

Arm® CoreSight™ ETM-M55

Revision: r0p1

Technical Reference Manual



Arm® CoreSight™ ETM-M55

Technical Reference Manual

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Release Information

Document History

Issue	Date	Confidentiality	Change
0000-02	07 June 2019	Confidential	First beta release for r0p0
0000-04	20 December 2019	Confidential	First limited access release for r0p0
0001-05	31 March 2020	Non-Confidential	First early access release for r0p1

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LES-PRE-20349

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The information in this document is Final, that is for a developed product.

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Preface

This preface introduces the *Arm® CoreSight™ ETM-M55 Technical Reference Manual*.

It contains the following:

- *About this book* on page 7.
- *Feedback* on page 10.

About this book

This book is for the CoreSight Embedded Trace Macrocell™ for the Cortex®-M55 processor. You implement ETM-M55 with the Cortex-M55 processor. In this manual, in general, any reference to the processor applies to the Cortex-M55 processor, as appropriate.

Product revision status

The *rm**pn* identifier indicates the revision status of the product described in this book, for example, r1p2, where:

rm Identifies the major revision of the product, for example, r1.

pn Identifies the minor revision or modification status of the product, for example, p2.

Intended audience

This book is written for designers of development tools providing support for ETM functionality and hardware and software engineers integrating the macrocell into an ASIC that includes a Cortex®-M55 processor. Implementation-specific behavior is described in this document. You can find complementary information in the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* and *Arm® Cortex®-M55 Processor Integration and Implementation Manual*.

Using this book

This book is organized into the following chapters:

Chapter 1 Introduction

This chapter describes ETM-M55.

Chapter 2 Functional Description

This chapter describes the ETM-M55 functional features and operation.

Chapter 3 Programmers model

This chapter describes the mechanisms for programming the registers used to set up the trace and triggering facilities of the macrocell. The programmers model enables you to use the ETM-M55 registers to control the macrocell.

Chapter 4 ETM-M55 register descriptions

This chapter describes the ETM-M55 registers.

Appendix A Revisions

This appendix describes the technical changes between released issues of this book.

Glossary

The Arm Glossary is a list of terms used in Arm documentation, together with definitions for those terms. The Arm Glossary does not contain terms that are industry standard unless the Arm meaning differs from the generally accepted meaning.

See the *Arm® Glossary* for more information.

Typographic conventions

italic

Introduces special terminology, denotes cross-references, and citations.

bold

Highlights interface elements, such as menu names. Denotes signal names. Also used for terms in descriptive lists, where appropriate.

monospace

Denotes text that you can enter at the keyboard, such as commands, file and program names, and source code.

monospace

Denotes a permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.

monospace italic

Denotes arguments to monospace text where the argument is to be replaced by a specific value.

monospace bold

Denotes language keywords when used outside example code.

<and>

Encloses replaceable terms for assembler syntax where they appear in code or code fragments. For example:

```
MRC p15, 0, <Rd>, <CRn>, <CRm>, <Opcode_2>
```

SMALL CAPITALS

Used in body text for a few terms that have specific technical meanings, that are defined in the *Arm® Glossary*. For example, IMPLEMENTATION DEFINED, IMPLEMENTATION SPECIFIC, UNKNOWN, and UNPREDICTABLE.

Timing diagrams

The following figure explains the components used in timing diagrams. Variations, when they occur, have clear labels. You must not assume any timing information that is not explicit in the diagrams.

Shaded bus and signal areas are undefined, so the bus or signal can assume any value within the shaded area at that time. The actual level is unimportant and does not affect normal operation.

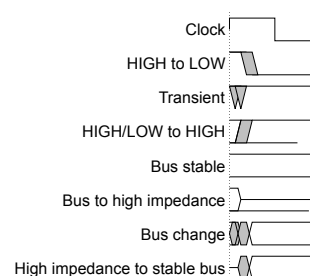


Figure 1 Key to timing diagram conventions

Signals

The signal conventions are:

Signal level

The level of an asserted signal depends on whether the signal is active-HIGH or active-LOW. Asserted means:

- HIGH for active-HIGH signals.
- LOW for active-LOW signals.

Lowercase n

At the start or end of a signal name, n denotes an active-LOW signal.

Additional reading

This book contains information that is specific to this product. See the following documents for other relevant information.

Arm publications

- *Arm® CoreSight™ DAP-Lite Technical Reference Manual* (DDI 0316).
- *Arm® CoreSight™ Architecture Specification v3.0* (IHI 0029).
- *AMBA® APB Protocol Version 2.0 Specification* (IHI 0033).
- *AMBA® 4 ATB Protocol Specification* (IHI 0032).
- *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* (ARM IHI 0064).
- *Arm®v8-M Architecture Reference Manual* (DDI 0553).
- *Arm® Cortex®-M55 Processor Technical Reference Manual* (101051).

The following confidential book is only available to licensees:

- *Arm® Cortex®-M55 Processor Integration and Implementation Manual* (101052).

Other publications

None.

Feedback

Feedback on this product

If you have any comments or suggestions about this product, contact your supplier and give:

- The product name.
- The product revision or version.
- An explanation with as much information as you can provide. Include symptoms and diagnostic procedures if appropriate.

Feedback on content

If you have comments on content then send an e-mail to errata@arm.com. Give:

- The title *Arm CoreSight ETM-M55 Technical Reference Manual*.
- The number 101053_0001_05_en.
- If applicable, the page number(s) to which your comments refer.
- A concise explanation of your comments.

Arm also welcomes general suggestions for additions and improvements.

————— **Note** —————

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Chapter 1

Introduction

This chapter describes ETM-M55.

It contains the following sections:

- *1.1 CoreSight™ ETM-M55 features* on page 1-12.
- *1.2 Compliance* on page 1-14.
- *1.3 Features* on page 1-15.
- *1.4 Interfaces and configurable options* on page 1-18.
- *1.5 Design process* on page 1-19.
- *1.6 Documentation* on page 1-20.
- *1.7 Product revisions* on page 1-21.

1.1 CoreSight™ ETM-M55 features

ETM-M55 can provide non-intrusive program-flow trace for the Cortex-M55 processor. ETM-M55 generates information that trace software tools use to reconstruct the execution of an entire program or part of a program.

ETM-M55 implements instruction trace only. ETM-M55 is able to trace:

- All instructions, including condition code pass or fail
- Target addresses of indirect branch operations that have been taken
- Target addresses of direct branch operations that have been taken when TRCONFIGR.BB is set to 1
- Exceptions
- Entry to and return from debug state when Halting debug mode is enabled
- Cycle counts relating to instruction execution

ETM-M55 contains resource logic that enables you to control instruction trace. This resource logic includes one reduced function counter. For more information on the provision of a reduced function counter, see the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4*. Other resources available for ETM-M55 include *Data Watchpoint and Trace (DWT)* processor comparators and external inputs. You can specify the exact set of trigger and filter conditions that are required for a particular application.

ETM-M55 is a CoreSight component that provides instruction trace functionality.

For more information about CoreSight, see:

- *Arm® CoreSight™ Architecture Specification v3.0*
- *Arm® CoreSight™ System-on-Chip SoC-600 Technical Reference Manual*

For more information about the ETM architecture, see the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4*.

1.1.1 The CoreSight™ debug environment

The CoreSight debug environment contains a software debugger that provides a user interface to ETM-M55. ETM-M55 is designed for instruction trace and it has a single 8-bit AMBA 4 ATB interface.

Software debugger

A software debugger provides a user interface to ETM-M55. You can use this interface to:

- Configure ETM-M55 facilities such as filtering.
- Configure optional trace features such as cycle counting.
- Configure the other CoreSight components such as the *Trace Port Interface Unit (TPIU)*.
- Access the processor debug registers and *Performance Monitoring Units (PMUs)*.

ETM-M55 outputs its trace to the AMBA 4 ATB interface.

You can use the CoreSight infrastructure to design systems that provide the option to:

- Export the trace information through a trace port. An external *Trace Port Analyzer (TPA)* captures the trace information as shown in [Figure 1-1 Example CoreSight system with ETM-M55 on page 1-13](#).
- Write the trace information to a trace-capable device that can access local or system memory. You can read out the trace at low speed using a *Joint Test Action Group (JTAG)* or *Serial Wire (SW)* interface.

The software debugger has a copy of the executed image from memory and the captured trace information from the TPA or on-chip trace buffer. It decompresses the image to provide full disassembly with symbols of the code that was executed. ETM-M55 generates trace information that gives the software debugger the capability to link this data back to the original high-level source code. This provides a visualization of how the code was executed on the Cortex-M55 processor.

Example CoreSight™ system with ETM-M55

The following figure shows an example of how ETM-M55 fits into a CoreSight debug environment to provide instruction trace capabilities in a single processor system.

In this example, the external debug software configures the trace and debug components through the *Debug Access Port* (DAP). The top-level ROM table contains:

- A unique identification code for the SoC.
- The base addresses of the components that are connected to the *External Private Peripheral Bus* (EPPB) on the Cortex-M55 processor.

The ETM-M55 trace interfaces are replicated to provide on-chip storage using the CoreSight ETB and output off-chip using the TPIU. Cross-triggering operates through the *Cross Trigger Interface* (CTI) and *Cross Trigger Matrix* (CTM) components.

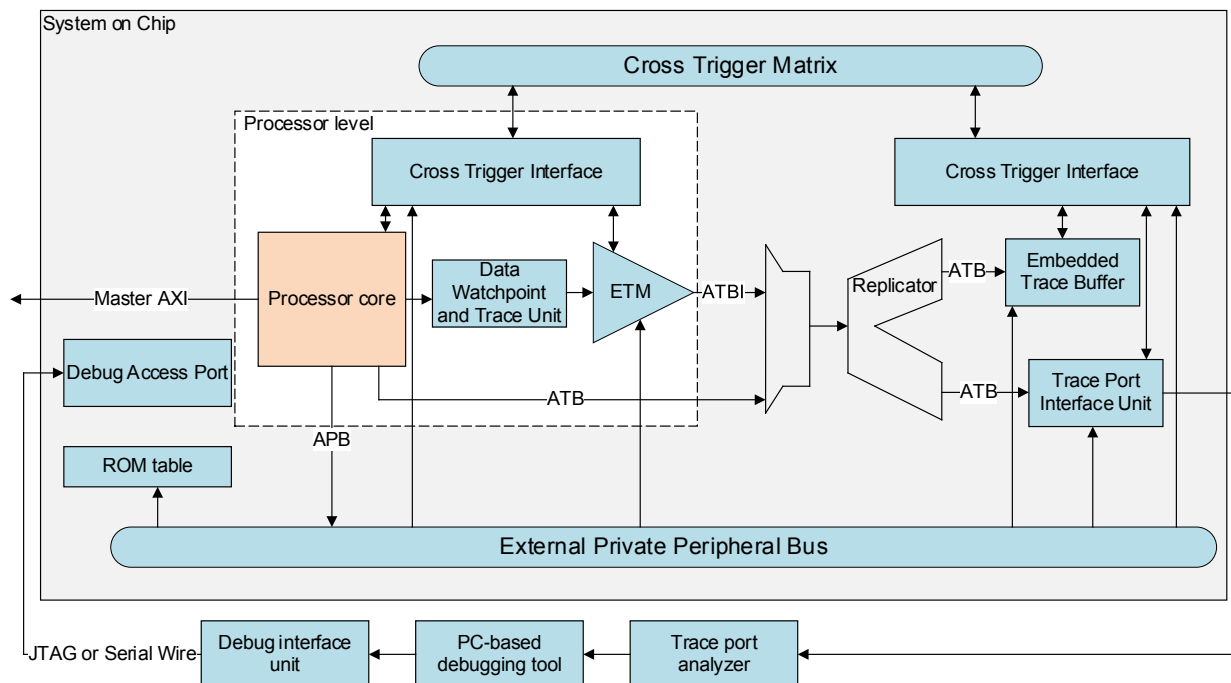


Figure 1-1 Example CoreSight system with ETM-M55

As an alternative to using an external computer to run a software debugger, the Cortex-M55 processor (or another processor on the *System-on-Chip* (SoC) can access ETM-M55 and an on-chip trace buffer to provide self-hosted debug and trace functionality.

1.2 Compliance

ETM-M55 is compatible with the CoreSight architecture and implements the architecture specification and protocols shown in the following table.

This manual complements architecture reference manuals, architecture specifications, protocol specifications, and relevant external standards. It does not duplicate information from these sources.

The following table shows the architecture specifications, protocols, and protocol specifications that the ETM-M55 is compatible with.

Table 1-1 Architecture specifications and protocols

Component	Specification
ETM	ETM-M55 implements the ETM architecture version 4.5. For more information, see <i>Arm® Embedded Trace Macrocell Architecture Specification ETMv4</i> .
Interconnect architecture	ETM-M55 complies with the AMBA 4 APB and AMBA 4 ATB protocols. For more information, see the <i>AMBA® APB Protocol Version 2.0 Specification</i> and <i>AMBA® 4 ATB Protocol Specification</i> .

1.3 Features

The ETM-M55 has features that are IMPLEMENTATION DEFINED based on either the number of times the feature is implemented or the size of the feature.

See the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* for information about:

- The trace protocol.
- The ETM version 4.5 features.
- Controlling tracing using triggering and filtering resources.

The following table shows the ETM-M55 features that are IMPLEMENTATION DEFINED, in terms of either:

- The number of times the feature is implemented.
- The size of the feature.

Table 1-2 ETM-M55 features with IMPLEMENTATION DEFINED number of instances or size

Feature	ETM-M55 configuration	Description
Address comparators	0 pairs	See bits[3:0] of the 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Instruction trace cycle counting minimum allowable threshold value	4	-
Data value comparators	0	See bits[7:4] of the 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Context ID comparators	0	See bits[27:24] 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Single-Shot comparator controls	1	The single-shot comparators are only sensitive to the processor comparator inputs. See bits [23:20] in 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Counters	1	This indicates reduced function counter implementation. See bits[30:28] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.
Trace events supported	2	See bits[11:10] of the 4.16.1 TRCIDR0, ID Register 0 on page 4-52.
Cycle counter size	12 bits	See bits[28:25] of the 4.16.3 TRCIDR2, ID Register 2 on page 4-54.
Sequencer	0	See bits[27:25] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.
Processor comparator inputs	2 or 4	See bits[15:12] of the 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
External inputs	4+number of <i>Performance Monitor Unit</i> (PMU) events	See bits[8:0] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.
External outputs	2	-
External input selectors	4	See bits[11:9] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.

Table 1-2 ETM-M55 features with IMPLEMENTATION DEFINED number of instances or size (continued)

Feature	ETM-M55 configuration	Description
Resource selection pairs	2	See bits[19:16] of the 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Instruction trace port size	8-bit	-
Instruction FIFO	64 bytes with 8-bit output	Uses <i>Advanced Trace Bus</i> (ATB).
Claim tag bits	4	-

The following table shows the optional features of the ETM architecture that ETM-M55 implements.

Table 1-3 ETM-M55 implementation of optional features

Feature	Implemented	Description
Commit mode	No	-
Configurable FIFO	No	-
Trace Start/Stop block	Yes	-
Branch broadcast tracing support	Yes	See bit[5] of the 4.16.1 TRCIDR0, ID Register 0 on page 4-52.
Trace of conditional instructions	Yes	See bits[13:12] and bit[6] of the 4.16.1 TRCIDR0, ID Register 0 on page 4-52.
Data trace	No	-
System error trace	Yes	-
Load and store instruction data trace	No	-
Low-power override	Yes	See bit[23] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.
Support for overflow avoidance	Yes	-
Cycle counting in instruction trace	Yes	See bit[7] of the 4.16.1 TRCIDR0, ID Register 0 on page 4-52.
Data address comparison	No	ETM-M55 does not implement data address comparison.
OS Lock mechanism	No	The Cortex-M55 processor does not implement OS Lock.
Secure non-invasive debug	Yes	The Cortex-M55 processor implements optional Security Extensions.
Context ID tracing	No	See bits[9:5] of the 4.16.3 TRCIDR2, ID Register 2 on page 4-54.
Trace output	Yes	Uses ATB.
Timestamp size	64-bit	See bits[28:24] of the 4.16.1 TRCIDR0, ID Register 0 on page 4-52.
Memory mapped access to ETM-M55 registers	Yes	See the <i>Arm® Embedded Trace Macrocell Architecture Specification ETMv4</i> for more information about the access permissions behavior on register accesses for different states of ETM-Cortex-M55.
External debugger access to ETM-M55 registers	Yes	
System instruction access to ETM-M55 registers	No	
<i>Virtual Machine ID</i> (VMID) comparator support	No	See bits[31:28] of the 4.16.5 TRCIDR4, ID Register 4 on page 4-56.
Q-element filtering support	No	-

Table 1-3 ETM-M55 implementation of optional features (continued)

Feature	Implemented	Description
Q-element support	No	-
Reduced function counter	Yes	See bit [31] in 4.16.6 TRCIDR5, ID Register 5 on page 4-57.
Return stack support	Yes	-
Stall control support	Yes	-
Software lock	No	-
Synchronization period support	Yes	Read-only support is provided
ATB trigger support	Yes	See bit[22] of the 4.16.6 TRCIDR5, ID Register 5 on page 4-57.

1.4 Interfaces and configurable options

ETM-M55 has four main interfaces.

ETM-M55 interfaces

The following table shows the main interfaces in ETM-M55.

Table 1-4 ETM-M55 interfaces

Interface	Description
Processor interface	This interface connects the M55 processor to ETM-M55. It has the following functions: <ul style="list-style-type: none"> Tracking execution information from the processor. Decoding the control signals. Passing on the decoded information to the internal interfaces.
AMBA 4 ATB interface	This is the instruction ATB interface. This interface reads single bytes of packet information from the instruction FIFO and the information is sent over the interface.
AMBA 4 APB interface	This is an interface to the APB that provides access to the programmable registers.
Production test interface	This interface contains the scan enable signal that is used in ETM-M55 production testing.

Configurable options

ETM-M55 has no configurable options.

1.5 Design process

ETM-M55 is delivered as synthesizable RTL.

Before it can be used in a product, it must go through the design process that is described in the following table.

Table 1-5 ETM-M55 design process

Stage	Description
Implementation	For <i>Microcontroller Units</i> (MCUs), often a single design team integrates the processor and ETM-M55 before synthesizing the complete design. Alternatively, the team can synthesize the processor on its own or partially integrated, to produce a hard macrocell. Then, the same team or a separate team, integrates the hard macrocell into the design.
Integration	The integrator connects the implemented design into a <i>System on Chip</i> (SoC). This includes connecting it to a memory system and peripherals.
Programming	This is the last stage in the process. The system programmer develops the software required to configure and initialize ETM-M55, and tests the required application software.

The operation of the final device depends on:

Build configuration

The implementer chooses the options that affect how the RTL source files are pre-processed. These options usually include or exclude logic that affects one or more of the following:

- Area.
- Maximum frequency.
- Features of the resulting design.

Configuration inputs

The integrator configures some of the ETM-M55 features by tying inputs to specific values. These configurations affect the start-up behavior before any software configuration is made. They can also limit the options available to the software.

Software configuration

The programmer configures ETM-M55 by programming particular values into registers. This affects the ETM-M55 behavior.

Note

- This manual refers to IMPLEMENTATION DEFINED features that are applicable to build configuration options. Any reference to:
 - An included feature means that the appropriate build and pin configuration options are selected.
 - An enabled feature means one that has also been configured by software.
 - Each stage of the process:
 - Can be performed by a different party.
 - Can include implementation and integration choices that affect the ETM-M55 behavior and features.
-

1.6 Documentation

ETM-M55 documentation is as follows:

Technical Reference Manual

The *Technical Reference Manual* (TRM) describes the functionality and the effects of functional options on the ETM-M55 behavior. It is required at all stages of the design flow. Some behavior described in the TRM might not be relevant because of the way that ETM-M55 is implemented and integrated.

Integration and Implementation Manual

For both the processor and ETM-M55, the *Arm® Cortex®-M55 Processor Integration and Implementation Manual* (IIM) describes:

- The available build configuration options and related issues in selecting them.
- How to configure the *Register Transfer Level* (RTL) with the build configuration options.
- How to integrate the processor into a *System on Chip* (SoC). This includes a description of the pins that the integrator must tie off to configure the macrocell for the required integration.
- The processes to sign off the integration and implementation of the design.

The Arm product deliverables include reference scripts and information about using them to implement your design.

Reference methodology documentation from your EDA tools vendor complements the IIM.

The IIM is a confidential document that is only available to licensees.

1.7 Product revisions

The following product revisions have been released.

- | | |
|------|--|
| r0p0 | First release for Beta r0p0. |
| | First limited access release for r0p0. |
| r0p1 | First early access release for r0p1. |

Chapter 2

Functional Description

This chapter describes the ETM-M55 functional features and operation.

It contains the following sections:

- [2.1 ETM-M55 functional blocks on page 2-23.](#)
- [2.2 External input and output connections on page 2-24.](#)
- [2.3 Operation on page 2-25.](#)

2.1 ETM-M55 functional blocks

ETM-M55 performs real-time instruction tracing based on the ETM architecture ETM version 4.5.

ETM-M55 is a CoreSight component and is an integral part of the Arm real-time debug solution, Arm Development Studio.

The following figure shows the main functional blocks of ETM-M55.

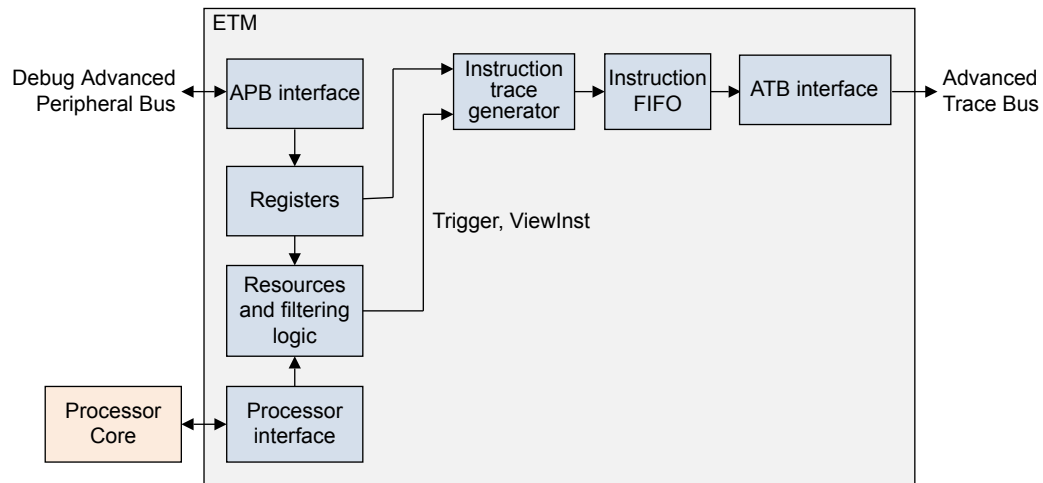


Figure 2-1 ETM-M55 block diagram

The following table describes the ETM-M55 functional blocks.

Table 2-1 ETM-M55 functional blocks

Functional block	Description
Processor interface	The processor interface from ETM-M55 connects to the Cortex-M55 processor. It has the following functions: <ul style="list-style-type: none"> Tracking execution information from the processor. Decoding the control signals. Passing on the decoded information to the internal interfaces.
Resources and filtering logic	These blocks contain resources which are programmed by trace software to trigger and filter the trace information. They start and stop trace generation, depending on the conditions that have been set.
AMBA 4 APB interface	This is an interface to the APB that provides access to the programmable registers.
Instruction trace generator	This block generates the trace packets that are a compressed form of the instruction execution information provided by the Cortex-M55 processor. The trace packets are then passed to the instruction FIFO.
Instruction FIFO	This block buffers bursts of trace packets. There is one FIFO provided for the instruction trace stream.
AMBA 4 ATB interface	This is the instruction ATB interface. This interface reads single bytes of packet information from the instruction FIFO and the information is sent over the interface.
Global timestamping	ETM-M55 supports connection to a global timestamp source. This provides a 64-bit timestamp that a debugger can use for coarse-grained profiling and correlation of the trace source. Arm recommends that the timestamp counter is no slower than 10% of the maximum processor clock frequency.

2.2 External input and output connections

The following table shows the external input connections. These inputs can be selected using the external input selectors controlled by TRCEXTINSEL.

For more information, see [4.14 TRCEXTINSEL, External Input Select Register](#) on page 4-50.

Table 2-2 External input connections

External input bits	Description
[3:0]	CTI
[3+N:4] where N is the number of PMU events	PMU events

The following table shows the ETM-M55 external input and output bit connections to the *Cross Trigger Interface* (CTI).

Table 2-3 CTI connections

ETM-M55 external input and output bits	CTI input
ETM external input bits [3:0]	CTI output bits [7:4]
ETM external output bits [1:0]	CTI input bits [5:4]

2.3 Operation

The ETM-M55 has IMPLEMENTATION DEFINED operations.

For information on the operation, see the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4*.

2.3.1 ETM-M55 registers

There are two groups of ETM-M55 registers:

- Registers that are completely defined by the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4*.
- Registers that are partly IMPLEMENTATION DEFINED.

2.3.2 Precise ViewInst events

The only condition that ensures **ViewInst** is precise is that the enabling event condition is TRUE.

For more information, see the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4*.

2.3.3 Parallel instruction execution

The Cortex-M55 processor supports parallel instruction execution. This means that ETM-M55 is capable of tracing two instructions per cycle.

If **ViewInst** is active in a cycle when two instructions are executed, then both instructions are traced.

2.3.4 Trace features

The ETM-M55 implements the following ETMv4.5 trace features:

- Cycle-accurate tracing.
- Timestamping.

See the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* for descriptions of these features.

2.3.5 Packet formats

This section describes the packet formats that the ETM-M55 instruction trace interface supports.

The ETM-M55 instruction trace interface does not support the following trace packet types:

- Speculation resolution packets are not supported.
- Q instruction trace packets are not supported.

ETM-M55 supports conditional tracing, but does not trace APSR condition flag values. See the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* for the trace packet format descriptions.

2.3.6 Resource selection

The ETM-M55 uses event selectors to control resources.

The ETM-M55 has the following resources:

- Reduced function counter
- *Data Watchpoint and Trace* (DWT) processor comparators
- Single shot comparator
- External inputs

The ETM-M55 generates the following events:

- Trace events, triggers, and markers in the trace stream
- Timestamp event
- ViewInst event

An event selector is configured to be sensitive to a resource selector pair, and one resource selector pair can control more than one event selector. The event selectors for Cortex-M55 are located in the following registers:

- Event Control 0 Register, TRCEVENTCTL0R
- Global Timestamp Control Register, TRCTSCTLR
- ViewInst Main Control Register, TRCVICTLR

The ETM-M55 provides:

- A fixed resource selector pair, registers TRCRSCTLR0 and TRCRSCTLR1 with static values of 0 = FALSE and 1 = TRUE, respectively
- A configurable resource selector pair, registers TRCRSCTLR2 and TRCRSCTLR3

A resource selector pair enables up to two resource groups to be selected, and enables one or more resources to be selected in each group. If more than one resource is selected, the outputs of the selected resources are OR-gated. See the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* for more information.

The following table shows the resources that can be selected for the instruction trace.

Table 2-4 Instruction trace resource selection

Group	Select	Resource
0b0000	Bits 0-3	External input selectors 0-3. When select bit N is set, then the resource selector is sensitive to external input selector N.
0b0001	Bits 0-3	When select bit N is set, the resource selector is sensitive to processor comparator input N.
0b0010	0	Counter at zero 0
0b0011	0	Single-Shot Comparator control 0
0b0100-0b1111	0-15	Reserved

For example, the following figure shows the steps necessary to use a single-shot comparator to generate a trigger event and an *Advanced Trace Bus* (ATB) trigger. This example uses the user-configurable resource selector 2.

The DWT unit controls the processor comparator inputs.

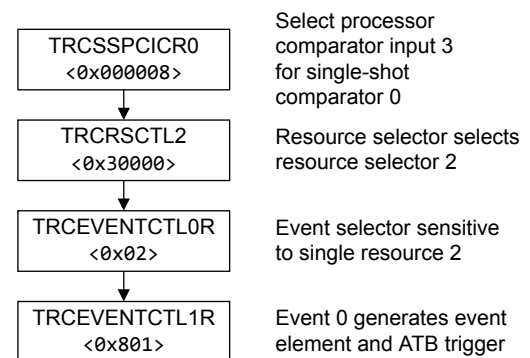


Figure 2-2 Trigger event resource selection

The ETM-M55 single-shot and start-stop logic might not reliably trigger when DWT comparators are programmed for comparisons other than instruction address comparison.

2.3.7 Trace flush behavior

Events that ETM-M55 observes can be confirmed to have reached the trace bus output by using the ATB flush protocol.

The ETM-M55 internally flushes instruction trace whenever the flush request is seen. When the processor enters a low-power state, this also causes instruction trace to be output from the ETM-M55.

2.3.8 Low-power state behavior

When the processor enters a low-power state, there is a delay before the resources in the ETM-M55 become inactive.

This permits the last instruction executed to trigger a comparator or update the counter, and the resulting event packet to be inserted in the specified trace stream. This event packet is presented on the trace bus before the ETM-M55 enters a low-power state.

If an event packet is generated for a different reason, it is not guaranteed to be output before the ETM-M55 enters a low-power state, but is traced when the processor leaves the low-power state, if the ETM-M55 logic is not reset before this can occur.

This low-power behavior can be disabled using `TRCEVENTCTL1R.LPOVERRIDE` bit. For more information on `TRCEVENTCTL1R`, see [4.6 *TRCEVENTCTL1R, Event Control 1 Register* on page 4-40](#). In this case, the ETM-M55 resources remain active.

2.3.9 Cycle counter

The ETM-M55 uses a 12-bit cycle counter.

The cycle counter does not count when non-invasive debug is disabled or when ETM-M55 is in a low-power state.

2.3.10 Event tracing and triggers

Instruction event packets can be inserted in the instruction trace stream on every cycle, but if events are traced continuously on every cycle the instruction FIFO is unable to drain because the rate at which the events enter the FIFO is the same as the rate at which events leave the FIFO. Therefore, the instruction FIFO overflows.

When used with the optimized Cortex-M55 TPIU, *Advanced Trace Bus* (ATB) triggers must not be enabled, `TRCEVENTCTL1R.ATB` must be set to 0. For more information on `TRCEVENTCTL1R`, see [4.6 *TRCEVENTCTL1R, Event Control 1 Register* on page 4-40](#).

Chapter 3

Programmers model

This chapter describes the mechanisms for programming the registers used to set up the trace and triggering facilities of the macrocell. The programmers model enables you to use the ETM-M55 registers to control the macrocell.

It contains the following section:

- [3.1 Modes of operation and execution on page 3-29.](#)

3.1 Modes of operation and execution

This section describes how to control and program the ETM and its registers.

3.1.1 Controlling ETM-M55 programming

When programming the ETM-M55 registers, you must enable all the changes at the same time.

For example, if the counter is reprogrammed, it might start to count based on incorrect events, before the trigger condition has been correctly set up.

To disable instruction trace operations during programming, use:

- The trace program enable bit in the Programming Control Register, TRCPRGCTLR.
- The Status Register, TRCSTATR, to indicate the ETM-M55 status.

The following figure shows the procedure to use.

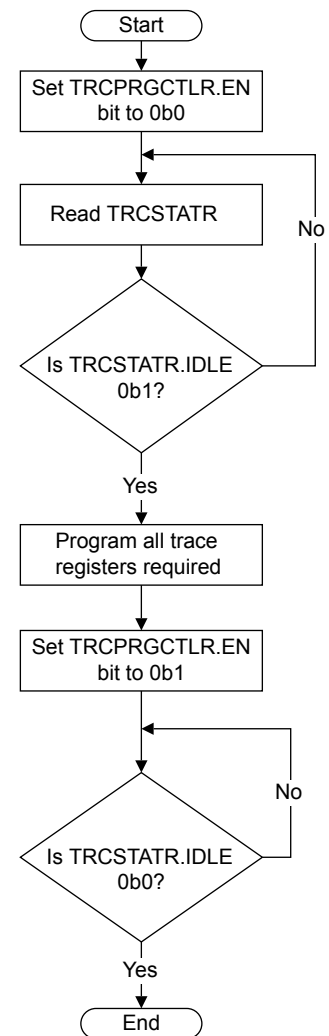


Figure 3-1 Programming ETM registers

The Cortex-M55 processor does not have to be in debug state while you program the ETM-M55 registers.

To access the ETM registers, use the external *Advanced Peripheral Bus* (APB) interface. This provides a direct method of programming the ETM.

Chapter 4

ETM-M55 register descriptions

This chapter describes the ETM-M55 registers.

These registers can be categorized into:

- General control and ID registers.
- Trace filtering control register.
- Derived resource register.
- Implementation specific and identification registers.
- Resource selection register.
- Single-shot comparator registers.
- Power control registers.
- Integration test registers.
- CoreSight management registers.

It contains the following sections:

- [4.1 Register summary](#) on page 4-32.
- [4.2 TRCPRGCTLR, Programming Control Register](#) on page 4-35.
- [4.3 TRCSTATR, Status Register](#) on page 4-36.
- [4.4 TRCCONFIGR, Trace Configuration Register](#) on page 4-37.
- [4.5 TRCEVENTCTL0R, Event Control 0 Register](#) on page 4-39.
- [4.6 TRCEVENTCTL1R, Event Control 1 Register](#) on page 4-40.
- [4.7 TRCSTALLCTLR, Stall Control Register](#) on page 4-41.
- [4.8 TRCTSCTLR, Global Timestamp Control Register](#) on page 4-42.
- [4.9 TRCSYNCPR, Synchronization Period Register](#) on page 4-43.
- [4.10 TRCCCCTLR, Cycle Count Control Register](#) on page 4-44.
- [4.11 TRCTRACEIDR, Trace ID Register](#) on page 4-45.
- [4.12 TRCVICTLR, ViewInst Main Control Register](#) on page 4-46.
- [4.13 TRCVIPCSSLR, ViewInst Start/Stop Processor Comparator Control Register](#) on page 4-48.

- 4.14 *TRCEXTINSEL*R, External Input Select Register on page 4-50.
- 4.15 *TRCCNTRLDVR*0, Counter Reload Value Register 0 on page 4-51.
- 4.16 *TRCIDR*0-13, ID Registers on page 4-52.
- 4.17 *TRCRSCTL*Rn, Resource Selection Registers 2-3 on page 4-62.
- 4.18 *TRCSSCCR*0, Single-shot Comparator Control Register 0 on page 4-64.
- 4.19 *TRCSSCSR*0, Single-shot Comparator Status Register 0 on page 4-65.
- 4.20 *TRCSSPCICR*0, Single-shot Processor Comparator Input Control Register 0 on page 4-67.
- 4.21 *TRCPDCR*, Power Down Control Register on page 4-68.
- 4.22 *TRCPDSR*, Power Down Status Register on page 4-69.
- 4.23 Integration test registers on page 4-70.
- 4.24 *TRCCLAIMSET*, Claim Tag Set Register on page 4-75.
- 4.25 *TRCCLAIMCLR*, Claim Tag Clear Register on page 4-76.
- 4.26 *TRCAUTHSTATUS*, Authentication Status Register on page 4-77.
- 4.27 *TRCDEVARCH*, Device Architecture Register on page 4-78.
- 4.28 *TRCDEVID*, Device ID Register on page 4-79.
- 4.29 *TRCDEVTYPE*, Device Type Register on page 4-80.
- 4.30 *TRCPIDR*0-7, Peripheral Identification Registers on page 4-81.
- 4.31 *TRCCIDR*0-3, Component Identification Registers on page 4-83.

4.1 Register summary

All ETM-M55 registers are 32 bits wide.

Note

Registers not listed in the following table and not described in this document are not implemented. Reading a non-implemented register address returns zero. Writing to a non-implemented register address has no effect.

The table below:

- Lists the ETM-M55 registers in numerical order and describes each register.
- Includes the following additional information about each register:
 - The base offset address of the register. The base offset of a register is always four times its register number. For information on the base address of the registers, see *Arm®v8-M Architecture Reference Manual*.
 - The register access type.
 - Additional information about the implementation of the register, where appropriate.

Table 4-1 ETM-M55 register summary

Register number	Base offset	Name	Type	Reset value	Description
1	0x004	TRCPRGCTLR	RW	0x00000000	4.2 TRCPRGCTLR, Programming Control Register on page 4-35
3	0x00C	TRCSTATR	RO	UNKNOWN	4.3 TRCSTATR, Status Register on page 4-36
4	0x010	TRCCONFIGR	RW	UNKNOWN	4.4 TRCCONFIGR, Trace Configuration Register on page 4-37
6	0x018	TRCAUXCTLR	RW	UNKNOWN	Auxiliary Control Register. This register is not implemented.
8	0x020	TRCEVENTCTL0R	RW	UNKNOWN	4.5 TRCEVENTCTL0R, Event Control 0 Register on page 4-39
9	0x024	TRCEVENTCTL1R	RW	UNKNOWN	4.6 TRCEVENTCTL1R, Event Control 1 Register on page 4-40
11	0x02C	TRCSTALLCTLR	RW	UNKNOWN	4.7 TRCSTALLCTLR, Stall Control Register on page 4-41
12	0x030	TRCTSCTLR	RW	UNKNOWN	4.8 TRCTSCTLR, Global Timestamp Control Register on page 4-42
13	0x034	TRCSYNCPR	RO	0x0000000A	4.9 TRCSYNCPR, Synchronization Period Register on page 4-43
14	0x038	TRCCCCTLR	RW	UNKNOWN	4.10 TRCCCCTLR, Cycle Count Control Register on page 4-44
16	0x040	TRCTRACEIDR	RW	UNKNOWN	4.11 TRCTRACEIDR, Trace ID Register on page 4-45
32	0x080	TRCVICTLR	RW	UNKNOWN	4.12 TRCVICTLR, ViewInst Main Control Register on page 4-46
35	0x08C	TRCVIPCSSCTLR	RW	UNKNOWN	4.12 TRCVICTLR, ViewInst Main Control Register on page 4-46

Table 4-1 ETM-M55 register summary (continued)

Register number	Base offset	Name	Type	Reset value	Description
72	0x120	TRCEXTINSEL	RW	UNKNOWN	4.14 TRCEXTINSEL , External Input Select Register on page 4-50
80	0x140	TRCCNTRLDVR0	RW	UNKNOWN	4.15 TRCCNTRLDVR0 , Counter Reload Value Register 0 on page 4-51
96	0x180	TRC IDR8	RO	0x00000000	4.16.9 TRC IDR8 , ID Register 8 on page 4-59
97	0x184	TRC IDR9	RO	0x00000000	4.16.10 TRC IDR9 , ID Register 9 on page 4-59
98	0x188	TRC IDR10	RO	0x00000000	4.16.11 TRC IDR10 , ID Register 10 on page 4-60
99	0x18C	TRC IDR11	RO	0x00000000	4.16.12 TRC IDR11 , ID Register 11 on page 4-60
100	0x190	TRC IDR12	RO	0x00000001	4.16.13 TRC IDR12 , ID Register 12 on page 4-60
101	0x194	TRC IDR13	RO	0x00000000	4.16.14 TRC IDR13 , ID Register 13 on page 4-61
112	0x1C0	TRC IMSPC0	RW	0x00000000	Implementation specific Register 0. There are not IMPLEMENTATION SPECIFIC extensions supported, and this register is not implemented.
120	0x1E0	TRC IDR0	RO	0x280006E1	4.16.1 TRC IDR0 , ID Register 0 on page 4-52
121	0x1E4	TRC IDR1	RO	0x4100F451	4.16.2 TRC IDR1 , ID Register 1 on page 4-53
122	0x1E8	TRC IDR2	RO	0x00000004	4.16.3 TRC IDR2 , ID Register 2 on page 4-54
123	0x1EC	TRC IDR3	RO	0x0F090004	4.16.4 TRC IDR3 , ID Register 3 on page 4-55
124	0x1F0	TRC IDR4	RO	- ^a	4.16.5 TRC IDR4 , ID Register 4 on page 4-56
125	0x1F4	TRC IDR5	RO	0x90C70004	4.16.6 TRC IDR5 , ID Register 5 on page 4-57
126	0x1F8	TRC IDR6	-	UNKNOWN	Reserved, RES0.
127	0x1FC	TRC IDR7	-	UNKNOWN	Reserved, RES0.
130-131	0x208-0x20C	TRCRSCTLR2-3	RW	UNKNOWN	4.17 TRCRSCTLRn , Resource Selection Registers 2-3 on page 4-62
160	0x280	TRCSSCCR0	RW	UNKNOWN	4.18 TRCSSCCR0 , Single-shot Comparator Control Register 0 on page 4-64
168	0x2A0	TRCSSCSR0	RW	UNKNOWN	4.19 TRCSSCSR0 , Single-shot Comparator Status Register 0 on page 4-65
176	0x2C0	TRCSSPCICR0	RW	UNKNOWN	4.20 TRCSSPCICR0 , Single-shot Processor Comparator Input Control Register 0 on page 4-67
196	0x310	TRCPDCR	RW	0x00000000	4.21 TRCPDCR , Power Down Control Register on page 4-68
197	0x314	TRCPDSR	RO	0x00000003	4.22 TRCPDSR , Power Down Status Register on page 4-69
953	0xEE4	TRCITATBIDR	WO	UNKNOWN	4.23.1 TRCITATBIDR , Integration ATB Identification Register on page 4-71

^a 0x00114000
0x00112000

For 4 comparator configuration.
For 2 comparator configuration.

Table 4-1 ETM-M55 register summary (continued)

Register number	Base offset	Name	Type	Reset value	Description
955	0xEEC	TRCITIDATAR	WO	UNKNOWN	4.23.2 TRCITIDATAR, Integration Data Register on page 4-72
957	0xEF4	TRCITIATBINR	RO	UNKNOWN	4.23.3 TRCITIATBINR, Integration Instruction ATB In Register on page 4-72
959	0xEFC	TRCITIATBOUTr	WO	UNKNOWN	4.23.4 TRCITIATBOUTr, Integration Instruction ATB Out Register on page 4-73
960	0xF00	TRCITCTRL	RW	0x00000000	4.23.5 TRCITCTRL, Integration Mode Control Register on page 4-74
1000	0xFA0	TRCCLAIMSET	RW	0x0000000F	4.24 TRCCLAIMSET, Claim Tag Set Register on page 4-75
1001	0xFA4	TRCCLAIMCLR	RW	0x00000000	4.25 TRCCLAIMCLR, Claim Tag Clear Register on page 4-76
1006	0xFB8	TRCAUTHSTATUS	RO	UNKNOWN	4.26 TRCAUTHSTATUS, Authentication Status Register on page 4-77
1007	0xFBC	TRCDEVARCH	RO	0x47754A13	4.27 TRCDEVARCH, Device Architecture Register on page 4-78
1010	0xFC8	TRCDEVID	RO	0x00000000	4.28 TRCDEVID, Device ID Register on page 4-79
1011	0xFCC	TRCDEVTYPE	RO	0x00000013	4.29 TRCDEVTYPE, Device Type Register on page 4-80
1012-1019	0xFD0-0xFEC	TRCPIDR0-7	RO	4.30 TRCPIDR0-7, Peripheral Identification Registers on page 4-81	
1020-1023	0xFF0-0xFFC	TRCCIDR0-3	RO	4.31 TRCCIDR0-3, Component Identification Registers on page 4-83	

Note

In [Table 4-1 ETM-M55 register summary on page 4-32](#):

- The Reset value column shows the value of the register immediately after an ETM-M55 reset. For read only registers, every read of the register returns this value.
- Access type is described as follows:

RW Read and write.
RO Read only.
WO Write only.

4.2 TRCPRGCTLR, Programming Control Register

The TRCPRGCTLR enables ETM-M55.

Usage constraints

See [3.1.1 Controlling ETM-M55 programming on page 3-29](#).

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCPRGCTLR bit assignments.

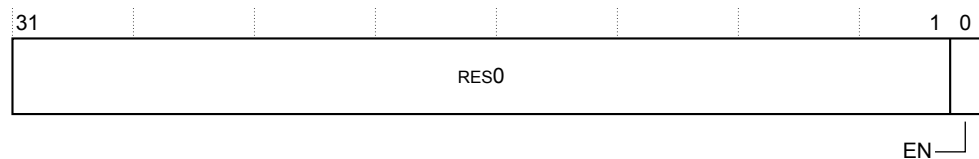


Figure 4-1 TRCPRGCTLR bit assignments

The following table shows the TRCPRGCTLR bit assignments.

Table 4-2 TRCPRGCTLR bit assignments

Bits	Name	Function
[31:1]	-	RES0.
[0]	EN	ETM-M55 enable bit: 0 ETM-M55 is disabled. 1 ETM-M55 is enabled.

4.3 TRCSTATR, Status Register

The TRCSTATR indicates the ETM-M55 status.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSTATR bit assignments.

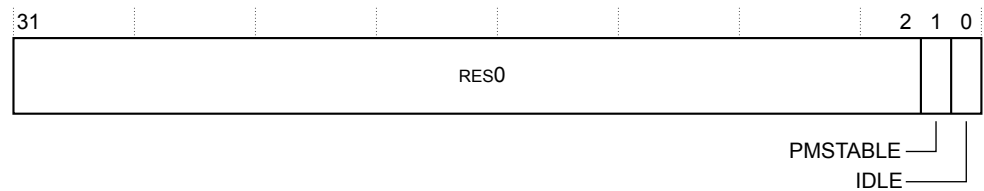


Figure 4-2 TRCSTATR bit assignments

The following table shows the TRCSTATR bit assignments.

Table 4-3 TRCSTATR bit assignments

Bits	Name	Function
[31:2]	-	RES0.
[1]	PMSTABLE	Indicates whether the ETM-M55 registers are stable and can be read: 0 The programmers model is not stable. 1 The programmers model is stable.
[0]	IDLE	Indicates whether ETM-M55 is inactive: 0 ETM-M55 is not idle. 1 ETM-M55 is idle. When the IDLE bit is set to 1: <ul style="list-style-type: none"> ETM-M55 is drained of any trace. Except for the programming interfaces, all external interfaces on ETM-M55 are quiescent.

4.4 TRCCONFIGR, Trace Configuration Register

The TRCCONFIGR sets the basic tracing options for the ETM-M55.

Usage constraints

This register must always be programmed as part of ETM-M55 initialization.
Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCCONFIGR bit assignments.

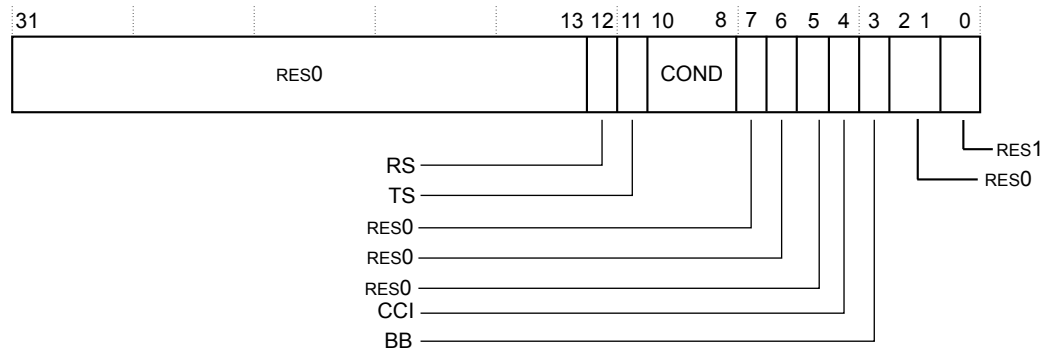


Figure 4-3 TRCCONFIGR bit assignments

The following table shows the TRCCONFIGR bit assignments.

Table 4-4 TRCCONFIGR bit assignments

Bits	Name	Function
[31:13]	-	RES0.
[12]	RS	Return stack enable: 0 Return stack disabled. 1 Return stack enabled.
[11]	TS	Global timestamp tracing: 0 Global timestamp tracing disabled. 1 Global timestamp tracing enabled. For more global timestamp tracing options, see 4.8 TRCTSCCLR, Global Timestamp Control Register on page 4-42 .

Table 4-4 TRCCONFIGR bit assignments (continued)

Bits	Name	Function
[10:8]	COND	<p>Conditional instruction tracing. The supported values are:</p> <p>0b000 Conditional instruction tracing is disabled.</p> <p>0b001 Conditional load instructions are traced.</p> <p>0b010 Conditional store instructions are traced.</p> <p>0b011 Conditional load and store instructions are traced.</p> <p>0b111 All conditional instructions are traced.</p> <p>All other values are Reserved.</p>
[7]	VMID	RES0.
[6]	CID	RES0.
[5]	-	RES0.
[4]	CCI	<p>Cycle counting in instruction trace:</p> <p>0 Cycle counting in instruction trace disabled.</p> <p>1 Cycle counting in instruction trace enabled.</p> <p>For more cycle counting options, see 4.10 TRCCCCTLR, Cycle Count Control Register on page 4-44.</p>
[3]	BB	<p>Branch broadcast mode:</p> <p>0 Branch broadcast mode disabled.</p> <p>1 Branch broadcast mode enabled.</p>
[2:1]	INSTP0	RES0
[0]	-	RES1

4.5 TRCEVENTCTL0R, Event Control 0 Register

The TRCEVENTCTL0R controls the tracing of arbitrary events. The events also drive the ETM-M55 external outputs.

Usage constraints

This register must always be programmed as part of ETM-M55 initialization.
Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCEVENTCTL0R bit assignments.

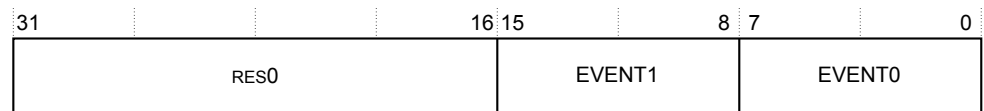


Figure 4-4 TRCEVENTCTL0R bit assignments

The following table shows the TRCEVENTCTL0R bit assignments.

Table 4-5 TRCEVENTCTL0R bit assignments

Bits	Name	Function
[31:16]	-	RES0.
[15:8]	EVENT1	Event selector 1.
[7:0]	EVENT0	Event selector 0.

4.6 TRCEVENTCTL1R, Event Control 1 Register

The TRCEVENTCTL1R controls how the events selected by TRCEVENTCTL0R behave.

See [4.5 TRCEVENTCTL0R, Event Control 0 Register on page 4-39](#).

Usage constraints

This register must always be programmed as part of ETM-M55 initialization.
Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCEVENTCTL1R bit assignments.

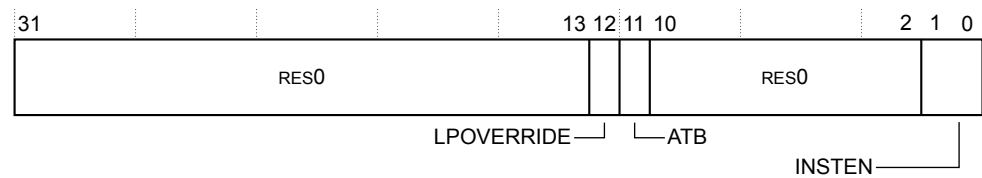


Figure 4-5 TRCEVENTCTL1R bit assignments

The following table shows the TRCEVENTCTL1R bit assignments.

Table 4-6 TRCEVENTCTL1R bit assignments

Bits	Name	Function
[31:13]	-	RES0.
[12]	LPOVERRIDE	Low power state behavior override: 0 Low power state behavior unaffected. 1 Low power state behavior overridden. The resources and event trace generation are unaffected by entry to a low power state.
[11]	ATB	ATB trigger enable: 0 ATB trigger disabled. 1 ATB trigger enabled.
[10:2]	-	RES0
[1:0]	INSTEN	One bit per event, to enable generation of an event element in the instruction trace stream when the selected event occurs: 0 ETM-M55 does not generate an event element. 1 ETM-M55 generates an event element.

4.7 TRCSTALLCTL, Stall Control Register

The TRCSTALLCTL enables ETM-M55 to stall the processor if the ETM-M55 FIFO goes over the programmed level to minimize risk of overflow.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

This register must always be programmed as part of ETM-M55 initialization.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSTALLCTL bit assignments.

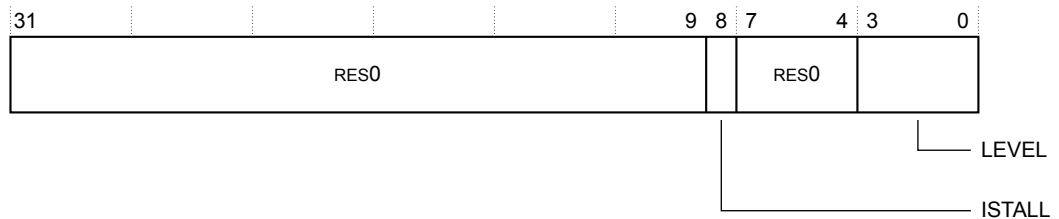


Figure 4-6 TRCSTALLCTL bit assignments

The following table shows the TRCSTALLCTL bit assignments.

Table 4-7 TRCSTALLCTL bit assignments

Bits	Name	Function
[31:9]	-	RES0.
[8]	ISTALL	<p>Stall processor based on instruction trace buffer space:</p> <p>0 ETM-M55 must not stall the processor.</p> <p>1 ETM-M55 can stall the processor.</p> <p>The LEVEL field controls the threshold at which the processor is stalled.</p>
[7:4]	-	RES0.
[3:0]	LEVEL	<p>Threshold at which stalling becomes active. This provides four levels. This level can be varied to optimize the level of invasion caused by stalling, balanced against the risk of a FIFO overflow:</p> <p>0b0000 Zero invasion. This setting has a greater risk of a FIFO overflow.</p> <p>0b0100 First level of invasion.</p> <p>0b1000 Second level of invasion.</p> <p>0b1100 Maximum invasion occurs, but there is less risk of a FIFO overflow.</p> <p>————— Note —————</p> <p>Writes to bits[1:0] are ignored and these bits are always set to 0b00.</p> <p>When the value of this field is 0b0100 or higher, then ETM-M55 might suppress the generation of:</p> <ul style="list-style-type: none"> Periodic synchronization in the instruction trace stream. Global timestamps in the instruction trace stream. Cycle counting in the instruction trace stream, although the cumulative cycle count remains correct.

4.8 TRCTSCTLR, Global Timestamp Control Register

The TRCTSCTLR controls the insertion of global timestamps into the trace stream. A timestamp is always inserted into the instruction trace stream.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

This register must always be programmed as part of ETM-M55 initialization.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCTSCTLR bit assignments.

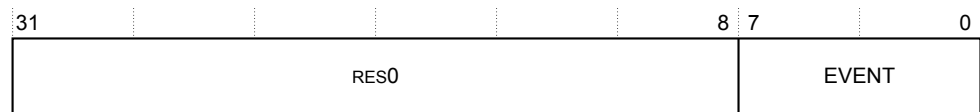


Figure 4-7 TRCTSCTLR bit assignments

The following table shows the TRCTSCTLR bit assignments.

Table 4-8 TRCTSCTLR bit assignments

Bits	Name	Function
[31:8]	-	RES0
[7:0]	EVENT	An event selector. When the selected event is triggered, ETM-M55 inserts a global timestamp into the trace streams. For more information on the trace unit event that is selected, see the <i>Arm® Embedded Trace Macrocell Architecture Specification ETMv4</i> . For more information on resource selection and event selectors, see 2.3.6 Resource selection on page 2-25 .

4.9 TRCSYNCPR, Synchronization Period Register

TRCSYNCPR defines the number of bytes of trace between requests for trace synchronization. This specifies the period of trace synchronization of the trace streams.

Usage constraints

The register is implemented as RO and the synchronization period, which is indicated by the PERIOD bit field, is 0b01010.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSYNCPR bit assignments.

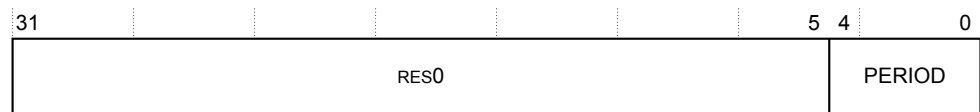


Figure 4-8 TRCSYNCPR bit assignments

The following table shows the TRCSYNCPR bit assignments.

Table 4-9 TRCSYNCPR bit assignments

Bits	Name	Function
[31:5]	-	RES0.
[4:0]	PERIOD	Defines the number of bytes of trace between trace synchronization requests as a total of the number of bytes generated by the instruction stream. For ETM-M55, this field is 0b01010.

4.10 TRCCCCTL, Cycle Count Control Register

The TRCCCCTL sets the threshold value for instruction trace cycle counting. The threshold represents the minimum interval between cycle count trace packets.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

This register must always be programmed as part of ETM-M55 initialization.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCCCCTL bit assignments.

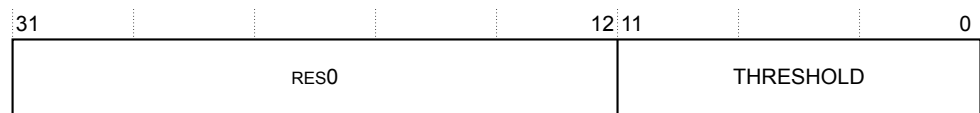


Figure 4-9 TRCCCCTL bit assignments

The following table shows the TRCCCCTL bit assignments.

Table 4-10 TRCCCCTL bit assignments

Bits	Name	Function
[31:12]	-	RES0
[11:0]	THRESHOLD	Instruction trace cycle count threshold. If the value for this field is less than 0x4, then the behavior is CONSTRAINED UNPREDICTABLE.

4.11 TRCTRACEIDR, Trace ID Register

The TRCTRACEIDR sets the trace ID on the trace bus. Each trace source in a CoreSight system must be programmed with a unique non-reserved trace ID value so trace tools can distinguish trace from different sources.

Usage constraints

In a CoreSight system, writing of reserved trace ID values, 0x00 and 0x70-0x7F, is UNPREDICTABLE. This register must always be programmed as part of ETM-M55 initialization. Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCTRACEIDR bit assignments.

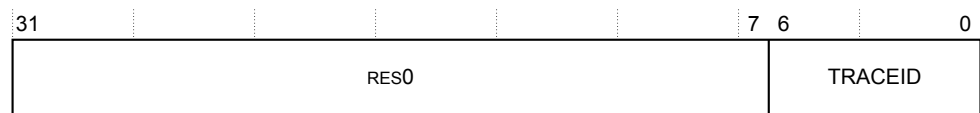


Figure 4-10 TRCTRACEIDR bit assignments

The following table shows the TRCTRACEIDR bit assignments.

Table 4-11 TRCTRACEIDR bit assignments

Bits	Name	Function
[31:7]	-	RES0
[6:0]	TRACEID	Trace ID value. This provides the instruction trace ID.

4.12 TRCVICTLR, ViewInst Main Control Register

The TRCVICTLR controls instruction trace filtering.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Only returns stable data when TRCSTATR.PMSTABLE is 1.

Must be programmed, particularly to set the value of the SSSTATUS bit, that sets the state of the start-stop logic.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCVICTLR bit assignments.

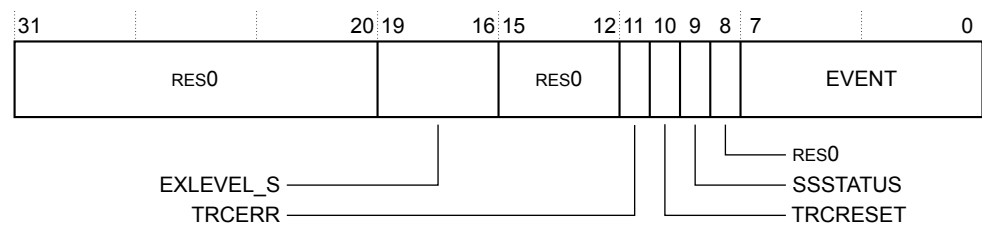


Figure 4-11 TRCVICTLR bit assignments

The following table shows the TRCVICTLR bit assignments.

Table 4-12 TRCVICTLR bit assignments

Bits	Name	Function
[31:20]	-	RES0
[19:16]	EXLEVEL_S	<p>In Secure state, each bit controls whether instruction tracing is enabled for the corresponding exception level:</p> <p>0 ETM-M55 does not generate instruction trace, in Secure state, for exception level n.</p> <p>1 ETM-M55 generates instruction trace, in Secure state, for exception level n.</p> <p>The exception levels are:</p> <p>Bit[16] Thread mode.</p> <p>Bit[17] RES0.</p> <p>Bit[18] RES0. EXLEVEL_S[2] is never implemented.</p> <p>Bit[19] Handler mode.</p>
[15:12]	-	RES0.
[11]	TRCERR	<p>Selects whether a system error exception must always be traced:</p> <p>0 System error exception is traced only if the instruction or exception immediately before the system error exception is traced.</p> <p>1 System error exception is always traced, regardless of the value of ViewInst.</p>

Table 4-12 TRCVICTLR bit assignments (continued)

Bits	Name	Function
[10]	TRCRESET	<p>Selects whether a reset exception must always be traced:</p> <p>0 Reset exception is traced only if the instruction or exception immediately before the reset exception is traced.</p> <p>1 Reset exception is always traced regardless of the value of ViewInst.</p>
[9]	SSSTATUS	<p>Indicates the current status of the start/stop logic:</p> <p>0 Start/stop logic is in the stopped state.</p> <p>1 Start/stop logic is in the started state.</p>
[8]	-	RES0
[7:0]	EVENT	<p>An event selector.</p> <p>For more information on the trace unit event that is selected, see the <i>Arm® Embedded Trace Macrocell Architecture Specification ETMv4</i>. For more information on resource selection and event selectors, see 2.3.6 Resource selection on page 2-25.</p>

4.13 TRCVIPCSSCTLR, ViewInst Start/Stop Processor Comparator Control Register

The TRCVIPCSSCTLR is used to set or read which processor comparator inputs can control the ViewInst start/stop logic.

Usage constraints

Only accepts writes when ETM-M55 is disabled.
This register must be programmed.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCVIPCSSCTLR bit assignments when there are two processor comparator inputs implemented for the *Data Watchpoint Trigger* (DWT). TRCIDR4.NUMPC is 0b0010. For more information on TRCIDR4, see [4.16.5 TRCIDR4, ID Register 4 on page 4-56](#).

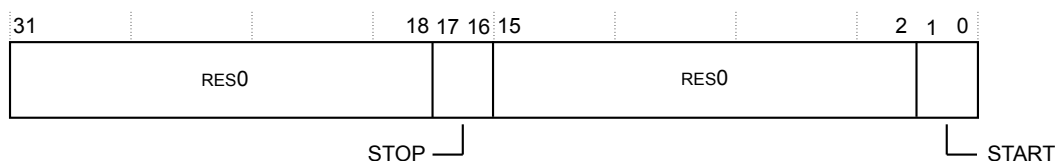


Figure 4-12 TRCVIPCSSCTLR bit assignments for two processor comparator inputs

The following table shows the TRCVIPCSSCTLR bit assignments for two processor comparator inputs.

Table 4-13 TRCVIPCSSCTLR bit assignments for two processor comparator inputs

Bits	Name	Function
[31:18]	-	RES0
[17:16]	STOP	Selects which processor comparator inputs are used with ViewInst start/stop control, for the purpose of stopping trace. Each bit represents a processor comparator input, so bit[m] controls the selection of processor comparator input m-16. If bit[m] is: 0 The single processor comparator input m-16 is not selected as a stop resource. 1 The single processor comparator input m-16 is selected as a stop resource.
[15:2]	-	RES0.
[1:0]	START	Selects which processor comparator inputs are used with ViewInst start/stop control, for the purpose of starting trace. Each bit represents a processor comparator input, so bit[n] controls the selection of processor comparator. If bit[n] is: 0 The single processor comparator input n is not selected as a start resource. 1 The single processor comparator input n is selected as a start resource.

The following figure shows the TRCVICTLR bit assignments when there are four processor comparator inputs implemented for the *Data Watchpoint Trigger* (DWT). TRCIDR4.NUMPC is 0b0100. For more information on TRCIDR4, see [4.16.5 TRCIDR4, ID Register 4 on page 4-56](#).

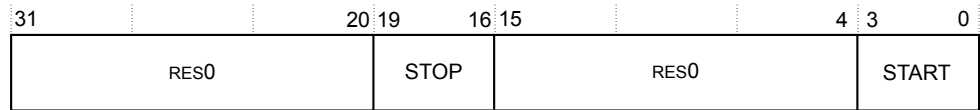


Figure 4-13 TRCVIPCSSCTLR bit assignments for four processor comparator inputs

The following table shows the TRCVIPCSSCTLR bit assignments for four processor comparator inputs.

Table 4-14 TRCVIPCSSCTLR bit assignments for four processor comparator inputs

Bits	Name	Function
[31:20]	-	RES0
[19:16]	STOP	<p>Selects which processor comparator inputs are used with ViewInst start/stop control, for the purpose of stopping trace. Each bit represents a processor comparator input, so bit[m] controls the selection of processor comparator input m-16. If bit[m] is:</p> <p>0 The single processor comparator input m-16 is not selected as a stop resource.</p> <p>1 The single processor comparator input m-16 is selected as a stop resource.</p>
[15:4]	-	RES0.
[3:0]	START	<p>Selects which processor comparator inputs are used with ViewInst start/stop control, for the purpose of starting trace. Each bit represents a processor comparator input, so bit[n] controls the selection of processor comparator. If bit[n] is:</p> <p>0 The single processor comparator input n is not selected as a start resource.</p> <p>1 The single processor comparator input n is selected as a start resource.</p>

4.14 TRCEXTINSEL, External Input Select Register

The TRCEXTINSEL is used to set or read which external inputs are resources to ETM-M55.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCEXTINSEL bit assignments.

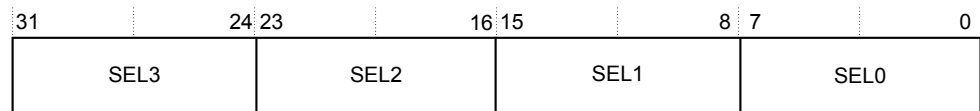


Figure 4-14 TRCEXTINSEL bit assignments for two processor comparator inputs

The following table shows the TRCEXTINSEL bit assignments.

Table 4-15 TRCEXTINSEL bit assignments

Bits	Name	Function
[31:24]	SEL3	This field is a binary value, of up to 8 bits, that selects which external input is a resource for ETM-M55.
[23:16]	SEL2	This field is a binary value, of up to 8 bits, that selects which external input is a resource for ETM-M55.
[15:8]	SEL1	This field is a binary value, of up to 8 bits, that selects which external input is a resource for ETM-M55.
[7:0]	SEL0	This field is a binary value, of up to 8 bits, that selects which external input is a resource for ETM-M55.

4.15 TRCCNTRLDVR0, Counter Reload Value Register 0

The TRCCNTRLDVR0 register defines the reload value for the reduced function counter.

Usage constraints

- Only accepts writes when ETM-M55 is disabled.
- The count value is only stable when TRCSTATR.PMSTABLE is 1.
- If software uses counter 0, then it must write to this register to set the counter reload value.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCCNTRLDVR0 bit assignments.

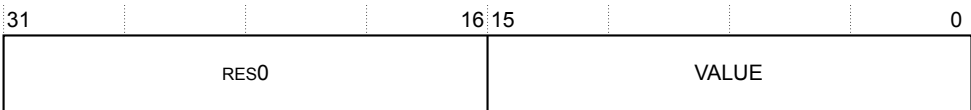


Figure 4-15 TRCCNTRLDVR0 bit assignments

The following table shows the TRCCNTRLDVR0 bit assignments.

Table 4-16 TRCCNTRLDVR0 bit assignments

Bits	Value	Function
[31:16]	-	RES0.
[15:0]	VALUE	Defines the reload value for the counter. This value is loaded into the counter each time the reload event occurs.

4.16 TRCIDR0-13, ID Registers

This section describes the ETM-M55 ID registers.

4.16.1 TRCIDR0, ID Register 0

The TRCIDR0 indicates the tracing capabilities of the ETM-M55 instruction trace.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary](#) on page 4-32.

The following figure shows the TRCIDR0 bit assignments.

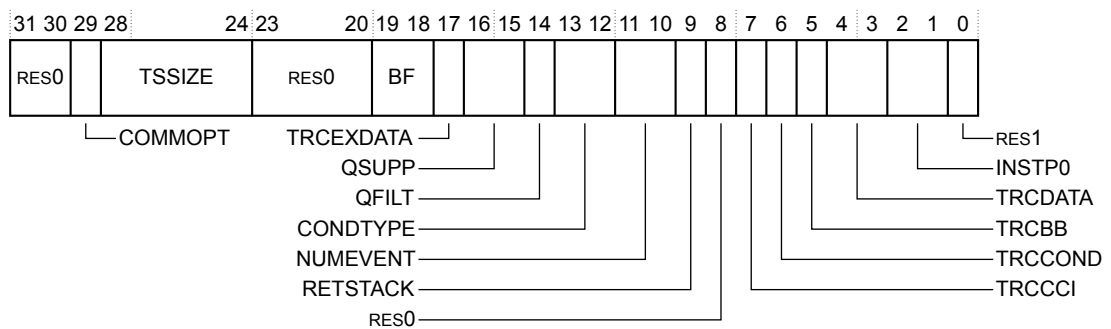


Figure 4-16 TRCIDR0 bit assignments

The following table shows the TRCIDR0 bit assignments.

Table 4-17 TRCIDR0 bit assignments

Bits	Name	Function
[31:30]	-	RES0.
[29]	COMMOPT	Indicates the meaning of the commit field in some packets: 1 Commit mode 1.
[28:24]	TSSIZE	Global timestamp size: 0b01000 Maximum of 64-bit global timestamp implemented.
[23:20]	-	Reserved, RES0.
[19:18]	BF	Branch Future Support. 0b00 Branch future not supported.
[17]	TRCEXDATA	Indicates support for the tracing of data transfers for exceptions and exception returns: 0 TRCVDCTLR.TRCEXDATA is not implemented.

Table 4-17 TRCIDR0 bit assignments (continued)

Bits	Name	Function
[16:15]	QSUPP	Indicates Q element support: 0b00 Q elements not supported.
[14]	QFILT	RES0.
[13:12]	CONDTYPE	Indicates how conditional results are traced: 0b00 ETM-M55 indicates only if a conditional instruction passes or fails its condition code check.
[11:10]	NUMEVENT	Number of events supported in the trace: 0b01 Two events supported.
[9]	RETSTACK	Return stack support: 1 Two entry return stack implemented.
[8]	-	RES0.
[7]	TRCCCI	Support for cycle counting in the instruction trace: 1 Cycle counting in the instruction trace is implemented.
[6]	TRCCOND	Support for conditional instruction tracing: 1 Conditional instruction tracing is implemented.
[5]	TRCBB	Support for branch broadcast tracing: 1 Branch broadcast tracing is implemented.
[4:3]	TRCDATA	Support for tracing of data: 0b00 Data tracing is not supported.
[2:1]	INSTP0	Support for tracing of load and store instructions as P0 elements: 0b00 Tracing of load and store instructions as P0 elements is not supported.
[0]	-	RES1

4.16.2 TRCIDR1, ID Register 1

The TRCIDR1 indicates the ETM-M55 architecture.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary](#) on page 4-32.

The following figure shows the TRCIDR1 bit assignments.

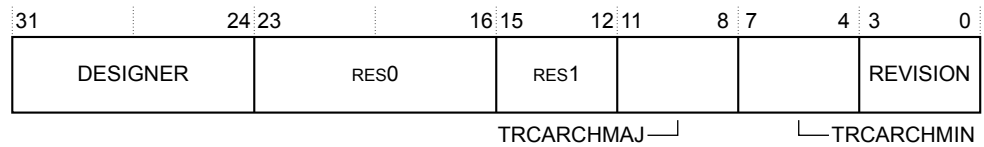


Figure 4-17 TRCIDR1 bit assignments

The following table shows the TRCIDR1 bit assignments.

Table 4-18 TRCIDR1 bit assignments

Bits	Name	Function
[31:24]	DESIGNER	Indicates the designer of the trace unit: 0x41 Arm
[23:16]	-	RES0.
[15:12]	-	RES1.
[11:8]	TRCARCHMAJ	Major ETM-M55 architecture version number: 0x4 ETMv4.
[7:4]	TRCARCHMIN	Minor ETM-M55 architecture version number: 0x5 Minor revision 5.
[3:0]	REVISION	Implementation revision number: 0x1 Implementation revision 1.

4.16.3 TRCIDR2, ID Register 2

The TRCIDR2 indicates the maximum sizes of certain aspects of items in the trace.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR2 bit assignments.

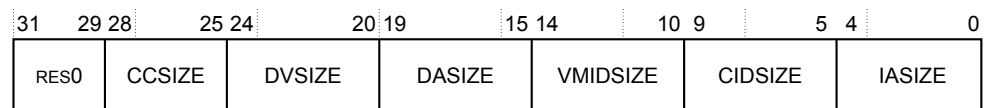


Figure 4-18 TRCIDR2 bit assignments

The following table shows the TRCIDR2 bit assignments.

Table 4-19 TRCIDR2 bit assignments

Bits	Name	Function
[31:29]	-	RES0.
[28:25]	CCSIZE	Indicates the size of the cycle counter in bits minus 12: 0b00000 Cycle count is 12 bits in length.
[24:20]	DVSIZE	Data value size in bytes: 0b00000 Data value size not supported.
[19:15]	DASIZE	Data address size in bytes: 0b00000 Data address size not supported.
[14:10]	VMIDSIZE	Virtual Machine ID size: 0b00000 Virtual Machine ID tracing not implemented.
[9:5]	CIDSIZE	Context ID tracing: 0b00000 Context ID tracing not implemented.
[4:0]	IASIZE	Instruction address size: 0b00100 Maximum of 32-bit address size.

4.16.4 TRCIDR3, ID Register 3

The TRCIDR3 indicates certain aspects of the ETM-M55 configuration.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR3 bit assignments.

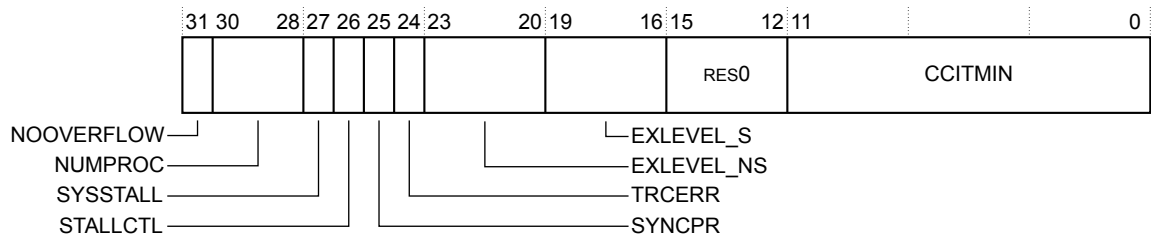


Figure 4-19 TRCIDR3 bit assignments

The following table shows the TRCIDR3 bit assignments.

Table 4-20 TRCIDR3 bit assignments

Bits	Name	Function
[31]	NOOVERFLOW	Indicates whether TRCSTALLCTLR.NOOVERFLOW is implemented: 0 NOOVERFLOW is not implemented.
[30:28]	NUMPROC	Indicates the number of processors available for tracing. 0b000 ETM-M55 can trace one processor. NUMPROC uses bits [30:28] and bits [13:12] to form a single 5-bit field. Bits [13:12] form the top bits of this field.
[27]	SYSSTALL	System support for stall control of the processor. 1 System supports stall control of the processor. This field is used with STALLCTL. The system supports stalling of the processor only when both SYSSTALL and STALLCTL are 1 .
[26]	STALLCTL	Stall control support: 1 TRCSTALLCTLR is implemented.
[25]	SYNCPR	Indicates trace synchronization period support: 1 TRCSYNCPR is read-only for instruction trace only configuration. The trace synchronization period is fixed.
[24]	TRCERR	Indicates whether TRCVICTLR.TRERR is implemented: 1 TRCERR is implemented.
[23:20]	EXLEVEL_NS	RES0
[19:16]	EXLEVEL_S	Exception levels implemented. One bit for each level. 0b1001 Privilege levels Thread and Handler are implemented. Thread is at exception level 0 and Handler is at exception level 3.
[15:14]	-	RES0.
[13:12]	NUMPROC	Indicates the number of processors available for tracing. 0b00 ETM-M55 can trace one processor. NUMPROC uses bits [30:28] and bits [13:12] to form a single 5-bit field. Bits [13:12] form the top bits of this field.
[11:0]	CCITMIN	Minimum value which can be programmed to TRCCCCTLR.THRESHOLD, defining the minimum cycle counting threshold. 0x4 Minimum of four instruction trace cycles.

4.16.5 TRCIDR4, ID Register 4

The TRCIDR4 indicates the available ETM-M55 resources.

Usage constraints

This register is read-only

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary](#) on page 4-32.

The following figure shows the TRCIDR4 bit assignments.

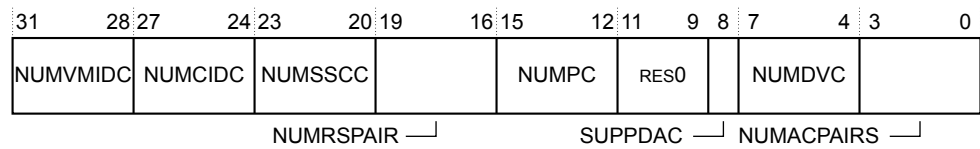


Figure 4-20 TRCIDR4 bit assignments

The following table shows the TRCIDR4 bit assignments.

Table 4-21 TRCIDR4 bit assignments

Bits	Name	Function
[31:28]	NUMVMIDC	Number of <i>Virtual Machine ID</i> (VMID) comparators implemented: 0b0000 VMID comparators are not implemented.
[27:24]	NUMCIDC	Number of Context ID comparators implemented: 0b0000 Context ID comparators are not supported.
[23:20]	NUMSSCC	Number of single-shot comparator controls implemented: 0b0001 One single-shot comparator control is implemented.
[19:16]	NUMRSPAIR	Number of resource selection pairs implemented: 0b0001 Two resource selection pairs are implemented.
[15:12]	NUMPC	Number of processor comparator inputs implemented for the DWT: 0b0010 Two processor comparator inputs. 0b0100 Four processor comparator inputs.
[11:9]	-	RES0
[8]	SUPPDAC	Data address comparisons implemented: 0 Data address comparisons are not supported.
[7:4]	NUMDVC	Number of data value comparators implemented: 0b0000 No data value comparators are implemented.
[3:0]	NUMACPAIRS	Number of address comparator pairs implemented: 0b0000 No address comparator pairs are implemented.

4.16.6 TRCIDR5, ID Register 5

The TRCIDR5 indicates the available ETM-M55 resources.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR5 bit assignments.

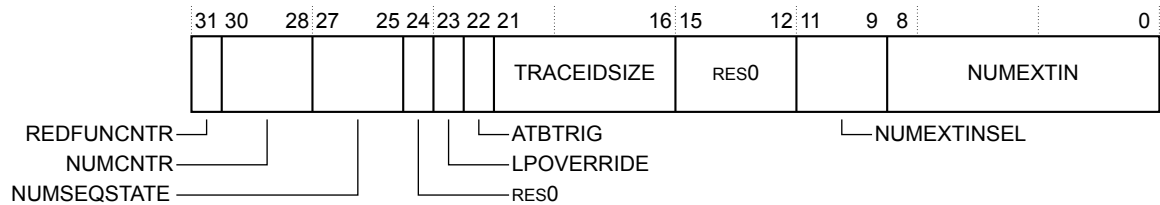


Figure 4-21 TRCIDR5 bit assignments

The following table shows the TRCIDR5 bit assignments.

Table 4-22 TRCIDR5 bit assignments

Bits	Name	Function
[31]	REDFUNCNTR	Reduced Function Counter implemented: 1 Counter 0 is implemented as a Reduced Function Counter.
[30:28]	NUMCNTR	Number of counters implemented: 0b001 One counter implemented.
[27:25]	NUMSEQSTATE	Number of sequencer states implemented: 0b000 No sequencer states implemented.
[24]	-	RES0
[23]	LPOVERRIDE	Low-power state override support: 1 Low-power state override support implemented.
[22]	ATBTRIG	ATB trigger support: 1 ATB trigger support implemented.
[21:16]	TRACEIDSIZE	Number of bits of trace ID: 0x07 7-bit trace ID implemented.
[15:12]	-	RES0.
[11:9]	NUMEXTINSEL	Number of input selectors implemented. 0b100 Four input selectors, SEL0 to SEL3, are present.
[8:0]	NUMEXTIN	Number of external inputs implemented: 0x4+ number of <i>Performance Monitor Unit</i> (PMU) events Four external inputs and any PMU event inputs are implemented.

4.16.7 TRCIDR6, ID Register 6

The TRCIDR6 is reserved, RES0.

4.16.8 TRCIDR7, ID Register 7

The TRCIDR7 is reserved, RES0.

4.16.9 TRCIDR8, ID Register 8

The TRCIDR8 indicates the maximum speculation depth of the instruction trace stream.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR8 bit assignments.

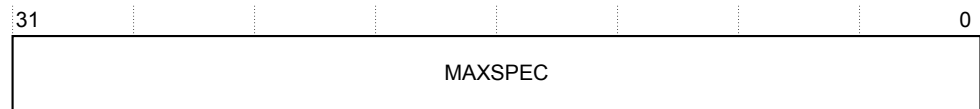


Figure 4-22 TRCIDR8 bit assignments

The following table shows the TRCIDR8 bit assignments.

Table 4-23 TRCIDR8 bit assignments

Bits	Name	Function
[31:0]	MAXSPEC	This is the maximum number of P0 elements that have not been committed in the trace stream at any time. 0x00000000 Maximum trace speculation depth is zero.

4.16.10 TRCIDR9, ID Register 9

The TRCIDRn indicates the number of P0 right-hand keys that are used.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR9 bit assignments.

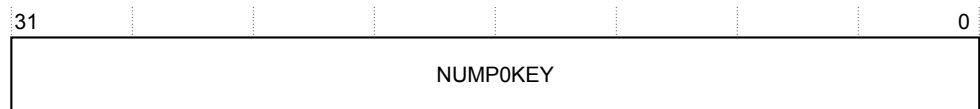


Figure 4-23 TRCIDR9 bit assignments

The following table shows the TRCIDR9 bit assignments.

Table 4-24 TRCIDR9 bit assignments

Bits	Name	Function
[31:0]	NUMPOKEY	0x00000000 No P0 keys used in instruction trace.

4.16.11 TRCIDR10, ID Register 10

The TRCIDR10 indicates the total number of P1 right-hand keys, including normal and special keys.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR10 bit assignments.

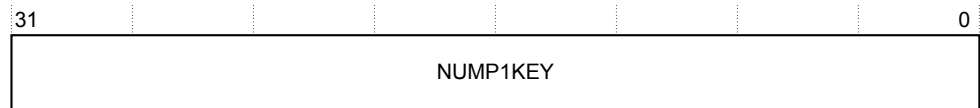


Figure 4-24 TRCIDR10 bit assignments

The following table shows the TRCIDR10 bit assignments.

Table 4-25 TRCIDR10 bit assignments

Bits	Name	Function
[31:0]	NUMP1KEY	0x00000000 No P1 right-hand keys used in instruction trace.

4.16.12 TRCIDR11, ID Register 11

The TRCIDR11 indicates the number of special P1 right-hand keys.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCIDR11 bit assignments.

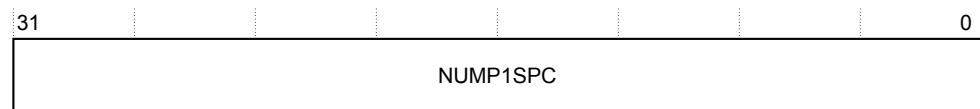


Figure 4-25 TRCIDR11 bit assignments

The following table shows the TRCIDR11 bit assignments.

Table 4-26 TRCIDR11 bit assignments

Bits	Name	Function
[31:0]	NUMP1SPC	0x00000000 No special P1 right-hand keys used in any configuration.

4.16.13 TRCIDR12, ID Register 12

The TRCIDR12 indicates the total number of conditional instruction right-hand keys, including normal and special keys.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in *Table 4-1 ETM-M55 register summary* on page 4-32.

The following figure shows the TRCIDR12 bit assignments.

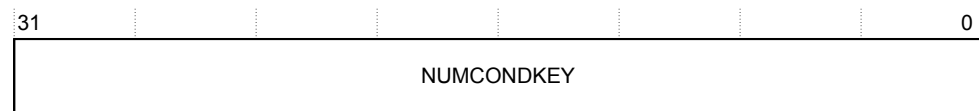


Figure 4-26 TRCIDR12 bit assignments

The following table shows the TRCIDR12 bit assignments.

Table 4-27 TRCIDR12 bit assignments

Bits	Name	Function
[31:0]	NUMCONDKEY	0x00000001 One conditional instruction right-hand key implemented.

4.16.14 TRCIDR13, ID Register 13

The TRCIDR13 indicates the number of special conditional instruction right-hand keys.

Usage constraints

This register is read-only.

Configurations

This register is available in all configurations.

Attributes

See the register summary in *Table 4-1 ETM-M55 register summary* on page 4-32.

The following figure shows the TRCIDR13 bit assignments.

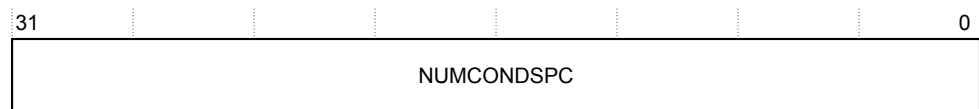


Figure 4-27 TRCIDR13 bit assignments

The following table shows the TRCIDR13 bit assignments.

Table 4-28 TRCIDR13 bit assignments

Bits	Name	Function
[31:0]	NUMCONDSPC	0x00000000 No special conditional instruction right-hand keys implemented.

4.17 TRCRSCTLRn, Resource Selection Registers 2-3

The TRCRSCTLRn controls the selection of trace resources.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCRSCTLRn bit assignments.

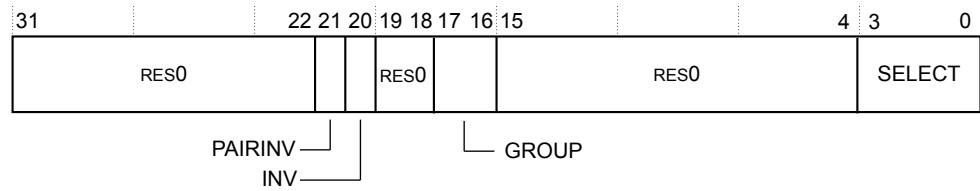


Figure 4-28 TRCRSCTLRn bit assignments

The following table shows the TRCRSCTLRn bit assignments.

Table 4-29 TRCRSCTLRn bit assignments

Bits	Name	Function
[31:22]	-	RES0.
[21]	PAIRINV	Inverts the result of a combined pair of resources. This bit is only implemented on TRCRSCTLR2 and not on TRCRSCTLR3.
[20]	INV	Inverts the selected resources: 0 Resource is not inverted. 1 Resource is inverted.
[19:18]	-	RES0.
[17:16]	GROUP	Selects a group of resources.
[15:4]	-	RES0.
[3:0]	SELECT	Selects one or more resources from the wanted group. One bit is provided per resource from the group.

The following table lists which resources are selected, depending on the values of the GROUP and SELECT fields.

Table 4-30 Resource selection

Group	Select	Resource
0b0000	Bits 0-3	External input selectors 0-3. When select bit N is set, then the resource selector is sensitive to external input selector N.
0b0001	Bits 0-3	When select bit N is set, the resource selector is sensitive to processor comparator input N.

Table 4-30 Resource selection (continued)

Group	Select	Resource
0b0010	0	Counter at zero 0
0b0011	0	Single-Shot Comparator control 0
0b0100-0b1111	0-15	Reserved

4.18 TRCSSCCR0, Single-shot Comparator Control Register 0

The TRCSSCCR0 controls the single-shot comparator.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSSCCR0 bit assignments.

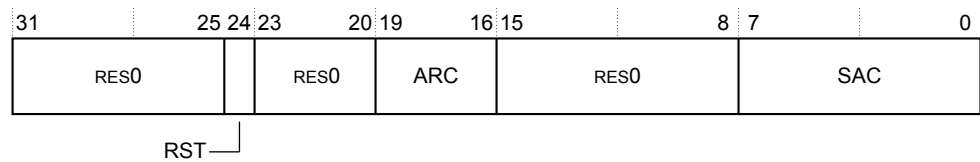


Figure 4-29 TRCSSCCR0 bit assignments

The following table shows the TRCSSCCR0 bit assignments.

Table 4-31 TRCSSCCR0 bit assignments

Bits	Name	Function
[31:25]	-	RES0.
[24]	RST	Enables the single-shot comparator resource to be reset when it occurs, to enable another comparator match to be detected: 0 When the single-shot comparator resource fires, it is not reset. 1 When the single-shot comparator resource fires, it is reset. This enables the single-shot comparator resource to fire multiple times.
[23:20]	-	RES0.
[19:16]	ARC	RAZ/WI.
[15:8]	-	RES0.
[7:0]	SAC	RAZ/WI.

4.19 TRCSSCSR0, Single-shot Comparator Status Register 0

The TRCSSCSR0 indicates the status of the single-shot comparators. TRCSSCSR0 is sensitive to instruction addresses.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSSCSR0 bit assignments.

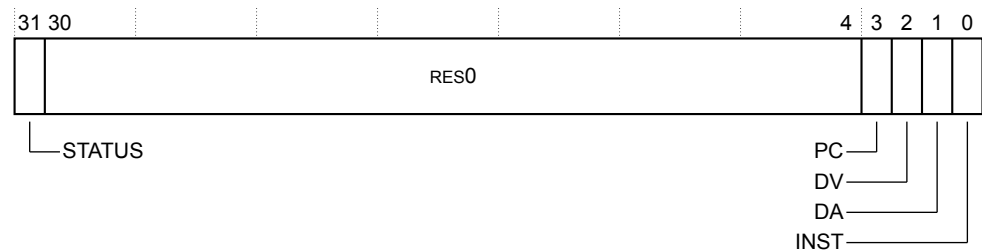


Figure 4-30 TRCSSCSR0 bit assignments

The following table shows the TRCSSCSR0 bit assignments.

Table 4-32 TRCSSCSR0 bit assignments

Bits	Name	Function
[31]	STATUS	<p>Single-shot status. This indicates whether any of the selected comparators have matched:</p> <p>0 Match has not occurred.</p> <p>1 Match has occurred at least once.</p> <p>When programming ETM-M55, if TRCSSCCR0.RST is 0, the STATUS bit must be explicitly written to 0 to enable this single-shot comparator control.</p> <p>If TRCSSCCR0.RST is set, the STATUS bit clears automatically so it is not necessary to clear the STATUS bit when programming. Otherwise, the STATUS bit must be cleared when programming ETM-M55 otherwise a single-shot comparison cannot occur.</p>
[30:4]	-	RES0
[3]	PC	<p>Indicates that the Single-shot comparator is sensitive to processor comparator inputs:</p> <p>1 Single-shot comparator is sensitive to processor comparator inputs.</p>
[2]	DV	<p>Data value comparator support:</p> <p>0 Single-shot data value comparisons not supported.</p>

Table 4-32 TRCSSCSR0 bit assignments (continued)

Bits	Name	Function
[1]	DA	Data address comparator support: 0 Single-shot data address comparisons not supported.
[0]	INST	Instruction address comparator support: 0 Single-shot instruction address comparisons not supported.

4.20 TRCSSPCICR0, Single-shot Processor Comparator Input Control Register 0

The TRCSSPCICR0 selects the processor comparator inputs for Single-shot control.

Usage constraints

Only accepts writes when ETM-M55 is disabled.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCSSPCICR0 bit assignments.

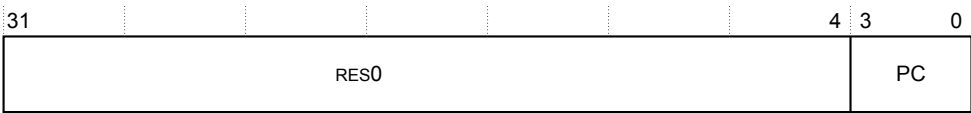


Figure 4-31 TRCSSPCICR0 bit assignments

The following table shows the TRCSSPCICR0 bit assignments.

Table 4-33 TRCSSPCICR0 bit assignments

Bits	Name	Function
[31:4]	-	RES0
[3:0]	PC	Selects one or more processor comparator inputs for Single-shot control. One bit is provided for each processor comparator input. The number of comparator inputs can be either two or four.

4.21 TRCPDCR, Power Down Control Register

The TRCPDCR request to the system power controller to keep ETM-M55 powered up.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCPDCR bit assignments.

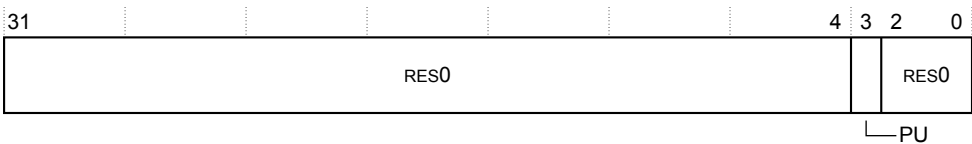


Figure 4-32 TRCPDCR bit assignments

The following table shows the TRCPDCR bit assignments.

Table 4-34 TRCPDCR bit assignments

Bits	Name	Function
[31:4]	-	RES0
[3]	PU	Power up request, to request that power to ETM-M55 and access to the trace registers is maintained: 0 Power not requested. 1 Power requested. This bit is reset to 0 on ETM-M55 reset.
[2:0]	-	RES0

4.22 TRCPDSR, Power Down Status Register

The TRCPDSR indicates the power down status of the ETM-M55.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCPDSR bit assignments.

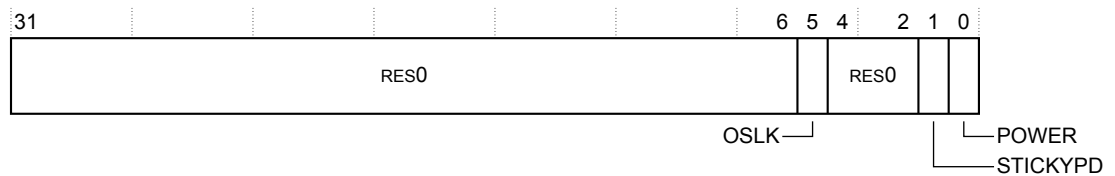


Figure 4-33 TRCPDSR bit assignments

The following table shows the TRCPDSR bit assignments.

Table 4-35 TRCPDSR bit assignments

Bits	Name	Function
[31:6]	-	RES0
[5]	OSLK	RES0
[4:2]	-	RES0
[1]	STICKYPD	<p>Sticky power down state.</p> <p>0 Trace register power has not been removed since the TRCPDSR was last read.</p> <p>1 Trace register power has been removed since the TRCPDSR was last read.</p> <p>This bit is set to 1 when power to the ETM-M55 registers is removed, to indicate that programming state has been lost. It is cleared after a read of the TRCPDSR.</p>
[0]	POWER	<p>Indicates ETM-M55 is powered up:</p> <p>1 ETM-M55 is powered up. All registers are accessible.</p> <p>If a system implementation allows ETM-M55 to be powered down independently of the debug power domain, the system must ensure:</p> <ul style="list-style-type: none"> • Accesses to ETM-M55 complete correctly. • Reads to this location return 0 to indicate that ETM-M55 can be powered down.

4.23 Integration test registers

The ETM-M55 integration test registers can be used to access some of the ports that are useful in determining the system level trace topology, by identifying the integration between specific components. Because the integration mode overrides the normal bus protocols, the ETM and ATB interconnect must be reset when any topology detection has been performed. Integration test registers are used to set the outputs and read the state of some of the signals.

To access the integration test registers, you must first set bit[0] of the [4.23.5 TRCITCTRL, Integration Mode Control Register on page 4-74](#) to 1.

- You can use the write-only integration test registers to set the outputs of some of the ETM-M55 signals. The following table shows the signals that can be controlled in this way.

Table 4-36 Output signals that the integration test registers can control

Signal	Register	Bits	Register description
AFREADYE	TRCITIATBOUTr	[1]	4.23.4 TRCITIATBOUTr, Integration Instruction ATB Out Register on page 4-73
ATIDE[6:0]	TRCITATBIDR	[6:0]	4.23.1 TRCITATBIDR, Integration ATB Identification Register on page 4-71
ATDATAE[6:0]	TRCITIDATAR	[6:0]	4.23.2 TRCITIDATAR, Integration Data Register on page 4-72
ATVALIDE	TRCITIATBOUTr	[0]	4.23.4 TRCITIATBOUTr, Integration Instruction ATB Out Register on page 4-73

- You can use the read-only integration test registers to read the state of some of the ETM-M55 input signals. The following table shows the signals that can be read in this way.

Table 4-37 Input signals that the integration test registers can read

Signal	Register	Bits	Register description
AFVALIDE	TRCITIATBINR	[1]	4.23.3 TRCITIATBINR, Integration Instruction ATB In Register on page 4-72
ATREADYE	TRCITIATBINR	[0]	4.23.3 TRCITIATBINR, Integration Instruction ATB In Register on page 4-72

See the *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* for more information about TRCITCTRL.

4.23.1 TRCITATBIDR, Integration ATB Identification Register

The TRCITATBIDR sets the state of output pins.

The output pins are listed in [Table 4-38 TRCITATBIDR bit assignments](#) on page 4-71.

Usage constraints

- Available when bit[0] of TRCITCTRL is set to 1.
- The value of the register sets the signals on the output pins when the register is written.
- This is a write-only register.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary](#) on page 4-32 and [Table 4-36 Output signals that the integration test registers can control](#) on page 4-70.

The following figure shows the TRCITATBIDR bit assignments.

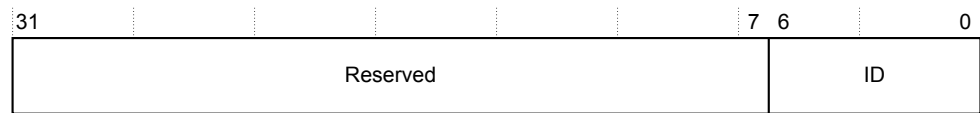


Figure 4-34 TRCITATBIDR bit assignments

The following table shows the TRCITATBIDR bit assignments.

Table 4-38 TRCITATBIDR bit assignments

Bits	Name	Function
[31:7]	-	RES0.
[6:0]	ID	Drives the ATIDE[6:0] output pin.

4.23.2 TRCITIDATAR, Integration Data Register

The TRCITIDATAR sets the state of output pins.

The output pins are listed in [Table 4-39 TRCITIDATAR bit assignments on page 4-72](#).

Usage constraints

- Available when bit[0] of TRCITCTRL is set to 1.
- The value of the register sets the signals on the output pins when the register is written.
- This is a write-only register.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#) and [Table 4-36 Output signals that the integration test registers can control on page 4-70](#).

The following figure shows the TRCITIDATAR bit assignments.

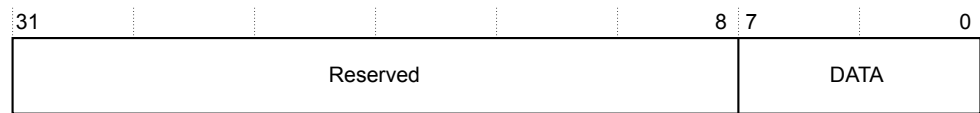


Figure 4-35 TRCITIDATAR bit assignments

The following table shows the TRCITIDATAR bit assignments.

Table 4-39 TRCITIDATAR bit assignments

Bits	Name	Function
[31:8]	-	RES0.
[7:0]	DATA	Drives the ATDATAE[7:0] output pin.

4.23.3 TRCITIATBINR, Integration Instruction ATB In Register

The TRCITIATBINR reads the state of the input pins.

The input pins are listed in [Table 4-40 TRCITIATBINR bit assignments on page 4-73](#).

Usage constraints

- Available when bit[0] of TRCITCTRL is set to 1.
- The values of the register bits depend on the signals on the input pins when the register is read.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#) and [Table 4-36 Output signals that the integration test registers can control on page 4-70](#).

The following figure shows the TRCITIATBINR bit assignments.

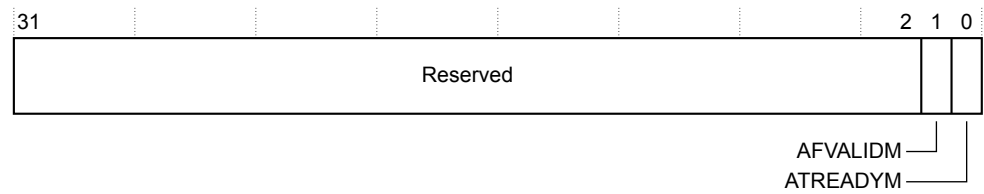


Figure 4-36 TRCITIATBINR bit assignments

The following table shows the TRCITIATBINR bit assignments.

Table 4-40 TRCITIATBINR bit assignments

Bits	Name	Function
[31:2]	-	Reserved. Read undefined.
[1]	AFVALIDM	Returns the value of the AFVALIDE input pin ^b .
[0]	ATREADYM	Returns the value of the ATREADYE input pin.

4.23.4 TRCITIATBOUTr, Integration Instruction ATB Out Register

The TRCITIATBOUTr sets the state of the output pins.

These output pins are listed in [Table 4-41 TRCITIATBOUTr bit assignments on page 4-74](#).

Usage constraints

- Available when bit[0] of TRCITCTRL is set to 1.
- The value of the register sets the signals on the output pins when the register is written.
- This is a write-only register.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#) and [Table 4-36 Output signals that the integration test registers can control on page 4-70](#).

The following figure shows the TRCITIATBOUTr bit assignments.

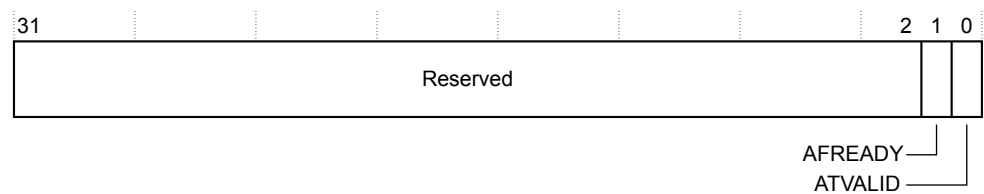


Figure 4-37 TRCITIATBOUTr bit assignments

The following table shows the TRCITIATBOUTr bit assignments.

^b When an input pin is LOW, the corresponding register bit is 0.
When an input pin is HIGH, the corresponding register bit is 1.
The TRCITIATBINR bit values always correspond to the physical state of the input pins.

Table 4-41 TRCITIATBOUTR bit assignments

Bits	Name	Function
[31:2]	-	Reserved. Read undefined.
[1]	AFREADY	Drives the AFREADYE output pin.
[0]	ATVALID	Drives the ATVALIDE output pin.

4.23.5 TRCITCTRL, Integration Mode Control Register

The TRCITCTRL enables topology detection or integration testing, by putting ETM-M55 into integration mode.

Usage constraints

Arm recommends that you perform a debug reset after using integration mode.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCITCTRL bit assignments.

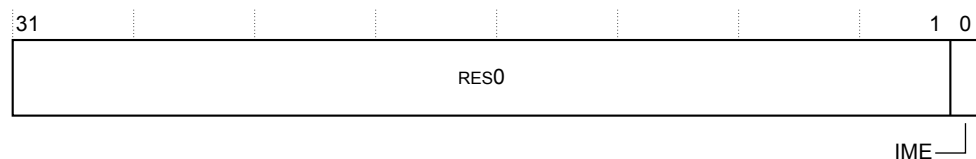


Figure 4-38 TRCITCTRL bit assignments

The following table shows the TRCITCTRL bit assignments.

Table 4-42 TRCITCTRL bit assignments

Bits	Name	Function
[31:1]	-	RES0
[0]	IME	Integration mode enable: 0 ETM-M55 is not in integration mode. This is the reset value. 1 ETM-M55 is in integration mode.

4.24 TRCCLAIMSET, Claim Tag Set Register

The TRCCLAIMSET sets bits in the claim tag and determines the number of claim tag bits implemented.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCCLAIMSET bit assignments.

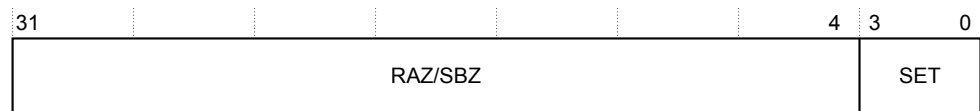


Figure 4-39 TRCCLAIMSET bit assignments

The following table shows the TRCCLAIMSET bit assignments.

Table 4-43 TRCCLAIMSET bit assignments

Bits	Name	Function
[31:4]	-	RAZ/SBZ.
[3:0]	SET	<p>On reads, each bit is:</p> <p>1 Claim tag bit is implemented. This value is returned for each of the claim bits 0-3, indicating 4 claim bits are implemented.</p> <p>On writes, setting each bit to:</p> <p>0 Has no effect.</p> <p>1 Sets the relevant bit of the claim tag.</p>

4.25 TRCCLAIMCLR, Claim Tag Clear Register

The TRCCLAIMCLR clears bits in the claim tag and determines the current value of the claim tag.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCCLAIMCLR bit assignments.

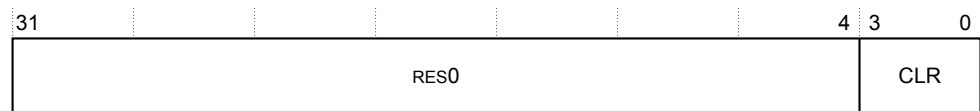


Figure 4-40 TRCCLAIMCLR bit assignments

The following table shows the TRCCLAIMCLR bit assignments.

Table 4-44 TRCCLAIMCLR bit assignments

Bits	Name	Function
[31:4]	-	RES0.
[3:0]	CLR	<p>On reads, for each bit:</p> <p>0 Claim tag bit is not set.</p> <p>1 Claim tag bit is set.</p> <p>On writes, for each bit:</p> <p>0 Has no effect.</p> <p>1 Clears the relevant bit of the claim tag.</p>

4.26 TRCAUTHSTATUS, Authentication Status Register

The TRCAUTHSTATUS indicates the current level of tracing permitted by the system.

Usage constraints

There are no usage constraints.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCAUTHSTATUS bit assignments.

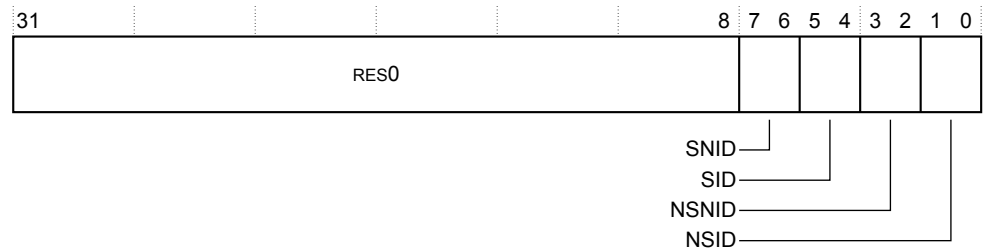


Figure 4-41 TRCAUTHSTATUS bit assignments

The following table shows the TRCAUTHSTATUS bit assignments.

Table 4-45 TRCAUTHSTATUS bit assignments

Bits	Name	Function
[31:8]	-	RES0
[7:6]	SNID ^c	Secure Non-Invasive Debug: 0b00 Secure Non-Invasive Debug not implemented. 0b10 Secure Non-Invasive Debug implemented, but disabled. 0b11 Secure Non-Invasive Debug implemented and enabled.
[5:4]	SID	Secure Invasive Debug: 0b00 Secure Invasive Debug not implemented.
[3:2]	NSNID	Non-secure Non-Invasive Debug: 0b10 Non-secure Non-Invasive Debug implemented, but disabled. 0b11 Non-secure Non-Invasive Debug implemented and enabled.
[1:0]	NSID	Non-secure Invasive Debug: 0b00 Non-secure Invasive Debug not implemented.

^c SNID bitfield is RAZ when the processor is configured without the Armv8-M Security Extension.

4.27 TRCDEVARCH, Device Architecture Register

The TRCDEVARCH identifies ETM-M55 as an ETMv4.5 component.

Usage constraints

This register is read-only.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCDEVARCH bit assignments.

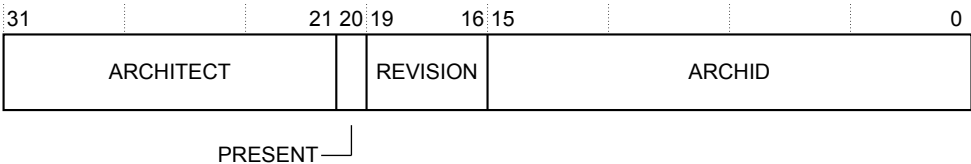


Figure 4-42 TRCDEVARCH bit assignments

The following table shows the TRCDEVARCH bit assignments.

Table 4-46 TRCDEVARCH bit assignments

Bits	Name	Function
[31:21]	ARCHITECT	Defines the architect of the component: 0x23B Arm.
[20]	PRESENT	Indicates the presence of this register: 0b1 Register is present.
[19:16]	REVISION	Architecture revision: 0x5 Architecture revision 4.5.
[15:0]	ARCHID	Architecture ID: 0x4A13 ETMv4.5 component.

4.28 TRCDEVID, Device ID Register

The TRCDEVID is reserved, RES0.

4.29 TRCDEVTYPE, Device Type Register

The TRCDEVTYPE indicates the type of the component.

Usage constraints

This register is read-only.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the TRCDEVTYPE bit assignments.

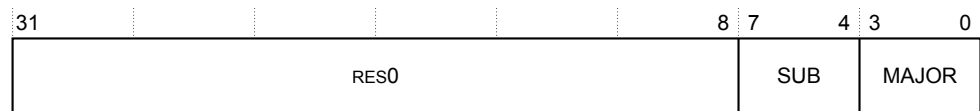


Figure 4-43 TRCDEVTYPE bit assignments

The following table shows the TRCDEVTYPE bit assignments.

Table 4-47 TRCDEVTYPE bit assignments

Bits	Name	Function
[31:8]	-	RES0.
[7:4]	SUB	The subtype of the component: 0b0001 Processor trace.
[3:0]	MAJOR	The main type of the component: 0b0011 Trace source.

4.30 TRCPIDR0-7, Peripheral Identification Registers

The TRCPIDR0-7 provides the standard Peripheral ID required by all CoreSight components.

Usage constraints

Only bits[7:0] of each register are used. This means that TRCPIDR0-7 define a single 64-bit *Peripheral ID*, as the following figure shows.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the mapping between TRCPIDR0-7 and the single 64-bit *Peripheral ID* value.

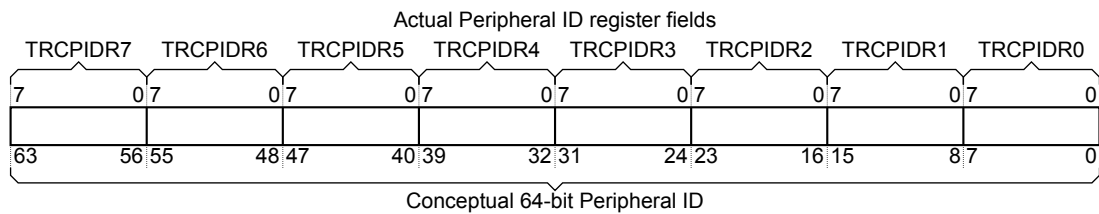


Figure 4-44 Mapping between TRCPIDR0-7 and the Peripheral ID value

The following figure shows the Peripheral ID bit assignments in the single conceptual Peripheral ID register.

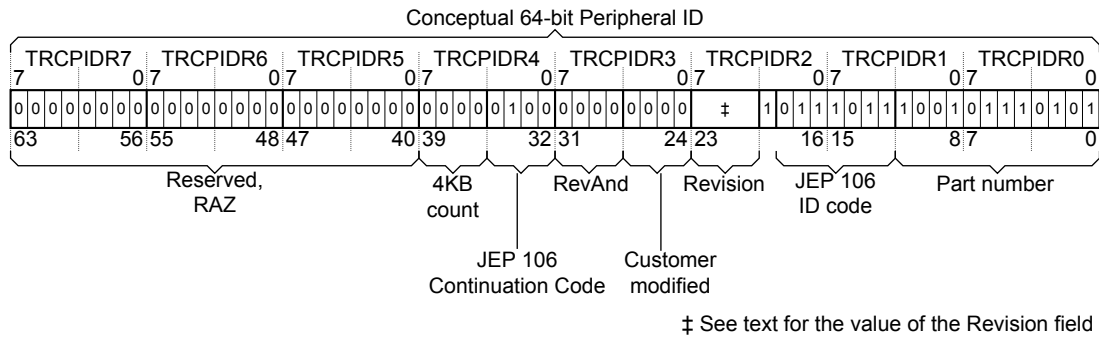


Figure 4-45 Peripheral ID fields

The following table shows the values of the fields when reading this set of registers. The *Arm® Embedded Trace Macrocell Architecture Specification ETMv4* gives more information about many of these fields.

The registers are listed in order of register name, from most significant (TRCPIDR7) to least significant (TRCPIDR0). This does not match the order of the register offsets.

Table 4-48 TCRPIDR0-7 bit assignments

Register	Register number	Register offset	Bits	Value	Description
TRCPIDR7	1015	0xFDC	[31:8]	-	RES0.
			[7:0]	0x00	RES0.
TRCPIDR6	1014	0xFD8	[31:8]	-	RES0.
			[7:0]	0x00	RES0.
TRCPIDR5	1013	0xFD4	[31:8]	-	RES0.
			[7:0]	0x00	RES0.
TRCPIDR4	1012	0xFD0	[31:8]	-	RES0.
			[7:4]	0x0	n, where 2 ⁿ is number of 4KB blocks used.
			[3:0]	0x4	JEP 106 continuation code.
TRCPIDR3	1019	0xFEC	[31:8]	-	RES0.
			[7:4]	0x0	RevAnd (at top level). Manufacturer revision number. ECOREVNUM[31:28].
			[3:0]	0x0	Customer Modified. 0x0 indicates from Arm.
TRCPIDR2	1018	0xFE8	[31:8]	-	RES0.
			[7:4]	See the Description column for more information.	Revision Number of Peripheral. This value is the same as the Implementation revision field of the TRCIDR1, see 4.16.2 TRCIDR1, ID Register 1 on page 4-53 .
			[3]	0x1	Always 1. Indicates that a JEDEC assigned value is used.
			[2:0]	0x3	JEP 106 identity code [6:4].
TRCPIDR1	1017	0xFE4	[31:8]	-	RES0.
			[7:4]	0xB	JEP 106 identity code [3:0].
			[3:0]	0xD	Part Number[11:8].
TRCPIDR0	1016	0xFE0	[31:8]	-	RES0.
			[7:0]	0x22	Part Number [7:0].

4.31 TRCCIDR0-3, Component Identification Registers

The TRCCIDR0-3 identifies ETM-M55 as a CoreSight component.

Usage constraints

Only bits[7:0] of each register are used. This means that TRCCIDR0-3 define a single 32-bit Component ID, as the following figure shows.

Configurations

Available in all configurations.

Attributes

See the register summary in [Table 4-1 ETM-M55 register summary on page 4-32](#).

The following figure shows the mapping between TRCCIDR0-3 and the single 64-bit *Component ID* value.

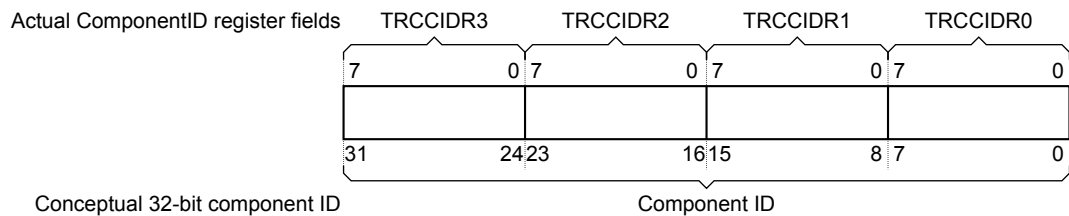


Figure 4-46 Mapping between TRCCIDR0-3 and the Component ID value

The following table shows the Component ID bit assignments in the single conceptual Component ID register.

The registers are listed in order of register name, from most significant (TRCCIDR3) to least significant (TRCCIDR0). This does not match the order of the register offsets.

Table 4-49 TRCCIDR0-3 bit assignments

Register	Register number	Register offset	Bits	Value	Description
TRCCIDR3	0x3FF	0xFFC	[31:8]	-	RES0.
			[7:0]	0xB1	Component identifier, bits[31:24].
TRCCIDR2	0x3FE	0xFF8	[31:8]	-	RES0.
			[7:0]	0x05	Component identifier, bits[23:16].
TRCCIDR1	0x3FD	0xFF4	[31:8]	-	RES0.
			[7:4]	0x9	Debug component with CoreSight-compatible registers (component identifier, bits[15:12]).
			[3:0]	0x0	Component identifier, bits[11:8].
TRCCIDR0	0x3FC	0xFF0	[31:8]	-	RES0.
			[7:0]	0x0D	Component identifier, bits[7:0].

Appendix A

Revisions

This appendix describes the technical changes between released issues of this book.

It contains the following section:

- [A.1 Revisions on page Appx-A-85](#).

A.1 Revisions

The following tables show any significant technical changes between released issues of this book.

Table A-1 Issue 0000-02

Change	Location	Updated in version
First Beta release for r0p0	-	-

Table A-2 Differences between issue 0000-02 and issue 0000-04

Change	Location	Updated in version
First limited access release for r0p0	-	-
Low-power override feature corrected to indicate that it is implemented	1.3 Features on page 1-15	r0p0
Example CoreSight system with ETM-M55 updated	1.1.1 The CoreSight™ debug environment on page 1-12	r0p0
Global timestamping functional block description changed.	Table 2-1 ETM-M55 functional blocks on page 2-23	r0p0
Description of external and input and output connection information between the ETM and CTI improved	2.2 External input and output connections on page 2-24	r0p0
Description of parallel instruction execution updated	2.3.3 Parallel instruction execution on page 2-25	r0p0
<ul style="list-style-type: none"> Instruction trace resource selection table updated Trigger event resource selection figure updated 	2.3.6 Resource selection on page 2-25 and 4.17 TRCRSCTLRn, Resource Selection Registers 2-3 on page 4-62	r0p0
Removed unnecessary subgrouping of register summary tables. Only single register summary table remains	4.1 Register summary on page 4-32	r0p0
Description of TRCSTALLCTLR.LEVEL field has been updated	4.7 TRCSTALLCTLR, Stall Control Register on page 4-41	r0p0
Description of TRCTRACEIDR has been updated	4.11 TRCTRACEIDR, Trace ID Register on page 4-45	r0p0
Description of TRCSSCSR0.STATUS has been updated	4.19 TRCSSCSR0, Single-shot Comparator Status Register 0 on page 4-65	r0p0

Table A-3 Differences between issue 0000-04 and issue 0001-05

Change	Location	Updated in version
First early access release for r0p1	-	-
Resource list updated	2.3.6 Resource selection on page 2-25	r0p1
TRCIDR1 reset value updated	<ul style="list-style-type: none"> 4.1 Register summary on page 4-32 4.16.2 TRCIDR1, ID Register 1 on page 4-53 	r0p1
TRCITIDATAR register description corrected	4.23.2 TRCITIDATAR, Integration Data Register on page 4-72	r0p1