

# **AMM Master Bridge v1.0**

## ***LogiCORE IP Product Guide***

**Vivado Design Suite**

**PG287 April 4, 2018**

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## Introduction

The Xilinx® LogiCORE™ multi-master AMM Master Bridge IP core connects AMM masters with AXI4 slaves. It converts traffic from the Avalon masters to AXI4-compatible traffic. Hence, it is also referred to as Avalon Memory Mapped (AMM) to AXI Bridge. This IP allows up to eight AMM masters to connect to an AXI slave.

## Features

- Supports 32, 64, 128, 256, 512, or 1,024-bits data width on both AXI and Avalon sides.
- Supports up to 1,024 burst count on Avalon side.
- AXI4 compliant.
- Optional linear incremental of byte-enables from LSB support for last data beat in a burst.
- Optional read only or write only support
- Optional pipelining support for read transactions.
- Supports up to eight Avalon masters.
- Round-robin arbitration for master requests.
- Up to 64-bit address support.
- Error response indication separate for read and write transactions along the corresponding master ID.

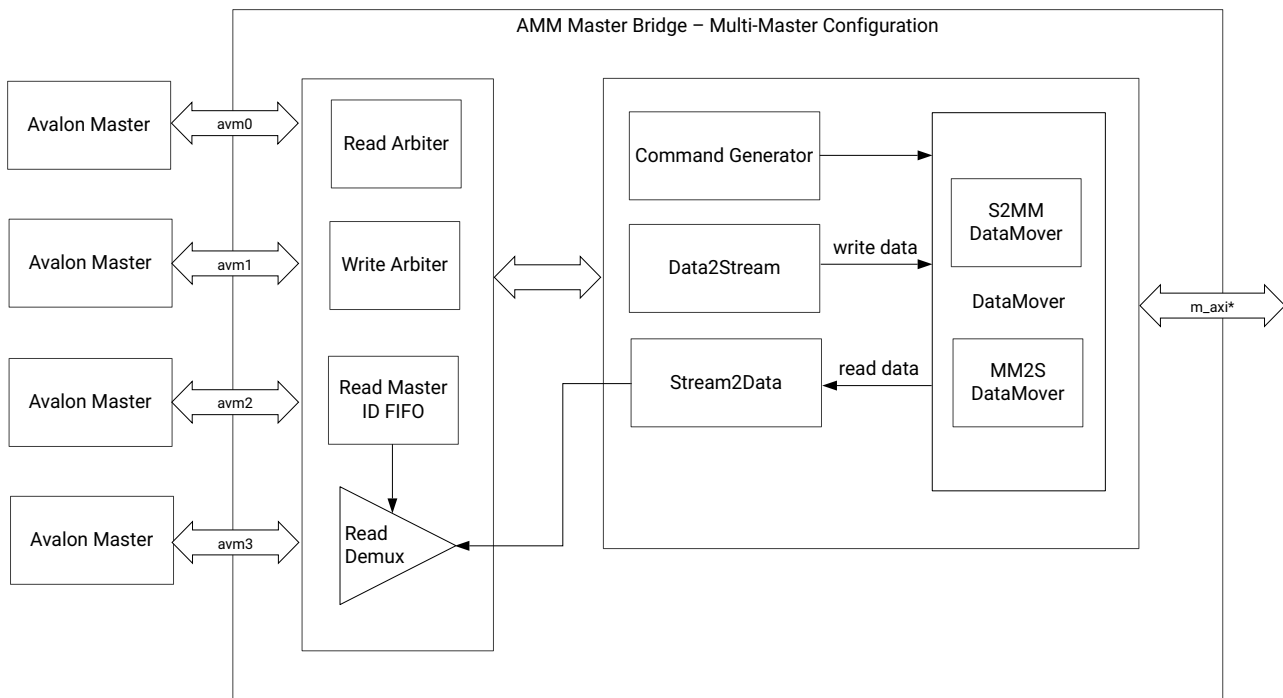
LogiCORE™ IP Facts Table	
<b>Core Specifics</b>	
Supported Device Family <sup>(1)</sup>	UltraScale+™ Families UltraScale™ Families Zynq® UltraScale+ MPSoC 7 Series FPGAs
Supported User Interfaces	AXI4, Avalon
Resources	<a href="#">Performance and Resource Utilization web page</a>
<b>Provided with Core</b>	
Design Files	Verilog
Example Design	Verilog
Test Bench	N/A
Constraints File	Xilinx Design Constraints (XDC)
Simulation Model	Not Provided
Supported S/W Driver	N/A
<b>Tested Design Flows<sup>(2)</sup></b>	
Design Entry	Vivado® Design Suite
Simulation	For supported simulators, see the <a href="#">Xilinx Design Tools: Release Notes Guide</a> .
Synthesis	Vivado Synthesis
<b>Support</b>	
Provided by Xilinx at the <a href="#">Xilinx Support web page</a>	

### Notes:

1. For a complete list of supported devices, see the Vivado IP catalog.
2. For the supported versions of the tools, see the [Xilinx Design Tools: Release Notes Guide](#).

# Overview

The top-level block diagram for the Xilinx® LogiCORE™ IP AMM Master Bridge with four Avalon masters support is shown in Figure 1-1. The Avalon traffic is arbitrated inside the bridge and generates one AXI4 master command at a time. The bridge functions as an Avalon slave on the Avalon interface and as an AXI4 master on the AXI4 interface. Figure 1-1 has for four Avalon masters and the bridge supports up to eight Avalon masters.



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Figure 1-1: AMM Master Bridge Top-Level Block Diagram

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## Feature Summary

- Supports 32, 64, 128, 256, 512, or 1,024-bits data width on both AXI and Avalon sides.
- Supports up to 1,024 burst count on Avalon side.
- AXI4 compliant.
- Optional linear incremental of byte-enables from LSB support for last data beat in a burst.
- Optional read only or write only support
- Optional pipelining support for read transactions.
- Supports up to eight Avalon masters.
- Round-robin arbitration for master requests.
- Up to 64-bit address support.
- Error response indication separate for read and write transactions along the corresponding master ID.

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## Applications

With no additional difficulty to you, the AMM Master Bridge helps connect available Avalon masters to the AXI4 slave peripherals in the Vivado<sup>®</sup> Design Suite.

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## Unsupported Features

- Fixed wait states and fixed latencies are not supported.
- No data width conversion that is, data width on AXI and Avalon side are the same.
- No support for unaligned addresses.
- No word addressing.
- No partial/sparse byte-enables except for last beat.
- No support for lock feature of Avalon.
- No support for optional Response channel of the Avalon interface.
- Only supports data width aligned address.

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## Licensing and Ordering

This Xilinx LogiCORE IP module is provided at no additional cost with the Xilinx Vivado Design Suite under the terms of the [Xilinx End User License](#).

Information about other Xilinx LogiCORE IP modules is available at the [Xilinx Intellectual Property](#) page. For information about pricing and availability of other Xilinx LogiCORE IP modules and tools, contact your [local Xilinx sales representative](#).

# Product Specification

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## Standards

- Processor Interface, AXI4: see the *Vivado Design Suite: AXI Reference Guide* (UG1037) [Ref 6]
  - Avalon Interface Specifications [Ref 2]
- 

## Performance

For full details about performance and resource utilization, visit the [Performance and Resource Utilization web page](#).

The performance characterization of this core was compiled using the margin system methodology. The details of the margin system characterization methodology are described in the *Vivado Design Suite User Guide: Designing With IP* (UG896) [Ref 11].

## Latency

[Table 2-1](#) shows the read and write latency.

*Table 2-1: Latency*

Function	Parameter	Latency
Read	avs_read to axi_arvalid	9
	axi_rvalid to avs_readdatavalid	0
Write	avs_write to axi_awvalid	9
	avs_write to axi_wvalid	11



## Throughput

Table 2-2 shows the throughput with data width 32-bit at 200 MHz (theoretical bandwidth = 6.4 Gb/s).

Table 2-2: Throughput

Channel Throughput	BL = 1	BL = 8	BL = 16	BL = 32	BL = 64	BL = 256	BL = 512	BL = 1024
Read	14.2% 0.908	88% 5.632	93.62% 5.99	96.7% 6.18	98.32% 6.29	99.57% 6.37	99.78% 6.38	99.89% 6.39
Write	9.98% 0.638	46.97% 3.00	63.92% 4.09	77.99% 4.99	87.63% 5.6	96.59% 6.18	98.26% 6.28	99.12% 6.34

---

## Resource Utilization

For full details about performance and resource utilization, visit the [Performance and Resource Utilization web page](#).

The approximate estimation of resources to use for this IP is the sum of the resources of the AXI DataMover IP and ~200 LUTs when configured for four Avalon masters.

## Parameter Descriptions

Table 2-3 shows the AMM Master Bridge parameters.

Table 2-3: Parameter Descriptions

Parameter	Default Value	Range	Description
C_AVA_ADDR_WIDTH	32	1 to 64	Address width of AMM address channel
C_AVA_DATA_WIDTH	32	32 to 1,024	Data width of AXI and AMM channels. Valid values are 32, 64, 128, 256, 512, and 1,024
C_ENABLE_PIPELINE	0	1, 0	Supports pipelining of read requests when 1. 0 = pipeline disabled 1 = pipeline enabled. Up to 16 read commands are pipelined.
C_MODE	2	0 to 2	0 = supports only read 1 = supports only write 2 = supports both read and write
C_NUM_MASTERS	1	1 to 8	Number of Avalon masters to support
C_AVA_BYTEENABLES	0	1, 0	Supports partial byte enables in a specific pattern for last data beat when 1. 0 = disable byte enables 1 = enable byte enables

## Port Descriptions

Table 2-4 shows the AMM Master Bridge signals.

Table 2-4: AMM Master Bridge Interface Signals

Signal Name	Interface	Presence	I/O	Width	Description
clk	Clock	M	I	1	AXI clock
aresetn	Reset	M	I	1	AXI reset
write_error	Error	M	O	1	Error indication in write command issued from a master.
write_error_valid	Error	M	O	1	Write error is valid only when this signal is 1.
write_error_master_ID	Error	M	O	3	Error corresponds to this particular masters write command. Values from 0 to 8.
read_error	Error	M	O	1	Error indication in read command issued from a master.
read_error_valid	Error	M	O	1	Read error is valid only when this signal is 1.
read_error_master_ID	Error	M	O	3	Error corresponds to this particular masters read command. Values from 0 to 8.
m_axi_*	AXI4 master	M	–	–	Master AXI ports to control AXI slave.

Table 2-4: AMM Master Bridge Interface Signals (Cont'd)

Signal Name	Interface	Presence	I/O	Width	Description
avs_address_s#	Avalon slave	M	I	C_AVA_ADDR_WIDTH	Avalon address channel
avs_byteenable_s#		O	I	C_AVA_DATA_WIDTH/8	Byte enables for write. This signal is present when C_BYTEENABLES = 1 & C_MODE > 0.
avs_write_s#		O	I	1	Write indication from Avalon. Present only when write is supported. (CMODE = 1 or 2.
avs_read_s#		O	I	1	Read indication from Avalon. Present only when C_MODE = 0 or 2.
avs_writedata_s#		O	I	C_AVA_DATA_WIDTH	Write data. Present only when C_MODE = 1 or 2.
avs_waitrequest_s#		M	O	1	Waitrequest to Avalon master
avs_readdata_s#		O	O	C_AVA_DATA_WIDTH	Read data output. Present only when C_MODE = 0 or 2.
avs_readdatavalid_s#		O	O	1	Read data valid indication to Avalon master. Present only when C_MODE = 1 or 2.
avs_burstcount_s#		M	I	11	Burst count for commands

**Notes:**

- [# is from 0 to {C\_NUM\_MASTERS - 1}];
- O in the "Presence" column of table indicates Optional signal and M indicates mandatory signals.

# Designing with the Core

This chapter includes guidelines and additional information to facilitate designing with the core.

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## Clocking

The IP has a single clock domain, `clk` and the AXI4 and Avalon interfaces are clocked with the same clock.

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## Resets

The system has an active-Low reset, `aresetn`. The reset has to be synchronous with `clk`. The same reset signal must be used by the Avalon masters as well as the AXI4 slave for the system to function properly. Separate resets to these systems can result in unexpected behavior.

---

## Arbitration

Read and write requests from multiple Avalon masters are granted access in a round-robin mode. An Avalon master never issues a read and write request simultaneously. The arbitration is done separately for read and write channels and are independent of each other. The behavior of the arbitration logic is explained as follows:

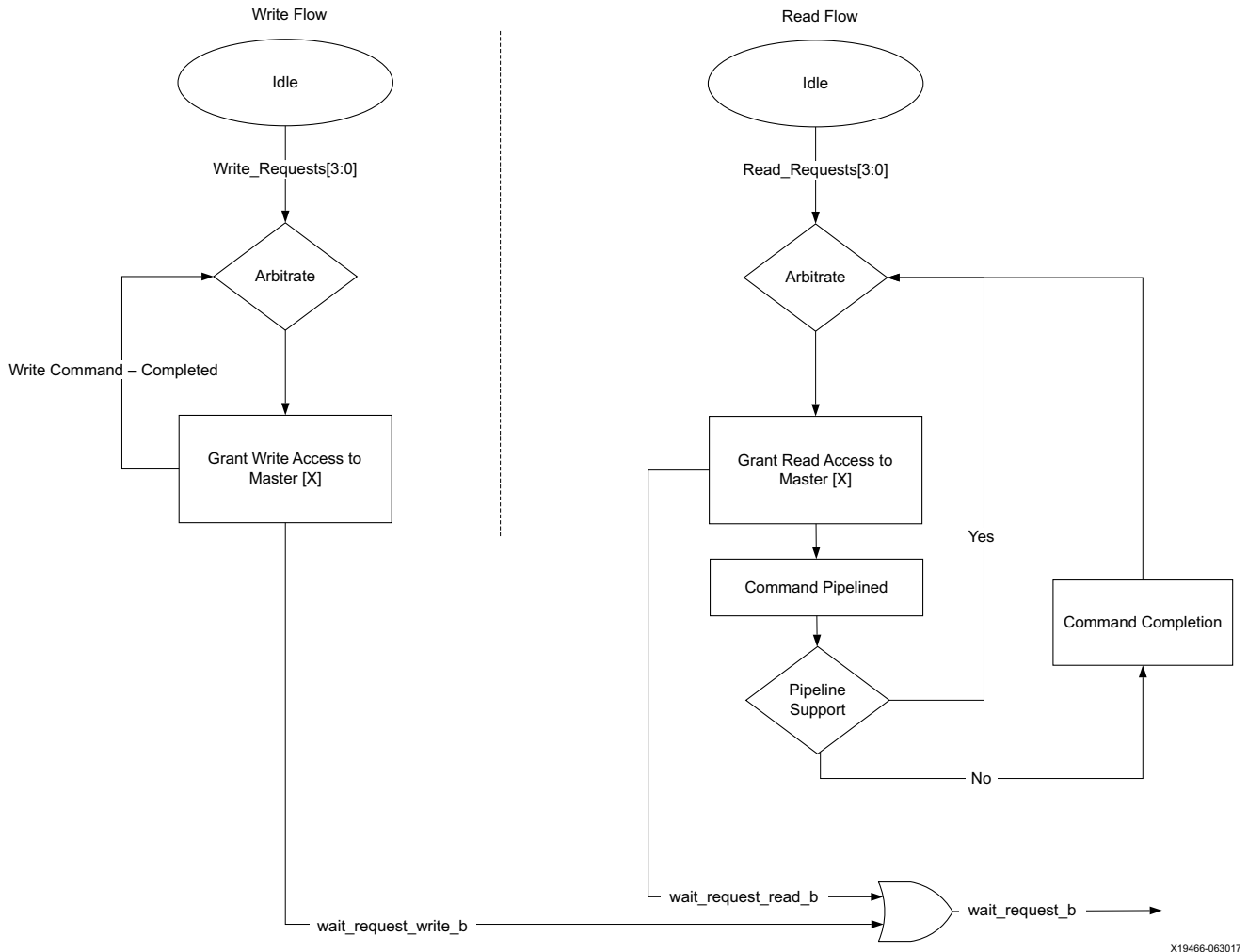


Figure 3-1: Arbitration Flow

A round-robin arbitration logic is used between the masters which requested a read or write transaction. The process of arbitration is as explained here:

- A Request is a vector created based on the Masters that have issued a request. A separate vector is created for reads and writes.
- Assume that Master2, Master3, and Master7 have issued a read/write request at the same time. The Request Vector has a value of 01000110.

In the first cycle of arbitration, Master2 is used, followed by Master3 and Master7.

- If Master5 requests a read/write while Master3 is underway, Master5 is used before Master7.
- If Master2 requests a read/write after it was used, then the new request is handled only after using all requests from Masters 3 to 7.

## Read Arbitration

When the Bridge is configured to enable Pipeline, each read request is accepted and saved in a FIFO. A new read request is accepted even before the previous read data is produced.

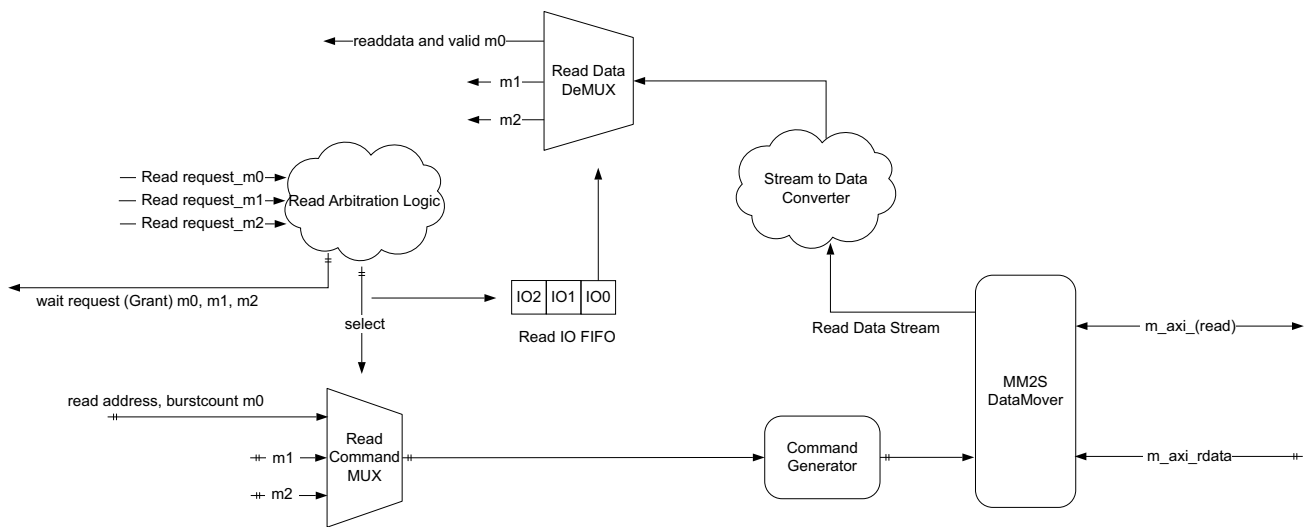
Assume that Master2, Master3, and Master7 have issued a read requests at the same time. The Request Vector has a value of 01000110.

- Read address and burst count from Masters 2, 3, and 7 are queued into a FIFO in three consecutive cycles.
- The requests are processed from a FIFO in the same order. First, the read request for Master2 followed by Master3 and Master7.
- Meanwhile, the FIFO keeps accepting the read commands from master until the depth is full.
- The AXI4 read data is available in the same order.

If the bridge is configured without Pipelining, then a new read request is accepted only after the complete read data is provided for the previous read request.

Assume that Master2, Master3, and Master7 have issued a read requests at the same time.

- At first, read request of Master2 is processed.
- The read request from Master3 is accepted only when the entire data for Master2 has been read and sent to Avalon.
- Similarly, the request from Master7 is processed only after request from Master3 is completed.



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Figure 3-2: Read Arbitration Flow

## Write Arbitration

As Avalon does not support pipelining of writes, the Bridge waits for each write to be completed before accepting the next write command from the same or other Masters.

Assume that Master2, Master3, and Master5 have issued a write requests at the same time.

- At first, the write request of Master2 is accepted and processed.
- After completion of write of Master2, the bridge accepts the write request of Master3.
- Request from Master5 is accepted only after completion of the write of Master3.

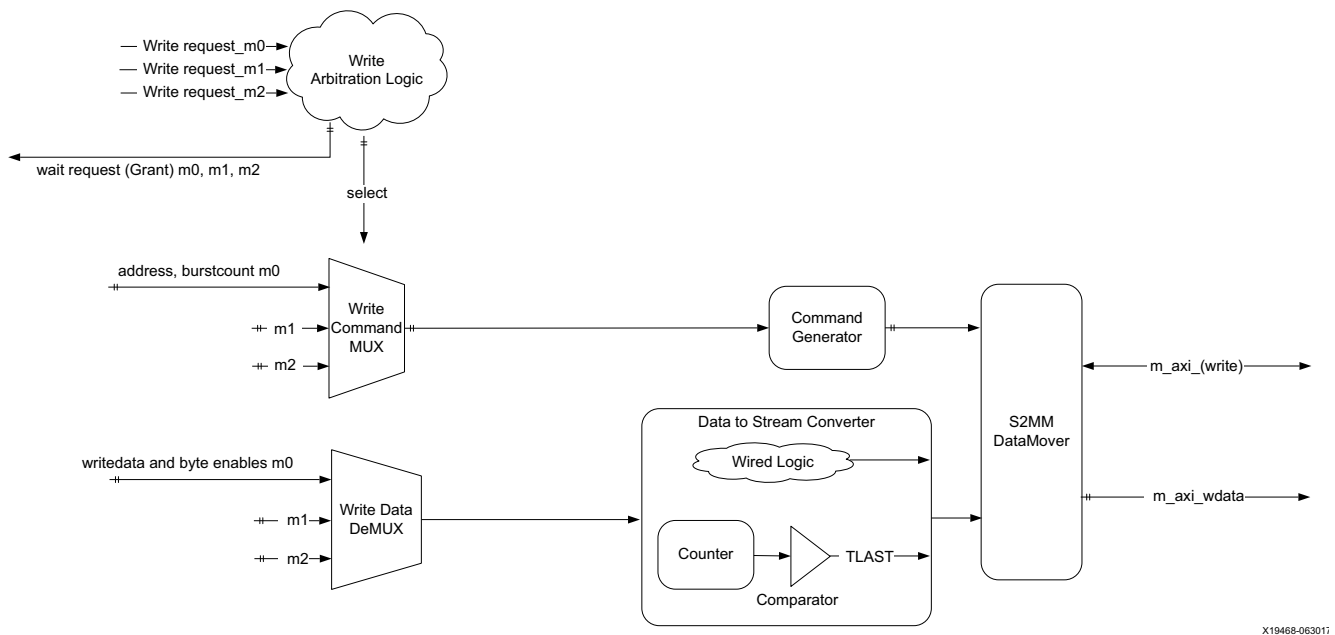


Figure 3-3: Write Arbitration Flow

## Bridge Operation

The AMM Master Bridge uses the Xilinx® AXI DataMover LogiCORE IP Product Guide (PG022) [Ref 4] to convert the Avalon transaction to AXI4. The Bridge extracts the necessary information from the Avalon transaction and forms a command for the AXI DataMover. The data transfer on the AXI4 is handled by AXI DataMover.

## Command Generator

The AXI DataMover accepts a command in a specific format containing the address and number of bytes to transfer. Separate commands are generated for read and write. When the Bridge is enabled with Pipelining, multiple read commands are posted to the AXI DataMover.



## Address

The AMM Master Bridge supports Avalon Address width from 1 to 64. If the Avalon address width is < 32, then the AXI4 address width is fixed to 32 by padding the required MSB with zeros. The Bridge supports only data width aligned address. Issuing Avalon transaction with unaligned address results in undefined behavior.

## Bytes to Transfer

The bytes to transfer is calculated using the `burst_count` and `Data_width`.

When the Bridge is configured with `C_BYTE_ENABLES = 0`, the ByteEnable bits on the Avalon interface are ignored.

When the Bridge is configured with `C_BYTE_ENABLES = 1`, the only ByteEnable bits on the last data beat of the Avalon interface are not ignored. Further, a sparse byteenable is only allowed on the last data beat in a specific pattern. Any other combination results in undefined behavior.

For example for a data width of 32-bits, the last byte-enables can only take values of 0001, 0011, 0111, or 1111. All the other patterns cause undefined behavior.

## Error Logic

This IP has an error generation logic to indicate a `SLVERR`, `DECERR`, or `INTERR` on the AXI response. The IP generates one error response per command which lasts for one clock only generating a valid indication and also the master ID from which the error causing command is issued. The master IDs are from 0 to 7 indicating the eight masters, `s0` to `s7` respectively.

Write and read commands have separate error indications. Both are self-clearing in a clock cycle. `Error = 0` indicates no error and `Error = 1` implies an error on the AXI response.

The error responses from two read or two write commands issued by a master are in order. While the error response for a read and write can come out of order.

# Design Flow Steps

This chapter describes customizing and generating the core, constraining the core, and the simulation, synthesis and implementation steps that are specific to this IP core. More detailed information about the standard Vivado® design flows and the IP integrator can be found in the following Vivado Design Suite user guides:

- *Vivado Design Suite User Guide: Designing IP Subsystems using IP Integrator* (UG994) [Ref 10]
- *Vivado Design Suite User Guide: Designing with IP* (UG896) [Ref 11]
- *Vivado Design Suite User Guide: Getting Started* (UG910) [Ref 12]
- *Vivado Design Suite User Guide: Logic Simulation* (UG900) [Ref 13]

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## Customizing and Generating the Core

This section includes information about using Xilinx tools to customize and generate the core in the Vivado Design Suite.

If you are customizing and generating the core in the Vivado IP integrator, see the *Vivado Design Suite User Guide: Designing IP Subsystems using IP Integrator* (UG994) [Ref 10] for detailed information. IP integrator might auto-compute certain configuration values when validating or generating the design. To check whether the values do change, see the description of the parameter in this chapter. To view the parameter value, run the `validate_bd_design` command in the Tcl console.

You can customize the IP for use in your design by specifying values for the various parameters associated with the IP core using the following steps:

1. Select the IP from the Vivado IP catalog.
2. Double-click the selected IP or select the **Customize IP** command from the toolbar or right-click menu.

For details, see the *Vivado Design Suite User Guide: Designing with IP* (UG896) [Ref 11] and the *Vivado Design Suite User Guide: Getting Started* (UG910) [Ref 12].

**Note:** Figures in this chapter are an illustration of the Vivado Integrated Design Environment (IDE). The layout depicted here might vary from the current version.

Figure 4-1 shows the AMM Master Bridge Vivado IDE main configuration screen.

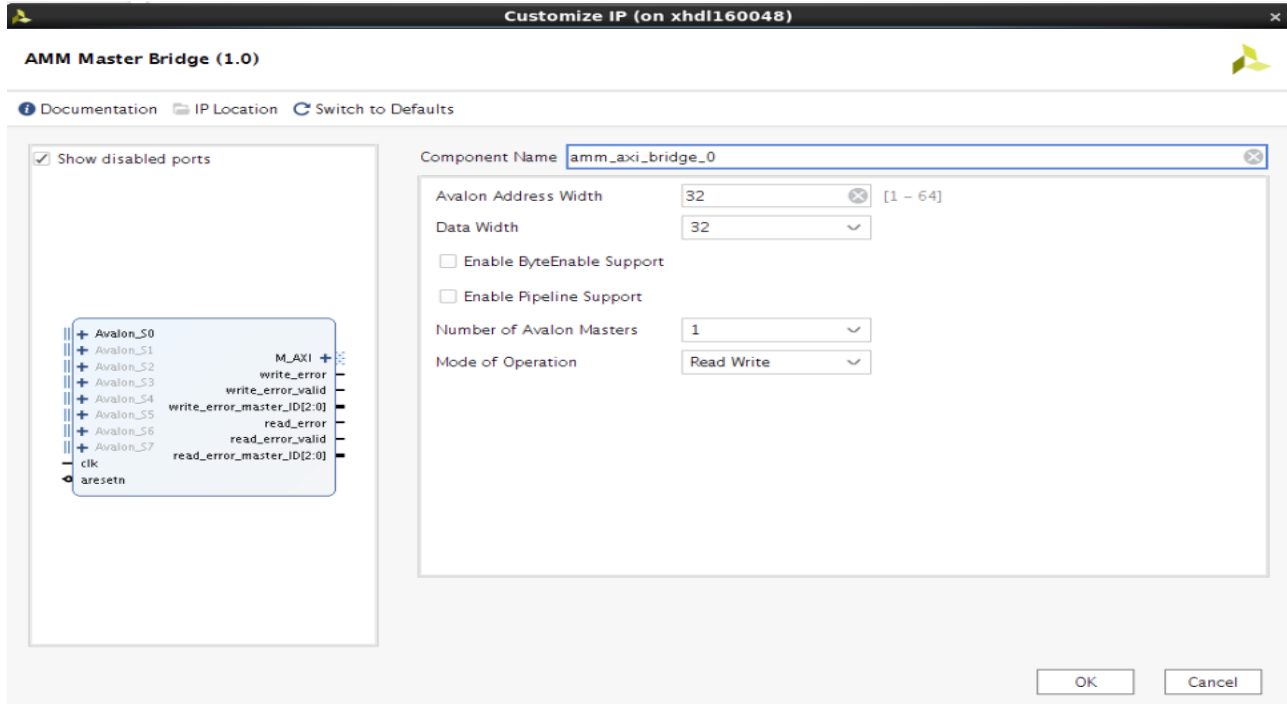


Figure 4-1: AMM Master Bridge Customize IP

The following settings are generally applicable:

- **Component Name** – The component name is used as the base name of output files generated for the module. Names must begin with a letter and must be composed from characters: a to z, 0 to 9 and "\_".
- **Avalon Address Width** – This parameter specifies the address width of `avs_address` ports. Select a value to match the Avalon master address width. The width of the AXI address ports is derived from this parameter. `AXI_Address_Width` is 32 when the Avalon address width is < 32 and equals the Avalon address width when it is > 32. [Table 4-1](#) shows an example of the Avalon and AXI address widths.

Table 4-1: Avalon and AXI Address Width Information:

Avalon Address	AXI Address
0x4	0x00000004
0x40000004	0x40000004
0x2440000008	0x2440000008

- **Data Width** – Specifies the width of data buses of AXI and Avalon interfaces. Same data width for AXI and Avalon interface.
- **ByteEnable Support** – Avalon write transactions support byteenables for last data beat of a transfer when this parameter is enabled. When disabled, optional byteenable port of the Avalon is removed.

- **Pipelining** – Avalon read commands are accepted and saved in a FIFO when pipelining is enabled. The pipeline depth is 16.
- **Number of Avalon Masters** – Specifies the number of Avalon slave interfaces for the bridge.
- **Mode of Operation** – Bridge can also support only read or only write transactions.

All the parameters specified in the customization are applicable to all the Avalon slave interfaces of the bridge. Different parameters cannot be specified for different slave interfaces.

## User Parameters

Table 4-2 shows the relationship between the fields in the Vivado IDE and the User Parameters (which can be viewed in the Tcl Console).

Table 4-2: Vivado IDE Parameter to User Parameter Relationship

Parameter	Default Value	Range	Description
C_AVA_ADDR_WIDTH	32	1 to 64	Address width of Avalon MM address channel
C_AVA_DATA_WIDTH	32	32, 64, 128, 256, 512, or 1024	Data width of AXI and AVM MM channels
C_ENABLE_PIPELINE	0	1, 0	Supports pipelining of read requests when 1. 0 = pipeline disabled 1 = pipeline enabled. Up to 16 read commands are pipelined
C_MODE	2	0 to 2	0 = supports only read 1 = supports only write 2 = supports both read and write
C_NUM_MASTERS	1	1 to 8	Number of Avalon masters to support
C_AVA_BYTEENABLES	0	1, 0	Supports partial byte enables in a specific pattern for last data beat when 1. 0 = disable byte enables 1 = enable byte enables

## Output Generation

For details, see the *Vivado Design Suite User Guide: Designing with IP* (UG896) [Ref 11].

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## Constraining the Core

This section contains information about constraining the core in the Vivado Design Suite.

### Required Constraints

This section is not applicable for this IP core.

### Device, Package, and Speed Grade Selections

This section is not applicable for this IP core.

### Clock Frequencies

This section is not applicable for this IP core.

### Clock Management

This section is not applicable for this IP core.

### Clock Placement

This section is not applicable for this IP core.

### Banking

This section is not applicable for this IP core.

### Transceiver Placement

This section is not applicable for this IP core.

### I/O Standard and Placement

This section is not applicable for this IP core.

## Simulation

For comprehensive information about Vivado simulation components, as well as information about using supported third-party tools, see the *Vivado Design Suite User Guide: Logic Simulation* (UG900) [Ref 13].



**IMPORTANT:** For cores targeting 7 series FPGAs or Zynq-7000 devices, UNIFAST libraries are not supported. Xilinx IP is tested and qualified with UNISIM libraries only.

## Synthesis and Implementation

For details about synthesis and implementation, see the *Vivado Design Suite User Guide: Designing with IP* (UG896) [Ref 11].

## Packaging Avalon Master Interface

For system migration, the Avalon Master IP has to be packaged for Vivado using the Avalon bus interface (Figure 4-2). This allows Avalon IP to integrate with the Vivado IP integrator system.

To package the Avalon slave IP, follow the steps mentioned in the *Vivado Design Suite Tutorial: Creating and Packaging Custom IP* (UG1119) [Ref 9].

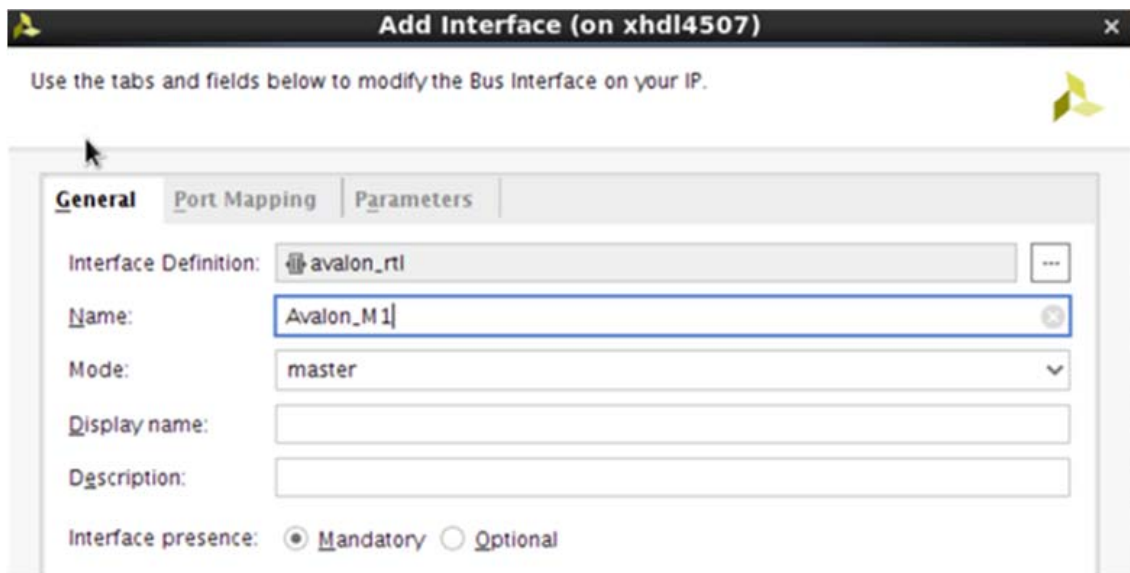


Figure 4-2: AMM Master Bridge Packaging

Figure 4-3 shows the bus interface with one Avalon slave interface.

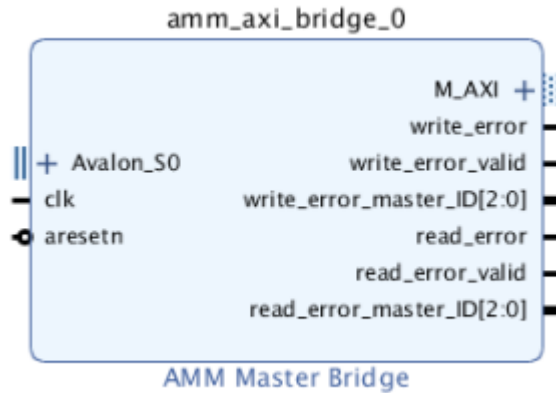


Figure 4-3: AMM Master Bridge with One Avalon Slave interface

Figure 4-4 shows the bus interface with eight Avalon slave interface.

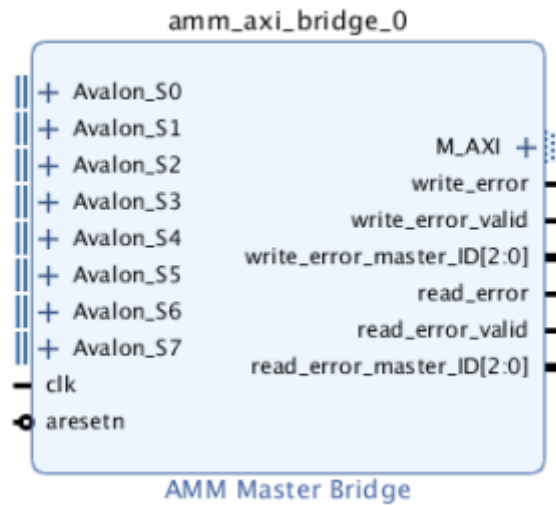


Figure 4-4: AMM Master Bridge with Eight Avalon Slave interface

## Creating an IP Integrator Design

Figure 4-5 shows an IP integrator design that uses the `amm_axi_bridge` and `axi_amm_bridge` as Avalon masters. The AMM Master Bridge is configured with eight slave interfaces.

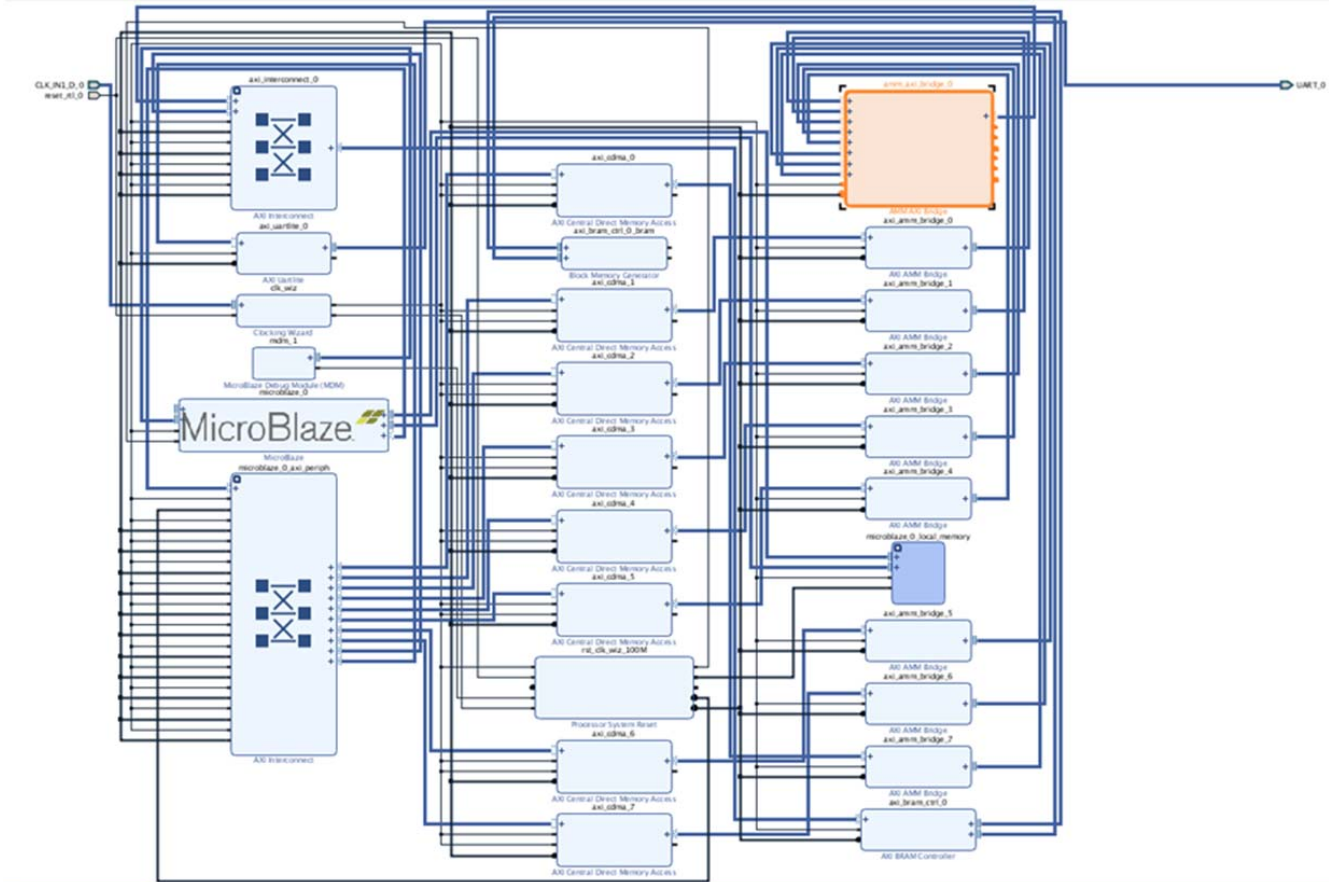


Figure 4-5: AMM Master Bridge with an IP Integrator Design



# Example Design

This chapter contains information about the example design provided in the Vivado® Design Suite.

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## Overview

The example design demonstrates the functioning of the AMM Master Bridge. An Avalon Master is modeled to generate the write and read transactions from a specified address location. The read data is then compared with the write data. Each master writes and reads from the different address location of the memory. If the read and write data for each master matches, the test is said to be completed successfully.

The example design contains the following:

- An instance of AMM Master Bridge as DUT
- Selected number of modeled Avalon masters for each slave interface of DUT
- AXI block RAM controller to act as AXI slave to the AXI Bridge
- XPM single port RAM as memory block
- Clocking wizard and reset generator for generating clock and synchronous reset for the system

**Note:** The Avalon master and the example design are not generic configurations. The Avalon master and example design are generated based on IP configuration of DUT. Any changes in the models are not recommended. The Avalon slave in the example design works only with the corresponding bridge configuration.

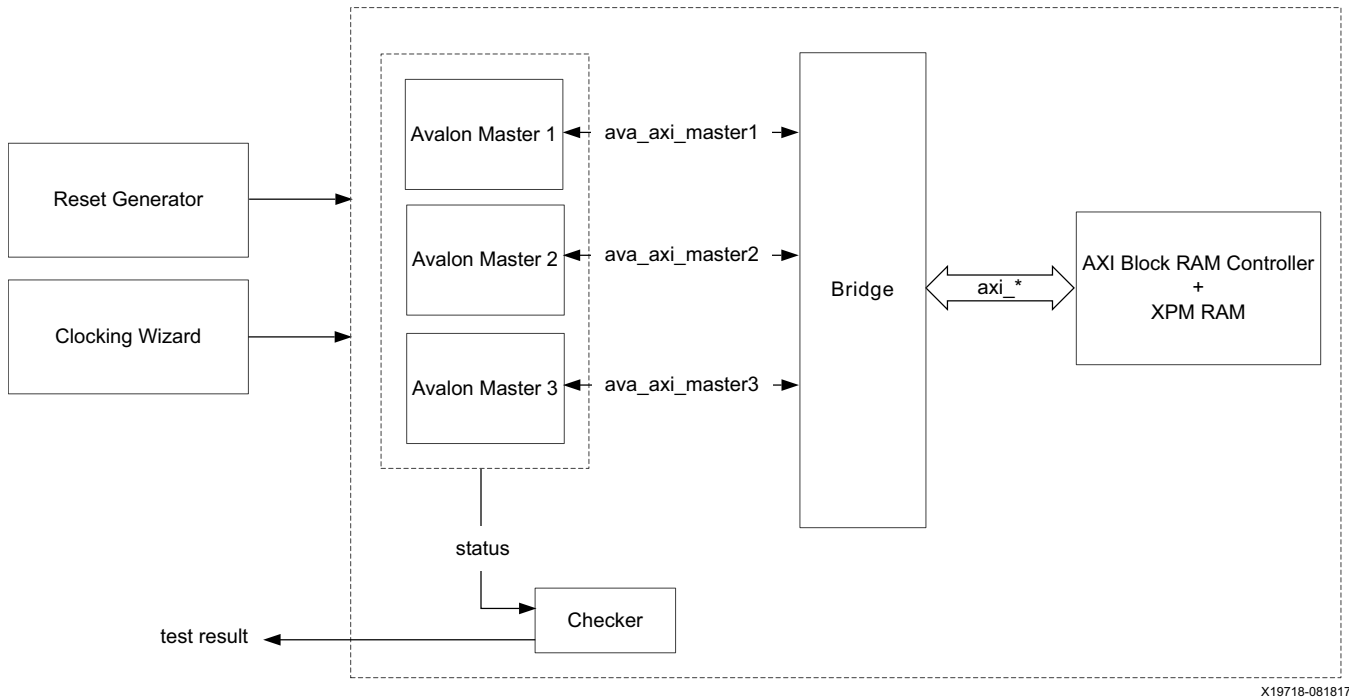


Figure 5-1: AMM Master Bridge Example Design

## Implementing the Example Design

After following the steps described in [Chapter 4, Customizing and Generating the Core](#), implement the example design using the following instructions:

1. Right-click the core in the Hierarchy window, and select **Open IP Example Design**.
2. A new window pops up, asking you to specify a directory for the example design. Select a new directory or keep the default directory.
3. A new project is automatically created in the selected directory and it is opened in a new Vivado IDE window.
4. In the Flow Navigator (left pane), click **Run Implementation** and follow the directions.

## Example Design Directory Structure

In the current project directory, a new project named `<component_name>_ex` is created and the files are generated in `<component_name>_example.src/sources_1/ip/<component_name>/` directory. This directory and its subdirectories contain all the source files that are required to create the AMM Master Bridge example design.

The example design directory is created in `imports/`. It contains the following generated example design top files:

- `<component_name>_exdes.v` – Top-level HDL file for the example design
- `ava_master.v` – Example design for the Avalon master model

---

## Simulating the Example Design

Using the example design delivered as part of the AMM Master Bridge, you can quickly simulate and observe the behavior of the core.

### Setting up the Simulation

The Xilinx simulation libraries must be mapped to the simulator. To set up the Xilinx simulation models, see the *Vivado Design Suite User Guide: Logic Simulation* (UG900) [Ref 13]. To switch simulators, click **Simulation Settings** in the Flow Navigator (left pane). In the Simulation options list, change **Target Simulator**.

The example design supports functional (behavioral) and post-synthesis simulations. For information how to run simulation, see the *Vivado Design Suite User Guide: Logic Simulation* (UG900) [Ref 13].

### Simulation Results

The simulation script compiles the Avalon Master Bridge example design and supporting simulation files. It then runs the simulation and checks that it completed successfully.

If the test passes, the following message is displayed:

```
Test Completed Successfully
```

If the test hangs, the following message is displayed:

```
Test Failed: Done not receive in 6 ms
```

If the test fails, the following message is displayed:

```
Test Failed
```

# Debugging

This appendix includes details about resources available on the Xilinx Support website and debugging tools.

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## Finding Help on Xilinx.com

To help in the design and debug process when using the AMM Master Bridge, the [Xilinx Support web page](#) contains key resources such as product documentation, release notes, answer records, information about known issues, and links for obtaining further product support.

### Documentation

This product guide is the main document associated with the AMM Master Bridge. This guide, along with documentation related to all products that aid in the design process, can be found on the [Xilinx Support web page](#) or by using the Xilinx Documentation Navigator.

Download the Xilinx Documentation Navigator from the [Downloads page](#). For more information about this tool and the features available, open the online help after installation.

### Answer Records

Answer Records include information about commonly encountered problems, helpful information on how to resolve these problems, and any known issues with a Xilinx product. Answer Records are created and maintained daily ensuring that users have access to the most accurate information available.

Answer Records for this core can be located by using the Search Support box on the main [Xilinx support web page](#). To maximize your search results, use proper keywords such as

- Product name
- Tool message(s)
- Summary of the issue encountered

A filter search is available after results are returned to further target the results.

For the AMM Master Bridge Master Answer Record see Xilinx Answer [69656](#)

## Technical Support

Xilinx provides technical support at the [Xilinx Support web page](#) for this LogiCORE™ IP product when used as described in the product documentation. Xilinx cannot guarantee timing, functionality, or support if you do any of the following:

- Implement the solution in devices that are not defined in the documentation.
- Customize the solution beyond that allowed in the product documentation.
- Change any section of the design labeled DO NOT MODIFY.

To contact Xilinx Technical Support, navigate to the [Xilinx Support web page](#).

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## Debug Tools

There are many tools available to address AMM Master Bridge design issues. It is important to know which tools are useful for debugging various situations.

### Vivado Design Suite Debug Feature

The Vivado® Design Suite debug feature inserts logic analyzer and virtual I/O cores directly into your design. The debug feature also allows you to set trigger conditions to capture application and integrated block port signals in hardware. Captured signals can then be analyzed. This feature in the Vivado IDE is used for logic debugging and validation of a design running in Xilinx devices.

The Vivado logic analyzer is used with the logic debug IP cores, including:

- ILA 2.0 (and later versions)
- VIO 2.0 (and later versions)

See the *Vivado Design Suite User Guide: Programming and Debugging* (UG908) [\[Ref 15\]](#).

# Additional Resources and Legal Notices

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## Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see [Xilinx Support](#).

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## Documentation Navigator and Design Hubs

Xilinx® Documentation Navigator provides access to Xilinx documents, videos, and support resources, which you can filter and search to find information. To open the Xilinx Documentation Navigator (DocNav):

- From the Vivado® IDE, select **Help > Documentation and Tutorials**.
- On Windows, select **Start > All Programs > Xilinx Design Tools > DocNav**.
- At the Linux command prompt, enter `docnav`.

Xilinx Design Hubs provide links to documentation organized by design tasks and other topics, which you can use to learn key concepts and address frequently asked questions. To access the Design Hubs:

- In the Xilinx Documentation Navigator, click the **Design Hubs View** tab.
- On the Xilinx website, see the [Design Hubs](#) page.

**Note:** For more information on Documentation Navigator, see the [Documentation Navigator](#) page on the Xilinx website.

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## References

These documents provide supplemental material useful with this product guide:

1. Instructions on how to download the ARM® AMBA® AXI specifications are at [ARM AMBA Specifications](#). See the:

- AMBA AXI4 Protocol Specification
  - AMBA4 AXI4-Stream Protocol Specification
2. [Avalon Interface Specifications](#)
  3. *AMM Slave Bridge LogiCORE IP Product Guide* ([PG258](#))
  4. *AXI DataMover LogiCORE IP Product Guide* ([PG022](#))
  5. *7 Series FPGAs Data Sheet: Overview* ([DS180](#))
  6. *Vivado Design Suite: AXI Reference Guide* ([UG1037](#))
  7. *Xilinx Software Development Kit User Guide: System Performance Analysis* ([UG1145](#))
  8. *System Performance Analysis of an All Programmable SoC* ([XAPP1219](#))
  9. *Vivado Design Suite Tutorial: Creating and Packaging Custom IP* ([UG1119](#))
  10. *Vivado Design Suite User Guide: Designing IP Subsystems using IP Integrator* ([UG994](#))
  11. *Vivado Design Suite User Guide: Designing with IP* ([UG896](#))
  12. *Vivado Design Suite User Guide: Getting Started* ([UG910](#))
  13. *Vivado Design Suite User Guide: Logic Simulation* ([UG900](#))
  14. *ISE to Vivado Design Suite Migration Guide* ([UG911](#))
  15. *Vivado Design Suite User Guide: Programming and Debugging* ([UG908](#))
  16. *Vivado Design Suite User Guide: Implementation* ([UG904](#))

## Revision History

The following table shows the revision history for this document.

Date	Version	Revision
04/04/2018	1.0	Changed existing title 'Avalon Memory Mapped to AXI Bridge v1.0' to 'AMM Master Bridge v1.0'.
10/04/2017	1.0	Initial Xilinx release.

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