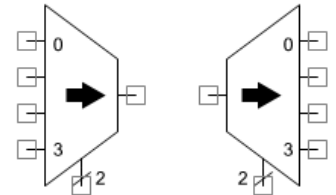


# Digital Multiplexer and Demultiplexer

1.10

## Features

- Digital Multiplexer
- Digital Demultiplexer
- Up to 16 channels



## General Description

The Multiplexer component is used to select 1 of  $n$  inputs while the Demultiplexer component is used to route 1 signal to  $n$  outputs.

The Multiplexer component implements a 2 to 16 input mux providing a single output, based on hardware control signals. The Demultiplexer component implements a 2 to 16 output demux from a single input, based on hardware control signals. Only one input or output connection may be made at a time.

## When to Use a Multiplexer

Use the Multiplexer and Demultiplexer components any time a digital signal must be dynamically routed under firmware or hardware control. The most common control method is to connect the mux select signals to a control register using a bus. The control register is then used to select the input or output for the mux/demux. Another option is to drive the select signals from hardware control logic to provide dynamic hardware routing.

## Input/Output Connections

This section describes the various input and output connections for the Multiplexer and Demultiplexer. An asterisk (\*) in the list of I/Os indicates that the I/O may be hidden on the symbol under the conditions listed in the description of that I/O.

## Multiplexer

### 0-n – Inputs

Inputs to the Multiplexer, only one of which is routed to the output based on the select input. The number of inputs depends on the size of the multiplexer.

**Output 0**

Output from the Multiplexer that is driven from the selected input.

**select – Input**

Selects input as source for the Multiplexer or output as destination for the Demultiplexer. The width of the select input depends on the number of inputs and outputs.

**Demultiplexer****0 – Input**

Input to the Demultiplexer that is routed to one of n outputs.

**Outputs 0-n**

Outputs from the Demultiplexer, only one of which is driven based on the select input. The number of outputs depends on the size of the demultiplexer. The number of outputs must be a power of 2. Not all outputs must be connected.

**select – Input**

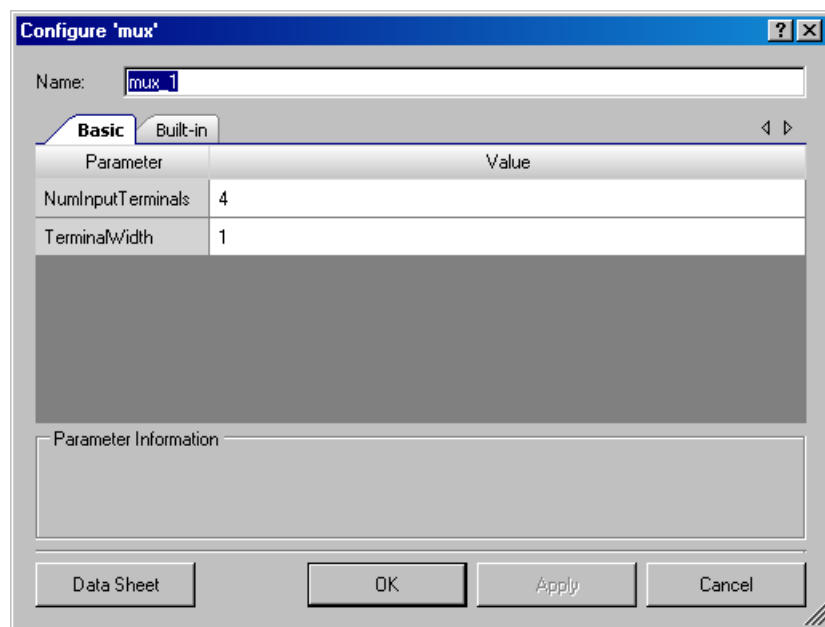
Selects input as source for the Multiplexer or output as destination for the Demultiplexer. The width of the select input depends on the number of inputs and outputs.

## Component Parameters

Drag a Multiplexer or Demultiplexer onto your design and double-click it to open the **Configure** dialog.

### Multiplexer

**Figure 1. Configure Multiplexer Dialog**



The Multiplexer provides the following parameters.

#### NumInputTerminals

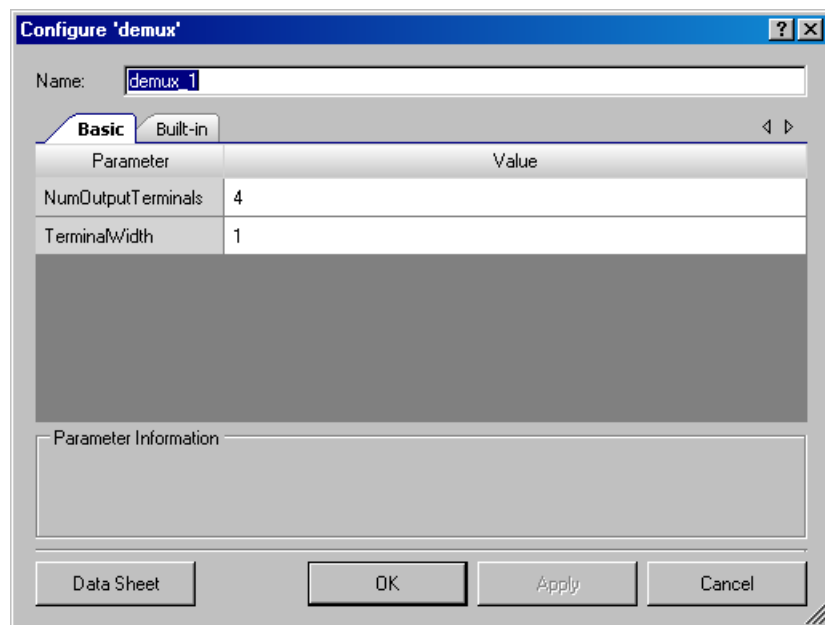
This parameter determines the number of Multiplexer inputs. The default is **4**. Acceptable values are 2, 4, 8, and 16 and the corresponding select input widths are 1, 2, 3, and 4. Unused input terminals may be left floating and, if selected, will be interpreted with a value of 0.

#### TerminalWidth

You can create an array of parallel Multiplexers, which may be useful when the inputs are buses. This parameter defines the bus width of the inputs. The default is **1**. The range of valid values is 1 to 32, inclusive. This parameter does not affect the width of the select input.

## Demultiplexer

**Figure 2. Configure Demultiplexer Dialog**



The Demultiplexer provides the following parameters.

### NumOutputTerminals

This parameter determines the number of Demultiplexer outputs. The default is **4**. Acceptable values are 2, 4, 8, and 16 and the corresponding select input widths are 1, 2, 3, and 4. Unused output terminals may be left floating.

### TerminalWidth

You can create an array of parallel Demultiplexers, which may be useful when the outputs are buses. This parameter defines the bus width of the outputs. The default is **1**. The range of valid values is 1 to 32, inclusive. This parameter does not affect the width of the select input.

## Sample Firmware Source Code

PSoC Creator provides many example projects that include schematics and example code in the Find Example Project dialog. For component-specific examples, open the dialog from the Component Catalog or an instance of the component in a schematic. For general examples, open the dialog from the Start Page or **File** menu. As needed, use the **Filter Options** in the dialog to narrow the list of projects available to select.

Refer to the “Find Example Project” topic in the PSoC Creator Help for more information.

## Functional Description

### Multiplexer

The Multiplexer selects one of several inputs based on the select input. A letter 'X' in the truth table indicates that the input does not affect the output.

**Table 1. Four-Input Multiplexer Truth Table**

| Select[1] | Select[0] | Input 3 | Input 2 | Input 1 | Input 0 | Output |
|-----------|-----------|---------|---------|---------|---------|--------|
| 0         | 0         | X       | X       | X       | 0       | 0      |
| 0         | 0         | X       | X       | X       | 1       | 1      |
| 0         | 1         | X       | X       | 0       | X       | 0      |
| 0         | 1         | X       | X       | 1       | X       | 1      |
| 1         | 0         | X       | 0       | X       | X       | 0      |
| 1         | 0         | X       | 1       | X       | X       | 1      |
| 1         | 1         | 0       | X       | X       | X       | 0      |
| 1         | 1         | 1       | X       | X       | X       | 1      |

### Demultiplexer

The Demultiplexer selects one of several outputs based on the select input. The value of the selected output is the value of the input. The value of unselected outputs is false.

**Table 2. Four-Output Demultiplexer Truth Table**

| Select[1] | Select[0] | Input | Output 3 | Output 2 | Output 1 | Output 0 |
|-----------|-----------|-------|----------|----------|----------|----------|
| 0         | 0         | 0     | 0        | 0        | 0        | 0        |
| 0         | 0         | 1     | 0        | 0        | 0        | 1        |
| 0         | 1         | 0     | 0        | 0        | 0        | 0        |
| 0         | 1         | 1     | 0        | 0        | 1        | 0        |
| 1         | 0         | 0     | 0        | 0        | 0        | 0        |
| 1         | 0         | 1     | 0        | 1        | 0        | 0        |
| 1         | 1         | 0     | 0        | 0        | 0        | 0        |
| 1         | 1         | 1     | 1        | 0        | 0        | 0        |

## Resources

The Multiplexer and Demultiplexer are implemented with logic equations and therefore are synthesized and mapped into PLD blocks within the UDB array. The component size and width determines the size of the logic equations and thus the number of PLDs used.

## Component Changes

This section lists the major changes in the component from the previous version.

| Version | Description of Changes   | Reason for Changes / Impact   |
|---------|--|---|
| 1.10.c  | Minor datasheet edits and updates.   |   |
| 1.10.b  | Minor datasheet edits and updates.   |   |
| 1.10.a  | Minor datasheet edits and updates.   |   |
| 1.10    | Symbol updates to differentiate the multiplexer from demultiplexer when the symbols are flipped. | Multiplexer and Demultiplexer looks same when symbols are flipped.                              |
|         | Minor datasheet edits to separate out the descriptions of multiplexer and demultiplexer          |   |
| 1.0.c   | Minor datasheet edits and updates  |   |
| 1.0.b   | Minor datasheet edits and updates  |   |
| 1.0.a   | Updated datasheet to show examples of firmware controlled components.                            | These were added to show how you can use and implement these components with control registers. |

© Cypress Semiconductor Corporation, 2011-2017. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit [cypress.com](http://cypress.com). Other names and brands may be claimed as property of their respective owners.

