
RTG4 uPROM Configuration User Guide

Introduction

The RTG4™ device features an embedded micro programmable read-only memory (uPROM) in silicon, which is used for storing program data. The uPROM has a custom fabric interface you can use to read data from your applications. The uPROM can hold 10,370 36-bit words. For more information, see the [RTG4 FPGA Fabric User Guide](#).

Libero® provides the uPROM Configurator for you to add and configure the uPROM. The memory clients you add or configure for the uPROM are programmed along with the fabric.

After Place and Route, you can update and modify the memory clients in the uPROM before it is programmed, without having to rerun Place and Route after the update to the uPROM content. For more information, see [Viewing the Initialization Client](#).

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1. uPROM Configuration

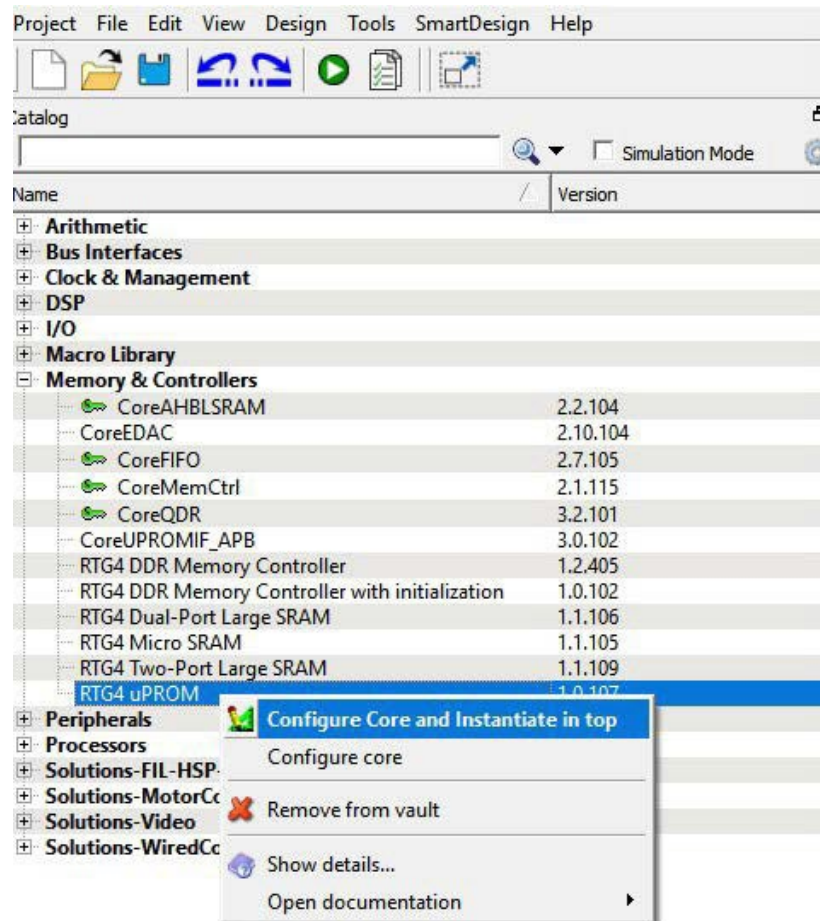
The following sections describe how to configure the uPROM.

1.1 uPROM Configurator

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

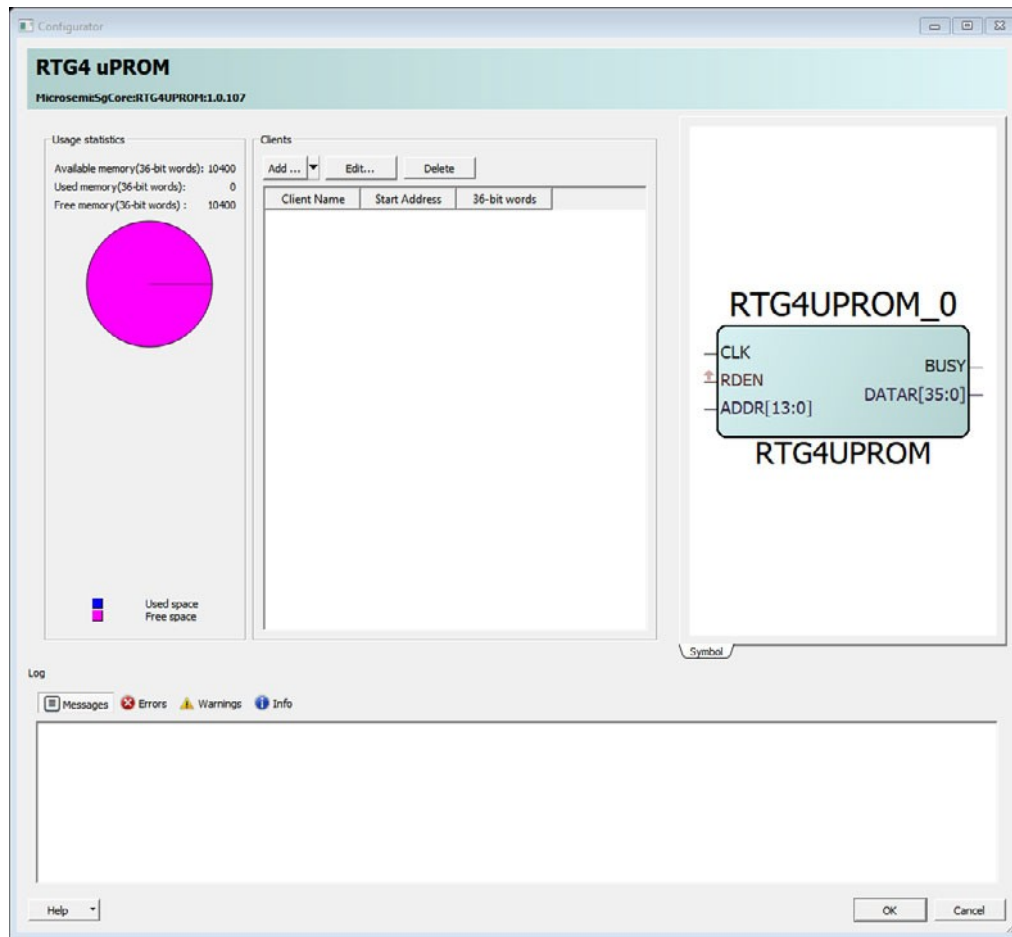
1. Expand **Memory & Controllers** in the Catalog.
2. Perform one of the following steps:
 - Double-click or right-click RTG4 uPROM and choose **Configure Core and Instantiate in <design_name>** to instantiate the uPROM in the SmartDesign canvas.

Figure 1-1. RTG4 uPROM Core in Catalog



- Double-click or right-click RTG4 uPROM and choose **Configure Core**. When prompted, enter a component name for the uPROM.
3. In the uPROM Configurator, click **Add** to add a Client to the uPROM (see the following figure). Two types of clients can be added:
 - **Data Storage Client** — 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), subject to the size limit of the uPROM.
 - **Initialization Client** — 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 MSCC_RAM_INITIALIZATION_TO_ZERO. The default client name, start address, and size (number of 36-bit words) are fixed and cannot be edited.

Figure 1-2. RTG4 uPROM Configurator



1.2 Usage Statistics

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

1.2.1 Available Memory

The uPROM can hold 10,370 36-bit words (total 373,320 bits).

1.2.2 Used Memory

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

1.2.3 Free Memory

Free memory (number of 36-bit words) appears in magenta in the pie chart.

1.3 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.

1.4 Log Window

The Log window displays warning or error messages, such as DRC warning and error messages.

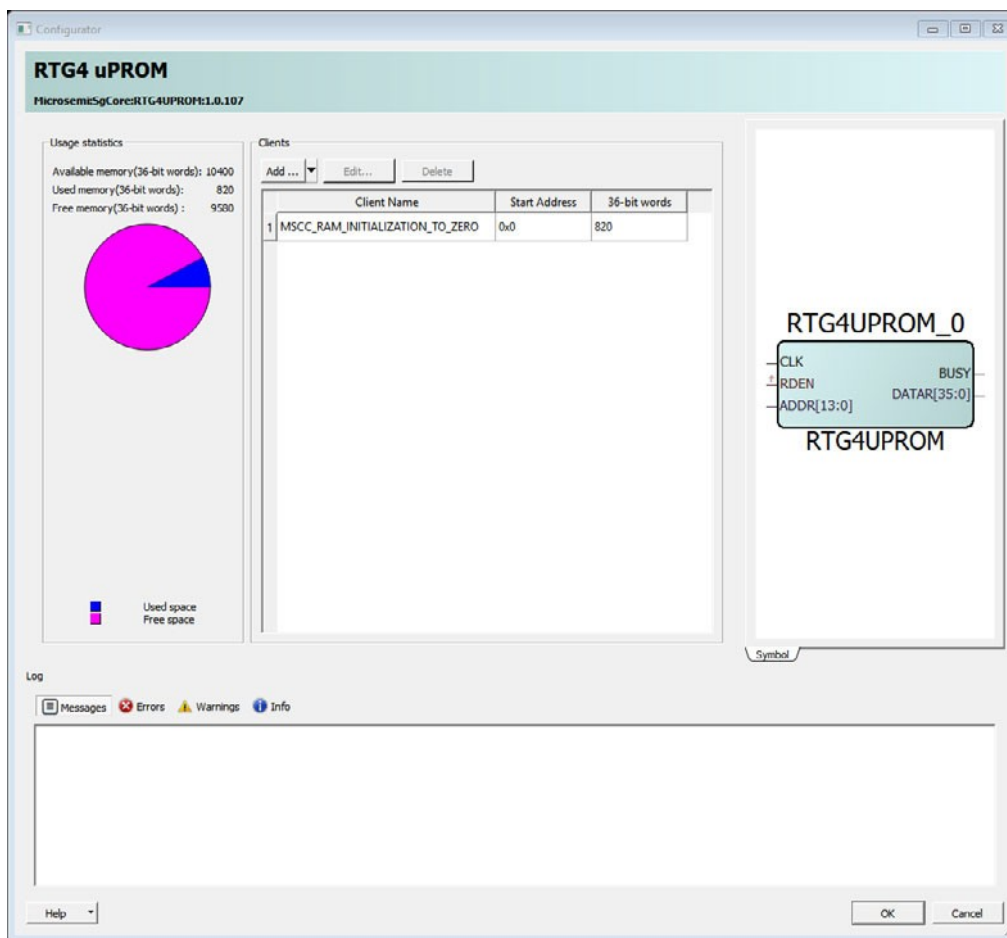
1.5 Add Init Client to System

Click the **Add** pull-down list and select **Add Init Client to System**. A default client name (MSCC_RAM_INITIALIZATION_TO_ZERO) is created, with a default start address of 0x0 and a default size of 820 36-bit words. 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.

Figure 1-3. Initialization Client Dialog Box



1.6 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 opens (see the following figure). Use this dialog box to specify the start address, client size, content of the client, and whether to use the memory content for simulation.

Figure 1-4. Add Data Storage Client Dialog Box

1.6.1 Client Name

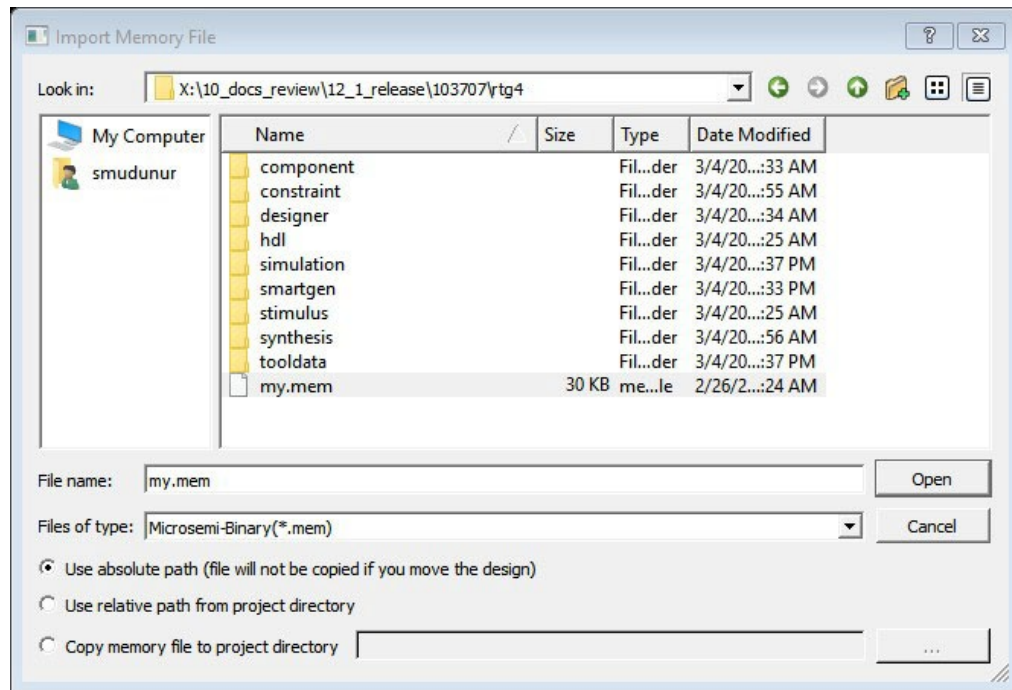
Enter a name for your memory client.

1.6.2 Content from File

Use this option to import your memory client from a memory file.

1. Click the three-dotted button at the far right, and then go to the location of the memory file you want to import.
2. Select the memory file.
Note: The memory file must have the file extension *.mem.
3. Click **Open**.

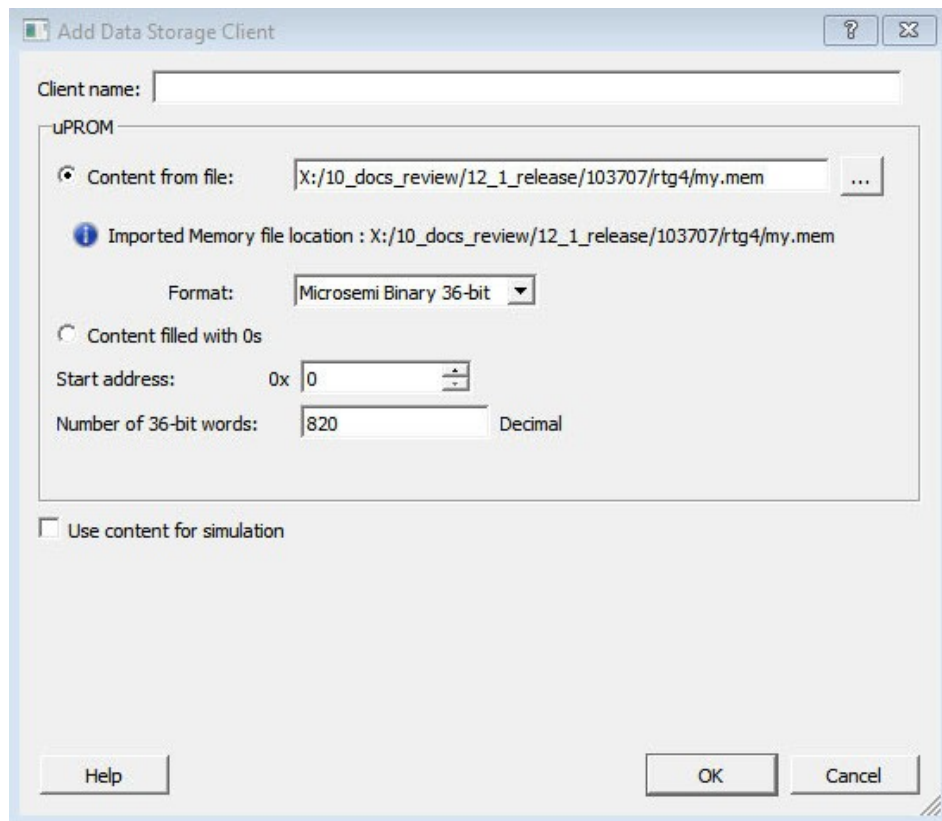
Figure 1-5. Import Memory File Dialog Box



1.6.2.1 Use Absolute Path

When you select **Use absolute path**, the absolute path of the memory file appears in the **Content from file** field.

Figure 1-6. Absolute Path of Memory File

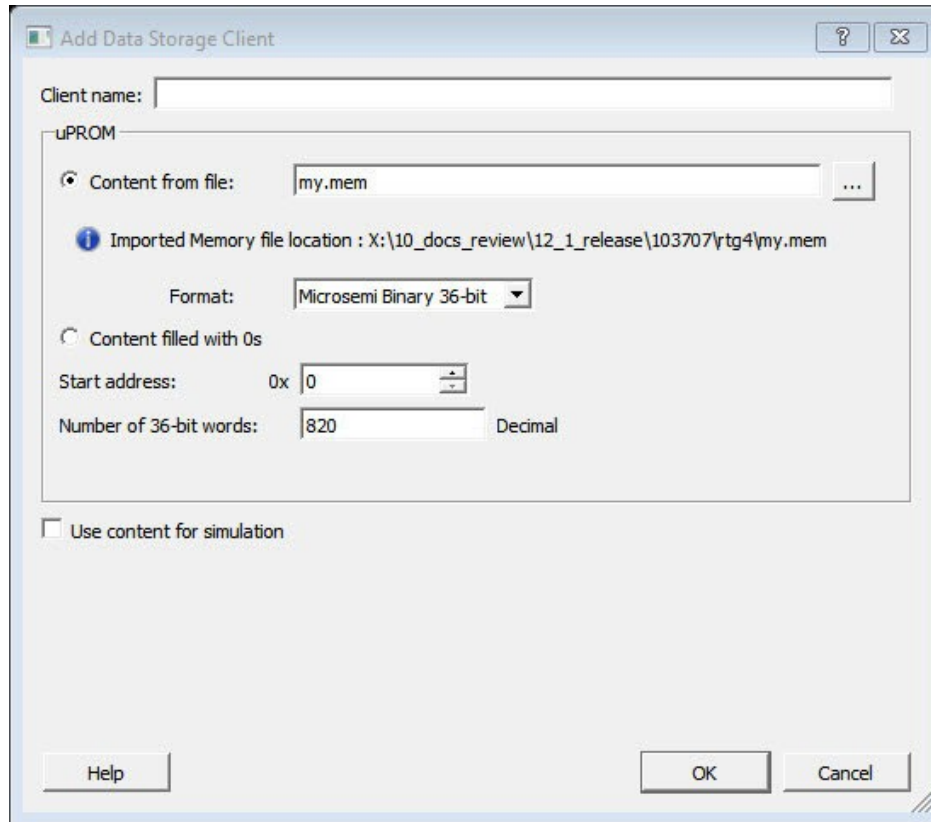


1.6.2.2 Use Relative Path from Project Directory

If you select **Use relative path from project directory**, the path of the memory file (relative to the Project location) you import appears in the **Content from file** field.

Note: On Windows systems, if the memory file and the project location reside on different drives, the absolute path is used even if you select **Use relative path from project directory**.

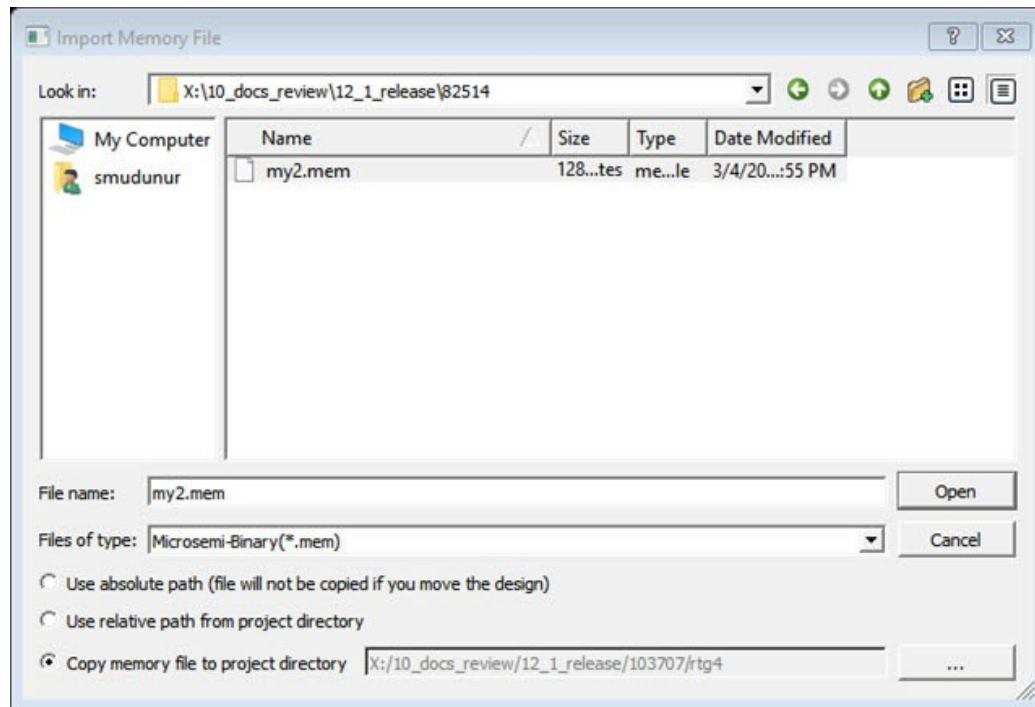
Figure 1-7. Relative Path of Memory File



1.6.2.3 Copy Memory File to Project Path

If you select **Copy memory file to project path**, click the three-dotted button at the far right, and then go to the location of the memory file from which you want to copy.

Figure 1-8. Location of Memory File from Which to Copy



Note: Observe the following guidelines:

- 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 you from inadvertently copying the memory file into these sub-folders, these project sub-folders are hidden from view when you select the project folder.
- The copied memory file path is stored internally as a relative path.
- If the memory file is copied to the project, updating the content of the memory file is your responsibility.

uPROM supports the Microchip Binary format (*.mem) for the memory content. The RTG4 uPROM Configurator also supports Hex, Simple Hex, and Motorola-S File formats.

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.

The following figure shows an example of a memory file.

Figure 1-9. Microchip Binary File (*.mem) Example

```
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000111
110000111110000111110000111110000000
110000111110000111110000111110001110
110000111110000111110000111110001110
110000111110000111110000111110001110
110000111110000111110000111110001110
110000111110000111110000111110000000
110000111110000111110000111110001111
110000111110000111110000111110001111
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110000111110000111110000111110001111
110000111110000111110000111110001111
110000111110000111110000111110001111
110000111110000111110000111110001111
```

1.6.3 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. For more information, see [Viewing the Initialization Client](#).

1.6.4 Start Address

Enter the 14-bit start address of your client in hexadecimal notation. Valid values are from 0x0 to 0x289F (hex).

Note: If an Initialization Client is added, the start address cannot be 0x0.

1.6.5 Number of 36-bit Words

Enter the size of your client (expressed as the number of 36-bit words) in decimal. When multiple clients are added, make sure 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.

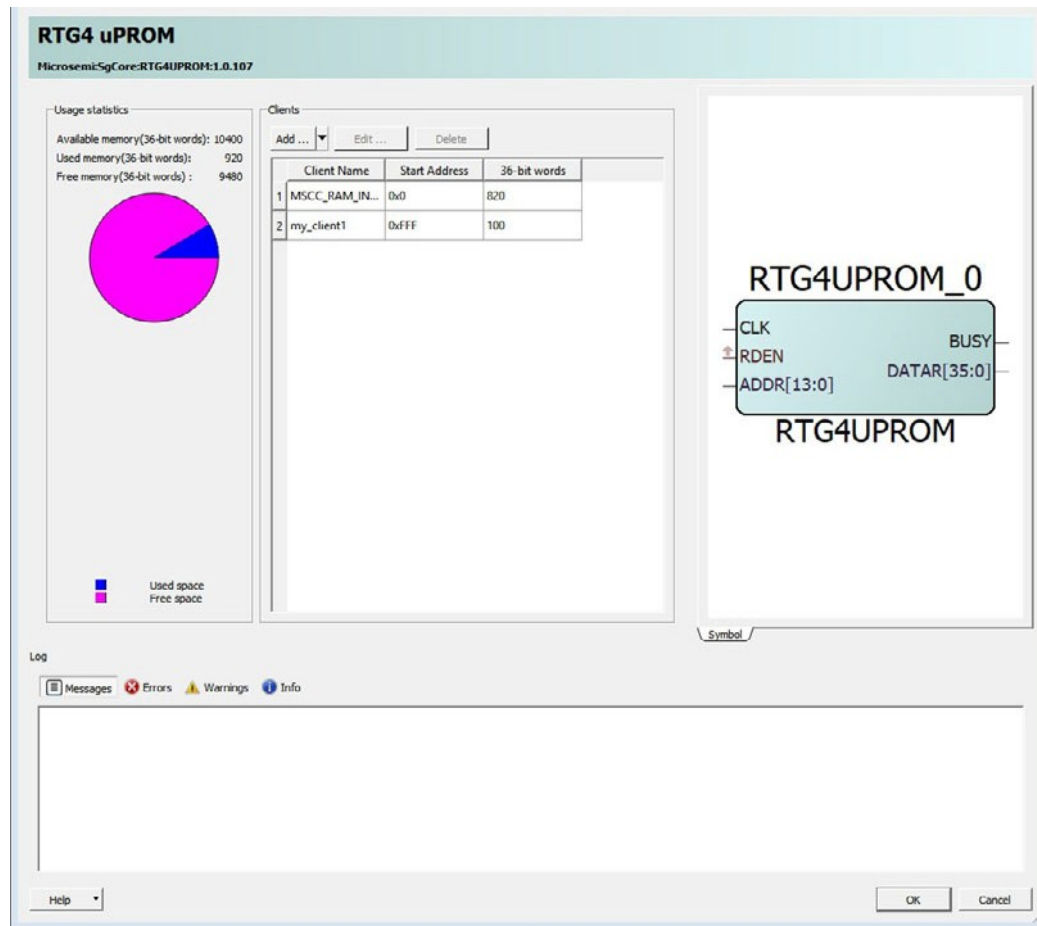
Note: The data storage client must not occupy the address space of an existing Initialization Client; otherwise, an error is flagged.

1.6.6 Use Content for Simulation

Check this box to include your memory content for simulation. When this box is checked, a `uPROM.mem` file is created automatically 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 add appear in the **User clients in uPROM** pane (see the following figure).

Figure 1-10. User Clients Added



1.7 Design Rules Check (DRC) Rules and Error Messages

To prevent out-of-bound memory addressing and overlapping of address space, Design Rules Check (DRC) rules are enforced and error messages are generated when:

- An invalid start address (outside 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 specified start address the number of words you entered exceeds the uPROM memory space.
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 you 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.

1.8 Editing a Client

To edit a data storage client:

1. Right-click the client and choose **Edit** (see the following figure) or click the **Edit** button.
The Edit Data Storage Client dialog box appears.

Note: You can view the configuration of the Initialization Client, but cannot edit it. For Initialization Clients, the View option replaces the Edit option.

Figure 1-11. Editable User Client

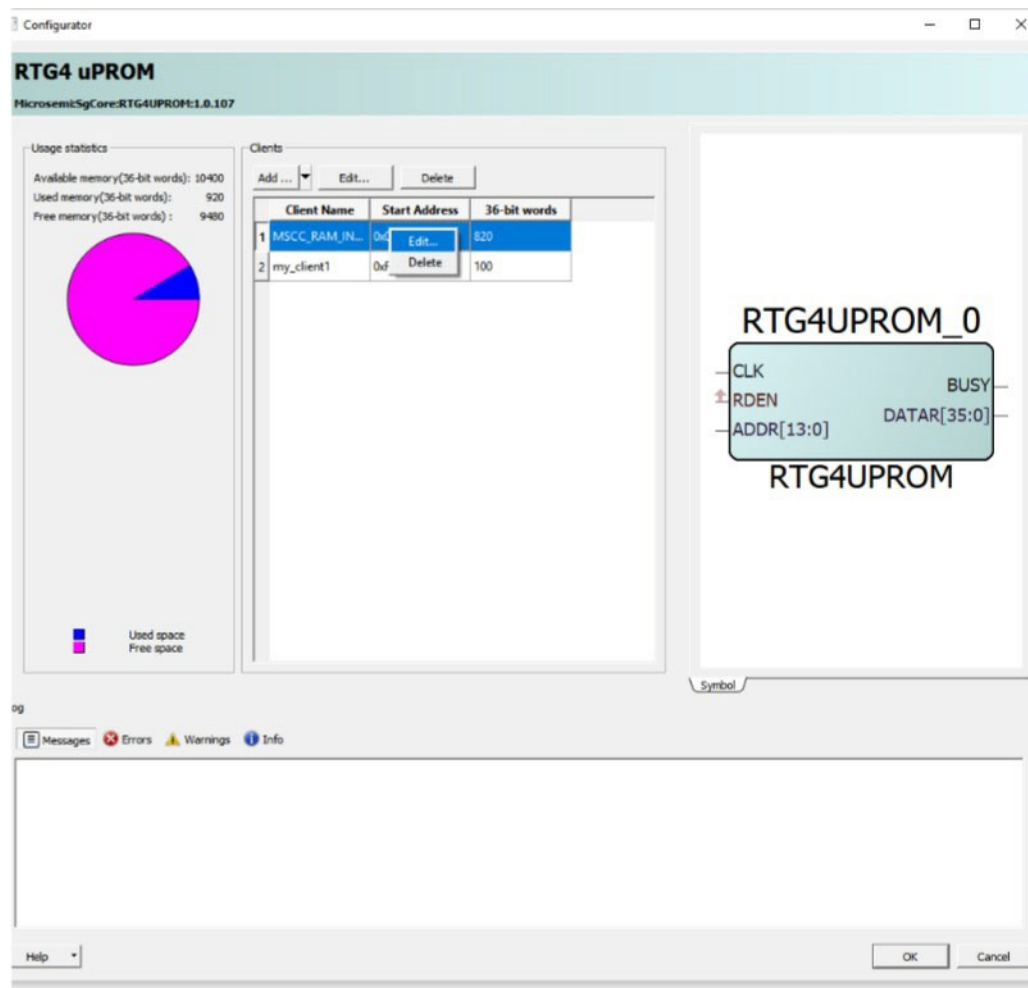
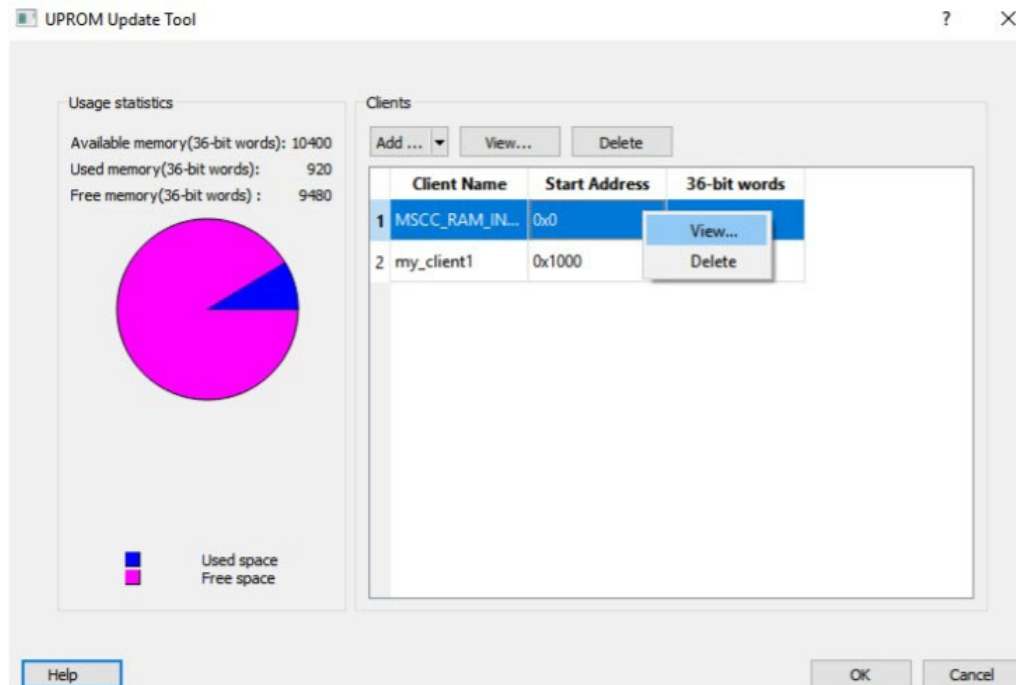
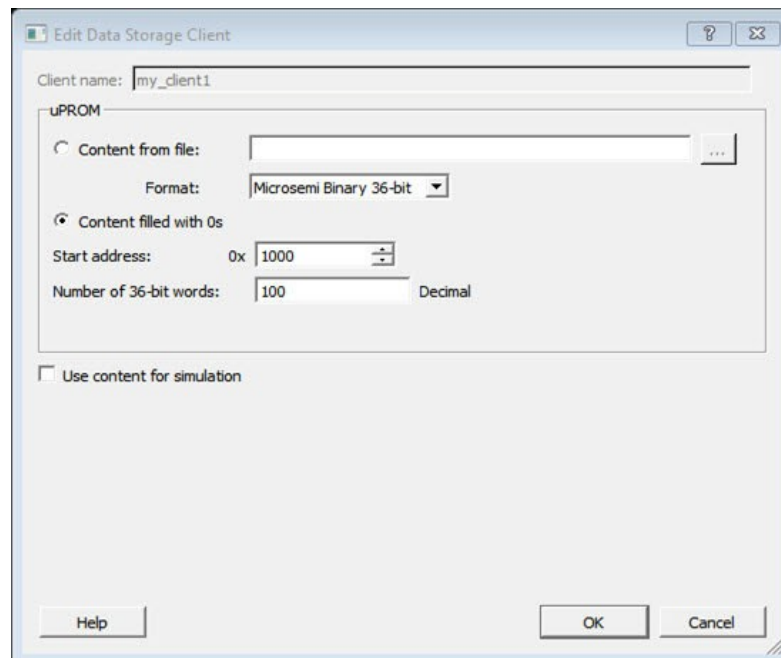


Figure 1-12. Non-Editable Initialization Client



2. Make your changes in the Edit Data Storage Client dialog box.
3. Click **OK** to save your edits (see the following figure).

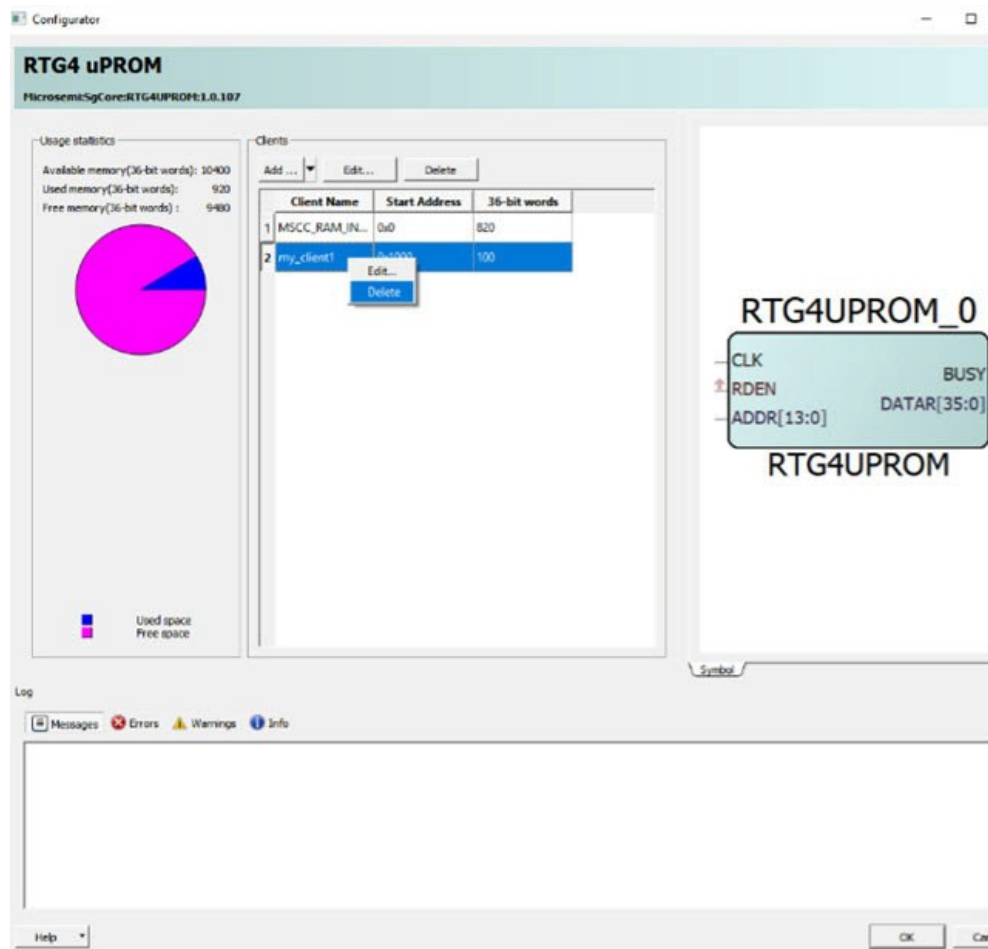
Figure 1-13. Edit Data Storage Client Dialog Box



1.9 Deleting a Client

Right-click the client and choose **Delete** (see the following figure). You can delete both the data client(s) and the Initialization Client.

Figure 1-14. Deleting a Client



1.10 Viewing the Initialization Client

To view the Initialization Client's default non-editable configuration, click the **View** button when the Initialization Client is selected.

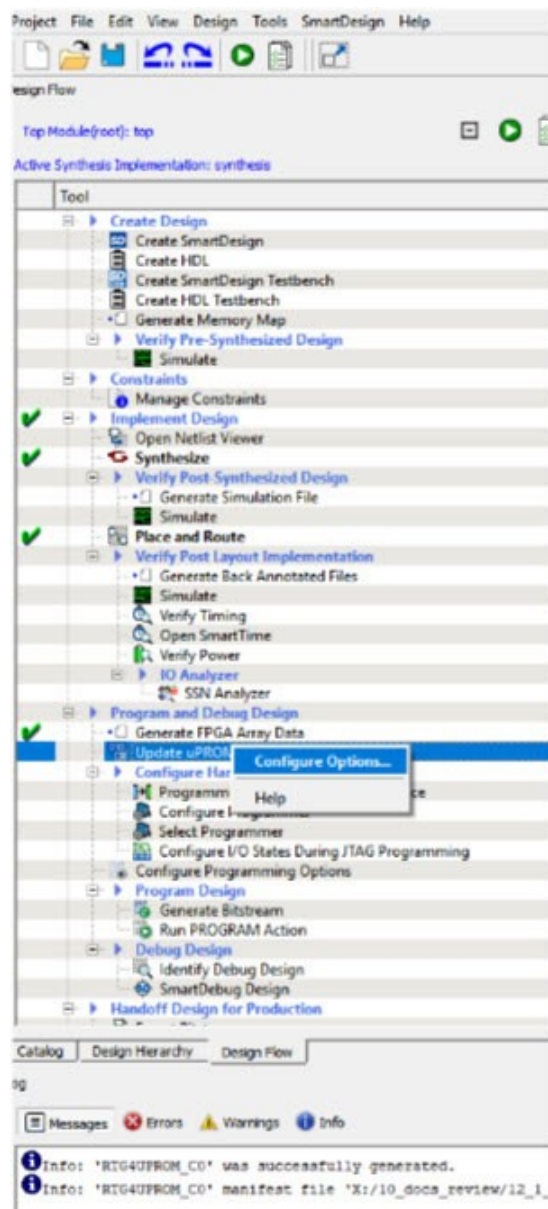
1.11 Update uPROM Memory Content

The Update uPROM Memory Content tool is useful if you reserved space in the uPROM Configurator and want to make changes to the uPROM client after Place and Route. After you make your 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:

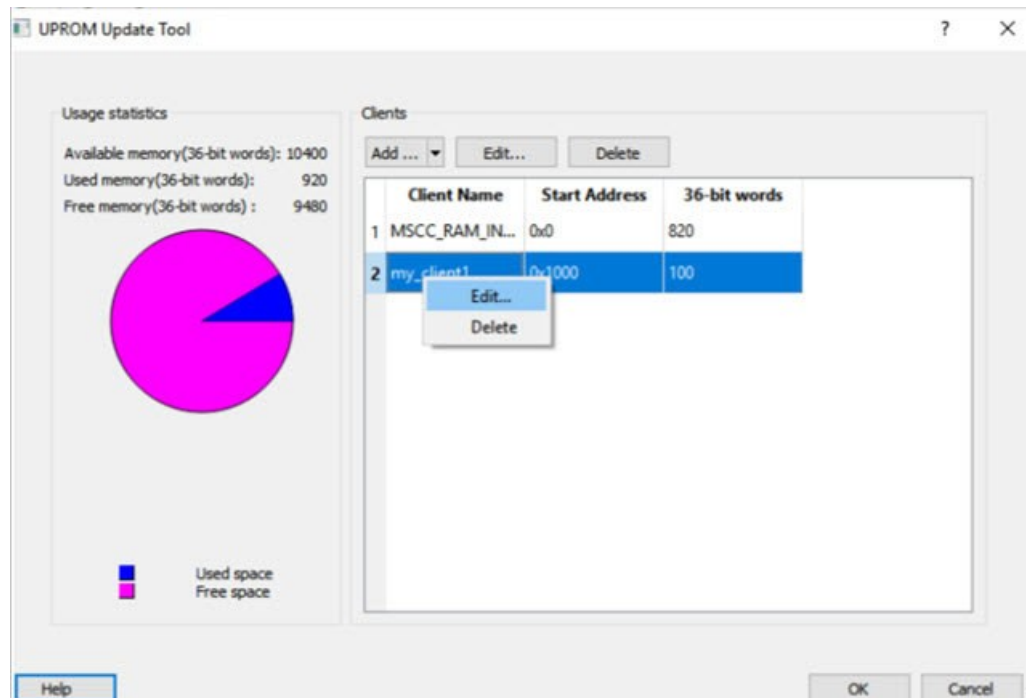
1. Right-click **Update uPROM Memory Content** in the Design Flow window and choose **Configure Options** (see the following figure).

Figure 1-15. Update uPROM Memory Content



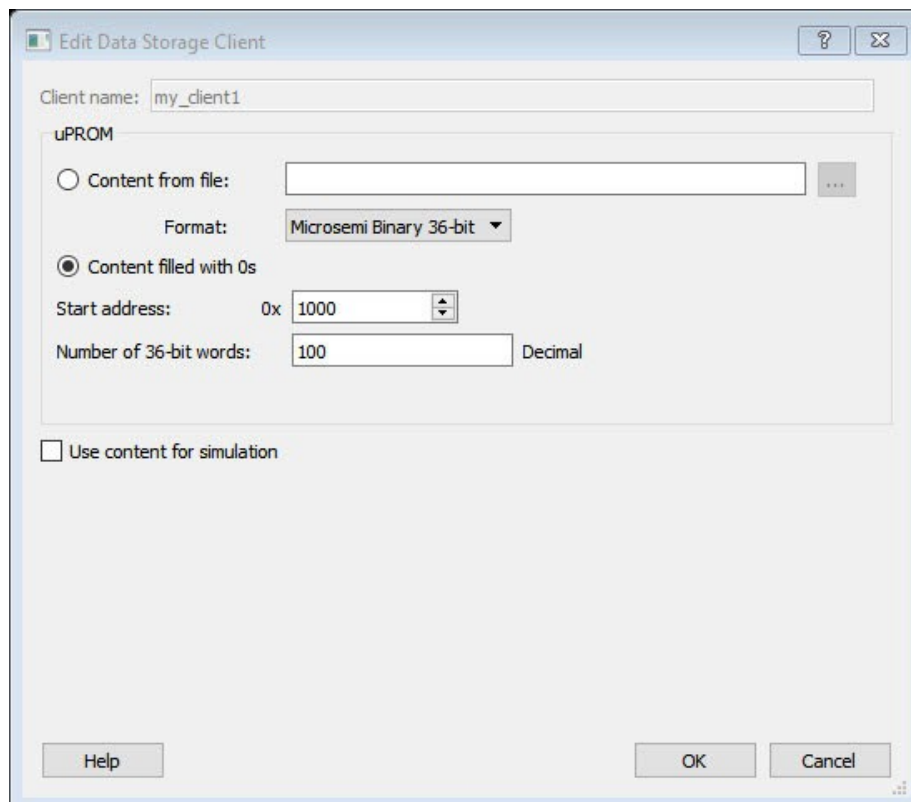
2. When the uPROM Update Tool appears, right-click the Memory Client you want to update and choose **Edit** (see the following figure).

Figure 1-16. uPROM Update Tool



The Edit Data Storage Client dialog box appears (see the following figure).

Figure 1-17. Edit Data Storage Client Dialog Box



3. You can make the following changes to the uPROM client:
 - a) Change the client's memory content, memory size, and start address.

- b) Reverse your decision about whether 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, use the uPROM Configurator to reconfigure your clients, and then regenerate your uPROM component and design.

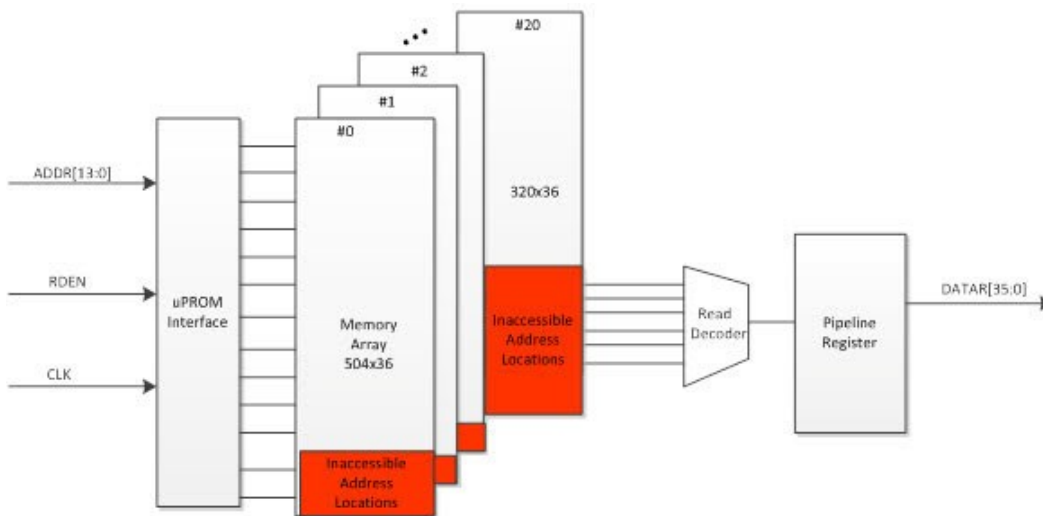
1.12 uPROM Architecture and Address Space

Architecturally, the uPROM is structured in 21 different memory arrays with 14-bit addressing. Each array consists of 512x36 bit words.

In the first 20 memory arrays, the last 8 words are not user accessible. Therefore, the size of each memory array is 504x36 for the first 20 memory arrays (#0 - #19). 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 the array has addresses you cannot access, the uPROM addressing scheme is not contiguous.

The following figure shows a simplified block diagram of the uPROM memory. For more information, see the [RTG4 Fabric User Guide](#).

Figure 1-18. uPROM Memory Blocks



To simplify uPROM addressing, the uPROM Configurator translates user-specified contiguous addresses automatically into the uPROM addressing scheme. Inaccessible addresses are skipped. The address translation is transparent to you and consumes approximately 80 4-LUTs from the fabric resources.

2. Port Description

The following table lists the uPROM ports.

Table 2-1. uPROM Ports

Port Name	Direction	Type	Description	Polarity
ADDR[13:0]	Input	Dynamic	Registered Address Input	—
CLK	Input	Dynamic	Clock Input	Rising
RDEN	Input	Dynamic	Read Enable	Active High
DATAR[35:0]	Output	Dynamic	Registered Data Output	—
BUSY	Output	Reserved	Leave unconnected	—

3. Revision History

Revision	Date	Description
2.0	11/2020	Converted this document to the Microchip template.
1.0	7/2015	Initial Revision

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