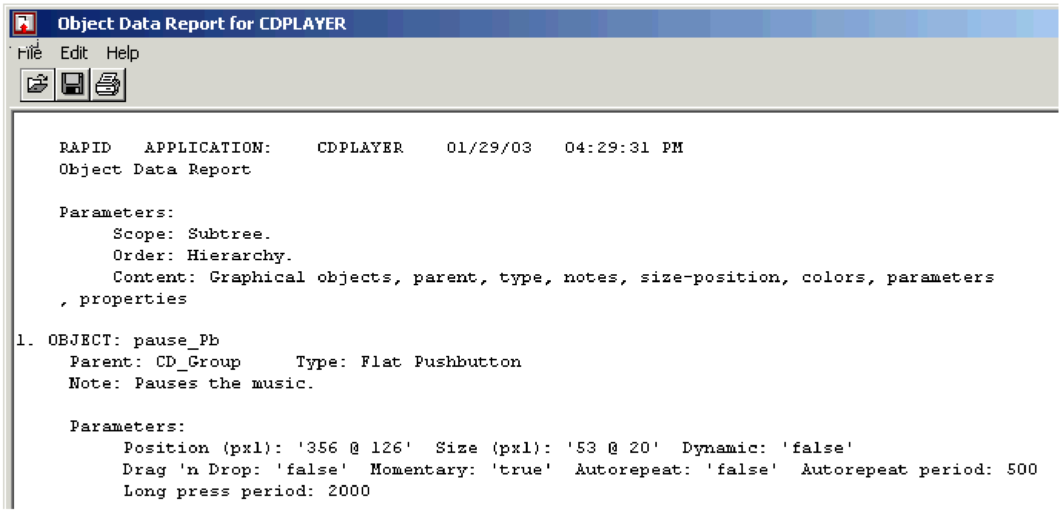
2 In the Application Manager, choose Reports|Objects|Tree; the Object Tree Report dialog box opens.

3 Click OK; the Report Viewer opens displaying the selected object's hierarchy.

You can print or save the report as explained in "Working with Reports in the Report Viewer" on p. 25-3.

Object Data Report

This report is an ASCII text file that summarizes object information. A typical report (as viewed in the Report Viewer) looks like this:

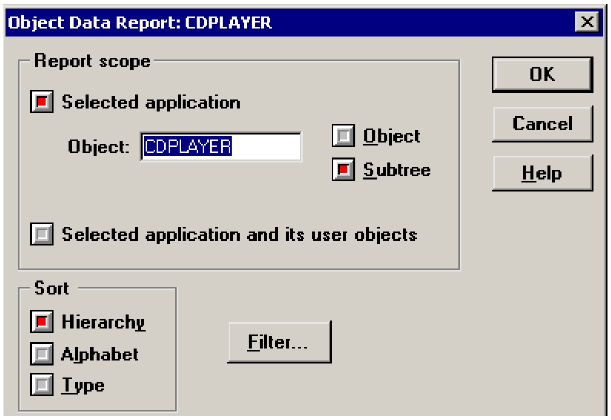


```
    RAPID   APPLICATION:    CDPLAYER    01/29/03    04:29:31 PM
    Object Data Report

    Parameters:
         Scope: Subtree.
         Order: Hierarchy.
         Content: Graphical objects, parent, type, notes, size-position, colors, parameters
    , properties

1. OBJECT: pause_Pb
     Parent: CD_Group     Type: Flat Pushbutton
     Note: Pauses the music.

     Parameters:
          Position (pxl): '356 @ 126'  Size (pxl): '53 @ 20'  Dynamic: 'false'
          Drag 'n Drop: 'false'  Momentary: 'true'  Autorepeat: 'false'  Autorepeat period: 500
          Long press period: 2000
```

To generate an Object Data report:

For a report about a specific object, select it in the Object Layout. For a report about the application (without its user objects), be sure that no object is selected in the layout area.

1 In the Application Manager, choose Reports|Objects|Data; the Object Data Report dialog box opens:


Object Data Report: CDPLAYER

Report scope

[✓ Selected application]

Object: CDPLAYER

Object [✓ Subtree]

Selected application and its user objects

Sort

[✓ Hierarchy]

Alphabet

Type

2 If you want to include the object's child objects, select the **Subtree** option.

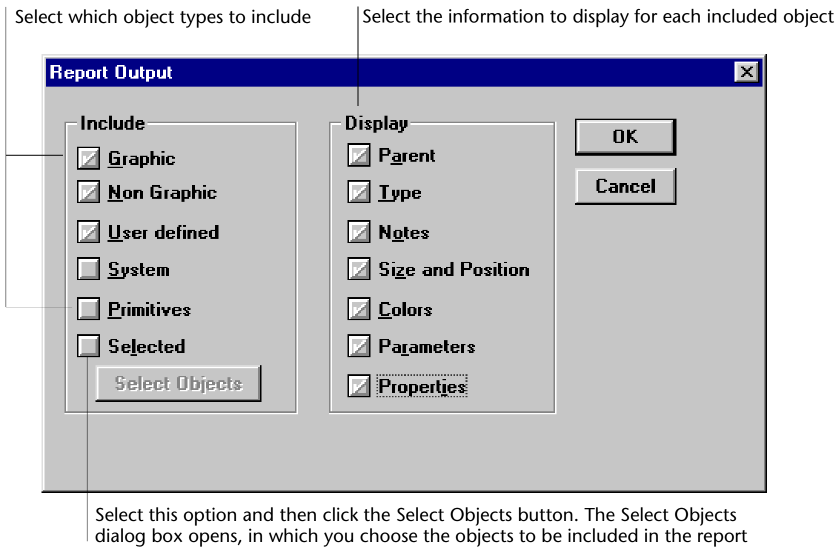
If you do not want to include the object's child objects, select the **Object** option.

If you want to generate a report about a different object, type its name in the **Object** box.

If you want to generate a report about the entire project, select the **Selected application and its user objects** option.

3 Select a **Sort** type.

4 Click the **Filter** button to open the Report Output dialog box for selecting the types of objects and data to include in the report:


Select which object types to include
Select the information to display for each included object
Report Output
Include
Display
OK
Cancel
Select Objects
Select this option and then click the Select Objects button. The Select Objects dialog box opens, in which you choose the objects to be included in the report

Include: [✓ Graphic] [✓ Non Graphic] [✓ User defined] System Primitives Selected

Display: [✓ Parent] [✓ Type] [✓ Notes] [✓ Size and Position] [✓ Colors] [✓ Parameters] [✓ Properties]

❖ *NOTE: In Object Data reports, size limits are displayed for string and array objects.*

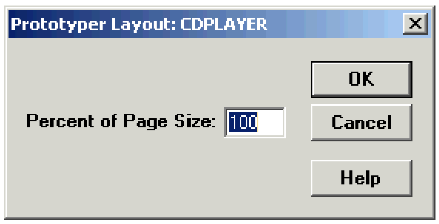
Prototyper Layout Report

This report is a printed “snapshot” of the application as it appears in the Prototyper.

To print a Prototyper Layout report:

1 Run the application in the Prototyper. You can either pause the Prototyper or continue to the next step (which automatically pauses the Prototyper).

2 In the Application Manager, choose Reports|Objects|Prototyper Layout; the following dialog box opens:



Percent of Page Size: 100

3 Either accept or change the Percent of Page Size value, then click OK.

   The default size is 100%, which means that the image will be scaled to print as large as possible on a single sheet, while maintaining the same aspect ratio and orientation. The smaller the percentage value, the smaller the image, and the faster the printout. For a complex layout image, the time difference may be substantial.

4 In the standard Microsoft Windows Print dialog box that opens, click Print.

MODE REPORTS

RapidPLUS can generated three types of reports about an application's modes:

- State Chart Plot
- Mode Tree report
- Mode Data report

Instructions for creating these reports are presented below.

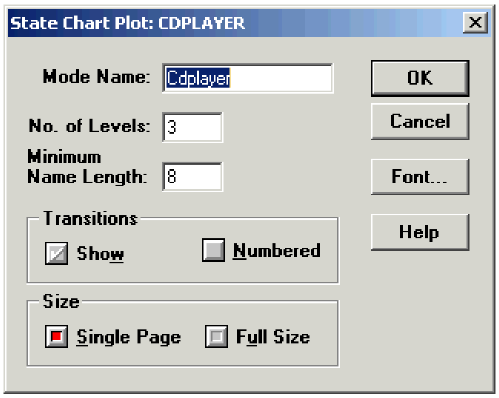
State Chart Plot

This report is a printout of the selected mode, with or without its descendants. The printout displays the modes in a nested chart format, similar to how they appear in the State Chart.

To generate a State Chart Plot:

1 In the State Chart or Mode Tree, select the mode for which you want to generate a plot (or you can type a mode name in the dialog box).

2 In the Application Manager, choose Reports|Modes|State Chart Plot; the State Chart Plot dialog box opens:


State Chart Plot: CDPLAYER

Mode Name: Cdplayer

No. of Levels: 3

Minimum Name Length: 8

Transitions: [✓ Show] Numbered

Size: [✓ Single Page] Full Size

3 In the **No. of Levels** box, specify how many mode levels you want to show below the selected mode.

4 In the **Minimum Name Length** box, specify a limit for the length of mode names at the lowest plotted mode level, which is based on the widest character of the selected font.

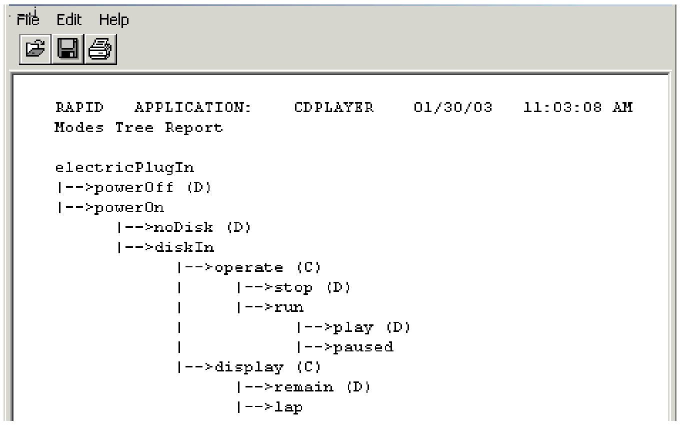
5 If you want to display transitions in the plot, select the **Show** check box in the Transitions group. If you want the displayed transitions to be numbered, select the **Numbered** check box.

6 In the Size group, select either **Single Page** or **Full Size**. The Single Page option restricts the plot to a single printed page. The Full Size option prints at the default size. The single page format may be more convenient, but the full size output usually provides a clearer result.

❖ *NOTE: The minimum name length that you specify determines the size of the Full Size plot. If you plot Single Page, RapidPLUS may reduce the specified number of characters printed in order to improve clarity.*

Mode Tree Report

This report is an ASCII text file that presents the hierarchy of the application's modes. A typical report (as viewed in the Report Viewer) looks like this:



```
RAPID   APPLICATION:    CDPLAYER    01/30/03   11:03:08 AM
Modes Tree Report

electricPlugIn
|-->powerOff (D)
|-->powerOn
      |-->noDisk (D)
      |-->diskIn
            |-->operate (C)
            |     |-->stop (D)
            |     |-->run
            |           |-->play (D)
            |           |-->paused
            |-->display (C)
                  |-->remain (D)
                  |-->lap
```

To generate a Mode Tree report:

1 In the Mode Tree, select the mode for which you want to generate a report (or you can type a mode name in the dialog box). If you want a report about all of the application's modes, select the root mode.

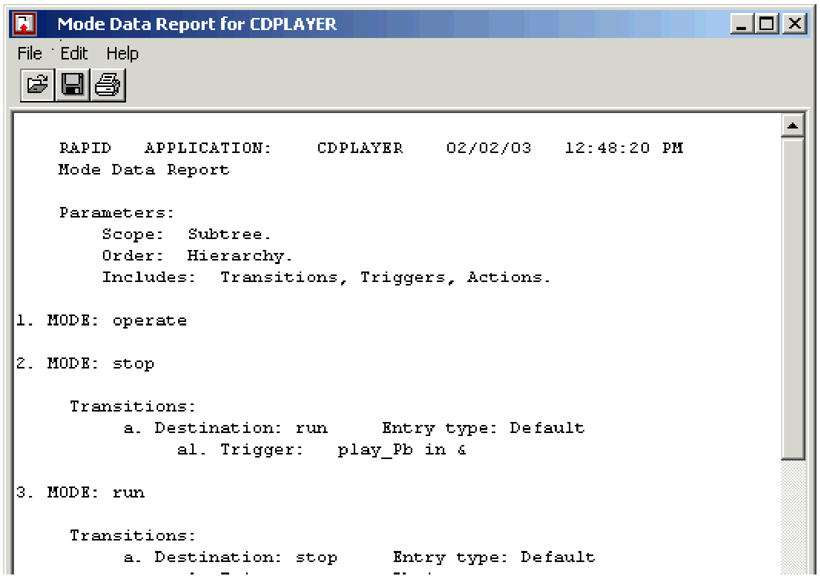
2 In the Application Manager, choose Reports|Modes|Tree; the Mode Tree Report dialog box opens.

3 Click OK; the Report Viewer opens displaying the mode's hierarchy.

You can print or save the report as explained in "Working with Reports in the Report Viewer" on p. 25-3.

Mode Data Report

This report is an ASCII text file that summarizes mode information. A typical report (as viewed in the Report Viewer) looks like this:

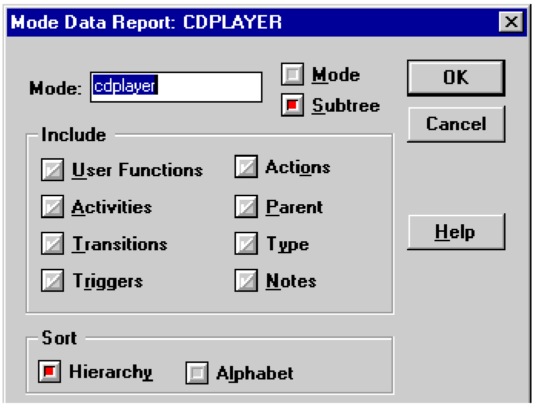


```
   RAPID   APPLICATION:    CDPLAYER    02/02/03   12:48:20 PM
   Mode Data Report

   Parameters:
       Scope:   Subtree.
       Order:   Hierarchy.
       Includes:  Transitions, Triggers, Actions.

1. MODE: operate

2. MODE: stop

    Transitions:
         a. Destination: run      Entry type: Default
              a1. Trigger:   play_Pb in &

3. MODE: run

    Transitions:
         a. Destination: stop      Entry type: Default
```

To generate a Mode Data report:

1 In the Mode Tree, select the mode for which you want to generate a report (or you can type a mode name in the dialog box).

2 In the Application Manager, choose Reports|Modes|Data; the Mode Data Report dialog box opens:



Mode: cdplayer
Mode [ ] Subtree [✓]
Include: User Functions [✓], Activities [✓], Transitions [✓], Triggers [✓], Actions [✓], Parent [✓], Type [✓], Notes [✓]
Sort: Hierarchy [✓], Alphabet [ ]

3 If you want to include information about the mode's descendants, select the **Subtree** option.

If you want to generate a report about the selected mode only, select the **Mode** option.

4 By default, all of the logic information is included in the report, i.e., all of the logic types in the **Include** group are selected. To exclude logic information from the report, clear the unnecessary check boxes in the Include group. Keep in mind that some logic types are dependent on other logic types (for example, actions cannot be included without triggers).

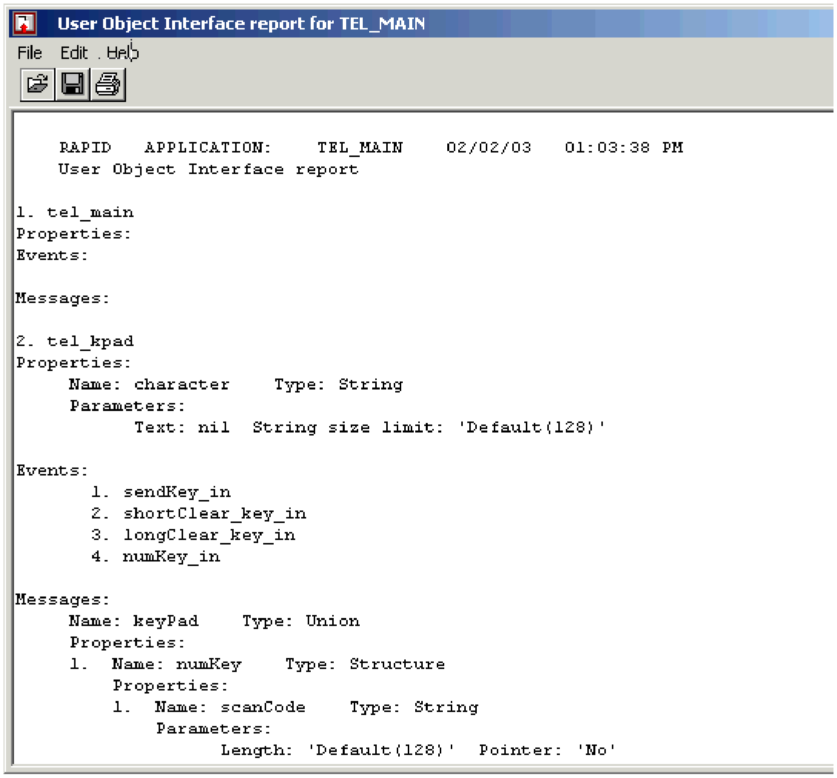
5 Select a **Sort** type.

6 Click OK; the Report Viewer opens displaying the selected mode's data information.

You can print or save the report as explained in "Working with Reports in the Report Viewer" on p. 25-3.

USER OBJECT INTERFACE REPORTS

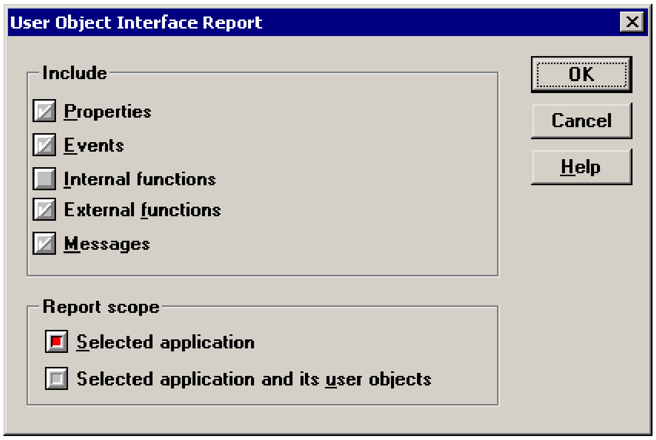
This report is an ASCII text file that summarizes information about an application's—or project's—interface with its user objects. A typical report (as viewed in the Report Viewer) looks like this:



```
    RAPID   APPLICATION:    TEL_MAIN    02/02/03    01:03:38 PM
    User Object Interface report

1. tel_main
Properties:
Events:

Messages:

2. tel_kpad
Properties:
     Name: character    Type: String
     Parameters:
           Text: nil  String size limit: 'Default(128)'

Events:
       1. sendKey_in
       2. shortClear_key_in
       3. longClear_key_in
       4. numKey_in

Messages:
     Name: keyPad    Type: Union
     Properties:
     1.  Name: numKey    Type: Structure
         Properties:
         1.  Name: scanCode    Type: String
             Parameters:
                   Length: 'Default(128)'  Pointer: 'No'
```

To generate a User Object Interface report:

1 In the Application Manager, choose Reports|Interface; the User Object Interface Report dialog box opens:



User Object Interface Report

Include

- [✓] Properties
- [✓] Events
- [ ] Internal functions
- [✓] External functions
- [✓] Messages

Report scope

- [✓] Selected application
- [ ] Selected application and its user objects

2 By default, all of the interface elements are included in the report, i.e., all of the elements in the **Include** group are selected. To exclude information from the report, clear the unnecessary check boxes in the Include group.

3 Under **Report scope**, select whether the report is for the current application only or for the application and its components.

4 Click OK; the Report Viewer opens displaying the interface information.

You can print or save the report as explained in “Working with Reports in the Report Viewer” on p. 25-3.

PROJECT COMPONENT REPORTS

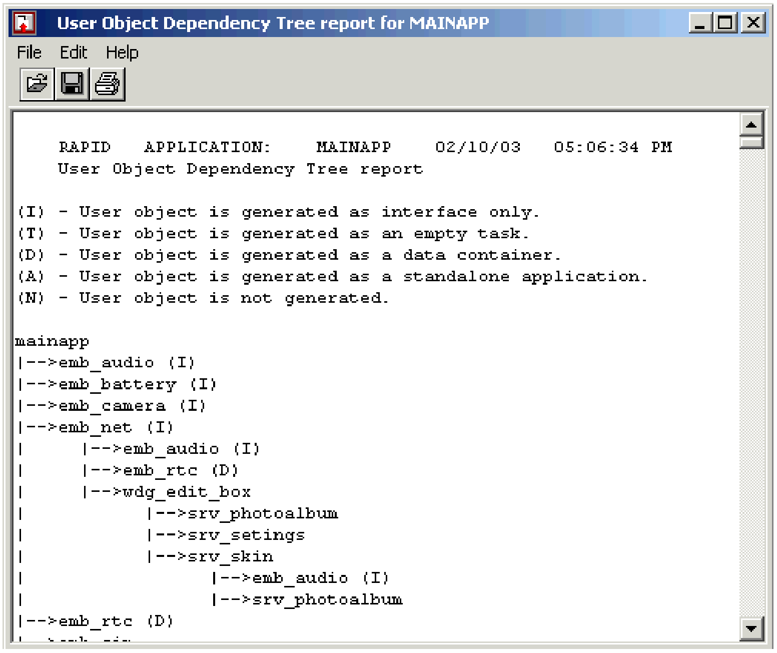
RapidPLUS can generated four types of reports about a project's components (the RPD file and each of its UDO files):

- Component Dependency Tree report
- Component List report
- Detailed Component List report
- Target Graphic Displays report

Instructions for creating these reports are presented below. You can print or save the reports as explained in "Working with Reports in the Report Viewer" on p. 25-3.

Component Dependency Tree Report

This report is an ASCII text file that presents the hierarchy of the project's components. A typical report (as viewed in the Report Viewer) looks like this:



```
    RAPID   APPLICATION:    MAINAPP    02/10/03    05:06:34 PM
    User Object Dependency Tree report

(I) - User object is generated as interface only.
(T) - User object is generated as an empty task.
(D) - User object is generated as a data container.
(A) - User object is generated as a standalone application.
(N) - User object is not generated.

mainapp
|-->emb_audio (I)
|-->emb_battery (I)
|-->emb_camera (I)
|-->emb_net (I)
|      |-->emb_audio (I)
|      |-->emb_rtc (D)
|      |-->wdg_edit_box
|            |-->srv_photoalbum
|            |-->srv_setings
|            |-->srv_skin
|                  |-->emb_audio (I)
|                  |-->srv_photoalbum
|-->emb_rtc (D)
```

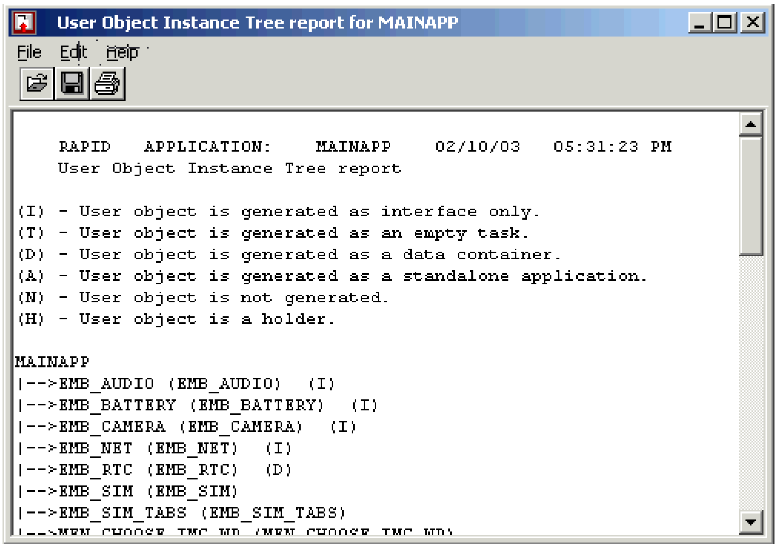
The components in each level are listed alphabetically by file name.

To generate a Component Dependency Tree report:

- Choose Reports|Components|Component Dependencies tree; the Report Viewer opens displaying the component tree.

Component List Report

This report (titled the User Object Instance Tree report) is an ASCII text file that presents a list of the project's components. A typical report (as viewed in the Report Viewer) looks like this:



```
    RAPID   APPLICATION:    MAINAPP    02/10/03    05:31:23 PM
    User Object Instance Tree report

(I) - User object is generated as interface only.
(T) - User object is generated as an empty task.
(D) - User object is generated as a data container.
(A) - User object is generated as a standalone application.
(N) - User object is not generated.
(H) - User object is a holder.

MAINAPP
|-->EMB_AUDIO (EMB_AUDIO)  (I)
|-->EMB_BATTERY (EMB_BATTERY)  (I)
|-->EMB_CAMERA (EMB_CAMERA)  (I)
|-->EMB_NET (EMB_NET)  (I)
|-->EMB_RTC (EMB_RTC)  (D)
|-->EMB_SIM (EMB_SIM)
|-->EMB_SIM_TABS (EMB_SIM_TABS)
```

The components are listed by name followed by the file name in parentheses and code generation type.

To generate a Component Dependency Tree report:

- In the Application Manager, choose Reports|Components|Component List; the Report Viewer opens displaying the components.

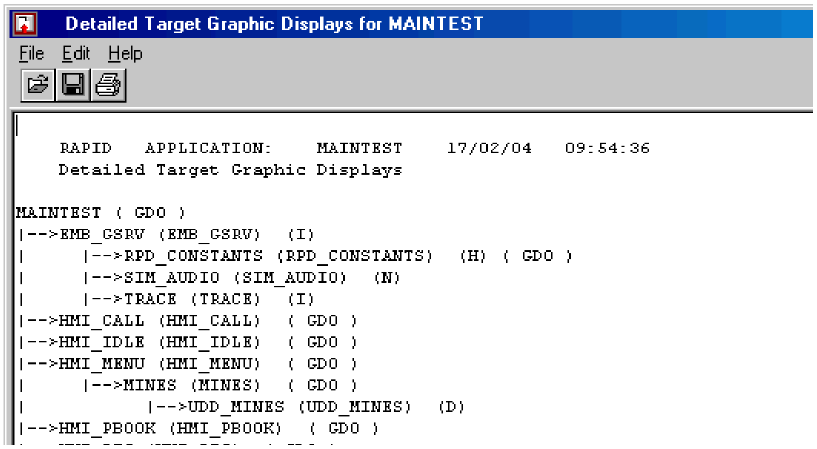
Detailed Component List Report

This report expands the Component List report by listing holders to user objects. For details about the Component List report, see the previous section.

Target Graphic Displays Report

This report is an ASCII text file that presents the graphic displays that are used in the various project components. The components are listed as they appear in the Detailed Component List report.

A typical report (as viewed in the Report Viewer) looks like this:



```
    RAPID   APPLICATION:    MAINTEST    17/02/04   09:54:36
    Detailed Target Graphic Displays

MAINTEST ( GDO )
|-->EMB_GSRV (EMB_GSRV)   (I)
|      |-->RPD_CONSTANTS (RPD_CONSTANTS)  (H)  ( GDO )
|      |-->SIM_AUDIO (SIM_AUDIO)  (N)
|      |-->TRACE (TRACE)   (I)
|-->HMI_CALL (HMI_CALL)   ( GDO )
|-->HMI_IDLE (HMI_IDLE)   ( GDO )
|-->HMI_MENU (HMI_MENU)   ( GDO )
|      |-->MINES (MINES)   ( GDO )
|            |-->UDD_MINES (UDD_MINES)  (D)
|-->HMI_PBOOK (HMI_PBOOK)   ( GDO )
```

The components are listed by name followed by the file name in parentheses the code generation type, and the name of the graphic display that is used by the component.

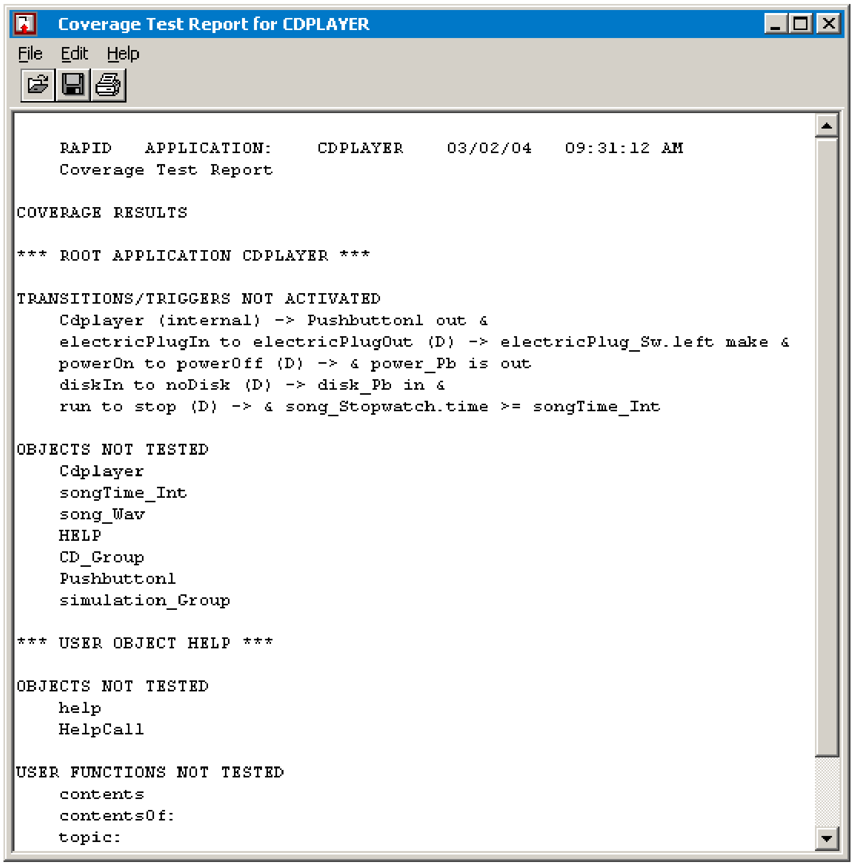
To generate a Target Graphic Displays report:

- In the Application Manager, choose Reports|Components|Target Graphic Displays; the Report Viewer opens displaying the components and their target graphic display.

COVERAGE TEST REPORTS

This report is an ASCII text file that presents coverage test results for an application that was run in the Prototyper. This project-wide test reports any modes, transitions, triggers, user functions, or objects that were not referenced while the Prototyper was running. Coverage Test reports can be used with third-party software that runs automatic tests on the application.

A typical report (as viewed in the Report Viewer) looks like this:



```
    RAPID   APPLICATION:    CDPLAYER    03/02/04    09:31:12 AM
    Coverage Test Report

COVERAGE RESULTS

*** ROOT APPLICATION CDPLAYER ***

TRANSITIONS/TRIGGERS NOT ACTIVATED
    Cdplayer (internal) -> Pushbutton1 out &
    electricPlugIn to electricPlugOut (D) -> electricPlug_Sw.left make &
    powerOn to powerOff (D) -> & power_Pb is out
    diskIn to noDisk (D) -> disk_Pb in &
    run to stop (D) -> & song_Stopwatch.time >= songTime_Int

OBJECTS NOT TESTED
    Cdplayer
    songTime_Int
    song_Wav
    HELP
    CD_Group
    Pushbutton1
    simulation_Group

*** USER OBJECT HELP ***

OBJECTS NOT TESTED
    help
    HelpCall

USER FUNCTIONS NOT TESTED
    contents
    contentsOf:
    topic:
```

To generate a Coverage Test report:

1 In the Prototyper, run the application until you reach the state from which you want to collect data for the coverage test.

2 Choose Controls|Coverage Test, or click the Coverage Test button.

From this point, all actions in the Prototyper, including recording and playing back with the Recorder, will be examined under the coverage test.

3 Continue to run the application until you have covered all of the actions required for the coverage test. You can pause, stop, or restart the Prototyper as often as necessary.

4 To stop collecting data for the coverage test, choose Controls|Coverage Test or click the Coverage Test button.

❖ *NOTE: Restarting data collection (by clicking the Coverage Test button again) overwrites the previous data.*

5 To generate the Coverage Test report, first **stop** the Prototyper. In the Application Manager, choose Reports|Coverage Test; the Report Viewer opens displaying the coverage test results.

You can print or save the report as explained in “Working with Reports in the Report Viewer” on p. 25-3.

You may want to run more than one coverage test while the application runs. For example, you may want to check the status of user objects at different stages in the application.

To generate multiple Coverage Test reports:

1 Run the application in the Prototyper and choose Controls|Coverage Test, or click the Coverage Test button, to begin data collection.

2 To generate the Coverage Test report, first **stop** the Prototyper. In the Application Manager, choose Reports|Coverage Test; the Report Viewer opens displaying the coverage test results.

3 Restart the Prototyper to continue collecting data for the next coverage test.

Each time you stop the Prototyper, you can choose Reports|Coverage Test to generate a new coverage test and displays the results in a new Report Viewer.

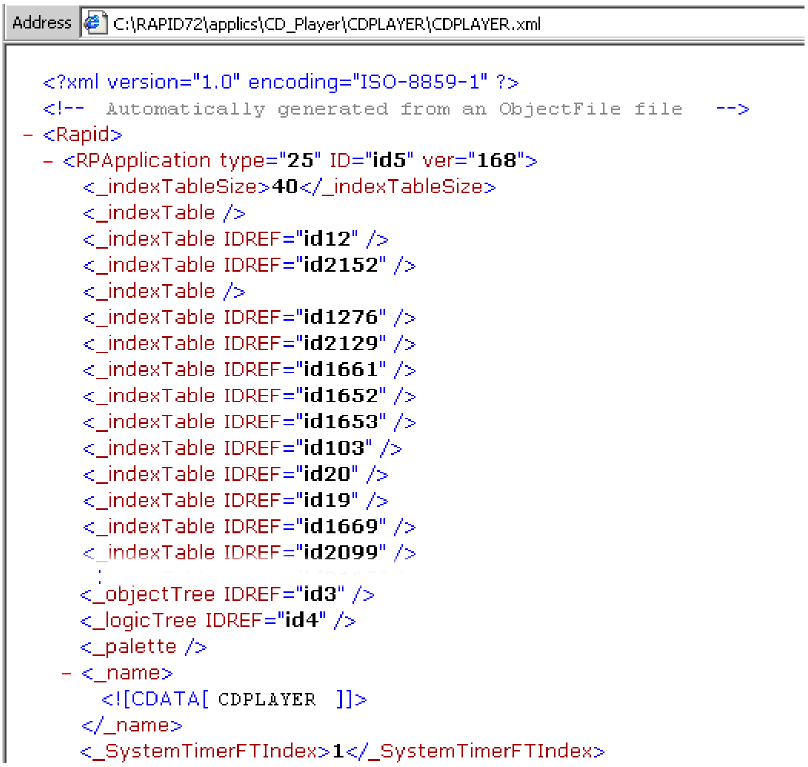
4 To stop collecting data for coverage tests, choose Controls|Coverage Test or click the Coverage Test button.

XML REPORTS

RapidPLUS can generate XML code for an application, with or without its user objects. The main purpose of XML reports is to allow automatic conversion of RPD/UDO files to formats used by other tools so that RapidPLUS applications can be imported into these other tools.

❖ *NOTE: XML reports will be supported through RapidPLUS version 8. The capability to save RapidPLUS applications in XML will render the XML reports feature unnecessary.*

The XML code is viewed from a Web browser or an XML editor. A typical report looks like this:



Address C:\RAPID72\applics\CD_Player\CDPLAYER\CDPLAYER.xml

```
  <?xml version="1.0" encoding="ISO-8859-1" ?>
  <!--  Automatically generated from an ObjectFile file   -->
- <Rapid>
  - <RPApplication type="25" ID="id5" ver="168">
      <_indexTableSize>40</_indexTableSize>
      <_indexTable />
      <_indexTable IDREF="id12" />
      <_indexTable IDREF="id2152" />
      <_indexTable />
      <_indexTable IDREF="id1276" />
      <_indexTable IDREF="id2129" />
      <_indexTable IDREF="id1661" />
      <_indexTable IDREF="id1652" />
      <_indexTable IDREF="id1653" />
      <_indexTable IDREF="id103" />
      <_indexTable IDREF="id20" />
      <_indexTable IDREF="id19" />
      <_indexTable IDREF="id1669" />
      <_indexTable IDREF="id2099" />
       :
      <_objectTree IDREF="id3" />
      <_logicTree IDREF="id4" />
      <_palette />
    - <_name>
        <![CDATA[ CDPLAYER  ]]>
      </_name>
      <_SystemTimerFTIndex>1</_SystemTimerFTIndex>
```

As you can see in the sample report, the XML code contains very detailed information about the RapidPLUS application. Some of the information is easily discernible and some is not, because it applies to internal structures that are used by RapidPLUS.

Generating an XML Report

Before you generate an XML report, you may want to change the language that will be used for encoding the report. By default, the application's language setting is used.

To select a language for the XML encoding:

1 In the Application Manager, open the Application Properties dialog box (by choosing File|Properties).

2 In the Character Set box, select a language. This language will be used for the encoding of the XML report file.

To generate an XML report:

1 In the Application Manager, make sure that the application for which you want to generate XML code is in focus.

2 From the Reports|XML menu, choose either "Selected Application" or "Main Application and User Objects."

   A subfolder for the application and each user object is added to the folder that contains the application. Each new subfolder contains:

   - An XML file named *<application name>.xml*.
   - Files for images that are embedded in the application. The names for these graphic files are based on the names of the bitmap/image objects that hold the embedded images.

     For example if an image object, named "Logo," contains an embedded image file with a JPG format, the generated file will be named *Logo0.jpg*.
   - A file named "Comment0," which contains the comments that appear in the Application Properties dialog box.

   The graphic and Comment0 files are referenced in the XML code in tags that contain an attribute named `SRC`. For example:

```
<_defaultImage SRC="Bitmap20.bmp" TYPE="bmp" SIZE="41800" />
```

❖ *IMPORTANT: Because the XML reports are generated from internal RapidPLUS code, the information in the reports is likely to change from version to version of RapidPLUS.*

Understanding the XML Reports

When XML code is generated from a RapidPLUS application, an XML file is produced comprising a tree of nodes. The top-most node—the root node—is `<Rapid>`. The first level of element nodes present high-level information about the RapidPLUS application and its objects, modes, and logic. Each of these elements contains the following attributes:

- **Element name:** a name used internally by RapidPLUS. For example, the element name for the application is `RPApplication`.
- **Type**: a numerical identifier for the element type. For example, all bitmap objects have the same Type number.
- **ID**: an identifier for each instance of an object, mode, and logic type. For example, each pushbutton will have a different ID.
- **Ver**: the version number of the RapidPLUS database in which the application was saved.

Additional information is provided in nested elements as necessary:

- **IDREF**: reference to another object using the referenced object's ID attribute. In some cases, the identifier will be listed as <number>. To find the object, you should look for an object with identifier "id<number>." An example of this is the tag `_notesHandle`, which is described in the section "Nested elements that apply to application object elements" on p. 25-29.
- **References to external binary or textual data**. The data is stored in files separate from the XML report file. These files are placed in the same folder as the XML report. The name of the file is usually contained in an `SRC` attribute to indicate the external reference.

The following sections provide details about various elements and tags used in XML reports for objects, modes, and logic. As mentioned earlier, much of the information in the generated XML reports pertains to internal structures in RapidPLUS and is therefore, not described here.

RapidPLUS Object Elements and Their Nested Tags

This section presents important tags for the application and its objects.

RPApplication Element

This element tag contains generic information about the application. Its nested tags include:

TAG	DESCRIPTION
`_name`	Name of the application.
`_objectTree`	ID of the root object (see “RPTopPanel” on p. 25-26).
`_logicTree`	ID of the root mode (see “RPRootMode” on p. 25-30).

RPDatabaseDescriptor Element

This element tag contains additional information about the application, such as properties from the Application Properties dialog box, libraries that the application requires, and information related to C code generation. Its nested tags include:

TAG	DESCRIPTION
`count`	Number of libraries that the application requires. For each required library, there are several nested tags that describe the library, including: `_name`: name of a required library. This name uniquely identifies the library and allows RapidPLUS to find it. This tag is interpreted differently according to `lib_type`. `_instanceCount`: number of instances of objects from this library in the application. `lib_type`: type of library. The types are J = JavaBean object, R = RPX object, U = user object, and X = ActiveX object.

TAG	DESCRIPTION
`_info`	Information from the Application Properties dialog box, including: `simulation`: descriptive name for the application. `designer`: logged-in user name. `company`: name of the company. `comment`: link to the external file, *Comment0*, via the `SRC` attribute. The text of the comments is contained in the *Comment0* file.

Application Object Elements

In this section, the first table presents the main element tags used for RapidPLUS objects. The subsequent tables present nested tags that provide specific information about each object.

TAG	DESCRIPTION
`RPTopPanel`	Tag for the root graphic object.
`RPGraphicWrapper`	Generic tag for graphic objects that were developed as external objects (RPX). Examples of such graphic objects are the lamp, indicator, and switch objects.
`RPNonGraphic-Wrapper`	Generic tag for nongraphic objects that were developed as external objects (RPX). Examples of such nongraphic objects are the Applink object, the Commlink object, and all of the multimedia objects.
`UDOGraphic-Wrapper, UDONon-GraphicWrapper`	Generic tags for user objects.
`RP<object name>`	Tag for primitive objects, system objects, and some nongraphic objects. For example, `RPInFrame`, `RPSystemTime`, and `RPTimer`.

TAG	DESCRIPTION
RPBitmapObject RPImageObject	Tags for bitmap and image objects. When the object's image file is embedded, a corresponding graphic file is created using the object's name and is placed in the folder with the XML report. A nested tag `_defaultImage SRC` provides a link to the external graphic file. When the object's image file is linked to the application, no graphic file is created. A nested tag `_imageFileName` provides the path to the linked graphic file. ❖ *NOTE: If you want linked image files to be included in the XML report's folder, you must copy them to the folder manually.*
RPDataStore RPDataRecord	Tags for data store objects. `RPDataStore` describes the data store object. Its nested tags include: `_properties`: defines field names and field types. `_editContents`: points to all of the records. `RPDataRecord` describes each record. Its nested tags include: `_data`: presents the record contents as a sequence of numbers. These numbers can be interpreted like this: for each field (in the data store definition), there is the following data: 2 bytes: length of the field value; and <n> bytes: the field value. Field values are stored according to field type. For example, integers are stored as 4 bytes (32-bit integer). Strings are stored as a sequence of characters terminated by 0. It is difficult to see the actual values from the XML report because of the numeric representation, but automatic convertors can easily interpret this data.

TAG	DESCRIPTION

`RPIntegerObject`
`RPNumberObject`
`RPStringObject`
`RPColorObject`
	Tags for data objects. Data objects can be properties of other RapidPLUS objects, or appear on their own as primitive types.
	When a data object is a property of another object, it will have a `_localId` tag containing a unique index of the data object within the properties of the containing object. Also, the parent of the data object will be the containing object.

`AXGraphicWrapper` `AXNonGraphic-Wrapper`	Tags for ActiveX objects.
`JBGraphicWrapper` `JBNonGraphic-Wrapper`	Tags for JavaBean objects.

Nested elements that apply to the root object

These elements apply only to `RPTopPanel`, which is the element for the root graphic object:

TAG	DESCRIPTION
`_displayList`	List of all visible graphic objects in the application, sorted by their Z-order (from the bottom-most to the top-most). Included in the list is the graphic for the Nongraphic Objects Icon.
`_subroutines`	IDREF to the element that defines user functions (see “RPSubroutineHolder Element” on p. 25-32).

Nested elements that apply to application object elements

TAG	DESCRIPTION
`_parent`	IDREF to the application object that is the parent of this object.
`_children`	List of application objects that are children of this object. Contains the following nested tags: `count`: number of children. `_children`: for each child object, an IDREF to the child.
`_properties`	List of the object's properties. This tag contains a nested `count` tag with the number of properties, followed by a tag for each property.
`_name`	Name of the object.
`_notesHandle`	ID of a source object (see "Source Element (`RPSource`)" below) containing notes about the object—the same notes that are entered in the Application Manager's notes area.

Nested elements that apply to graphic object elements only

These elements apply to objects defined as `RPGraphicWrapper`, `RPBitmap-Object`, and `RPImageObject`:

TAG	DESCRIPTION
`_left_top` `_right_bottom`	The bounding box of the object.

Source Element (`RPSource`)

`RPSource` is a generic placeholder for text, such as notes and logic. Its nested tags include:

TAG	DESCRIPTION
`text`	The element's source text (as it appears in RapidPLUS).

Mode Elements and Their Nested Tags

This section presents important tags for the RapidPLUS modes.

Mode Elements

TAG	DESCRIPTION
`RPRootMode`	Root mode of the application.
`RPXorMode`	Exclusive mode.
`RPAndMode`	Concurrent mode.

Nested elements that apply to modes

TAG	DESCRIPTION
`_parent`	IDREF to the mode that is the parent of this mode.
`_children`	List of modes that are children of this mode. Contains the following nested tags: `count`: number of children. `_children`: for each child mode, an IDREF to the child.
`_transitions`	List of transitions from this mode to other modes, or internal transitions within the mode. Each entry in the list is an IDREF to a transition element (see the four transition elements described in the section “Method Block Elements” on p. 25-31)

`_entryActivities`
`_modeActivities`
`_exitActivities`
	IDREF to a method block object containing the entry activities/mode activities/exit activities of the mode. (see `RPMethodBlock` described in the section “Method Block Elements” on p. 25-31).

Logic-Related Elements

This section presents various method elements and some of their nested tags.

Method Block Elements

A method block element contains a collection of compiled method elements that hold the actual logic. Method block elements are:

TAG	DESCRIPTION
`RPMethodBlock`	Generic method block, found in entry/mode/exit activities of a mode.
`RPDefault-Transition`	Default transition. The collection of compiled methods contains the actions of the transition. In addition, its last compiled method tag is the trigger of the transition.
`RPHistory-Transition`	History transition.
`RPDeepHistory-Transition`	Deep-history transition.
`RPInternal-Transition`	Internal transition.

RPCompiledMethod Nested Element

This nested element holds the actual logic of the application. It does not have an ID of its own, and it always appears as a nested tag of the `RPMethodBlock` and `RPSubroutineHolder` elements.

Most of its nested tags are used internally in RapidPLUS. Tags that you should understand are:

TAG	DESCRIPTION
`_methodFixed.source-ID`	ID of the source object containing the logic source code of this compiled method.

TAG	DESCRIPTION
`_methodFixed.destinationID`	ID of the destination mode, when the compiled method is a trigger of a non-internal transition (0 for an internal destination).
`_methodFixed.holder`	ID of the method, when it is a user function. (see “RPSubroutineHolder Element” below).

RPSubroutineHolder Element

This element contains definitions of all user functions in the application. It contains several types of information including, a collection of compiled method elements—one for each user function, the compiled code and a pointer to the user function’s source code (which is stored in an `RPSource` element). It also contains these nested tags:

TAG	DESCRIPTION
`_descriptors.count`	Number of user functions in the application.
`_oper`	Name of the user function.
`_verbId`	ID of the user function (linked to the `_methodFixed.holder` tag described in the previous table.
`_numArgs`	Number of arguments that the function accepts.
`classKey`	Type (class ID) of the argument or return value. There is one `classKey` tag per argument and one for the return value. The return value is always the last `classKey` tag in the group.

Following the Path from a Mode to Its Logic

Although the XML code appears long and unwieldy, it is actually not difficult to follow the path from a mode element to its source code (that is, the code as it appears in the Logic Editor).

The following instructions explain how to connect a mode to its logic. They include an example, which is taken from the XML report for *CDPLAYER.RPD*. After the instructions is a chart that illustrates the three steps below.

❖ *NOTE: These steps may vary depending on which type of information you want to find.*

To connect a mode to its logic:

1 Locate the mode's element in the XML report. This element (`RP<type>Mode`) will have nested elements presenting the mode's transitions and activities.

HINT: There are various ways to locate a mode. One way is to search for it using its name in RapidPLUS (for example, **powerOn**).

2 From one of the mode element's nested transition or activity elements, copy the IDREF and search for it in the XML report. The search will take you to an `RPMethodBlock` element.

Example: The powerOn `RPXorMode` element has an entry activity whose code looks like:

```
<_entryActivities IDREF="id1299" />
```

A search for `id1299` leads to:

```
<RPMethodBlock type="42" ID="id1299" ver="168">
```

3 The `RPMethodBlock` element has a nested element named `RPCompiledMethod`, which in turn has a nested element named `_methodFixed.sourceID`.

Copy the IDREF in `_methodFixed.sourceID` and search for it in the XML report. The search will take you to an `RPSource` element whose `text` element contains the source logic text.

Example: The `_methodFixed.sourceID` is:

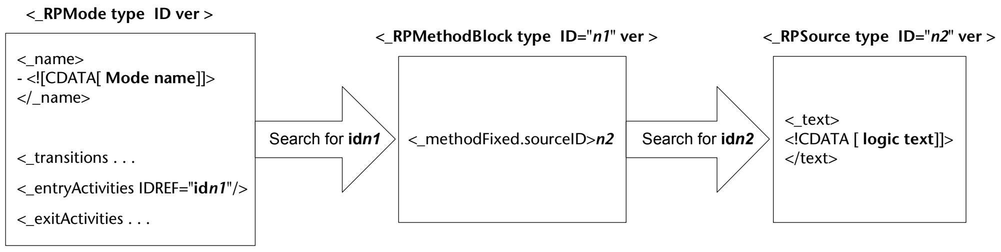
```
<_methodFixed.sourceID>1671</_methodFixed.sourceID>
```

A search for `id1671` leads to:

```
<RPSource type="131" ID="id1671" ver="168">
 - <text>
- <![CDATA[ power_Lamp on]]>
  </text>
```

These three steps take you from the mode to its logic. You can see from the above examples that powerOn mode’s entry activity is **power_Lamp on**. For a visual representation of these steps, see the following chart.

Following the path from a mode to one of its activities



CHAPTER 26

Object Enhancements

The following enhancements have been implemented on existing objects since version 4.0:

OBJECT	ENHANCEMENTS	REFERENCE
One-dimensional array	• Searching backwards through an entire array, or through a subset of its elements.	p. 26-2
Datastores, one- and two-dimensional arrays	• Reading Unicode strings	p. 26-4
	• Sorting by single or multiple fields (data stores) and columns (arrays).	p. 26-4
Two-dimensional array	• Functions previously reserved for one-dimensional arrays have been extended to two-dimensional arrays:	p. 26-8
	• Changes to assign (:=) and *loadFromFile*: function; it is no longer an error to assign or load a two-dimensional array of a different size.	p. 26-17
Commlink	• If requested by the user, send output and receive input one byte at a time.	p. 26-17
Pointer	• A three-segment pointer type has been added. During runtime, the middle segment can be offset from the pointer's axis of rotation.	p. 26-19

OBJECT	ENHANCEMENTS	REFERENCE
DLL	• DLL functions are selected from a list, not typed in. The DLL function call can be performed in a separate process.	p. 26-21
Pushbutton	• A new event, *longPress*, simulates an extended press on a pushbutton. The long press period is set in the Pushbutton dialog box.	p. 26-22
Text display	• Alignment functionality was added to enable changing alignment during design time and runtime.	p. 26-22

ONE-DIMENSIONAL ARRAYS

Searching Backwards

To search backwards in a one-dimensional array:

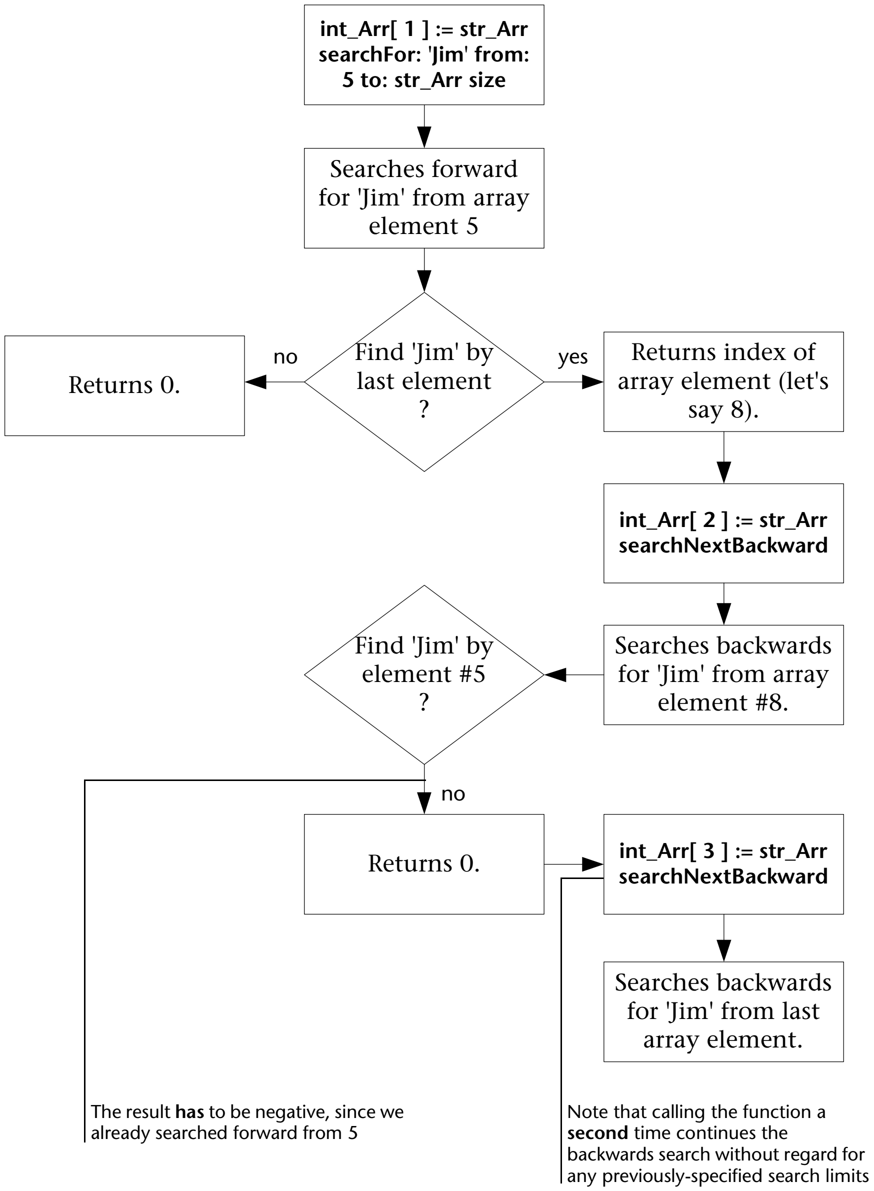
- Call the *searchFor:from:to:* function and provide a *from:* value that is greater than the *to:* value.

For example, the following logic returns the index of the first element in *str_Arr* that starts with a capital 'A', starting the search from the last array element and working towards the top:

```
int_Arr[ 1 ] := str_Arr searchFor: 'regexp:[A.+]' from: (str_Arr size) to: 1
```

To continue the search backwards:

- Call the *searchNextBackward* function. The most recent search is continued in a backwards direction. The flowchart on the following page illustrates how this function would work after a **forward** search within specified (*from: to:*) limits.


int_Arr[1] := str_Arr searchFor: 'Jim' from: 5 to: str_Arr size
Searches forward for 'Jim' from array element 5
Find 'Jim' by last element ?
no
Returns 0.
yes
Returns index of array element (let's say 8).
int_Arr[2] := str_Arr searchNextBackward
Searches backwards for 'Jim' from array element #8.
Find 'Jim' by element #5 ?
no
Returns 0.
int_Arr[3] := str_Arr searchNextBackward
Searches backwards for 'Jim' from last array element.
The result has to be negative, since we already searched forward from 5
Note that calling the function a second time continues the backwards search without regard for any previously-specified search limits

DATA STORES AND ARRAYS

Reading Unicode Strings

The RapidPLUS file formats for arrays (RAR) and data stores (RDS) have been modified to allow the storage of Unicode strings. Unicode strings are identified by the character 'L' before the string—such as L'h e l l o'.

RapidPLUS translates these strings from Unicode into the Windows native character set. If the translation fails, an empty string is assigned instead.

❖ *NOTE: It is possible to edit Unicode strings into a non-Unicode file using a code editor such as Codewright.*

Sorting Data Stores and Arrays

You can sort the records of a data store object or the elements of a one- or two-dimensional array according to the following criteria:

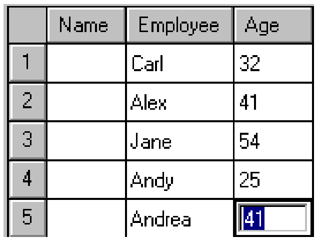
- **Single-field sort:** Ascending or descending order of a specified field (for a data store object), or ascending or descending order of array elements (for a one-dimensional array).
- **Multiple-field sort** (for data store objects and two-dimensional arrays only): By multiple fields or columns, according to priorities set at runtime; each field or column can be sorted by ascending or descending order. Thus, for example, you could initially sort the records in ascending order by the values of field_x (priority 1); if a number of records have the same value for field_x, you could then sort those records in descending order by the values of field_y (priority 2).

To carry out a simple sort of a data store or a one- or two-dimensional array:

- **Data store:** In the Properties pane of the Logic Palette, choose the field by which you want to sort the data store and then select the function *sortAscending* for an ascending sort or *sortDescending* for a descending sort.
- **One-dimensional array:** For the array's *self* property, select the function *sortAscending* for an ascending sort or *sortDescending* for a descending sort.
- **Two-dimensional array:** For the array's *self* property, select the function *setAscendingPriority: forColumn:* or *setDescendingPriority: forColumn:*, specifying a priority value of 1 and the column. Then call the function *sortByColumns*.

Example

Let's assume that you have a five-record data store object named "Staff_DS," with two fields: a string field called "Employee" and an integer field called "Age." Its initial values are as follows:



	Name	Employee	Age
1		Carl	32
2		Alex	41
3		Jane	54
4		Andy	25
5		Andrea	41

The activity **Staff_DS.Employee sortAscending** would sort the records as follows:

	Name	Employee	Age
1		Alex	41
2		Andrea	41
3		Andy	25
4		Carl	32
5		Jane	54

For the same initial values, the activity **Staff_DS.Age sortDescending** would sort the records as follows:

	Name	Employee	Age
1		Jane	54
2		Andrea	41
3		Alex	41
4		Carl	32
5		Andy	25

❖ *NOTE: The order of records with the same field value (such as Records 2 and 3 above) is arbitrary.*

To sort data store records or two-dimensional arrays by multiple fields or columns:

1 For each field/column whose values that you wish to use as sort criteria, set the sort priority and the sort order, as follows:

OBJECT	FUNCTION	RESULT
Data store field	*setAscendingPriority: <integer>*	Sorts the records by the field's values—in ascending order and according to the priority set by the integer argument.
	setDescendingPriority: <integer>	Sorts the records by the field's values—in descending order and according to the priority set by the integer argument.
Two-dimensional array	*setAscendingPriority: <integer> forColumn: <integer>*	Sets the sort order (ascending) and sort priority (an integer argument) for the specified column.
	setDescendingPriority: <integer> forColumn: <integer>	Sets the sort order (descending) and sort priority (an integer argument) for the specified column.

Thus, for example, the following two activities would first cause all records of data store "DS1" to be sorted by ascending order of "Age" field values; it would then cause any records that have the **same** "Age" value to be sorted by descending order of "Employee" field values:

DS1.Age setAscendingPriority: 1
DS1.Employee setDescendingPriority: 2

❖ *NOTES: You will get a runtime error if the priority assigned is less than 0 (zero) or if two fields or columns have been assigned the same priority.*

During runtime, RapidPLUS sets the priorities by their ascending order. Thus, assigning priorities of 2, 7, and 9 would have the same effect as assigning priorities of 1, 2, and 3.

2 To actually carry out the sort according to the priorities and orders set in Step 1, choose the *sort* function for a data store object or the *sortByColumns* function for a two-dimensional array.

❖ *NOTE: There is no meaning to the sort or sortByColumns functions without first setting priorities. See the example below (based on a data store object).*

Example

The diagram below shows how a five-record data store object with three integer fields is sorted according to the following sequence of activities:

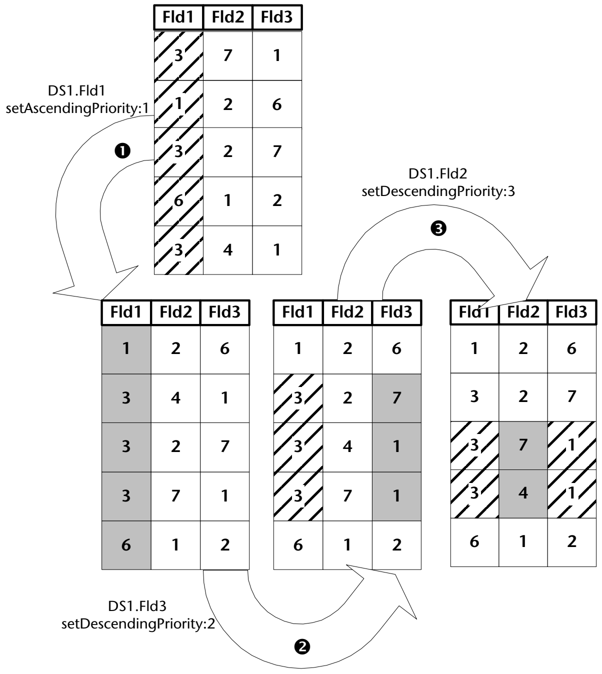
DS1.Fld1 setAscendingPriority: 1
DS1.Fld3 setDescendingPriority: 2
DS1.Fld2 setDescendingPriority: 3
DS1 sort

In other words:

1 First priority is given to Fld1, so first all the records are sorted by ascending values of Fld1. The three records that have the value "3" are sorted randomly.

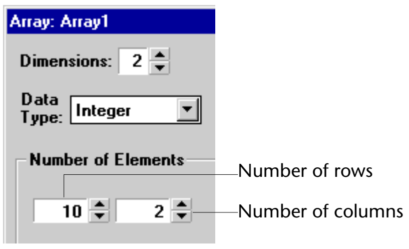
2 Second priority is given to Fld3; thus, the three records that have the same value for Fld1 are now sorted by descending values of Fld3.

3 Third priority is given to Fld2; thus, the two records that have the same value for Fld1 **and** Fld3 are now sorted by descending values of Fld2.



TWO-DIMENSIONAL ARRAYS: EXTENDED FUNCTIONALITY

Much of the functionality of one-dimensional arrays has been extended to two-dimensional arrays. The new functions, summarized on the following pages, frequently refer to columns and rows, which should be understood as follows:



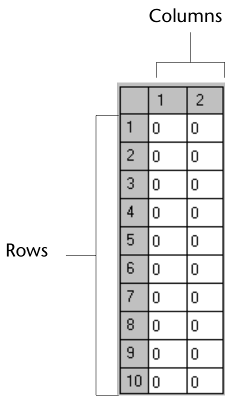
Array: Array1

Dimensions: 2

Data Type: Integer

Number of Elements: 10 2

In Object Layout



	1	2
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0

In the Prototyper (object inspector)

FUNCTION	DESCRIPTION	EXAMPLE
clearFromRow: <integer> fromColumn: < integer > toRow: <integer> toColumn: < integer >	Resets the specified elements to a null value.	**See "Usage Examples" on pp. 26-13 to 26-16.**
deleteColumns-From: <integer> to: integer>	Deletes the specified columns.	**Array1 deleteColumnsFrom: 2 to: 3** If the array previously had 5 columns, it now has 3.
deleteRows-From: <integer> to: integer>	Deletes the specified rows.	**Array1 deleteRowsFrom: 2 to 3:** If the array previously had 5 rows, it now has 3.

FUNCTION	DESCRIPTION	EXAMPLE
getArrayFrom-Row: <integer> fromColumn: <integer> toRow: <integer> toColumn: <integer>	Returns a two-dimensional array that has the values of the specified elements.	**See "Usage Examples" on pp. 26-13 to 26-16.**
getColumn: <integer>	Returns a one-dimensional array that has the values of the specified column.	**Array2 := Array1 getColumn: 3** where Array2 is a 1D-array of the same type as Array1.
getNumber-OfColumns	Returns the current number of columns.	**See "Usage Examples" on pp. 26-13 to 26-16.**
getNumber-OfRows	Returns the current number of rows.	**& Array1 getNumberOfRows < 5**
getRow: <integer>	Returns a one-dimensional array that has values of the specified row.	**Array2 := Array1 getRow: 3** where Array2 is a 1D array of the same type as Array1.
insertColumns: <integer> copiesOf: <1D array> atColumn: <integer>	Inserts the specified number of columns—each a copy of the specified one-dimensional array—**at** the specified column. If the specified column index is greater than the current number of columns, then the inserted columns are appended to the array.	**See "Usage Examples" on pp. 26-13 to 26-16.**
insertRows: <integer> copiesOf: <1D array> atRow: <integer>	Inserts the specified number of rows—each a copy of the specified one-dimensional array— **at** the specified row. If the specified row index is greater than the current number of rows, then the inserted rows are appended to the array.	**See "Usage Examples" on pp. 26-13 to 26-16 —as related to inserting columns.**

FUNCTION	DESCRIPTION	EXAMPLE
instancesOf: < value> fromRow: <integer> fromColumn: < integer > toRow: <integer> toColumn: < integer >	Returns the number of instances of the specified value[a] encountered in the specified range of elements.	**& Array1 instancesOf: dialStr fromRow: 2 fromColumn: 3 toRow: (Array1 getNumberOfRows) toColumn: (Array1 getNumberOfColumns) > 0**
overwriteWith: <1D_array> atColumn: <integer>	Overwrites the values of the specified column with the values of the specified array. The array size increases as necessary to accommodate the overwriting array; any empty cells created hold the calling array's default initial value.	**See "Usage Examples" on pp. 26-13 to 26-16.**
overwriteWith: <1D_array> atRow: <integer>	Overwrites the values of the specified row with the values of the specified array. See the comment above about changes to the array size as a result of overwriting.	**Array1 overwriteWith: Array2 atRow: 5** where Array2 is a 1D-array of the same type as Array1.
overwriteWith: <2D_array> atRow: <integer> atColumn: < integer >	Overwrites the values of this array with the values of the specified array, starting from the specified element (identified by row and column). See the comment above about changes to the array size as a result of overwriting.	**See "Usage Examples" on pp. 26-13 to 26-16.**

FUNCTION	DESCRIPTION	EXAMPLE
pullColumns-From: <integer> to: <integer>	Removes the columns **between** the specified points. The columns **after** the "pulled" section move left to close the gap. A series of new columns is created at the end of the array, containing the initial value defined in the Object Layout. The array size does not change.	**See "Usage Examples" on pp. 26-13 to 26-16.**
pullRowsFrom: <integer> to: <integer>	Same as the function described above, except it works on the rows.	
pushColumns-From: <integer> to: <integer>	Moves the columns between the first specified point and the end of the array to the specified column. A series of new columns is created in the vacated space, containing the initial value defined in the Object Layout. Any columns pushed beyond the end of the array are deleted. The array size does not change.	
pushRows-From: <integer> to: <integer>	Same as the function described above, except it works on the rows.	
searchFor: <value> inColumn: <integer>	Returns the row index if a match is found for the specified value in the specified column. Otherwise, returns 0.	**See "Usage Examples" on pp. 26-13 to 26-16.**
searchFor: <value> inColumn: <integer> fromRow: <integer> toRow: <integer>	Returns the row index if a match is found for the specified value[b] in the specified column, searching from the first-specified row up to (and including) the last-specified row. Otherwise, returns 0.	**index_int := Array1 searchFor: dialStr inColumn: Const_Set.NUMBER fromRow: 1 toRow: 6**

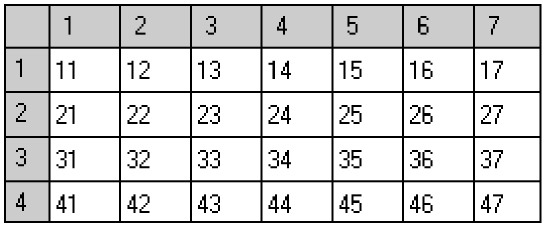
FUNCTION	DESCRIPTION	EXAMPLE
searchFor: <value> inColumn: <integer> fromRow: <integer>	Returns the row index if a match is found for the specified value^2 in the specified column, searching from the specified row to the last row. Otherwise, returns 0.	**index_int := Array1 searchFor: dialStr inColumn: Const_Set.NUMBER fromRow: 3**
searchFor: <value> inColumn: <integer> toRow: <integer>	Returns the row index if a match is found for the specified value^2 in the specified column, searching from the first row up to (and including) the specified row. Otherwise, returns 0.	**index_int := Array1 searchFor: dialStr inColumn: Const_Set.NUMBER toRow: 8**
searchNext	Continues the previous column search operation, in a forwards direction.	**index_int := Array1 searchNext**
searchNext-Backward	Continues the previous column search operation, in a backwards direction. For more information, please see the explanation for one-dimensional arrays on p. 26-2.	**index_int := Array1 searchNextBackward**
setNumber-OfColumns: <integer>	Sets the number of columns to the specified value. If the new size is larger than the previous size, the new columns are appended to the array (and hold the initial value defined in the Object Layout). If the new size is smaller than the previous size, the array is truncated.)	**Array1 setNumberOfColumns: 3**
setNumberOf-Rows: <integer>	Sets number of rows to the specified value. See the comments above.	**Array1 setNumberOfRows: 10**

a. The parameter type depends on the array type (string, integer, or number). If it is an array of strings, the value can also be a regular expression.

b. The parameter type depends on the array type (string, integer, or number). If it is an array of strings, the value can also be a regular expression.

Usage Examples

All of the examples in this section are based on the two-dimensional integer array (Array1) shown below. Its default initial value is 0.



	1	2	3	4	5	6	7
1	11	12	13	14	15	16	17
2	21	22	23	24	25	26	27
3	31	32	33	34	35	36	37
4	41	42	43	44	45	46	47

❖ *NOTE: Sections of tables that are of particular interest in the following examples are outlined with double lines.*

Getting a Two-Dimensional Array

Array1 := Array1 getArrayFromRow: 2 fromColumn: 5 toRow: (Array1 getNumberOfRows) toColumn: 6

The result is:

	1	2
1	25	26
2	35	36
3	45	46

Clearing a Section of the Array

Array1 clearFromRow: 2 fromColumn: 5 toRow: 3 toColumn: 6

The result is:

	1	2	3	4	5	6	7
1	11	12	13	14	15	16	17
2	21	22	23	24	0	0	27
3	31	32	33	34	0	0	37
4	41	42	43	44	45	46	47

Note the change

Inserting Columns/Rows

Array1 insertColumns: 2 copiesOf: Array2 atColumn: 3

If Array2 is {5,7}, then the result is:

	1	2	3	4	5	6	7	8	9
1	11	12	5	5	13	14	15	16	17
2	21	22	7	7	23	24	0	0	27
3	31	32	0	0	33	34	0	0	37
4	41	42	0	0	43	44	45	46	47

Empty cells hold default initial values

If Array2 is {1,2,3,4,5,6}, then the result is:

	1	2	3	4	5	6	7	8	9
1	11	12	1	1	13	14	15	16	17
2	21	22	2	2	23	24	0	0	27
3	31	32	3	3	33	34	0	0	37
4	41	42	4	4	43	44	45	46	47
5	0	0	5	5	0	0	0	0	0
6	0	0	6	6	0	0	0	0	0

Rows were added to accommodate the larger array

Array1 insertRows: 2 copiesOf: Array2 at: 20

If Array2 is {1,2,3,4,5,6}, then the result is:

	1	2	3	4	5	6	7
1	11	12	13	14	15	16	17
2	21	22	23	24	25	26	27
3	31	32	33	34	35	36	37
4	41	42	43	44	45	46	47
5	1	2	3	4	5	6	0

Overwriting with Another Array

Array1 overwriteWith: Array2 atRow:3 atColumn: 4

If Array2 is:

	1	2
1	5	6
2	7	8
3	9	10

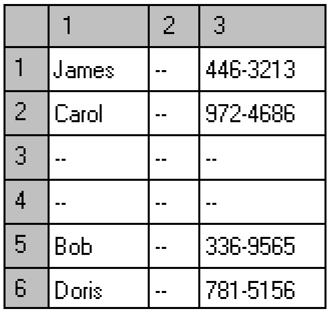
then the result is:

	1	2	3	4	5	6	7
1	11	12	13	14	15	16	17
2	21	22	23	24	25	26	27
3	31	32	33	5	6	36	37
4	41	42	43	7	8	46	47
5	0	0	0	9	10	0	0

Row added to accommodate the overwriting array. Empty cells hold the default initial value

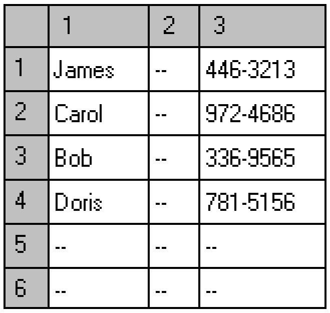
Pulling/Pushing Columns/Rows

The examples here are based on a two-dimensional string array with the following contents (and an initial value of '- -'):



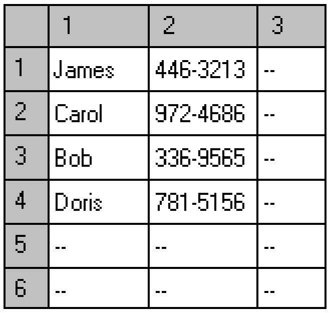
	1	2	3
1	James	--	446-3213
2	Carol	--	972-4686
3	--	--	--
4	--	--	--
5	Bob	--	336-9565
6	Doris	--	781-5156

❶ After **Array1 pullRowsFrom: 3 to: 5**, the array looks as follows:



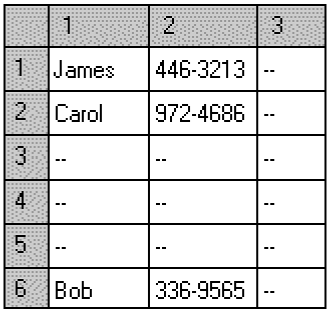
	1	2	3
1	James	--	446-3213
2	Carol	--	972-4686
3	Bob	--	336-9565
4	Doris	--	781-5156
5	--	--	--
6	--	--	--

❷ After **Array1 pullColumnsFrom: 2 to: 3**, the array is now:



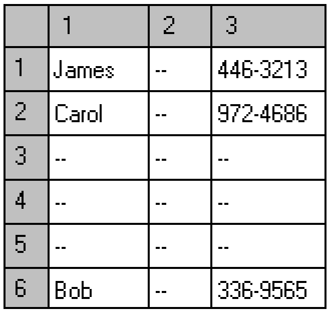
	1	2	3
1	James	446-3213	--
2	Carol	972-4686	--
3	Bob	336-9565	--
4	Doris	781-5156	--
5	--	--	--
6	--	--	--

❸ After **Array1 pushRowsFrom: 3 to: 6**, the array is now:



	1	2	3
1	James	446-3213	--
2	Carol	972-4686	--
3	--	--	--
4	--	--	--
5	--	--	--
6	Bob	336-9565	--

❹ After **Array1 pushColumnsFrom: 2 to: 3**, the array is now:



	1	2	3
1	James	--	446-3213
2	Carol	--	972-4686
3	--	--	--
4	--	--	--
5	--	--	--
6	Bob	--	336-9565

Changes to Assign and loadFromFile: Functions

It is now permissible to assign a two-dimensional array to an array of a different size. The array on the left side takes on the size of the array on the right side. Thus, for example, in the logic **Array1 := Array2**, *Array1* takes on the size of *Array2*, even if their sizes differ.

Similarly, if you use the *loadFromFile:* function to load array data from a file, the calling array's size changes as necessary to fit the size of the data in the file.

Thus, for example, in the logic:

```
Array1 loadFromFile: 'backup.rar'
```

Array1 takes on the size of the data in *backup.rar*, even if the size of its original data was different.

❖ *NOTE: You cannot assign a three- (or more) dimensional array to a two-dimensional array.*

COMMLINK OBJECT

General Information

If a user sends the same string over and over, the commlink object will generate the *dataArrived* event only once, because it does not detect a change in the property.

Xon/Xoff flow control: The following two values should not be sent when Xon/Xoff flow control is used:

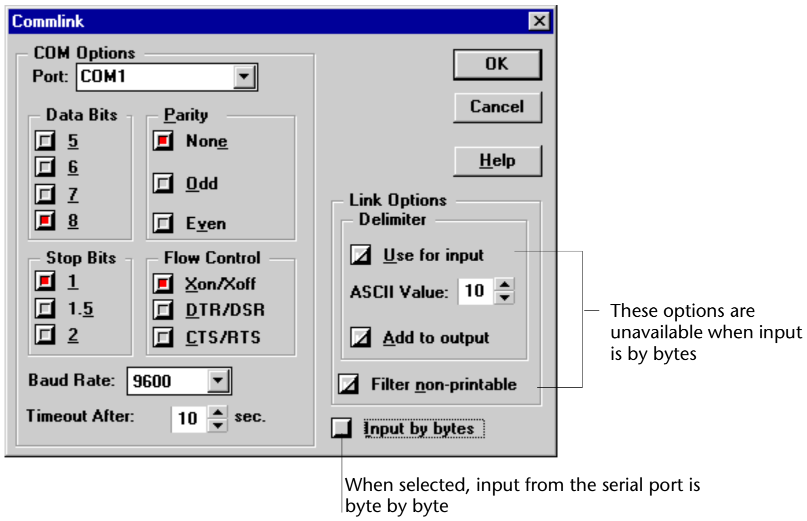
- 0x11 (hex)/17 (dec). This value stops the flow of data.
- 0x13 (hex)/19 (dec). This value starts the flow of data.

Input/Output by Byte

Depending on the requirements of the device connected to the serial port, you can send output and receive input byte by byte. By default, the object manages input and output as strings.

To enable input by byte:

- In the Commlink dialog box, select the Input by byte check box:


Commlink

COM Options
Port: COM1

Data Bits: [ ] 5 [ ] 6 [ ] 7 [✓ 8]
Parity: [✓ None] [ ] Odd [ ] Even
Stop Bits: [✓ 1] [ ] 1.5 [ ] 2
Flow Control: [✓ Xon/Xoff] [ ] DTR/DSR [ ] CTS/RTS

Baud Rate: 9600
Timeout After: 10 sec.

Link Options
Delimiter
[✓ Use for input]
ASCII Value: 10
[✓ Add to output]
[✓ Filter non-printable]

[ ] Input by bytes

These options are unavailable when input is by bytes

When selected, input from the serial port is byte by byte

- At runtime: In the Logic Editor, use the *enableInputByByte* and *disableInputByByte* functions, as follows:

  Commlink1 enableInputByByte (to enable)
  Commlink1 disableInputByByte (to disable)

To read an input byte:

- Use the *getInputByte* function, as follows:

  Str1 append: Commlink1 getInputByte

As long as the input buffer is not empty, this function returns the next byte and removes it from the buffer; otherwise, it returns -1.

❖ *NOTE: The condition* ***is inputBufferEmpty*** *returns FALSE if there is a byte in the input buffer.*

To send a byte to the output buffer:

- Use the *setOutputByte: <integer>* function as follows:

  Commlink1 setOutputByte: 75

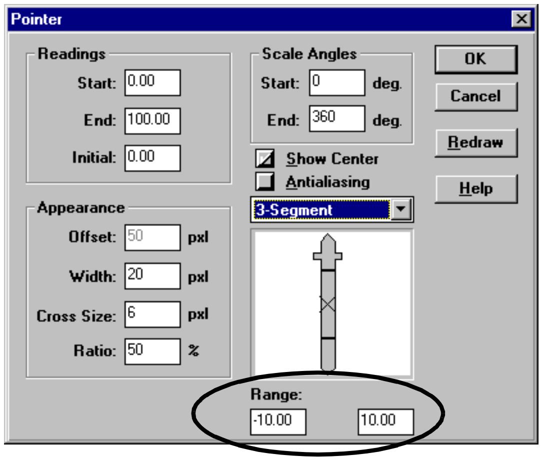
The specified integer is sent to the output buffer.

❖ *NOTE: There is no connection between this function and the functions that handle input by byte.*

THREE-SEGMENT POINTER

A three-segment pointer type has been added to the user pointer object. During runtime, the middle segment of the pointer can be offset from the object's rotation axis.

In the Object Layout, two range fields are added to the More dialog box when 3-segment is the selected pointer style:


Pointer

Readings
Start: 0.00
End: 100.00
Initial: 0.00

Scale Angles
Start: 0 deg.
End: 360 deg.

[✓] Show Center
[ ] Antialiasing
3-Segment

Appearance
Offset: 50 pxl
Width: 20 pxl
Cross Size: 6 pxl
Ratio: 50 %

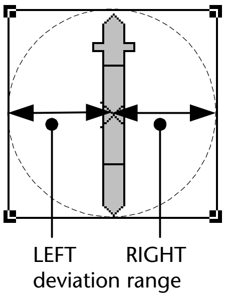
Range: -10.00 10.00

During runtime, the *deviation* property can be used to change the pointer's middle segment position independently of the other two segments. The range values are used to calculate the mid-segment's ratio of deviation in relation to the object's radius.

The permissible range values are:

left range: -(object radius) to 0

right range: 0 to (object radius)



❖ *NOTE: Although you are permitted to enter a range that exceeds the object's radius, during runtime RapidPLUS will truncate the deviation range values automatically.*

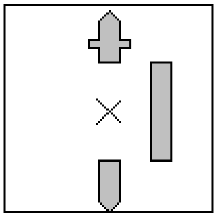
Deviation Property

If a three-segment pointer is selected in the logic palette, a unique *deviation* property becomes available. This number property, together with the range value set in the Object Layout, determines the middle segment's position in relation to the object's rotation axis, calculated as follows:

$$\text{deviation (in pixels)} = \frac{\text{deviation property value}}{\text{range value}} \times \text{object radius (in pixels)}$$

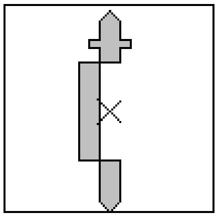
For example, assuming range values of -10.0 to 10.0 and a radius of 50 pixels, these activities have the following results in the Prototyper:

trisegment_ptr.deviation := 5



5/10 = 50% of the object radius, or 25 pixels to the right of the axis of rotation

trisegment_ptr.deviation := -2

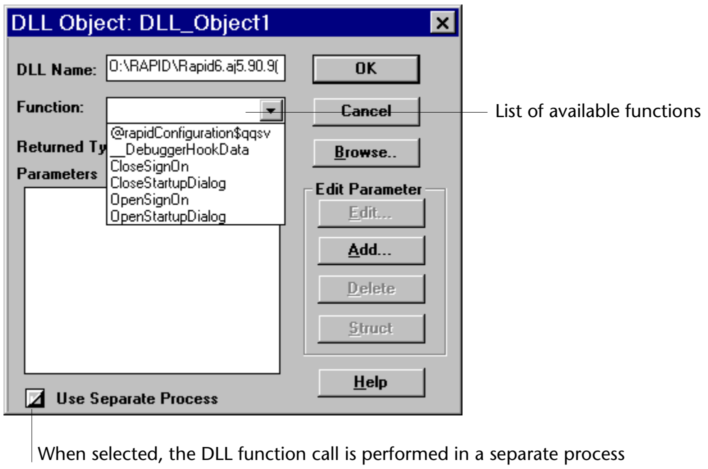


-2/-10 = 20% of the object radius, or 10 pixels to the left of the axis of rotation

DLL OBJECT

There have been two improvements to the DLL object in the Communication class:

- The Function text box has been replaced by a list box. Instead of having to type the function, you select it from the list.


DLL Object: DLL_Object1

DLL Name: O:\RAPID\Rapid6.aj5.90.9(

Function:

@rapidConfiguration$qqsv
__DebuggerHookData
CloseSignOn
CloseStartupDialog
OpenSignOn
OpenStartupDialog

- A check box, **Use Separate Process**, enables the DLL function call to be performed in a separate process.

  Performing the DLL function call in a separate process prevents crashes due to incorrect information input in this dialog box. However, it may affect RapidPLUS performance the first time the DLL is called.

  ❖ *NOTE: Some DLLs must use the same process as RapidPLUS in order to run properly.*

  Recommendation

  Select this check box when you build a new DLL object. After you have tested the object and seen that all the information was entered correctly, you may want to clear the check box.

❖ *NOTE: By default, this check box is selected. However, for applications created prior to version 6.0 that contain DLL objects, the default is "not selected."*

PUSHBUTTON OBJECT

A new event, *longPress*, simulates an extended press on a pushbutton. It is triggered once when a pushbutton is pressed-and-held during the defined period. The default long press period is 2 seconds. The long press period is set in the Pushbutton dialog box.

TEXT DISPLAY OBJECT

Alignment functionality was added to enable changing a text display's alignment during design time and runtime.

To set text alignment during design time:

1 Open the Text Display dialog box.

2 In the Align group, select either Left or Right. Left alignment is the default type.

   ❖ *NOTE: The Align group replaces the Entry group. Logic for setting entry type is still available in the Logic Editor.*

To change text alignment during runtime:

1 For left alignment, use the *leftAlign* function.

2 For right alignment, use the *rightAlign* function.

❖ *NOTE: Using the object's sizing handles only resizes its bounding box, and not the font.*

CHAPTER 27

Additional RapidPLUS Enhancements

This chapter presents new features and enhancements of existing features that have been implemented since version 4.0 (and are not described in other chapters of this manual).

The following tables present a brief description of each enhancement. Detailed descriptions and procedures are presented after the tables.

Multiple Tool Enhancements

New in version 8.0

New in version 8.0

FEATURE	ENHANCEMENT	REFERENCE
Back and Forward buttons	You can navigate among mode and user object selections that you made in the Mode Tree, State Chart, and Logic Editor.	p. 27-6
Multilevel global undo and redo	Undo/Redo commands available across tools and user objects.	p. 27-6

Application Manager

FEATURE	ENHANCEMENT	REFERENCE
Application name length	Application names are no longer limited to 8 characters. However, if an application name contains double-byte characters, it should be limited to 8 bytes.	
Changing RapidPLUS fonts	You can change RapidPLUS's system fonts.	p. 27-8
Saving current settings	You can save various system settings in the *Rapidxx.ini* file using one of two "Save Settings" commands.	p. 27-9
Pasting text from Telelogic DOORS	Notes for objects and modes can be created from requirements in DOORS using the popup menu Paste from DOORS command.	Refer to *Rapid-DOORS User Guide.doc* (Rapid CD\Util\Doors)
Chinese language support	Chinese text can be added to notes.	

FEATURE	ENHANCEMENT	REFERENCE
Default scale dialog box	This dialog box has been removed from RapidPLUS. The application units are pixels only.	
RapidPLUS Xpress	RapidPLUS Xpress, the tool for designing products quickly, is accessed from the Options menu. For information about RapidPLUS Xpress, refer to the *RapidPLUS Xpress User Manual*.	

Object Layout

FEATURE	ENHANCEMENT	REFERENCE
Naming conventions	The rules for naming objects have been modified.	p. 27-9
Root object	The name of the root object of every RapidPLUS application is "self." In previous versions, the root object name was the application name.	
Select from List dialog box	The dialog box displays each object, its type, and membership in a group (when applicable).	p. 27-10
Importing multiple bitmap files	You can import multiple bitmap files in one import operation using the File|Import Bitmaps command.	p. 27-11
User Object Properties dialog box	The dialog box has been expanded and divided into four tabbed pages. It is used for creating exported properties, events, messages, and functions.	p. 27-11
Constant set properties	Constant sets can be defined as user object properties. Also, when a constant set is duplicated, it can be duplicated as a user object property.	p. 27-13
Zoom capability	Use the Zoom In button for a close-up view of graphic objects, and then zoom out again.	

New in version 8.0

New in version 8.0

Logic Editor

FEATURE	ENHANCEMENT	REFERENCE
New in version 8.0 “Empty” property for each object	Each object’s functions, conditions, and events are located under an “empty” property that is designated by an ellipsis (…). In previous versions, the object property was named “self.”	
New in version 8.0 Viewing columns	You can zoom in and out of the four columns in the Logic Editor by double-clicking the columns. In previous versions, there were toolbar buttons that controlled zooming.	
Color coding	You can use colors to define logic.	p. 27-16
Local variables	You can declare local variables.	p. 27-16
Mode activities	There are minor changes to how mode activities are implemented in the RapidPLUS state machine.	p. 27-18
User functions	User functions can contain up to 255 different object and/or objects+properties.	p. 27-19
	User functions can return values.	p. 27-20
	New in version 8.0 You can navigate to a user function’s definition by right-clicking it in the Logic Palette and choosing the “Go to definition in Function Editor” command.	

Object Editor

FEATURE	ENHANCEMENT	REFERENCE
Cursor Coordinates status box	Displays information about shapes as they are drawn on an object.	p. 27-24
Pasting a bitmap into the Object Editor	You can preserve high-color and true-color palettes.	p. 27-24

Prototyper

New in version 8.0

FEATURE	ENHANCEMENT	REFERENCE
Coverage Test	You can generate reports listing modes, transitions, triggers, user functions, or objects that are not referenced in data collected from the Prototyper.	"Coverage Test Reports" on p. 25-20

Internet Packager

ENHANCEMENT
The Internet Packager *(iPack.exe)* and the Document Manager's Simulator preserve folder hierarchy. That is, when an application is packaged, the Packager retains the folder and subfolder locations so that when the packaged application is launched, the files are extracted to the appropriate folder and subfolders.

Librarian

In versions prior to 6.0, the only way to use the same object in more than one application was to store objects in object libraries. Now that objects can be copied and pasted among applications, object libraries have become obsolete.

Therefore all object library functions were removed in version 6.0.

If you have existing object libraries (RLD), we advise that you use version 5.0 to add the objects to an application file (RPD). This RPD file can then be used as your "Object Library." Simply copy objects from it and paste them into another application.

MULTIPLE TOOL ENHANCEMENTS

The following enhancements are available through more than one RapidPLUS tool.

Back and Forward Buttons: Retracing Mode Selections

As you select modes and user objects (whether or not you edit them), RapidPLUS logs the selections. You can use the Back and Forward buttons to retrace your selections. This can be helpful when trying to find your place after browsing through a long mode tree or through many user objects.

The Back and Forward buttons retrace modes that were selected through the Mode Tree, State Chart, and Logic Editor, and shows the selected modes in each of these windows.

To select previously visited modes, do one of the following:

Alt+← Alt+→

- In the Application Manager, click the View Back button (or choose View|Back).
- In the Mode Tree or Object Layout, choose Edit|Back.
- In the Logic Editor or State Chart, choose View|Back.

Undo/Redo

You can undo (and then redo) editing actions in RapidPLUS tools, such as, the Object Layout, Mode Tree, Logic Error View, Logic and Function Editors, and State Chart. The capability is:

- **Multilevel**, so that you can undo a sequence of actions, one action at a time.
- **Global**, so that you can undo actions from any of the tools, regardless of the tool used to do the action.

Undoing (and Redoing) Actions

In most cases, the Undo feature is accessed the same way as it is in many other Microsoft Windows-based applications, and performs as expected. The same is true for redoing actions that have been undone.

To undo the last action, do one of the following:

Ctrl+Z Ctrl+Y

- In the Application Manager, press Ctrl+Z. Press Ctrl+Y to redo the last undone action.
- Click the Undo button, or choose Edit|Undo from any of the following tools:
  - Mode Tree
  - Logic Editor
  - Function Editor
  - Object Layout
  - State Chart
  - Logic Error View
- In the Find and Replace dialog box, click the Replace tab. After replacing an instance of a string, the Undo button becomes available, and functions as in other editing tools.

❖ *NOTE: Choosing Edit|Undo shows a description of the specific action. For example, the Edit menu may show "Undo Insert Lamp1."*

Clicking the Undo or Redo button (or choosing Edit|Undo or Edit|Redo) activates the relevant tool's window.

Example: Deleting an Object

You deleted an object from the Object Layout, and commented out (or deleted) referenced logic. Clicking the Undo button from any of the tools will do the following:

- Activate the Object Layout.
- Return the deleted object to its place.
- Return the object's referenced logic to its normal state.

❖ *NOTE: Results in the Logic Error View may reflect a change in the logic, using the edited logic icon (!), and not necessarily the logic line's validity status.*

Actions That Cannot Be Undone

The following actions **cannot be undone** and clear the undo stack:

- Changing top-panel properties, events, messages, and functions (i.e., changes in the top panel's More dialog box).

- Changing pipe object properties that are set in the More dialog box.
- Replacing user objects through the Advanced menu command (File|Advanced|Replace User Object).
- Compacting files (choose File|Advanced|Compact or Compact All).
- Updating JavaBean objects.
- Saving the application (no warning appears).

Actions that cannot be undone provide a warning that the undo stack will be cleared. You can disable this warning by selecting the check box in the window. The warning will be enabled the next time you start RapidPLUS.

Setting the Levels of Undo

The undo stack is, by default, unlimited, but you can set a limit to the number of undo levels.

To set a limit for the undo levels:

1. In the Application Manager, choose Options|Undo Levels.
2. In the Number of Undo Levels dialog box, select Limit.
3. Set the maximum number of undo levels to allow, and click OK.

When the limit is reached, the earliest action will be dropped from the undo stack and the most recent action will be added.

APPLICATION MANAGER

Changing RapidPLUS Fonts

RapidPLUS uses two system fonts, both of which you can change:

- One font is used to display the modes in the Mode Tree, the information in the Logic Palette, and the application logic in the Logic Editor.
- The other font is used in all of the user-editable fields.

To change the display font:

1. Choose Options|Fonts|Change Font; the Font dialog box opens.
2. Select the desired font and style, then click OK.

To change the edit font:

1 Choose Options|Fonts|Change Edit Font; the Font dialog box opens.

2 Select the desired font and style, then click OK.

To revert back to the default fonts:

- Choose Options|Fonts|Restore Default Fonts.

❖ *NOTE: To save the fonts you set as the ones used each time you open RapidPLUS, choose either Options|Save Settings Now or Options|Save Settings on Exit.*

Saving Current Settings

There are two “Save Settings” commands in the Options menu that save various system settings in the *Rapidxx.ini* file. These settings—such as the RapidPLUS fonts, the report editor, tool tips enabled/disabled, and the RapidPLUS window sizes and locations—become the system defaults.

To save system settings when RapidPLUS is exited:

- Choose Options|Save Settings on Exit.

Settings are saved each time you exit RapidPLUS. The saved settings become the system defaults the next time you open RapidPLUS.

To save system settings without exiting RapidPLUS:

- Choose Options|Save Settings Now.

OBJECT LAYOUT

Modification to the Rules for Naming Objects

The rules for naming objects (and modes) have been slightly modified. For convenience, all of the rules are presented here.

- Object names must begin with either a letter or an underscore (_).
- Illegal characters for an object name are: ! @ ^ & * ( ) - + = { } [ ] ; : , < > . ? / \ | and [space]. All other characters are legal. If RapidPLUS detects an illegal character, it will replace each illegal character with an underscore (_).

- Object names are case-sensitive, so you can have one object called “Switch” and another called “switch.”
- Objects can have the same name as long as they have different parents.
- The following words are reserved, that is, you cannot use them as names of objects: *action, and, begin, break, clear, continue, end, entry, exit, has, internal, is, mode, not, or, resetValue, self, subroutine, x, y.* If these words are capitalized, they can be used.

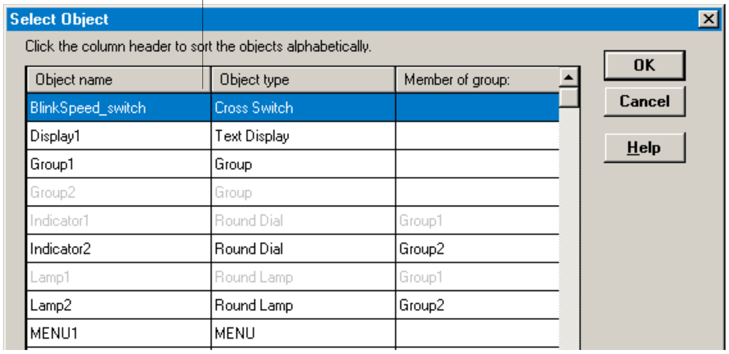
Selecting Objects from a List

The Select Object dialog box has been expanded to display each object, its type, and its membership in a group (if applicable). This list displays all objects: graphic, nongraphic, and user as well as hidden objects.

To select objects from a list:

1 Choose Edit|Select from List to open the Select Object dialog box:

Click the column headers to sort the objects alphabetically



Click the column header to sort the objects alphabetically.

Object name	Object type	Member of group:
BlinkSpeed_switch	Cross Switch	
Display1	Text Display	
Group1	Group	
Group2	Group	
Indicator1	Round Dial	Group1
Indicator2	Round Dial	Group2
Lamp1	Round Lamp	Group1
Lamp2	Round Lamp	Group2
MENU1	MENU	

2 Select the objects (all objects are selectable). Colors used in the list are:

COLOR	DESIGNATES
Black	Graphic objects, user objects, groups that are not in edit mode, members of groups that are in edit mode.

COLOR	DESIGNATES
Blue	Nongraphic objects.
Gray	Groups that are in edit mode, members of groups that are not in edit mode. ❖ *NOTE: If you select a gray group member, RapidPLUS places the group in edit mode.*

❖ *NOTE: When a hidden object is selected, its location on the object layout is indicated by a frame. The selection itself does not change the object's hidden state. To show the selected object, use Layout|ShowObject.*

Importing Bitmap Files

Multiple selection is available in the Import Bitmap File dialog box (File|Import Bitmaps). RapidPLUS assigns the original file name to each bitmap object created by the import. When the original file name is not a valid RapidPLUS name, it is replaced by the generic name “Bitmap” followed by a consecutive number: Bitmap1, Bitmap2, etc. If an existing bitmap object has the same name as a file selected for import, a consecutive number is added to it.

User Object Properties Dialog Box

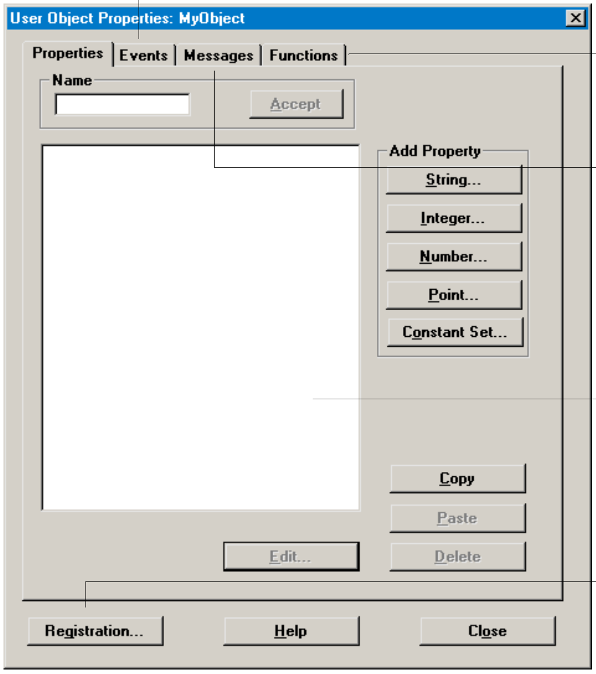
This dialog box has been expanded and divided into four tabbed pages. It is used for creating exported properties, events, messages, and functions.

To open the User Object Properties dialog box:

1 Choose Edit|User Object Properties or double-click anywhere in the Object Layout work area (but **not** on an object).

2 Click the More button in the root object's parameter pane. The following dialog box opens, at the Properties tab:

Opens the Events page for adding and editing events. Refer to pp. 19-9 to 19-10 in the *Rapid User Manual*



Opens the Functions page for viewing, deleting, or tagging user functions as exported. See the illustration below

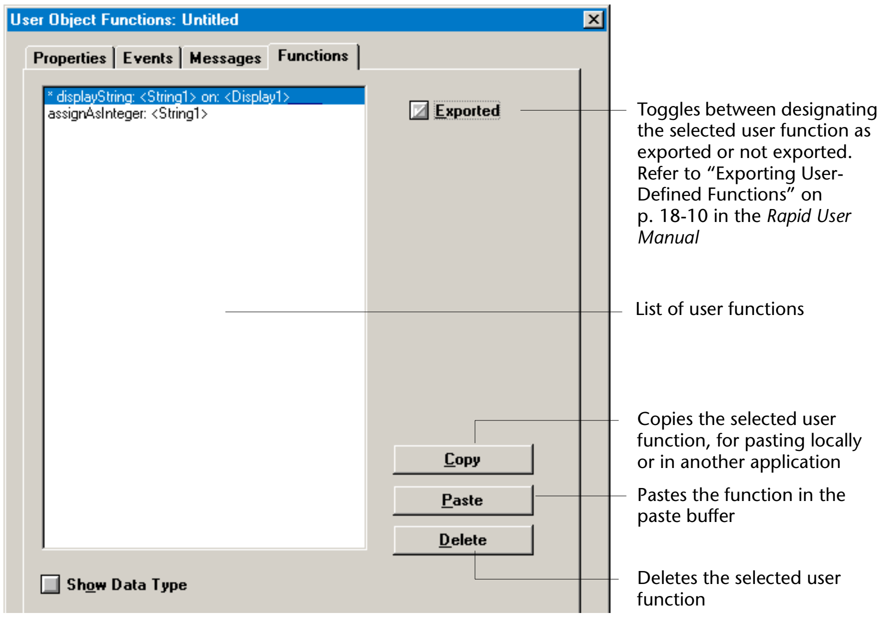
Opens the Messages page for adding and editing messages. See Chapter 22: "User Objects with Messages" for details

The Properties page is for adding and editing properties in the user object interface. Refer to pp. 19-7 to 19-8 in the *Rapid User Manual*

Opens a dialog box for defining the object's class, button, and/or customized Help file

To work with user functions:

- Click the Functions tab. The following page is displayed:


User Object Functions: Untitled
Properties
Events
Messages
Functions
* displayString: <String1> on: <Display1>
assignAsInteger: <String1>
Exported
Copy
Paste
Delete
Show Data Type

Toggles between designating the selected user function as exported or not exported. Refer to “Exporting User-Defined Functions” on p. 18-10 in the *Rapid User Manual*

List of user functions

Copies the selected user function, for pasting locally or in another application

Pastes the function in the paste buffer

Deletes the selected user function

Using Constant Set Properties

Constant sets can be defined as user object properties. As exported properties, the constant set items have the same functions as a constant integer. They allow you to share constants between the user object and parent application.

Another advantageous use of constant sets as exported properties is that you can build a user object that contains only constant sets. The constant set values can then be used by multiple user objects via a holder.

Adding Constant Set Properties

To add a constant set property:

1 Open the User Object Properties dialog box; the Properties tab is displayed.

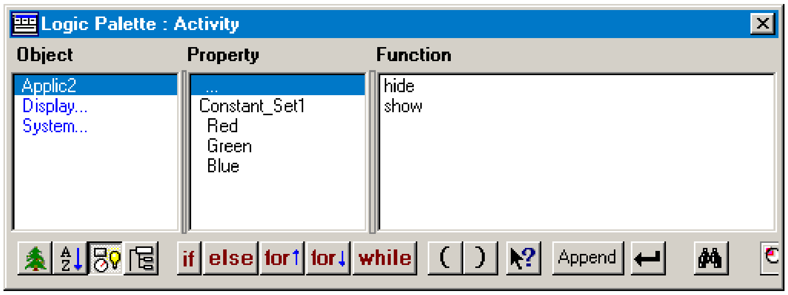
2 Click the Constant Set property button.

3 In the Constant Set dialog box, add the desired number of items. For instructions about adding items, see p. 11-4.

❖ *NOTE: The constant set's items are not listed in the Properties list. To see items, select the constant set and click the Edit button.*

Using Constant Set Properties in Logic

Constant set properties appear as properties of the user object. The illustration below shows a sample Logic Palette that contains constant set properties:



Sample Logic Editor containing constant set properties

These constant set properties have the same functions as a constant integer.

Example

In the following logic:

Current_Color := Applic2.Colors.Red as number
where:

- "Current_Color" is a number object,
- "Applic2" is the application name,
- "Colors" is the name of the constant set, and
- "Red" is the name of an item in the constant set.

Current_Color receives the value of "Red."

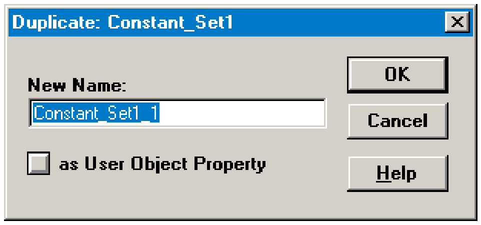
Converting Constant Sets to User Object Properties

You can duplicate a constant set and turn it into a user object property.

To duplicate an existing constant set as an exported property:

1 Open the Nongraphic Objects dialog box.

2 Select the constant set object you want to duplicate and click the Duplicate button; the Duplicate dialog box opens:



New Name: Constant_Set1_1

as User Object Property

3 Assign a name to the new constant set object.

4 Select the “as User Object property” check box and click OK. The new constant set object is added to the User Object Properties dialog box.

❖ *NOTE: The new constant set property has no connection to the original constant set object. Changes to the original do not affect the property and vice versa.*

Using Constant Set Properties in a Holder

Constant set properties of a holder object are accessible—**even if the holder is empty**!

Example

A user object, *constant.udo*, contains an exported constant set property called Colors. In the parent application, there is a holder object, Holder1. Holder1’s default object is *constant.udo*.

The following logic can be executed without causing runtime errors:

```
Holder1 clear
Integer1 := Holder1.Colors.Red
```

Sharing global constants in a project

You can define all your constant set objects as properties of a user object *const.udo*. You can then add a holder of type *const.udo* to any user object in the project that needs to access these constant set objects. As explained, there is no need to initialize the holder to make the constants accessible.

LOGIC EDITOR

Color Coding in the Logic Editor

You can use colors to define logic in the Logic Editor. Using different colors can make writing and reading logic clearer.

The default color settings are:

ITEM	COLOR
Object	Black
Property	Dark gray
Function	Blue
Literal (value/argument)	Red
Accessory (symbol)	Black
Event	Dark green
Special (construct)	Dark blue, bold
Comment	Dark cyan
Default	Black

To change a color setting:

- Choose Options|Syntax highlighting|<Item name>|<Color setting>.

Declaring Local Variables

In programming, a local variable is a variable used only within the routine or function in which it is defined. In RapidPLUS, a local variable is used similarly. It is declared (that is, added) in the Logic Editor for use within a block of logic lines and nowhere else.

Why use a local variable? Because sometimes you only need to use a number or integer value once, or just a few times within a block of logic, and you don’t want to create a number or an integer object in the Object Layout. The local variable can have either a number or integer value. Once declared, it has all the functions appropriate for a constant number or an integer object.

Declaring local variables provides a quick way of using variable values without overloading the application with data objects. In code generation, using local variables rather than additional data objects creates more efficient code.

Where Local Variables are Used

A local variable is used:

- As the loop counter in a For loop.
- As a declared local variable.
- As a user function argument.

Example of a local variable used as a loop counter in a For loop

```
for <Integer:i> from 1 to Array1 size step 1
    Array1 [Integer:i] initialize
```

For details about For loops, see Chapter 7: “Writing Logic Using Loops and Branches.”

Example of a declared local variable

```
declare <Integer:sum>  <Number:average>
    <sum> := 0
    for <Integer:i> from 1 to Array1 size Step 1
        <sum> := <sum>  +  Array1[ <i> ]
    <average> := <sum>  / Array1 size
    // Next activity ....
```

Example of a local variable used as a user function argument

```
myFunc: <myUDO:k> length: <Integer:len> lampArray: <Round_Lamp_Array2D:my-
    LampArray>
    myHolder hold:  <k>
    myLength := <len>
    for <Integer:i> from 1 to <myLampArray> size step 1
        <myLampArray> [ <i>, <i> ]   blink
```

User function arguments can be of most RapidPLUS types, including arrays and holders of known types. These arguments can be automatically generated using the Functions|Add Arguments/Generate Arguments commands. For details about user function arguments, refer to Chapter 18: “User-Defined Functions” in the *Rapid User Manual*.

Declaring a Local Variable

Local variables can be declared in entry activities, exit activities, actions, and user functions. More than one local variable can be declared in a logic block.

Local variables are assigned default names. In each block, the first local variable is assigned the default letter, "i." Subsequent default names are: j, k, l, etc. The default value of local variables is zero.

Example

The following logic line declares three local variables:

declare <Integer:i> <Integer:j> <Number:k>

To declare a local variable:

1 In the Logic Editor, select an empty logic line.

2 Choose Logic|Declare local variable|Integer (or Number). The following logic is appended:

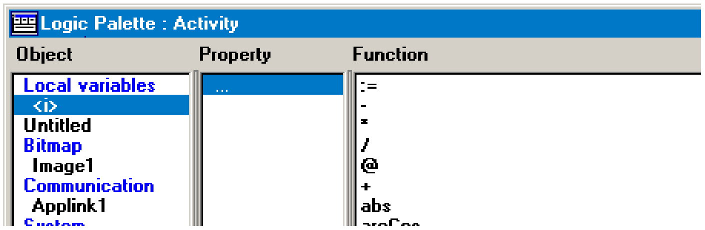
   declare <Integer:i> (or **declare: <Number:i>**)

   You can change the local variable name.

Using Local Variable Functions

Once a local variable has been declared, it has all the functions appropriate for a constant integer or a number object. To see the functions of a local variable in the Logic Palette, a logic line that is included in the local variable block must be selected in the Logic Editor.

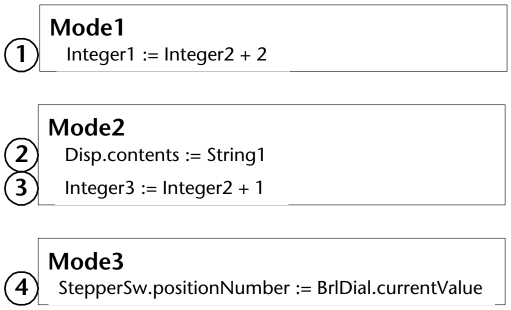
All local variables appear under the class, Local variables:



Execution of Mode Activities

The sequence in which the RapidPLUS state machine executes mode activities is somewhat different in version 5.0 and higher, and could possibly cause differences in application behavior for applications converted from previous versions.

In order to explain in what sequence the RapidPLUS state machine executes mode activities, we will assume an application where the modes shown below are active concurrently and the activities indicated are mode activities:



When the modes first become active, the mode activities are performed one after the other, according to the sequence of the modes in the mode tree and the order of the mode activities in each mode.

While the modes are active, a mode activity is performed whenever an object on the right side of the mode activity assignment function changes. For example, activity #1 is performed when Integer2 changes or activity #4 is performed when the barrel dial's current value property changes.

If several object changes take place "simultaneously," the mode activities are performed in the sequence that the changes were passed on to the state machine. Thus, if the barrel dial's current value changed before String 1 changed, activity #4 is performed first and activity #2 second.

If several mode activities reference the same changed object, the mode activities are performed according to the sequence of the modes in the mode tree. Thus, if Integer2 changes, activity #1 is performed before activity #3.

User Functions: Limit on Number of Objects

A single user function can contain up to 255 different objects and/or objects+properties.

If you refer to the same object in two different lines, it equals one use. However, if you use an object and its properties in the same function, each one counts as a use of the object.

Example

If the user function contains logic for *Switch1*, *Switch1.position1*, *Switch1.position2*, and *Switch1.position3*, then that equals four uses.

Should you need to build a user function that requires more than 255 objects, you must divide the user function into two user functions and either nest one in the other or have one user function call the other.

User Functions: Returning Specified Values

User functions can return:

- No value (void functions)
- Boolean values (conditional functions)
- A value that you specify. The specified return value can be a data type (integer, number, or string), any RapidPLUS object, or a user object (UDO). The return value of an integer or number is the value of the integer or number. The return value of a string is a copy of the string. The return value for all the other RapidPLUS objects and user objects is a pointer to the object.

User functions that do not need explicit return statements or return Boolean values are described in Chapter 18 of the *Rapid User Manual*.

Example

You have several strings of different lengths. The strings must be centered in a text display.

You can create a user function, *centerString*, to determine the necessary amount of padding, and return a new string with the padding plus the original text.

```
centerString: <String:TempString> total: <Integer:charsInDisplay>
    declare <Integer:i>
        <i> :=(<charsInDisplay>  -  <TempString> length) /2
        return <TempString> padSpacesLeftTo: ((<TempString> length ) +  <i> )
```

Specifying a Return Value in a User Function

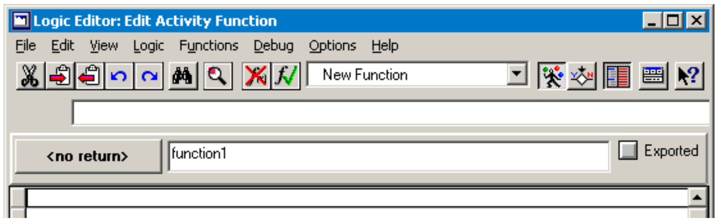
There are two stages in specifying a return value:

1. Select the return type from a list of possible return values.
2. Add one or more return statements in the Function Editor.

These stages are described below.

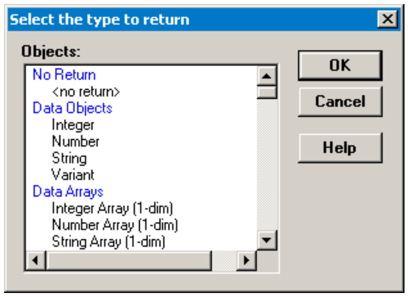
To select the return type:

1 Open the Function Editor:


Logic Editor: Edit Activity Function
File Edit View Logic Functions Debug Options Help
New Function
<no return>
function1
Exported

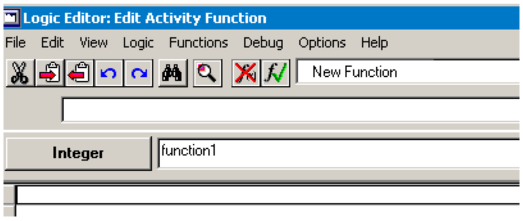
Notice the button labeled <no return>. This button displays the currently selected return type. When it displays <no return>, the function does not return a value.

2 Click the <no return> button. The list of available return types opens:



❖ *NOTE: Boolean does not appear as an available return type. Instead, you must define a conditional function, where the return type is Boolean by default.*

3 Select a return type and click OK. The selected return type is displayed on the button. For example, if you select Integer, the button changes accordingly:


Logic Editor: Edit Activity Function
File Edit View Logic Functions Debug Options Help
New Function
Integer
function1

After you have selected the return type, you build the user function. All flow paths, and in particular the last line of the logic, must contain a return statement, returning a value of the type you have specified.

To build a return statement:

1 Select Logic|Return, or click the return button in the Logic Palette. A line of logic is added to the edit line with “return” plus a prompt for the return type you have specified (if any).

For example, with a return type of Integer, you will see:

```
return <Integer>
```

2 Complete the return logic statement, then save the user function.

Possible Errors

Below are possible errors that can occur when working with user functions that return values.

Path with no return value

If you specify a return type for a user function, all flow paths through the user function must return a value. For example, both blocks of an If...Else statement must have a return statement, if no return statement follows the If...Else blocks.

If you do not include a return statement, a warning message appears, and you have the opportunity to fix it. If you choose not to fix the function, the function will return null, 0 (zero), or '' (empty string) from the path with no return values, according to the specified return type. This may result in an error at runtime.

Object type deleted

If you have specified a user object (UDO) as an argument or return type, you will get a warning if you try to delete the last instances of that object type. The warning reminds you that the object is used in logic, and allows you to comment out the affected logic, remove the logic, or cancel the operation.

If you do delete the objects:

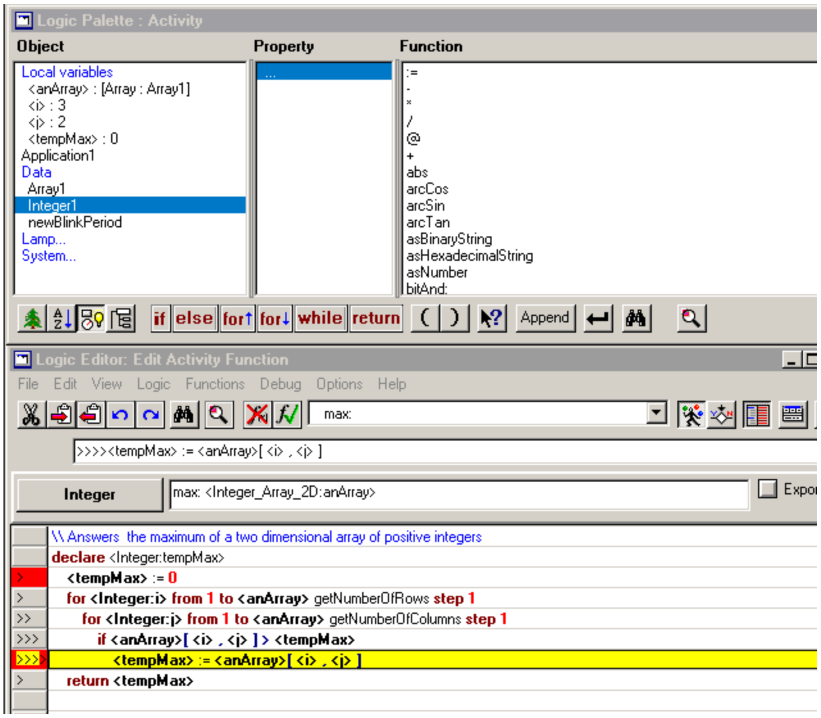
- The argument type is changed to Integer.
- The return type of the affected function is changed to void (no return).

If you replace the last instance of a user object with another, the replacement is automatically made in any user function that uses this type as argument type or return type.

Viewing Values of Local Variables and User Function Arguments

The values of local variables and of user function arguments are displayed in the Logic Palette's Object list when the Prototyper is paused at a breakpoint or when stepping in logic. Each time a breakpoint is reached, the values are updated.

The following illustration shows how status information is presented for local variables and user function arguments:



```
Local variables
  <anArray> : [Array : Array1]
  <i> : 3
  <j> : 2
  <tempMax> : 0
Application1
Data
  Array1
  Integer1
  newBlinkPeriod
Lamp...
System...
```

```
...
```

```
:=
-
*
/
@
+
abs
arcCos
arcSin
arcTan
asBinaryString
asHexadecimalString
asNumber
bitAnd:
```

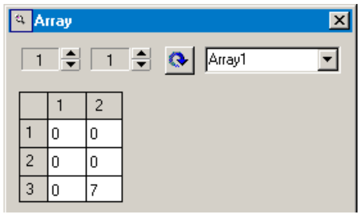
```
max:
>>>><tempMax> := <anArray>[ <i> , <j> ]
max: <Integer_Array_2D:anArray>
```

```
    \\ Answers  the maximum of a two dimensional array of positive integers
    declare <Integer:tempMax>
>     <tempMax> := 0
>     for <Integer:i> from 1 to <anArray> getNumberOfRows step 1
>>      for <Integer:j> from 1 to <anArray> getNumberOfColumns step 1
>>>       if <anArray>[ <i> , <j> ] > <tempMax>
>>>>        <tempMax> := <anArray>[ <i> , <j> ]
>     return <tempMax>
```

The Prototyper is paused at the second breakpoint, after several cycles

In the Logic Palette, notice that the user function arguments and local variables are listed in the Object column, together with their current values. Look at the first user function argument: *anArray*. This argument is a Rapid-

PLUS object and it can be inspected with an Inspector window. To do so, right-click *anArray* and choose Inspect:



	1	2
1	0	0
2	0	0
3	0	7

After the Inspector window is opened, it will not necessarily show the value of the user function argument in successive calls to that function, but rather it will keep showing the same object for which it was opened. For information about Inspector windows, see “The Inspector Window” on p. 4-27.

OBJECT EDITOR

Cursor Coordinates Status Box

The cursor coordinates status box displays information about shapes as they are drawn on an object. Information displayed includes the shape’s beginning and ending coordinates and its size.

Pasting Bitmaps into the Object Editor

When a bitmap created with a 256-color (or less) palette is pasted, and the display setting is either True or High color, a message box opens in which you can choose to preserve the pasted bitmap’s palette

CHAPTER 28

Application Packager

The Application Packager is a distribution utility for packaging a RapidPLUS application and its supporting files. Types of applications that can be packaged are:

- RPD: single applications or projects (main application and its user objects).
- UDO: user objects.
- RVR and RDO: read-only applications and user objects that were generated to run in the Rapid Reviewer.

Supporting file types that are packaged include RAR, RDS, BMP, WAV, DLL, and fonts. The Application Packager collects all the files used by the RapidPLUS application and creates a self-installing package file (an EXE file).

The Application Packager makes it easy for you to distribute a RapidPLUS application with all the elements that you want to provide. You can include the Rapid Reviewer in the package file so that when the package is installed on any system, the application will run in the Rapid Reviewer. You can also designate a program folder and shortcut for the RapidPLUS application, as well as a Readme file.

When the end user installs the package file, the Application Packager creates the program folder on the end user's system for easy access to the RapidPLUS application.

This chapter presents:

- Instructions for using the Application Packager.
- Instructions for distributing and using a packaged application.

BUILDING AN APPLICATION PACKAGE

A packaged application contains all of the files necessary for running a RapidPLUS application on an end-user's system. The packaging process is simple, and a series of dialog boxes will guide you through the process of building an application package:

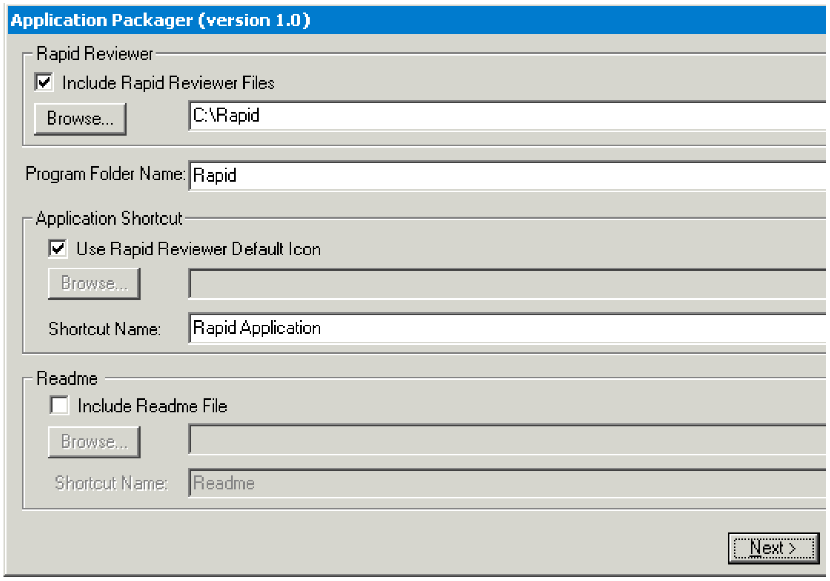
DIALOG BOX	USED TO
Application Packager	• Add the Rapid Reviewer to the package (required when the end user does not have RapidPLUS or the Rapid Reviewer installed). • Name the package's program folder. • Add a shortcut for the application. • Add a Readme file to the package.
Files and Folders for Packaging	• Select the RapidPLUS application to be packaged. Most of the resource files used by the application are automatically added to the package. • Add additional files and fonts to the package.
Destination Folders	• Select the Package destination folder. This folder will contain all of the package files. As soon as the package is built, this folder will be created on your system. • Select the Installed Application destination folder. This folder will be added to the end user's system when the package is installed. (It is not added to your system.)

The only input that is always required of you is to select the RapidPLUS application to be packaged in the second dialog box. The Application Packager supplies the rest of the information. You can, however, change the default values as necessary.

Step 1: Setting Up the Application Packager

1 Open the Application Packager by running the file *Packager.exe* located in the Rapidxx\Packager folder.

2 In the Application Packager dialog box, select the options as necessary:


Application Packager (version 1.0)

Rapid Reviewer
[✓] Include Rapid Reviewer Files
Browse... C:\Rapid

Program Folder Name: Rapid

Application Shortcut
[✓] Use Rapid Reviewer Default Icon
Browse...
Shortcut Name: Rapid Application

Readme
[ ] Include Readme File
Browse...
Shortcut Name: Readme

Next >

OPTION	DESCRIPTION	DEFAULT SETTING
Include Rapid Reviewer Files	Adds the Rapid Reviewer's files (including *rapidrt.exe*). In order to include the Rapid Reviewer, its path must be given.	Selected, using the Rapidxx path
Program Folder Name *(which will be listed under "Start\Programs")*	When the package is installed—on the end user's system—the specifed program folder will be created. The program folder will contain two or three shortcuts: one to the application, one to uninstall the application, and one to the Readme file (if included).	"Rapid"

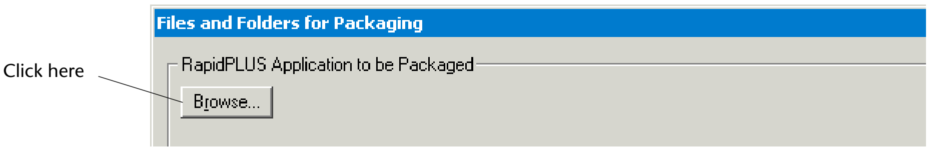
OPTION	DESCRIPTION	DEFAULT SETTING
Application Shortcut	When the package is installed, a shortcut is created in the program folder to the application, using the specified icon and name.	
* *Use Rapid Reviewer Default Icon*	If the "Use Rapid Reviewer Default Icon" check box is not selected, you must specify another file, otherwise the Application Packager cannot continue.	Rapid Reviewer
Shortcut Name	If the Shortcut Name field is left blank, "<file name> Application" will be used.	"Rapid Application"
Readme	Adds the specified Readme file to the package. Formats supported are HTML, DOC, WRI, and TXT. When these formats are used, the Readme file opens in the appropriate program (for example, an HTML file opens in the system's default Web browser). Additional formats are opened in Microsoft® Notepad.	Not selected

* required field

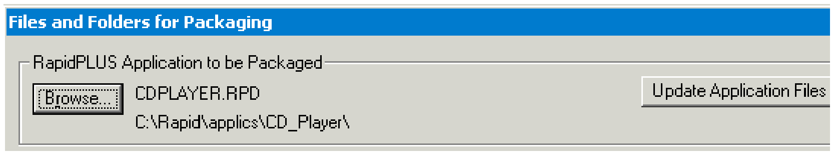
3 Click Next.

Step 2: Selecting the Application and Files to Package

1 In the Files and Folders for Packaging dialog box, click Browse to select the application (RPD, RVR, UDO, or RDO):

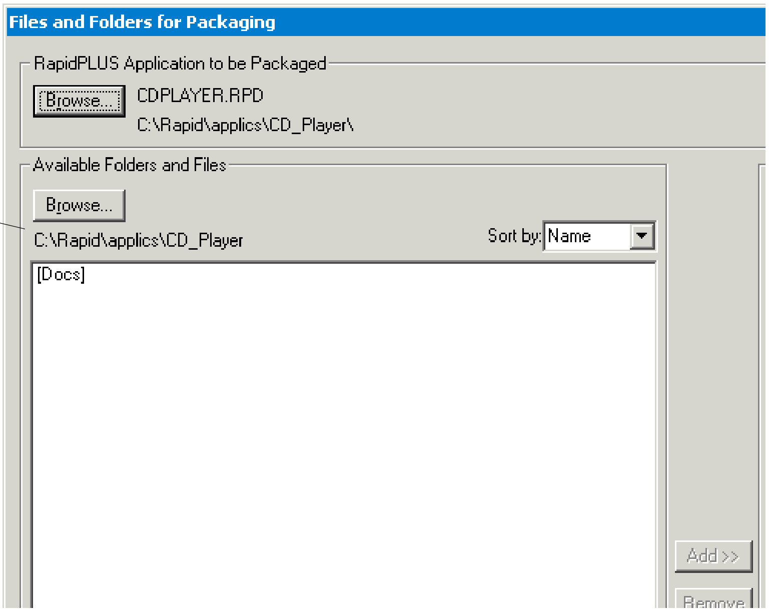

Click here
Files and Folders for Packaging
RapidPLUS Application to be Packaged
Browse...

The application and its path are displayed and the other fields and options are enabled:


Files and Folders for Packaging
RapidPLUS Application to be Packaged
Browse...
CDPLAYER.RPD
C:\Rapid\applics\CD_Player\
Update Application Files

Notice the Update Application Files button. This button is useful when an application that has already been packaged has changed. (See “Editing a Package” on p. 28-10 for more information.)

The **Available Folders and Files** pane (left pane) presents the contents of the application folder:

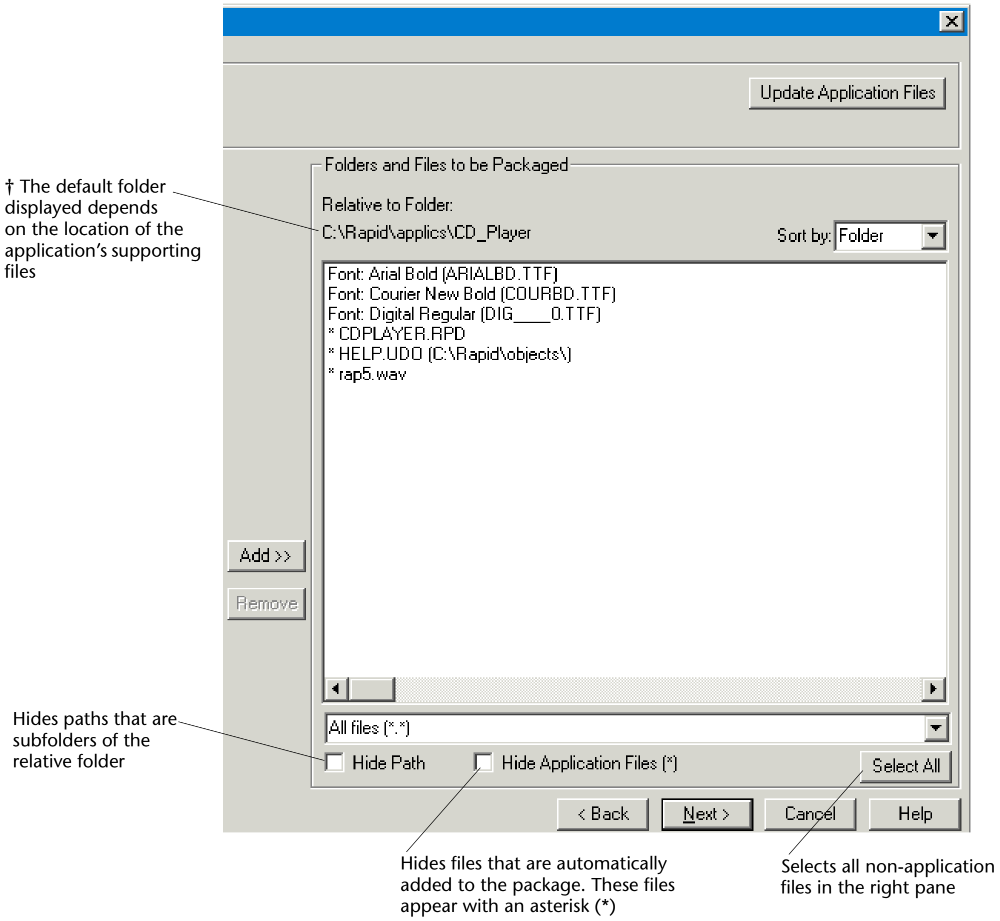

† The default folder displayed depends on the location of the application’s supporting files
Files and Folders for Packaging
RapidPLUS Application to be Packaged
Browse...
CDPLAYER.RPD
C:\Rapid\applics\CD_Player\
Available Folders and Files
Browse...
C:\Rapid\applics\CD_Player
Sort by: Name
[Docs]
Add >>
Remove

† The default folder depends on the location of the supporting files. The application folder is selected when all supporting files are located in the application folder or a subfolder. Also, if a supporting file is located in a different drive, the application folder is selected. (In the above example, that folder would be C:\Rapid\applics\CD_Player).

When a supporting file is located in the same drive as the application, but in a higher folder, the highest folder that the application and supporting file have in common is selected (in the above example, that folder would be either C:\, C:\Rapid, or C:\Rapid\applics depending on where the supporting files are located).

All resource files that are used by the application are automatically added to the **Folders and Files to be Packaged** pane (right pane). The only exceptions are files that are **loaded in runtime**.

The resource files are marked with an asterisk(*); they cannot be removed from the package. The referenced fonts are presented in the format “Font: <font name> (<font file>).”


Update Application Files
Folders and Files to be Packaged
Sort by:
Add >>
Remove
Select All
< Back
Next >
Cancel
Help
† The default folder displayed depends on the location of the application’s supporting files
Hides paths that are subfolders of the relative folder
Hides files that are automatically added to the package. These files appear with an asterisk (*)
Selects all non-application files in the right pane

Relative to Folder:
C:\Rapid\applics\CD_Player

Sort by: Folder

```
Font: Arial Bold (ARIALBD.TTF)
Font: Courier New Bold (COURBD.TTF)
Font: Digital Regular (DIG____0.TTF)
* CDPLAYER.RPD
* HELP.UDO (C:\Rapid\objects\)
* rap5.wav
```

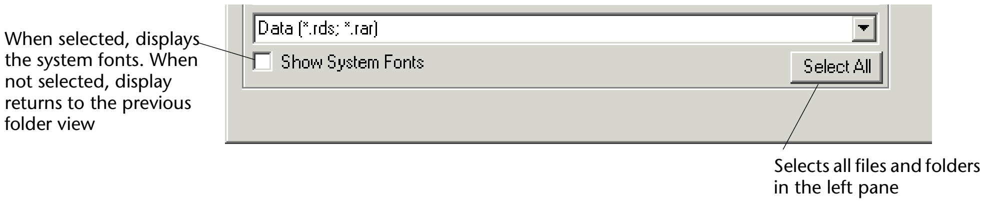
All files (*.*)

☐ Hide Path ☐ Hide Application Files (*)

† See comment on p. 28-5.

2 (Optional) Add additional files to the package by selecting them in the left pane and clicking the **Add>>** button. Remove files from the right pane using the **Remove** button.

The elements below the left pane are:


When selected, displays the system fonts. When not selected, display returns to the previous folder view
Data (*.rds; *.rar)
Show System Fonts
Select All
Selects all files and folders in the left pane

3 To add system fonts to the package, select the **Show System Fonts** check box. Select fonts from the system fonts list and click Add>>.

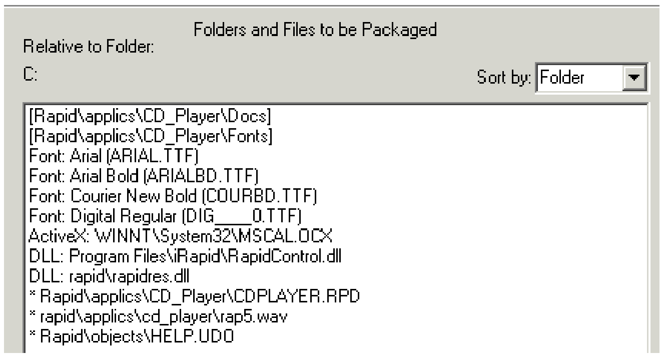
4 When the right pane contains all of the additional files and fonts that you want to include in the package, click Next.

Order of files in the "Folders and Files to be Packaged" pane

The added files and folders are listed in the following order:

1 Folders
2 Font files
3 ActiveX objects
4 DLL files
5 JavaBean objects
6 Files added from the "Available Folders and Files" pane
7 Application and supporting files

Example



```
[Rapid\applics\CD_Player\Docs]
[Rapid\applics\CD_Player\Fonts]
Font: Arial (ARIAL.TTF)
Font: Arial Bold (ARIALBD.TTF)
Font: Courier New Bold (COURBD.TTF)
Font: Digital Regular (DIG____0.TTF)
ActiveX: WINNT\System32\MSCAL.OCX
DLL: Program Files\iRapid\RapidControl.dll
DLL: rapid\rapidres.dll
* Rapid\applics\CD_Player\CDPLAYER.RPD
* rapid\applics\cd_player\rap5.wav
* Rapid\objects\HELP.UDO
```

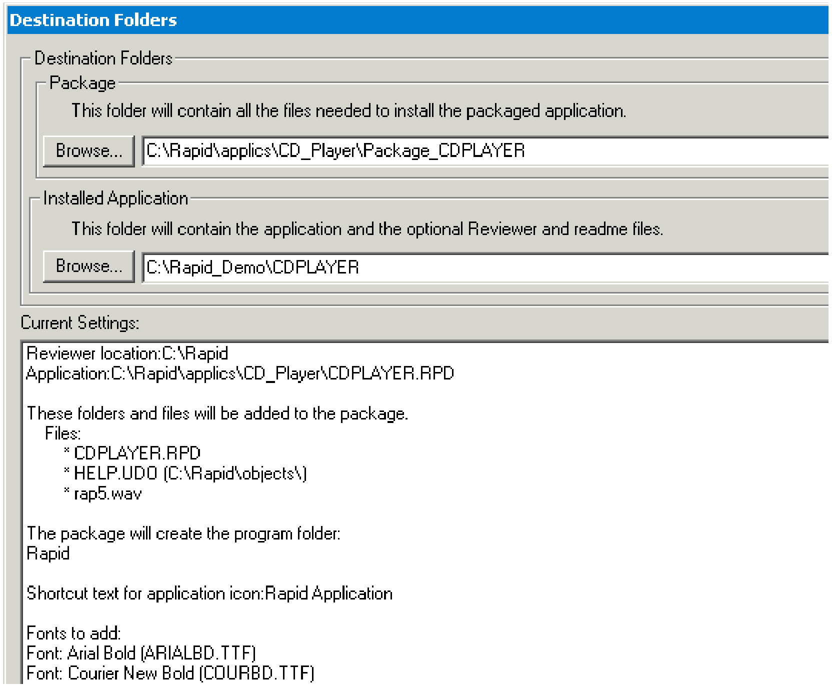
Step 3: Selecting Destination Folders/Building the Package

The third dialog box presents the destination folders and a summary of your settings. The destination folders are:

FOLDER	DESCRIPTION
Package	This destination folder contains all the setup files for installing the packaged application. It will be created on your system when the package is built. Its files are: • A self-installing package file (Setup.exe). • A text file, PackagedFiles.txt, which contains a list of all the files that are included in the package (the application, its user objects, and resources). • A subfolder for special fonts used in the application (if included). • The Readme file (if included). • Various setup, data, and administrative files. The default folder is "Package_<application file name>" located in the application folder.
Installed Application	This field presents the folder that will be added to the end user's system when setup.exe is run. The default folder name is "C:\Rapid_Demo\<application name>". If the Rapid Reviewer was included in the package, a subfolder named "Reviewer" will also be added. (See "Distributing and Using a Packaged Application" on p. 28-11 for information about the destination folder.)

To change the destination folder(s) and/or build the package:

1 For either destination folder: type a folder name, or click the Browse button and select a different folder.



This folder will contain all the files needed to install the packaged application.

C:\Rapid\applics\CD_Player\Package_CDPLAYER

This folder will contain the application and the optional Reviewer and readme files.

C:\Rapid_Demo\CDPLAYER

```
Reviewer location:C:\Rapid
Application:C:\Rapid\applics\CD_Player\CDPLAYER.RPD

These folders and files will be added to the package.
   Files:
      * CDPLAYER.RPD
      * HELP.UDO (C:\Rapid\objects\)
      * rap5.wav

The package will create the program folder:
Rapid

Shortcut text for application icon:Rapid Application

Fonts to add:
Font: Arial Bold (ARIALBD.TTF)
Font: Courier New Bold (COURBD.TTF)
```

❖ *NOTE: If the Package destination folder does not exist, the Application Packager will prompt you to create it (after you click the Build button).*

2 Check the Current Settings, then click Build. The Application Packager builds the package.

All of the installation files are placed in the Package destination folder. An additional file, <*application name*>*.pak*, is located in the application folder. This file is useful for editing a package (as described on the next page).

❖ ***IMPORTANT**: If you have already created a package in the selected Package destination folder, creating an additional package will overwrite the first—without warning. Be sure to use different folders for each package that you want to keep.*

EDITING A PACKAGE

You may want to edit a package after you have made changes to the application or any of its user objects. The editing procedure uses the PAK file that was saved when the package was built. This file is located in the application folder.

Editing a PAK File in the Application Packager

This editing method opens the Application Packager with the previous settings.

To edit the package file:

1. Double-click the <application name>.PAK file.
2. If you made changes to the application or any of its user objects, click the **Update Application Files** button in the second dialog box. It updates these files in the "Folders and Files to be Packaged" pane (right pane).
3. Add or remove other files as necessary.
4. Click Next, and then click Build. The previously built package is replaced by the new package.

Editing a PAK File Without Opening the Application Packager

This editing method contains a silent command that updates the Application Packager without actually opening it.

To edit the package file:

1. In a text editor, create a BAT file with the following line:

```
C:\Rapidxx\Packager\Packager.exe /Silent=C:\<application path>\<application name>.PAK
```

   For example,

```
C:\Rapidxx\Packager\Packager.exe /Silent=C:\Rapidxx\applics\CD_Player\CDPLAYER.PAK
```

2. Each time you edit the RapidPLUS application or its user objects, run the BAT file. It automatically updates the PAK file and all the files in the destination folder.

DISTRIBUTING AND USING A PACKAGED APPLICATION

❖ *TIP: We suggest that you compress the files in the Package destination folder before you give them to the end user.*

The following instructions are for the end user.

To use the packaged application:

1 Extract the compressed setup files to a temporary folder on your local hard disk.

2 Run the ***Setup.exe*** file.

3 In the Select Destination Folder dialog box, either accept the default destination folder (Rapid_Demo\<name of application>) or browse to another folder, then click Next to begin installation.

4 If the application contains special fonts, a dialog box will open asking whether or not to install the fonts. Click Yes to install the fonts.

5 When the installation process is completed, a final dialog box opens. If a Readme file was included in the package, you will be prompted to view it.

6 A window will open displaying shortcuts to the application, to uninstall the application, and to the Readme file (if a Readme file was packaged). Double-click the application shortcut to run it in the Rapid Reviewer.

APPENDIX A

RapidPLUS Search Paths

RapidPLUS looks for files in the following locations and in the order specified.

*** = If no drive is specified, RapidPLUS looks for the file relative to the application folder.

MODULE	FILE TYPE	SEARCH PATH
Active X	OCX, DLL	Application folder and subfolders, Rapidxx\Objects folder, Rapidxx\Applics folder, Rapidxx folder, a RapidPLUS search path defined by the user
Array	RAR	Save: application folder Load: ***
Bitmap object	BMP, JPG, etc.	***
Data store	RDS	Save: application folder Load: ***
DBAccess object	dbase file	***
DLL	DLL	***, Rapidxx folder

MODULE	FILE TYPE	SEARCH PATH
JavaBean object	JAR	Application folder and subfolders, Rapidxx\Objects folder, Rapidxx\Applics folder, Rapidxx folder, a RapidPLUS search path defined by the user
Multimedia	WAV, FLC, etc.	***
Recorder	RCD	Save: Rapidxx folder Load: Rapidxx folder, application folder
Report	TRL, TRN, etc.	Save: Rapidxx folder Load: Rapidxx\Reports folder
RPX object	RPX	Application folder and subfolders, Rapidxx\Objects folder, Rapidxx\Applics folder, Rapidxx folder, a RapidPLUS search path defined by the user
State	RST	Save: Rapidxx folder Load: Rapidxx folder, application folder
User object	UDO, UXO, RDO, RXO	Application folder and subfolders, Rapidxx\Objects folder, Rapidxx\Applics folder, Rapidxx folder, a RapidPLUS search path defined by the user

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❖ *NOTE: All file names as well as RapidPLUS conditions, events, functions, and properties are italicized; non-RapidPLUS events, functions, methods, and properties are not italicized.*