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Introduction

The RTG4 device features an embedded micro programmable read-only memory (uPROM) in the silicon, which is used for storing program data. The uPROM has a custom fabric interface that users can use to read data from their application.

The uPROM can hold up to 10370 36-bit words.

Refer to the RTG4 FPGA Fabric User Guide for more information.

Libero provides the uPROM Configurator for you to add and configure the uPROM. The memory clients you have added/configured for the uPROM will be programmed along with the fabric.

After Place and Route, you can update/modify the Memory Clients in the uPROM before it is programmed. There is no need to rerun Place and Route after the update to the uPROM content. See "Viewing the Initialization Client" on page 17.
1 – uPROM Configuration

uPROM Configurator

The uPROM Configurator is available from the Catalog tab. To invoke the Configurator:

1. Expand Memory & Controllers in the Catalog.
2. Do one of the following to invoke the uPROM Configurator:
   - Double-click or right-click RTG4 uPROM and choose **Configure Core and Instantiate in** `<design_name>` to instantiate the uPROM in the SmartDesign canvas.
   - Double-click or right-click RTG4 uPROM and choose **Configure Core**. Enter a component name for the uPROM when prompted.
3. In the uPROM Configurator, click **Add** to add a Client to the uPROM (Figure 1-2). Two types of client can be added:

- **Data Storage Client** – This is a user data client added by selecting **Add client to system** from the pull-down list. The name of the client is user-specified and the size of the client (number of 36-bit words) can be configured by the user, subject to the size limit of the uPROM.

- **Initialization Client** – This is a system client for zeroization. Select **Add init client to system** from the pull-down list to add this client. This client has the default name **RTG4**.

---

**Figure 1-1 • RTG4 uPROM Core in Catalog**

3. In the uPROM Configurator, click **Add** to add a Client to the uPROM (Figure 1-2). Two types of client can be added:

- **Data Storage Client** – This is a user data client added by selecting **Add client to system** from the pull-down list. The name of the client is user-specified and the size of the client (number of 36-bit words) can be configured by the user, subject to the size limit of the uPROM.

- **Initialization Client** – This is a system client for zeroization. Select **Add init client to system** from the pull-down list to add this client. This client has the default name **RTG4**.
MSCC_RAM_INITIALIZATION_TO_ZERO. The default client name, start address, and size (number of 36-bit words) are fixed and non-editable.

**Usage statistics**

Usage statistics displays the total memory size of the uPROM, the size of used memory and free memory. All memory sizes are expressed in terms of the number of 36-bit words.

**Available memory**

The uPROM can hold 10,370 36-bit words (total 373320 bits).

**Used memory**

When you add memory clients, the Used memory displays the total amount of memory (number of 36-bit words) used by all clients. This is indicated in blue in the pie chart.

**Free memory**

Free memory (number of 36-bit words) is displayed in magenta in the pie chart.
Symbol View

The Symbol View presents a symbol view of the RTG4 uPROM with the input/output ports including the address bus and the data bus.

Log Window

The Log Window displays Warning or Error messages, such as DRC Warning and Error messages.

Add Init Client to System

Click the Add pull-down list and select Add Init Client to System. A default client name (MSCC_RAM_INITIALIZATION_TO_ZERO) with default start address (0x0) and default size (820 36-bit words) is created. No user configuration is allowed. Two user actions are available when the client is selected:

- **Delete** – Remove the client.
- **View** – View the non-editable default configuration of the client.

![Initialization Client Dialog Box](image-url)
Add Data Storage Clients to System

Click Add and select Add Clients to System from the pull-down list to add a data storage client. The Add Data Storage Client dialog box (Figure 1-4) appears for you to specify the start address, client size, the content of the client and whether or not to use the memory content for simulation.

![Add Data Storage Client Dialog Box](image)

**Figure 1-4 • Add Data Storage Client Dialog Box**

**Client name**

Enter a name for your memory client.

**Content from file**

Import your memory client from a memory file with this option. Click the Browse button at the far right to navigate to the location of the memory file you want to import. Select the Memory File and click Open.
Note: The memory file must have the *.mem file extension.

Figure 1-5 • Import Memory File Dialog Box
Use Absolute Path
When this radio button is checked, the Absolute Path of the Memory File appears in the Content from File field.

![Image of Add Data Storage Client window with absolute path example]

Figure 1-6 • Absolute Path of Memory File

Use Relative Path from Project Directory
When this radio button is checked, the Relative Path of the Memory File (relative to the Project location) you import appears in the Content from File field.
Note: On the Windows systems, if the memory file and the Project location are on different drives, the Absolute Path is used even if you select Relative Path.

Figure 1-7 • Relative Path of Memory File
Copy Memory File to Project Path
Click this radio button and click the Browse button at the far right to navigate to the location of the memory file to copy from.

![Import Memory File](image)

**Figure 1-8 • Location of Memory File to Copy From**

**Note**: The memory file cannot be copied to and stored in the project's sub-folders: component, smartgen, synthesis, designer, simulation, stimulus, tooldata, and constraint. To prevent users from inadvertently copying the memory file into these sub-folders, these project sub-folders are hidden from view when you select the project folder.

**Note**: The copied Memory File path is internally stored as relative path.

**Note**: If the Memory File is copied to the project, updating the content of the Memory File is the responsibility of the user.

uPROM supports only the Microsemi Binary format (*.mem) for the memory content. The *.mem file must meet the following requirements:

- Each row is one 36-bit binary word (only 0s and 1s).
- Only 0s and 1s are allowed.
- The number of rows in the file (word count) should be less than or equal to the memory space of the uPROM (up to 10,370 words).
- The memory file must have the *.mem file extension.

**Figure 1-9** shows an example memory file.
Content filled with 0s

Fill the content of the memory client with 0s as a place holder. You can update the memory client after Place and Route and before Programming. There is no need to rerun Place and Route after you update the uPROM Memory Content. See "Viewing the Initialization Client" on page 17 for details.

Start address

Enter the Start address (14-bit) of your client in HEX. The start address cannot be 0x0 if an Initialization Client is added already. Valid values are from 0x0 to 0x289F (HEX).

Number of 36-bit words

Enter the size of your client (expressed as the number of 36-bit words) in decimal.

Note: When multiple clients are added, ensure that the address range of each client does not overlap with the other clients. Overlapping of address range is not allowed and will be flagged as an error when it occurs.

Note: The Data Storage client must not occupy the address space of an existing Initialization Client. An error is flagged when this occurs.
Use content for simulation

Check this box to include your memory content for simulation. When this box is checked, a uPROM.mem file is automatically created in the <prj_location>/simulation folder when simulation is invoked in the Design Flow window. The uPROM.mem file is read by the uPROM simulation model to initialize the uPROM content when the simulation starts. Only clients with the "Use Client for Simulation" check box checked have the contents added to the UPROM.mem file for simulation.

The clients you have added appear in the User clients in uPROM pane (Figure 1-10).

![RT4 PROM](image)

Figure 1-10 • User Clients Added

DRC Rules and Error Messages

To prevent out-of-bound memory addressing and overlapping of address space, DRC rules are enforced and error messages are given when:

- An invalid start address (outside of the uPROM memory space) is entered. The uPROM address range is 0x0000 through 0x289F (HEX).
  DRC Error: The specified start address is invalid; legal addresses range from 0x0 to 0x289F.
- The start address and the number of words the user has entered put the user client beyond the memory space of the uPROM.
  DRC Error: For the specified start address the number of words cannot exceed the total number of words of 10370.
• The number of 36-bit words the user has entered is less than the number of words in the memory file used to fill the content of the client.
  DRC Error: The number of words cannot be less than the number of words <mem_file_word_count> specified in the memory file <mem_file_name>.
• There is more than one user client and the address range of one client overlaps with that of another.
  DRC Error: This client overlaps with: <client name>.
• The memory file (*.mem) size exceeds the total uPROM memory space.
  DRC Error: The memory file <memoryFileName> size exceeds the total uPROM space.

**Editing a Client**

To edit a data storage client, right-click the client and choose **Edit** (Figure 1-11) or click the **Edit** button to open the Edit Data Storage Client dialog box.

**Note:** The configuration of the Initialization Client cannot be edited, but it can be viewed. For Initialization Clients, the Edit option is replaced by the View option.

*Figure 1-11 • Editable User Client*
n.

**Figure 1-12 • Non-Editable Initialization Client**

Make your changes in the Edit Data Storage Client dialog box and click OK to save your edits (Figure 1-13).

**Figure 1-13 • Edit Data Storage Client Dialog Box**
Deleting a Client

Right-click the client and choose **Delete**. (Figure 1-14). Both the data client(s) and the Initialization Client can be deleted.

![Deleting a Client](image)

**Figure 1-14 • Deleting a Client**

Viewing the Initialization Client

The Initialization Client's default non-editable configuration can be viewed by clicking the **View** button when the Initialization Client is selected.

Update uPROM Memory Content

The Update uPROM Memory Content tool is useful if you have reserved space in the uPROM Configurator and you want to make changes to the uPROM client after Place and Route. After you have made the updates to the uPROM Memory Content, there is no need to rerun Place and Route.

To update the uPROM Memory Content from the Design Flow window:
1. Right-click Update uPROM Memory Content in the Design Flow window and choose **Configure Options**. *(Figure 1-15)*
2. When the uPROM Update Tool appears, right-click the Memory Client you want to update and choose **Edit** (Figure 1-16).

*Figure 1-16 • uPROM Update tool*
The Edit Data Storage Client dialog box appears (Figure 1-17).

![Figure 1-17 • Edit Data Storage Client Dialog Box](image)

You can make the following changes to the uPROM client:

- Change the memory content, memory size and start address of the client
- Reverse your decision on whether or not to use content for simulation

**Note:** You cannot use the uPROM Update Tool to add or delete a client. To add or delete a client, you must use the uPROM Configurator to reconfigure your clients and regenerate your uPROM component and your design.

**UPROM Architecture and Address Space**

Architecturally, the uPROM is structured in 21 different memory arrays with 14-bit addressing. Each array is 512x36 bit words. In the first 20 memory arrays, the last eight words are not user accessible. Therefore, for the first 20 memory arrays (#0 - #19), the size of each memory array is 504x36. In the last memory array (#20), there are 192 words that are not user accessible. Therefore, the size of memory array #20 is 320x36. Because there are user inaccessible addresses in the array, the addressing scheme...
for the uPROM is not contiguous. Figure 1-18 shows a simplified block diagram of the uPROM memory. For details, refer to the RTG4 Fabric User Guide.

**Figure 1-18 • uPROM Memory Blocks**

To make uPROM addressing easy for the user, the uPROM Configurator takes the user-specified contiguous address and automatically translates that address into the uPROM addressing scheme. Inaccessible addresses are skipped. The address translation is transparent to the user and takes up about 80 4-LUTs from the fabric resources.
# 2 – Port Description

Table 2-1 lists the uPROM ports.

**Table 2-1 • uPROM Ports**

<table>
<thead>
<tr>
<th>Port Name</th>
<th>Direction</th>
<th>Type</th>
<th>Description</th>
<th>Polarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDR[13:0]</td>
<td>Input</td>
<td>Dynamic</td>
<td>Registered Address Input</td>
<td></td>
</tr>
<tr>
<td>CLK</td>
<td>Input</td>
<td>Dynamic</td>
<td>Clock Input</td>
<td>Rising</td>
</tr>
<tr>
<td>RDEN</td>
<td>Input</td>
<td>Dynamic</td>
<td>Read Enable</td>
<td>Active High</td>
</tr>
<tr>
<td>DATAR[35:0]</td>
<td>Output</td>
<td>Dynamic</td>
<td>Registered Data Output</td>
<td></td>
</tr>
<tr>
<td>BUSY</td>
<td>Output</td>
<td>Reserved</td>
<td>Leave unconnected</td>
<td></td>
</tr>
</tbody>
</table>
A – Product Support

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

Customer Service
Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.
From North America, call 800.262.1060
From the rest of the world, call 650.318.4460
Fax, from anywhere in the world, 650.318.8044

Customer Technical Support Center
Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues, and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

Technical Support

Website
You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group home page, at www.microsemi.com/soc.

Contacting the Customer Technical Support Center
Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

Email
You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.
The technical support email address is soc_tech@microsemi.com.
Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer's responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided "as is, where is" and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.