Arm® RME System Architecture Compliance Suite

Version 2.0

User Guide

Non-Confidential

Issue 01
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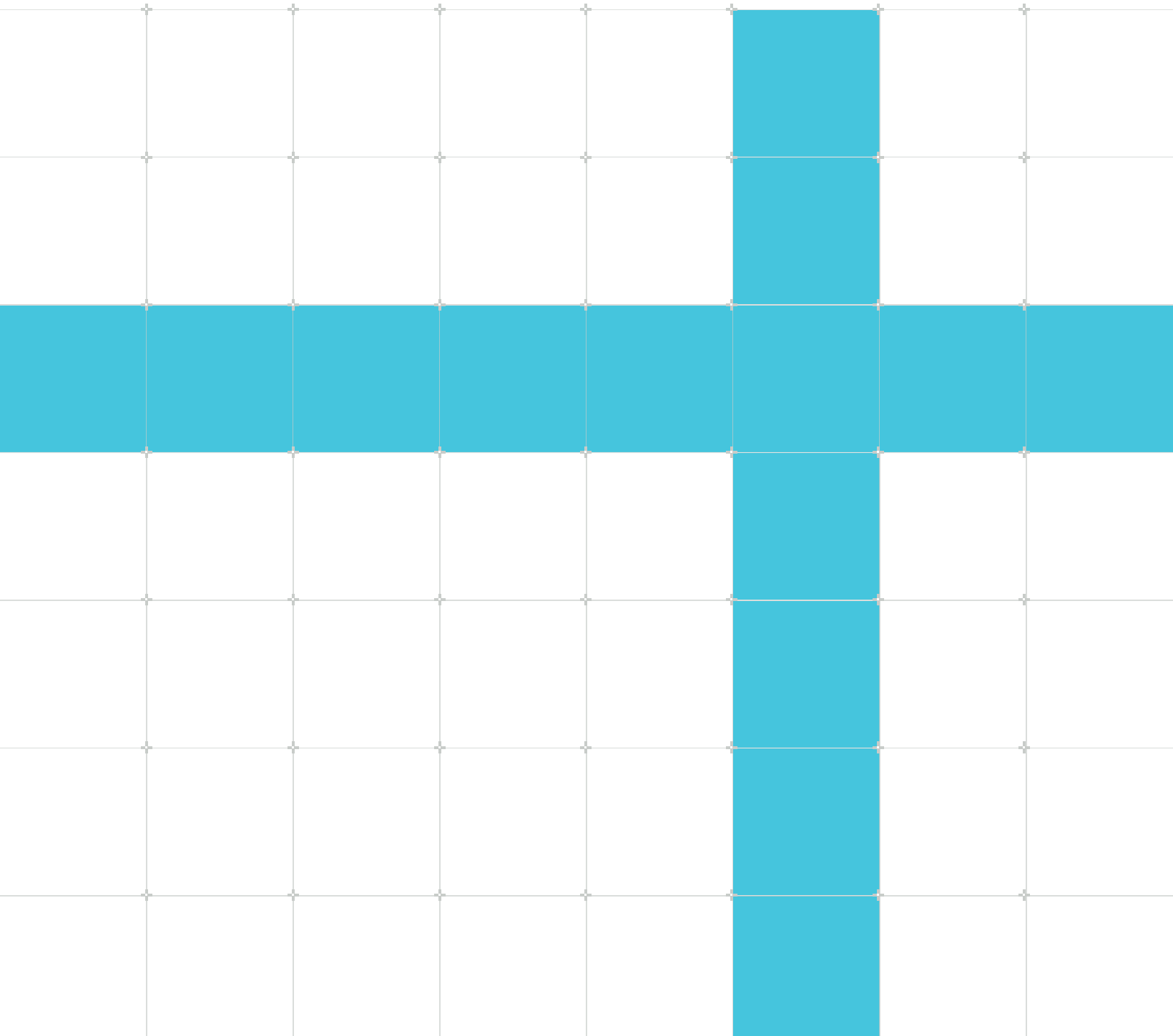

Arm® RME System Architecture Compliance Suite

User Guide

Release Information

Document history

Issue	Date	Confidentiality	Change
0200-01	15 November 2024	Non-Confidential	Beta release for issue B
0100-02	9 August 2024	Non-Confidential	First internal release
0100-01	13 December 2023	Non-Confidential	First release for v1.0
0007-01	6 November 2023	Non-Confidential	First release for v0.7
0006-01	25 August 2023	Confidential	First internal release for v0.6
0005-01	24 April 2023	Confidential	First internal release for v0.5

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Contents

1. Introduction

1.1 Conventions

The following subsections describe conventions used in Arm documents.

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: developer.arm.com/glossary.

Convention	Use
italic	Citations.
bold	Terms in descriptive lists, where appropriate.
`monospace`	Text that you can enter at the keyboard, such as commands, file and program names, and source code.
`monospace underline`	A permitted abbreviation for a command or option. You can enter the underlined text instead of the full command or option name.
`<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	Terms that have specific technical meanings as defined in the *Arm® Glossary*. For example, **IMPLEMENTATION DEFINED**, **IMPLEMENTATION SPECIFIC**, **UNKNOWN**, and **UNPREDICTABLE**.

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Arm product resources	Document ID	Confidentiality
Arm® Realm Management Extension (RME) System Architecture	DEN0129	Non-Confidential
Arm® System Memory Management Unit Architecture Specification	IHI0070	Non-Confidential

Arm architecture and specifications	Document ID	Confidentiality
Arm® Architecture Reference Manual for A-profile architecture	DDI0487	Non-Confidential
Arm® Generic Interrupt Controller Architecture Specification for GIC architecture version 3.0 and version 4.0	IHI0069C	Non-Confidential


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1.3 Other information

See the Arm® website for other relevant information.

- Arm® Developer.
- Arm® Documentation.
- Technical Support.
- Arm® Glossary.

2. Overview of the RME tests

This chapter provides an overview of the Realm Management Extension (RME) tests and the test IDs.

2.1 Abbreviations

The following table lists the abbreviations used in this document.

Table 2-1: Abbreviations and expansions

Abbreviation	Expansion
ACPI	Advanced Configuration and Power Interface
ACS	Architecture Compliance Suite
BDF	Bus, Device, and Function
CATU	CoreSight Address Translation Unit
DA	Device Assignment
DPT	Device Permission Table
ELx	Exception Level x (where x can be 0 to 3)
ETR	Embedded Trace Router
GIC	Generic Interrupt Controller
HVC	Hyper Visor Call
IOMMU	Input-Output Memory Management Unit
ITS	Interrupt Translation Service
IDE	Integrity and Data Encryption
KM	Key Management
LPI	Locality-specific Peripheral Interrupt
MPAM	Memory System Resource Partitioning and Monitoring
MSI	Message-Signaled Interrupt
MTE	Memory Tagging Extension
NUMA	Non-Uniform Memory Access
PAL	Platform Abstraction Layer
PCIe	Peripheral Component Interconnect express
PCCT	Platform Communications Channel Table
PE	Processing Element
PMU	Performance Monitor Unit
PSCI	Power State Coordination Interface
RAS	Reliability, Availability, and Serviceability
RAS2	Reliability, Availability, and Serviceability 2
RCiEP	Root Complex integrated End Point

Abbreviation	Expansion
RME	Realm Management Extension
RMM	Realm Management Monitor
RMSD	Realm Management Security Domain
SBSA	Server Base System Architecture
SMC	Secure Monitor Call
SMMU	System Memory Management Unit
SoC	System on Chip
TDI	TEE Device Interface
TDISP	TEE Device Interface Security Protocol
TEE	Trusted Execution Environment
UEFI	Unified Extensible Firmware Interface
UART	Universal Asynchronous Receiver and Transmitter
VAL	Validation Abstraction Layer

2.2 Overview of RME tests

The following table describes the general divisions of Arm Realm Management Extension System Architecture compliance tests between Unified Extensible Firmware Interface (UEFI) shell application and Bare-metal.

Table 2-2: Test environment and test suites

Test environment	Test suites
UEFI shell	RME, GIC, SMMU, Legacy System, and DA.
Bare-metal	RME, GIC, SMMU, Legacy System, and DA.

2.3 Test IDs

Each test ID is generated in addition to module ID and testcase ID. For a given module, testcase ID begins from 1.

The following table lists the module names and their IDs.

Table 2-3: Module names and module IDs

Module name	Module ID
RME	0
Exerciser	100
GIC	200
PCIe	300
SMMU	400

Module name	Module ID
Legacy System	500
DA	600

3. UEFI shell application

This chapter provides information on executing tests from the UEFI Shell application and its PAL API implementation.

3.1 UEFI application arguments

Run the UEFI Shell application with the following set of arguments:

```
uefi shell> rme.efi [-v <n>] [-skip <x,y,z>] [-t <test id>] [-m <module id>]
```

The following table provides descriptions to the arguments.

Table 3-1: Descriptions of UEFI application arguments

Argument	Description
`-v`	Print level **1** INFO and above. **2** DEBUG and above. **3** TEST and above. **4** WARN and ERROR. **5** ERROR.
`-skip`	Overrides the suite to skip the execution of a particular test. It allows a maximum of three values (comma-separated). For example, 300 skips test case with ID = 300. 400 skips all tests in module with ID = 400. For more information on module IDs, see, 2.3 Test IDs on page 10.
`-t`	To run only a single selected test. **Note:** `-m` will override `-t` if used on the same module.
`-m`	To run only single selected module.


Note

The UEFI session becomes unusable after the RME tests are run and the test results are printed on the UEFI console.

Examples of UEFI application arguments

Example 1

```
shell> rme.efi -v 2 -skip 200,2
```

The set of parameters shown in the code block:

- Prints messages with verbosity of 2 and above.
- Skips execution of all tests belonging to GIC module and test number 2.

Example 2

```
shell > rme.efi -m 0 -skip 1
```

The set of parameters shown in the code block:

- Runs only the RME module.
- Skips the RME test 1.

3.2 UEFI implementation of PAL APIs

This section provides information on infrastructure APIs and module-specific APIs.

3.2.1 Infrastructure APIs

The following table describes the Platform Abstraction Layer (PAL) APIs and UEFI interfaces.

Table 3-2: PAL APIs and UEFI interfaces

PAL APIs	UEFI interfaces
pal_print	AsciiPrint
mem_alloc	gBS->AllocatePool
mem_free	gBS->FreePool
mem_alloc_shared	gBS->AllocatePool
mem_free_shared	gBS->FreePool
mem_get_shared_addr	None
mem_alloc_cachebale	gBS->AllocatePages
mem_free_cacheable	gBS->FreePages
time_delay_ms	gBS->Stall
mem_alloc_pages	gBS->AllocatePages
mem_free_pages	gBS->FreePages
mmio_read	None
mmio_write	None

3.2.2 Module-specific APIs

The following table represents the mapping of PAL API to Advanced Configuration and Power Interface (ACPI), if the system firmware presents platform configuration through ACPI tables.

Table 3-3: PAL APIs, UEFI interfaces, and ACPI tables consumed

PAL API	UEFI interfaces consumed	ACPI table consumed
`pe_create_info_table`	• gST->ConfigurationTable • CompareGuid • IndustryStandard/Acpi.h	MADT Table
`pe_execute_payload`	-	-
`pe_install_esr`	• gEfiCpuArchProtocolGuid • Cpu->RegisterInterruptHandler	-
`gic_create_info_table`	• gST->ConfigurationTable • CompareGuid • IndustryStandard/Acpi.h	MADT table
`pcie_create_info_table`	• gST->ConfigurationTable • CompareGuid • IndustryStandard/Acpi.h	MCFG table
`peripheral_create_info_table`	• gEfiPciIoProtocolGuid • Pci->GetLocation • Pci->Pci.Read	-
`memory_create_info_table`	gBS->GetMemoryMap	-

Appendix A Revisions

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

A.1 Revisions

The following tables describe the changes between different issues of this document.

Table A-1: Issue 0005-01

Change	Location
First release	-

Table A-2: Differences between Issue 0005-01 and Issue 0006-01

Change	Location
Information about legacy system is added.	See 2.3 Test IDs on page 10

Table A-3: Differences between Issue 0006-01 and Issue 0007-01

Change	Location
Module list has been updated.	See 2.2 Overview of RME tests on page 10

Table A-4: Differences between Issue 0007-01 and Issue 0100-01

Change	Location
No technical changes	-

Table A-5: Differences between Issue 0100-01 and Issue 0100-02

Change	Location
Added new abbreviations.	See 2.1 Abbreviations on page 9
Updated the test environment and test suites table.	See 2.2 Overview of RME tests on page 10
Updated the description of test IDs.	See 2.3 Test IDs on page 10

Table A-6: Differences between Issue 0100-02 and Issue 0200-01

Change	Location
Added new abbreviation.	See 2.1 Abbreviations on page 9.