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# RTEMS 6

Ready to Fly

**RTEMS Qualification  
Data Package  
Software Configuration  
File**

**[sparc/gr712rc/smp/6]**

**Release 7**

# CONTENTS

<b>1 Introduction</b>	<b>3</b>
<b>2 Applicable and Reference Documents</b>	<b>5</b>
2.1 Applicable Documents . . . . .	5
2.2 Reference Documents . . . . .	5
<b>3 Terms, definitions and abbreviated terms</b>	<b>7</b>
<b>4 Software Configuration Item Overview</b>	<b>11</b>
4.1 ECSS Software Documentation Overview . . . . .	11
4.1.1 Requirements Baseline . . . . .	11
4.1.2 Technical Specification (TS) . . . . .	12
4.1.3 Design Definition File (DDF) . . . . .	12
4.1.4 Design Justification File (DJF) . . . . .	12
4.1.5 Management File (MGT) . . . . .	13
4.1.6 Maintenance File (MF) . . . . .	13
4.1.7 Operational (OP) . . . . .	13
4.1.8 Product Assurance File (PAF) . . . . .	14
4.2 Technical Notes Overview . . . . .	14
4.3 RTEMS Documentation Overview . . . . .	14
4.4 Formal Methods Documentation Overview . . . . .	15
4.5 ISVV Documentation Overview . . . . .	15
4.6 Git Repositories . . . . .	17
4.6.1 Git Repository: src/rsb . . . . .	17
4.6.2 Git Repository: src/rtems . . . . .	18
4.6.3 Git Repository: src/rtems-docs . . . . .	18
4.7 Guidelines for the Application Build . . . . .	18
4.7.1 Recommended Optimization Flags . . . . .	18
4.7.2 Mandatory Compiler/Linker Flags . . . . .	19
4.7.3 BSP Selection . . . . .	19
4.8 Static Memory Usage Benchmarks . . . . .	19
4.8.1 Benchmarks Based on: spec:/rtems/val/mem-basic . . . . .	20
4.8.2 Benchmarks Based on: spec:/rtems/val/mem-smp-1 . . . . .	22
4.8.3 Benchmark: spec:/rtems/val/mem-basic . . . . .	22
4.8.4 Benchmark: spec:/bsp/val/mem-clock . . . . .	22
4.8.5 Benchmark: spec:/rtems/barrier/val/mem-wait-rel . . . . .	22
4.8.6 Benchmark: spec:/rtems/barrier/val/mem-wait-rel-del . . . . .	23
4.8.7 Benchmark: spec:/rtems/clock/val/mem-get-uptime . . . . .	23
4.8.8 Benchmark: spec:/rtems/clock/val/mem-set . . . . .	23

4.8.9 Benchmark: spec:/rtems/clock/val/mem-set-get-tod . . . . .	23
4.8.10 Benchmark: spec:/rtems/event/val/mem-snd-rcv . . . . .	23
4.8.11 Benchmark: spec:/rtems/fatal/val/mem-fatal . . . . .	24
4.8.12 Benchmark: spec:/rtems/message/val/mem-bcst-rcv . . . . .	24
4.8.13 Benchmark: spec:/rtems/message/val/mem-snd-rcv . . . . .	24
4.8.14 Benchmark: spec:/rtems/message/val/mem-snd-rcv-del . . . . .	24
4.8.15 Benchmark: spec:/rtems/message/val/mem-ugt-rcv . . . . .	24
4.8.16 Benchmark: spec:/rtems/part/val/mem-get-ret . . . . .	25
4.8.17 Benchmark: spec:/rtems/part/val/mem-get-ret-del . . . . .	25
4.8.18 Benchmark: spec:/rtems/ratemon/val/mem-period . . . . .	25
4.8.19 Benchmark: spec:/rtems/ratemon/val/mem-period-del . . . . .	25
4.8.20 Benchmark: spec:/rtems/val/mem-smp-1 . . . . .	25
4.8.21 Benchmark: spec:/rtems/val/mem-smp-global-2 . . . . .	26
4.8.22 Benchmark: spec:/rtems/val/mem-smp-global-4 . . . . .	26
4.8.23 Benchmark: spec:/rtems/val/mem-smp-part-2 . . . . .	26
4.8.24 Benchmark: spec:/rtems/val/mem-smp-part-4 . . . . .	26
4.8.25 Benchmark: spec:/rtems/scheduler/val/mem-add-cpu . . . . .	26
4.8.26 Benchmark: spec:/rtems/scheduler/val/mem-rm-cpu . . . . .	27
4.8.27 Benchmark: spec:/rtems/sem/val/mem-obt-rel . . . . .	27
4.8.28 Benchmark: spec:/rtems/sem/val/mem-obt-rel-del . . . . .	27
4.8.29 Benchmark: spec:/rtems/signal/val/mem-catch-snd . . . . .	27
4.8.30 Benchmark: spec:/rtems/task/val/mem-delete . . . . .	27
4.8.31 Benchmark: spec:/rtems/task/val/mem-exit . . . . .	28
4.8.32 Benchmark: spec:/rtems/task/val/mem-get-affinity . . . . .	28
4.8.33 Benchmark: spec:/rtems/task/val/mem-get-priority . . . . .	28
4.8.34 Benchmark: spec:/rtems/task/val/mem-get-scheduler . . . . .	28
4.8.35 Benchmark: spec:/rtems/task/val/mem-mode . . . . .	28
4.8.36 Benchmark: spec:/rtems/task/val/mem-restart . . . . .	29
4.8.37 Benchmark: spec:/rtems/task/val/mem-set-affinity . . . . .	29
4.8.38 Benchmark: spec:/rtems/task/val/mem-set-priority . . . . .	29
4.8.39 Benchmark: spec:/rtems/task/val/mem-set-scheduler . . . . .	29
4.8.40 Benchmark: spec:/rtems/task/val/mem-sus-res . . . . .	29
4.8.41 Benchmark: spec:/rtems/task/val/mem-wake-after . . . . .	30
4.8.42 Benchmark: spec:/rtems/task/val/mem-wake-when . . . . .	30
4.8.43 Benchmark: spec:/rtems/timer/val/mem-after . . . . .	30
4.8.44 Benchmark: spec:/rtems/timer/val/mem-cancel . . . . .	30
4.8.45 Benchmark: spec:/rtems/timer/val/mem-delete . . . . .	30
4.8.46 Benchmark: spec:/rtems/timer/val/mem-reset . . . . .	31
4.8.47 Benchmark: spec:/rtems/timer/val/mem-srv-after . . . . .	31
4.8.48 Benchmark: spec:/rtems/timer/val/mem-srv-init . . . . .	31
4.8.49 Benchmark: spec:/rtems/timer/val/mem-srv-when . . . . .	31
4.8.50 Benchmark: spec:/rtems/timer/val/mem-when . . . . .	31
4.8.51 Benchmark: spec:/rtems/userext/val/mem-create . . . . .	32
4.8.52 Benchmark: spec:/rtems/userext/val/mem-delete . . . . .	32
4.9 Memory Usage of Objects . . . . .	32
4.9.1 Barrier Manager . . . . .	32
4.9.2 Message Manager . . . . .	32
4.9.3 Partition Manager . . . . .	32
4.9.4 Rate Monotonic Manager . . . . .	33
4.9.5 Schedulers . . . . .	33
4.9.6 Semaphore Manager . . . . .	33

4.9.7 Task Manager . . . . .	33
4.9.8 Timer Manager . . . . .	34
4.9.9 User Extensions Manager . . . . .	34
4.10 Migration Hints for Applications . . . . .	34
4.10.1 No -specs bsp_specs GCC Option . . . . .	34
4.10.2 No Manager Stubs . . . . .	34
4.10.3 rtems_task_create() vs. rtems_task_construct() . . . . .	34
4.10.4 Task Storage Area for Initialization Task . . . . .	35
4.10.5 rtems_message_queue_create() vs. rtems_message_queue_construct() . . . . .	36
4.10.6 How to install interrupt handlers? . . . . .	37
4.10.7 No free() . . . . .	37
4.10.8 No Filesystem Support . . . . .	37
4.10.9 No Newlib Reentrancy Support . . . . .	37
4.10.10 Linker Command File Requirements . . . . .	37
4.10.11 No EDISOFT RTEMS Improvement Error Reporting . . . . .	39
4.10.12 Customize the Inter-Processor Interrupt Number . . . . .	39
4.10.13 Hardware Errata . . . . .	39
4.11 Pre-Qualified Interfaces . . . . .	39
4.11.1 Application Configuration Information . . . . .	40
4.11.2 Barrier Manager . . . . .	40
4.11.3 Base Definitions . . . . .	41
4.11.4 CPU Usage Reporting . . . . .	42
4.11.5 Cache Manager . . . . .	42
4.11.6 Classic API Configuration . . . . .	42
4.11.7 Classic API Initialization Task Configuration . . . . .	43
4.11.8 Clock Manager . . . . .	43
4.11.9 Device Driver Configuration . . . . .	44
4.11.10 Directive Status Codes . . . . .	44
4.11.11 Dynamic Memory Allocation . . . . .	44
4.11.12 Event Manager . . . . .	44
4.11.13 Fatal Error Manager . . . . .	44
4.11.14 Filesystem Configuration . . . . .	44
4.11.15 General Scheduler Configuration . . . . .	44
4.11.16 General System Configuration . . . . .	45
4.11.17 Idle Task Configuration . . . . .	45
4.11.18 Interrupt Manager . . . . .	45
4.11.19 Kernel Character I/O Support . . . . .	46
4.11.20 Message Manager . . . . .	46
4.11.21 Object Services . . . . .	47
4.11.22 Partition Manager . . . . .	47
4.11.23 Rate-Monotonic Manager . . . . .	47
4.11.24 Scheduler Manager . . . . .	47
4.11.25 Semaphore Manager . . . . .	48
4.11.26 Signal Manager . . . . .	48
4.11.27 Support Services . . . . .	48
4.11.28 Task Manager . . . . .	48
4.11.29 Task Modes . . . . .	49
4.11.30 Task Stack Allocator Configuration . . . . .	49
4.11.31 Timer Manager . . . . .	49
4.11.32 User Extensions Manager . . . . .	50
4.11.33 spec:/c/if/group . . . . .	50

4.11.34 spec:/newlib/if/group . . . . .	50
<b>5 Inventory of Materials</b>	<b>51</b>
<b>6 Baseline Documents</b>	<b>53</b>
<b>7 Inventory of Software Configuration Item</b>	<b>55</b>
<b>8 Means Necessary for the Software Configuration Item</b>	<b>57</b>
<b>9 Installation Instructions</b>	<b>59</b>
9.1 Prepare the Host Computer . . . . .	59
9.1.1 Debian . . . . .	59
9.1.2 openSUSE . . . . .	59
9.2 Check the QDP Integrity . . . . .	59
9.3 Unpack the QDP Archive . . . . .	60
9.4 Build an Example Application . . . . .	60
9.5 Build a C++ Example Application . . . . .	61
9.6 Build an Ada Example Application . . . . .	62
9.7 Use QDP in a Docker solution . . . . .	63
<b>10 Change List</b>	<b>65</b>
10.1 Package Version 6 . . . . .	65
10.1.1 New issues . . . . .	66
10.1.2 Open issues . . . . .	66
10.1.3 Closed issues . . . . .	71
10.2 Package Version 5 . . . . .	73
10.2.1 New issues . . . . .	75
10.2.2 Open issues . . . . .	81
10.2.3 Closed issues . . . . .	81
10.3 Package Version 4 . . . . .	82
10.3.1 New issues . . . . .	82
10.3.2 Open issues . . . . .	83
10.3.3 Closed issues . . . . .	83
10.4 Package Version 3 . . . . .	83
10.4.1 New issues . . . . .	84
10.4.2 Open issues . . . . .	84
10.4.3 Closed issues . . . . .	84
10.5 Package Version 2 . . . . .	87
10.5.1 New issues . . . . .	87
10.5.2 Open issues . . . . .	89
10.5.3 Closed issues . . . . .	89
10.6 Package Version 1 . . . . .	94
10.6.1 New issues . . . . .	94
10.6.2 Open issues . . . . .	94
10.6.3 Closed issues . . . . .	94
<b>11 Auxiliary Information</b>	<b>95</b>
11.1 QDP Service and Maintenance . . . . .	95
11.2 Frequently Asked Questions . . . . .	95
11.2.1 How can I adopt the QDP to a new BSP, for example leon2? . . . . .	95
11.2.2 Is C++ supported? . . . . .	96
11.2.3 Is OpenMP supported? . . . . .	96

11.2.4	Is Ada supported? . . . . .	96
11.3	Targets . . . . .	96
11.3.1	GR712RC Dual-Core LEON3-FT Development Board . . . . .	96
11.3.2	SIS configured to simulate the GR712RC . . . . .	97
11.4	Guidance for RTEMS Qualification in User's Environment . . . . .	98
11.4.1	Engineering activities . . . . .	98
11.4.2	Product Assurance activities . . . . .	103
11.5	Use of Externally Provided Items . . . . .	105
11.6	Available and On Request QDPs for RTEMS . . . . .	107
11.6.1	AMD Xilinx . . . . .	108
11.6.2	fentISS Hypervisors . . . . .	108
11.6.3	Frontgrade Gaisler . . . . .	109
11.6.4	Microchip . . . . .	109
11.6.5	Teledyne e2v Semiconductors . . . . .	109
11.6.6	Texas Instruments . . . . .	110
11.7	License information . . . . .	110
11.7.1	Directory - src/binutils-2.41 . . . . .	110
11.7.1.1	File - COPYING . . . . .	110
11.7.1.2	File - COPYING3 . . . . .	117
11.7.2	Directory - src/doxygen-1.9.7 . . . . .	131
11.7.2.1	File - LICENSE . . . . .	131
11.7.3	Directory - src/expat-2.5.0 . . . . .	138
11.7.3.1	File - COPYING . . . . .	139
11.7.4	Directory - src/gcc-13.2.0 . . . . .	139
11.7.4.1	File - COPYING . . . . .	139
11.7.4.2	File - COPYING.LIB . . . . .	146
11.7.4.3	File - COPYING.RUNTIME . . . . .	157
11.7.4.4	File - COPYING3 . . . . .	159
11.7.4.5	File - COPYING3.LIB . . . . .	173
11.7.5	Directory - src/gdb-13.2 . . . . .	176
11.7.5.1	File - COPYING . . . . .	176
11.7.5.2	File - COPYING3 . . . . .	183
11.7.6	Directory - src/gmp-6.3.0 . . . . .	197
11.7.6.1	File - COPYINGv3 . . . . .	197
11.7.6.2	File - COPYING.LESSERv3 . . . . .	211
11.7.7	Directory - src/isl-0.26 . . . . .	215
11.7.7.1	File - LICENSE . . . . .	215
11.7.8	Directory - src/mpc-1.3.1 . . . . .	216
11.7.8.1	File - COPYING.LESSER . . . . .	216
11.7.9	Directory - src/mpfr-4.2.0 . . . . .	219
11.7.9.1	File - COPYING . . . . .	219
11.7.9.2	File - COPYING.LESSER . . . . .	233
11.7.10	Directory - src/sourceware-mirror-newlib-cygwin-fbc5496 . . . . .	237
11.7.10.1	File - COPYING.NEWLIB . . . . .	237
11.7.11	Directory - src/rsb . . . . .	269
11.7.11.1	File - LICENSE . . . . .	269
11.7.11.2	File - source-builder/sb/markdown/LICENSE.md . . . . .	270
11.7.12	Directory - src/rtems . . . . .	270
11.7.12.1	File - LICENSE . . . . .	271
11.7.12.2	File - LICENSE.Apache-2.0 . . . . .	271
11.7.12.3	File - LICENSE.BSD-2-Clause . . . . .	275

11.7.12.4 File - LICENSE.BSD-3-Clause . . . . .	277
11.7.12.5 File - LICENSE.CC-BY-SA-4.0 . . . . .	277
11.7.12.6 File - LICENSE.Freescale . . . . .	286
11.7.12.7 File - LICENSE.GPL-2.0 . . . . .	289
11.7.12.8 File - LICENSE.JFFS2 . . . . .	296
11.7.12.9 File - LICENSE.LLVM . . . . .	297
11.7.13 BSD-2-Clause copyrights . . . . .	303
<b>12 Possible Problems and Known Errors</b>	<b>305</b>
12.1 Open issues . . . . .	305
12.2 Postponed ISVV Findings . . . . .	310
12.3 Waiver . . . . .	312
<b>Bibliography</b>	<b>317</b>

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### Release: 7, Date: 2023-12-01, Status: Approved

Final release issued for project *RTEMS SMP SINGLE-CORE* with ESA Contract No. 4000140680/23/NL/AS. The following changes were implemented:

- Section *Change List* was updated.
- Section *Possible Problems and Known Errors* was updated.
- Section *Build an Ada Example Application* was added.
- Section *Service Providers* was replaced by section *QDP Service and Maintenance*.
- Section *Use of Externally Provided Items* was added.
- The presentation of the static memory benchmark results was clarified in section *Static Memory Usage Benchmarks*.
- Section *License information* was added.
- Section *BSP Selection* was added.
- Logos were alphabetically sorted by company names.

### Release: 6, Date: 2023-06-20, Status: Replaced



This is a release issued as a result of the ISVV activity.

The following ISVV findings and changes were implemented:

- RTEMS-SMP-REQ-VER-041 - Units for data representing a physical quantity.
- Logos and layout were updated.
- Updated *Change List* and *Possible Problems and Known Errors*.

**Release: 5, Date: 2022-05-18, Status: Replaced**

This is a warranty release issued for project *Qualification of RTEMS Symmetric Multiprocessing (SMP)* with ESA Contract No. 4000125572/18/NL/GLC/as. The following changes were implemented:

- In *Change List*, describe changes for package version 4.
- Add José Valdez (EDISOFT) as a writer of the document.

**Release: 4, Date: 2021-12-10, Status: Replaced**

This is the final release issued for project *Qualification of RTEMS Symmetric Multiprocessing (SMP)* with ESA Contract No. 4000125572/18/NL/GLC/as.

**Release: 3, Date: 2021-10-01, Status: Replaced**

Release issued for the *QR/2*.

**Release: 2, Date: 2021-05-28, Status: Replaced**

Release issued for the *QR/1*.

**Release: 1, Date: 2021-03-12, Status: Replaced**

Release issued for the *CDR*.

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## CHAPTER ONE

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## INTRODUCTION

The *RTEMS Qualification Data Package (QDP)* provides you with a comprehensive set of tools, libraries, header files, sources, and documentation to build applications using the *RTEMS* real-time operating system. Some components are pre-qualified for use in criticality category B systems according to *ECSS* standards for software products (ECSS-E-ST-40C [ECS09a] and ECSS-Q-ST-80C Rev.1 [ECS17]).

The QDP is shipped in the separate archive file `rtems-6-sparc-gr712rc-smp-6.tar.xz`<sup>1</sup>. Please read the *Installation Instructions* section before you unpack this archive. You may obtain this document and the QDP from the following ESA web site: <https://rtems-qual.io.esa.int/>.

The *ECSS Software Documentation Overview*, *Technical Notes Overview*, *RTEMS Documentation Overview* and *Formal Methods Documentation Overview* sections give you a structured overview and quick access to all documents of the QDP.

For help to migrate existing applications from a previous RTEMS version to the RTEMS version delivered by the QDP, see the *Migration Hints for Applications*. Migrating applications and a qualification according to ECSS standards is a complex task, especially if you migrate also from a uniprocessor system to an *SMP* system. For the QDP and related activities, service and maintenance is provided by embedded brains, see also *QDP Service and Maintenance*.

*Guidance for RTEMS Qualification in User's Environment* is provided in a dedicated section, describing the necessary steps to qualify the QDP in its own hardware platform. For *target* systems used to execute the validation tests of the QDP, see *Targets*.

### Important Notice

The QDP contains several open source software products which are covered by various open source licenses. You find all sources and licenses in the `/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src` directory in case the QDP was unpacked in `/opt/rtems`. See also the *License information*. The QDP is provided by the copyright holders and contributors “as is” and any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. In no event shall the copyright owner or contributors be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, procurement of substitute goods or services; loss of use, data, or profits; or business interruption) however caused and on any theory of liability, whether in contract, strict liability, or tort (including

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<sup>1</sup> The archive file `rtems-6-sparc-gr712rc-smp-6.tar.xz` has an SHA512 digest of `a59c59817faa0f4e01709d116bd71124ba6450b9210b27f2aea7ebc3bfd35768077cd0ad30fbbc122bcc221139bb3537cf0bf0b6a3a2eaf49d2f3b188089e849`.

negligence or otherwise) arising in any way out of the use of this software, even if advised of the possibility of such damage.

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## CHAPTER

## TWO

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# APPLICABLE AND REFERENCE DOCUMENTS

## 2.1 Applicable Documents

There are no *applicable documents*.

## 2.2 Reference Documents

For reference documents see the *bibliography*.

## RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]

Release 7

This document relates to ESA Contract No. 4000140680/23/NL/AS.

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## CHAPTER THREE

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### TERMS, DEFINITIONS AND ABBREVIATED TERMS

#### ABI

This term is an acronym for Application Binary Interface.

#### API

This term is an acronym for Application Programming Interface.

#### applicable document

This term is defined by the *ECSS* standard ECSS-S-ST-00-01C as a “document that contains provisions which, through reference in the source document, constitute additional provisions of the source document”.

#### Board Support Package

A collection of device initialization and control routines specific to a particular type of board or collection of boards.

#### BSP

This term is an acronym for *Board Support Package*.

#### C++11

The standard ISO/IEC 14882:2011.

#### C11

The standard ISO/IEC 9899:2011.

#### CDR

Critical Design Review

#### Clock Driver

The Clock Driver is a driver which provides the *clock tick* and a time counter. The time counter is used to drive the *CLOCK\_REALTIME* and *CLOCK\_MONOTONIC*. The Clock Driver can be initialized by the application with the *CONFIGURE\_APPLICATION\_NEEDS\_CLOCK\_DRIVER* and *CONFIGURE\_MICROSECONDS\_PER\_TICK* application configuration options.

#### clock tick

The clock tick is a coarse time measure provided by RTEMS. The *Clock Driver* emits clock ticks at rate specified by the *CONFIGURE\_MICROSECONDS\_PER\_TICK* application configuration option. In contrast to *CLOCK\_REALTIME* and *CLOCK\_MONOTONIC*, the clock tick rate is not affected by incremental adjustments.

#### CLOCK\_MONOTONIC

The *CLOCK\_MONOTONIC* is a clock provided by RTEMS which measures the time since an unspecified starting point. In contrast to *CLOCK\_REALTIME*, this clock cannot be set.

It may be affected by incremental adjustments for example carried out by the *NTP* or the use of a *PPS* signal. See also *CLOCK\_REALTIME*, *clock tick*, and *Clock Driver*.

### CLOCK\_REALTIME

The *CLOCK\_REALTIME* is a clock provided by RTEMS which measures the real time (also known as wall-clock time). It is defined by *POSIX*. In particular, every day is treated as if it contains exactly 86400 seconds and leap seconds are ignored. This clock can be set by the application which may result in time jumps. It may be affected by incremental adjustments for example carried out by the *NTP* or the use of a *PPS* signal. RTEMS can represent time points of this clock in nanoseconds ranging from 1988-01-01T00:00:00.000000000Z to 2514-05-31T01:53:03.999999999Z. See also *CLOCK\_MONOTONIC*, *clock tick*, and *Clock Driver*.

### ECSS

This term is an acronym for European Cooperation for Space Standardization.

### ESA

European Space Agency

### GCC

This term is an acronym for GNU Compiler Collection.

### GNU

This term is an acronym for GNU's Not Unix.

### GPLv3

This term is an acronym for GNU General Public License Version 3.

### GR712RC

The *GR712RC* is a *system-on-chip* containing two processors of the *SPARC target architecture*.

### IDLE task

A special low priority task which assumes control of the CPU when no other task is able to execute.

### IRD

This term is an acronym for Software Interface Requirements Document.

### LLVM

This term is an acronym for *Low Level Virtual Machine*. The LLVM Project is a collection of modular and reusable compiler and toolchain technologies.

### NTP

This term is an acronym for *Network Time Protocol*.

### OBC

This term is an acronym for On-Board Computer.

### OpenMP

This term is an acronym for *Open Multi-Processing*.

### POSIX

This term is an acronym for *Portable Operating System Interface*.

### PPS

This term is an acronym for *Pulse-Per-Second*.

**QDP**

This term is an acronym for Qualification Data Package.

**QR**

Qualification Review

**RB**

This term is an acronym for Requirements Baseline.

**RSB**

RTEMS Source Builder

**RTEMS**

This term is an acronym for Real-Time Executive for Multiprocessor Systems.

**SIS**

This term is an acronym for Simple Instruction Simulator. The SIS is a *SPARC V7/V8* and RISC-V RV32IMACFD *target architecture* simulator.

**SMP**

This term is an acronym for Symmetric Multiprocessing.

**SPARC**

This term is an acronym for *Scalable Processor ARChitecture*. See also *target architecture*.

**SRS**

Software Requirement Specification

**SSS**

This term is an acronym for Software System Specification.

**system-on-chip**

This project uses the *system on a chip definition of Wikipedia*: “A system on a chip or system-on-chip is an integrated circuit that integrates most or all components of a computer or other electronic system.”

Systems on a chip are *target* systems for applications using *RTEMS*.

**target**

The system on which the application will ultimately execute.

**target architecture**

The target architecture is the instruction set architecture (ISA) of the *target*. Some RTEMS features depend on the target architecture. For the details consult the *RTEMS CPU Architecture Supplement*.

**TLS**

This term is an acronym for Thread-Local Storage [Dre13]. TLS is available in *C11* and *C++11*. The support for TLS depends on the CPU port [con21a].



**RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]**

Release 7

This document relates to ESA Contract No. 4000140680/23/NL/AS.

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## CHAPTER

## FOUR

## SOFTWARE CONFIGURATION ITEM OVERVIEW

Documents generated specifically for a QDP contain a package variant identification and version, for example [sparc-gr712rc-smp-6]. The package variant may have an impact on the content of documents. For example, the *SRS* generated for an SMP configuration will contain other requirements compared to the *SRS* generated for an uniprocessor configuration. Another example are the memory benchmarks and object sizes presented in this document, see *Static Memory Usage Benchmarks* and *Memory Usage of Objects*. In addition to the package variant identification and version, each document has a release number which is defined in the document-specific changes information placed after the table of contents.

### 4.1 ECSS Software Documentation Overview

Before trying to access the documents, please read the *Installation Instructions* section and unpack the QDP archive.

#### 4.1.1 Requirements Baseline

The Requirement Baseline (*RB*) which consists of the Software System Specification (*SSS*) and the Software Interface Requirements Document (*IRD*) is not contained in the QDP. The system requirements are to be defined by you, the end user of the QDP. RTEMS is designed as a reusable software product which can be utilized by application designers to ease the development of their applications. The requirements of the end system (system requirements) using RTEMS are only known to the application designer. RTEMS itself is developed by the RTEMS maintainers and they do not know the requirements of a particular end system in general. RTEMS is designed as a real-time operating system to meet typical system requirements for a wide range of applications. Its suitability for a particular application must be determined by the application designer based on the technical specification provided by the QDP accompanied with performance data for a particular target platform.

## 4.1.2 Technical Specification (TS)

The QDP includes the following documents of the Technical Specification (TS):

- Software Requirements Specification (SRS) [HK+23b]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/srs/srs.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/srs/html/index.html
- Interface Control Document (ICD) [HK+23a]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/icd/icd.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/icd/html/index.html

## 4.1.3 Design Definition File (DDF)

The QDP includes the following documents of the Design Definition File (DDF):

- Software Configuration File (SCF)

The SCF is this document. It is an exception, since it is contained outside the QDP. The reason for being not included in the QDP is that the SCF may be used to verify the authenticity and integrity of the QDP, see *Inventory of Software Configuration Item*.
- Software Detailed Design (SDD) [con23]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ddf/sdd/html/index.html
- Software Release Document (SReID) [H+23]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ddf/sreld/sreld.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ddf/sreld/html/index.html
- Software User Manual (SUM)

The QDP does **not** provide a SUM which strictly follows the ECSS clauses. Please refer to the SCF (this document) and the *RTEMS Documentation Overview*.

## 4.1.4 Design Justification File (DJF)

The QDP includes the following documents of the Design Justification File (DJF):

- Software Reuse File (SRF)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/srf/SRF-024.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/srf/html/index.html
- Software Unit and Integration Test Plan (SUITP) [HK+23c]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/suitp/suitp.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/suitp/html/index.html
- Software Unit and Integration Test Report (SUITR)

The Software Unit and Integration Test Report is a part of the Software Verification Report (SVR) [HK+23e].

- Software Validation Specification (SVS) with Respect to TS [HK+23d]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svs/svs.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svs/html/index.html
- Software Validation Report (SValR)

The Software Validation Test Report is a part of the Software Verification Report (SVR) [HK+23e].
- Software Verification Report (SVR) [HK+23e]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svr/svr.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svr/html/index.html

#### 4.1.5 Management File (MGT)

The QDP includes the following documents of the Management File (MGT):

- Software Development Plan (SDP) [S+21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/sdp/SDP-000.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/sdp/html/index.html
- Software Review Plan (SRevP) [Ram21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/srevp/SRevP-018.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/srevp/html/index.html
- Software Configuration Management Plan (SCMP) [Sil21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/scmp/SCMP-001.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/scmp/html/index.html

#### 4.1.6 Maintenance File (MF)

The maintenance software life cycle state is not covered by the QDP. The RTEMS development will continue independently. One goal of the project which delivered this QDP was to establish procedures in the RTEMS community so that the quality level achieved by the activity can be maintained in the future development of RTEMS.

#### 4.1.7 Operational (OP)

The operational software life cycle state is not covered by the QDP. You, as an end user of the QDP, will hopefully have an operational phase if the software product delivered by the QDP is used in your applications.

### 4.1.8 Product Assurance File (PAF)

The QDP includes the following documents of the Product Assurance File (PAF):

- Software Product Assurance Milestone Report (SPAMR) [KGV+23]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spamr/spamr.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spamr/html/index.html
- Software Product Assurance Plan (SPAP) [Mat21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spap/SPAP-002.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spap/html/index.html

## 4.2 Technical Notes Overview

Before trying to access the documents, please read the *Installation Instructions* section and unpack the QDP archive.

The QDP includes the following technical notes:

- QT-109 Technical Note: RTEMS SMP Qualification Target [HVM+21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/technical-notes/tn-qt/QT-109.pdf
- Technical Note: Space Profile [HV21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/technical-notes/tn-sp/tn-space-profile.pdf
- TI-003 Tools Identification [VP21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/technical-notes/tn-ti/TI-003.pdf

## 4.3 RTEMS Documentation Overview

Before trying to access the documents, please read the *Installation Instructions* section and unpack the QDP archive.

The QDP includes the following manuals of the RTEMS documentation set:

- RTEMS User Manual [con21f]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/user.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/user/index.html
- RTEMS Classic API Guide [con21c]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/c-user.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/c-user/index.html
- RTEMS Software Engineering [con21d]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/eng.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/eng/index.html

- RTEMS CPU Supplement [con21b]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/cpu-supplement.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/rtems/cpu-supplement/index.html

## 4.4 Formal Methods Documentation Overview

Before trying to access the documents, please read the *Installation Instructions* section and unpack the QDP archive.

The QDP includes the following Formal Methods documentation set:

- Formal Verification Plan (Algorithms, Requirements, Approach) [BH21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fvp/FV1-200.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fvp/index.html
- Formal Verification Artefacts (Architecture, Models, Assumptions, Traceability, Supporting Tests) [BT23]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fva/FV2-201.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fva/index.html
- Formal Verification Report [But21]
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fvr/FV3-202.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/fm/fvr/index.html

## 4.5 ISVV Documentation Overview

Before trying to access the documents, please read the *Installation Instructions* section and unpack the QDP archive.

### ISVV Documents Copyrights and License

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- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/gls/  
CSW-RTEMSISVV-2021-GLS-04956\_4-rtems-smp-isvv-glossary-and-acronyms.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivep/  
CSW-RTEMSISVV-2023-PLN-01130\_2-rtems-smp-isvv-ive-plan.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report.pdf

- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report-code-annex.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report-code-annex.xlsx
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivap/  
CSW-RTEMSISVV-2021-SVP-04961\_6-rtems-smp-isvv-iva-plan.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2021-RPT-04962\_4-rtems-smp-isvv-iva-report.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2021-RPT-04962\_4-rtems-smp-isvv-iva-report-execution-logs-annex.zip
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2022-TCS-02711\_9-rtems-smp-isvv-iva-test-specification-worksheet.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2022-TCS-02711\_9-rtems-smp-isvv-iva-test-specification-worksheet.xlsx
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2023-LST-01297\_3-rtems-smp-isvv-all-findings-except-for-code-analysis.pdf
- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2023-LST-01297\_3-rtems-smp-isvv-all-findings-except-for-code-analysis.xlsx

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The QDP includes the following Independent Software Verification and Validation (ISVV) documentation set:

- Glossary and Acronyms
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/gls/  
CSW-RTEMSISVV-2021-GLS-04956\_4-rtems-smp-isvv-glossary-and-acronyms.pdf
- Independent Verification Plan
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivep/  
CSW-RTEMSISVV-2023-PLN-01130\_2-rtems-smp-isvv-ive-plan.pdf
- Independent Verification Report (and Code Analysis Annex)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report-code-annex.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/iver/  
CSW-RTEMSISVV-2021-RPT-04960\_7-rtems-smp-isvv-ive-report-code-annex.xlsx

- Independent Validation Plan
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivap/  
CSW-RTEMSISVV-2021-SVP-04961\_6-rtems-smp-isvv-iva-plan.pdf
- Independent Validation Report and Artefacts (Test Specification and Results, Test Procedures, Execution Logs)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2021-RPT-04962\_4-rtems-smp-isvv-iva-report.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2021-RPT-04962\_4-rtems-smp-isvv-iva-report-execution-logs-annex.  
zip
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2022-TSP-05453\_1-rtems-smp-isvv-iva-test-procedures.zip
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2022-TCS-02711\_9-rtems-smp-isvv-iva-test-specification-worksheet.  
pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/ivar/  
CSW-RTEMSISVV-2022-TCS-02711\_9-rtems-smp-isvv-iva-test-specification-worksheet.  
xlsx
- List of All Findings (except for code analysis)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/CSW-RTEMSISVV-2023-LST-01297\_  
3-rtems-smp-isvv-all-findings-except-for-code-analysis.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/isvv/CSW-RTEMSISVV-2023-LST-01297\_  
3-rtems-smp-isvv-all-findings-except-for-code-analysis.xlsx

## 4.6 Git Repositories

The QDP contains the following Git repositories. Optionally, you can fetch the repository state with the `git fetch origin` command from the upstream project. For example, this gives you access to the complete source code history of the RTEMS Project. Since the source code is delivered in Git repositories you know exactly which changes were done for the QDP on top of the software baseline provided by the RTEMS Project. You can directly use the QDP branches to do project-specific customizations.

### 4.6.1 Git Repository: src/rsb

This repository contains the RTEMS Source Builder. It was used to provide the RTEMS tool suite shipped with the QDP. The QDP contains a binary distribution of the RTEMS tools suite. The `rtems/patches` and `rtems/sources` directories in the RSB directory contain the patches and sources of the tool suite used to build the binary distribution. This helps you to meet the GPL requirements of some tools. You do not have to run the RSB on your own. For example, you may run the RSB to adopt the QDP to a different host computer platform.

The `qdp` branch with commit `ae81810adcfef8bd3ab8cfca2ed5ba4ac4b9779f` was used to build the QDP. This branch is checked out after unpacking the archive. It is based on `com-`



mit [ae81810adcfef8bd3ab8cfca2ed5ba4ac4b9779f](#) of the master branch of the origin remote repository.

## 4.6.2 Git Repository: src/rtems

This repository contains the RTEMS sources. It is used to provide the BSPs shipped with the QDP.

The qdp branch with commit [4f55ae1c76be4f843d4c1dc327c6e67e55f1bf7a](#) was used to build the QDP. This branch is checked out after unpacking the archive. It is based on commit [ac16e3b9611297697ffd8f6d80166c2c05f745e5](#) of the master branch of the origin remote repository.

## 4.6.3 Git Repository: src/rtems-docs

This repository contains the RTEMS Documentation sources. It is used to provide the RTEMS Documentation shipped with the QDP.

The qdp branch with commit [fb1caee76676112b2d23226f79c5cb548d4cb877](#) was used to build the QDP. This branch is checked out after unpacking the archive. It is based on commit [2c88912893ebbcc3b9fa14d4fcc100c42252d0df](#) of the master branch of the origin remote repository.

## 4.7 Guidelines for the Application Build

### 4.7.1 Recommended Optimization Flags

It is recommend to use the following optimization flags to compile C code of applications and libraries:

```
-O2 -ffunction-sections -fdata-sections -g
```

These flags are used to compile the production BSPs provided by the QDP. To link executables, it is recommended to enable the linker garbage collection with `-Wl,--gc-sections`. The test programs of the BSP were linked with this option. The rationale for using `-O2` is that this optimization level is commonly used.

Using function and data sections has an impact on the code generation since locations in translation units are unknown until link time. However, together with the linker garbage collection, smaller statically-linked executables can be produced. This helps to include only code in the executable that is actually used by the application. It avoids shipping executables with dead (or deactivated) code, which just wastes the typically expensive memory in the space domain. In addition, it may reduce the bandwidth requirements when flight software needs to be patched or uploaded in flight.

The application may use other optimization flags if necessary. However, the *ABI* shall be compatible to the BSP. See also *Build an Example Application*.

## 4.7.2 Mandatory Compiler/Linker Flags

It is absolutely mandatory to adhere to the *ABI* defined by the BSP. It is recommended to use exactly the ABI relevant flags (machine flags) defined by the BSP for the application. You can query the ABI flags, CFLAGS, and linker flags of the desired BSP with the pkg-config command line tool, for example:

```
$ pkg-config --variable=ABI_FLAGS /opt/rtems/rtems-6-sparc-gr712rc-smp-6/lib/
↳pkgconfig/sparc-rtems6-gr712rc-qual-only.pc
-mcpu=leon3 -mfix-gr712rc

$ pkg-config --cflags /opt/rtems/rtems-6-sparc-gr712rc-smp-6/lib/pkgconfig/sparc-
↳rtems6-gr712rc-qual-only.pc
-mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-gr712rc-smp-6/sparc-
↳rtems6/gr712rc-qual-only/lib/include

$ pkg-config --libs /opt/rtems/rtems-6-sparc-gr712rc-smp-6/lib/pkgconfig/sparc-
↳rtems6-gr712rc-qual-only.pc
-B/opt/rtems/rtems-6-sparc-gr712rc-smp-6/sparc-rtems6/gr712rc-qual-only/lib -
↳qrtems -nodefaultlibs -Wl,--start-group -lrtemsbasp -lrtemscpu -lgcc -Wl,--end-
↳group -Wl,--gc-sections
```

Using pkg-config to query the tool flags of the BSP avoids having hard coded flags in the application build system. It is recommended to place the linker flags provided by pkg-config to the end of the linker command line used to link the application executable. See also [Build an Example Application](#). Linking to libgcc.a is not strictly required to use the operating system services, see also [Use of Externally Provided Items](#). It is strongly recommended to review the linker map file of the application executable to check that all dependencies have an adequate quality level.

## 4.7.3 BSP Selection

There are two BSP installations provided. The sparc/gr712rc-qual-only variant contains only the pre-qualified feature set of RTEMS. This variant shall be used by applications which are required to use the pre-qualified RTEMS. To support development, prototyping, and debugging activities, the sparc-extra variant is provided. This variant contains the full RTEMS feature set (except POSIX signals). The build system and configuration maintainers of the application should take care that the right BSP variant is selected.

## 4.8 Static Memory Usage Benchmarks

The memory usage benchmarks help you to get a rough estimate of the static memory usage of selected RTEMS features. For each benchmark program, the size in bytes of the following sections is listed:

### **.text**

This section covers the benchmark program *code*.

### **.rodata**

This section covers the *read-only data* of the benchmark program.

**.data**

This section covers the *initialized read-write data* of the benchmark program.

**.bss**

This section covers the *zero-initialized read-write data* of the benchmark program.

**.noinit**

This section covers the *not initialized read-write data* of the benchmark program. Similar to the .bss section, this section as no content in the program image. However, in contrast to the zero-initialized .bss section, the content of .noinit section is not initialized at all during system start. Objects in this sections shall be fully initialized before they are used. This section contains statically allocated stacks. For example, stacks for the system initialization, idle threads, and interrupt processing. It contains also statically allocated system-provided objects and the associated maintenance data structures, the so called RTEMS Workspace.

In the tables below, the first data row of the table refers to a memory benchmark program which is used as a reference for the following memory benchmark programs. This gives you a hint how the statically allocated memory usage changes if certain features are added on top of the reference memory benchmark program.

For example, in *Benchmarks Based on: spec:/rtems/val/mem-basic* the reference memory benchmark program is specified by spec:/rtems/val/mem-basic. The .text section of this memory benchmark program has 35712 bytes. In one of the following rows, the sections of the memory benchmark program specified by spec:/bsp/val/mem-clock are compared with the reference memory benchmark program. The number +2672 in the .text section column indicates that the program code increased by this amount of bytes with respect to the reference memory benchmark program of the table. In this case, this gives you an estimate how much code is required for the *Clock Driver*.

**4.8.1 Benchmarks Based on: spec:/rtems/val/mem-basic**

The following static memory benchmarks are based on the reference memory benchmark specified by *spec:/rtems/val/mem-basic*. The numbers of the first row represent the section sizes of the reference memory benchmark program in bytes. The numbers in the following rows indicate the change in bytes of the section sizes with respect to the reference memory benchmark program of the first row. A + indicates a size increase and a - indicates a size decrease. This hints how the static memory usage changes when the feature set changes with respect to the reference memory benchmark.

Specification	.text	.rodata	.data	.bss	.noinit
<i>/rtems/val/mem-basic</i>	35712	96	560	4080	14048
<i>/bsp/val/mem-clock</i>	+2672	+0	+48	+32	+16
<i>/rtems/barrier/val/mem-wait-rel</i>	+1552	+0	+64	+0	+48
<i>/rtems/barrier/val/mem-wait-rel-del</i>	+1712	+0	+64	+0	+80
<i>/rtems/clock/val/mem-get-uptime</i>	+336	+0	+16	+0	-16
<i>/rtems/clock/val/mem-set</i>	+3168	+0	+64	+16	+32
<i>/rtems/clock/val/mem-set-get-tod</i>	+5328	+0	+64	+16	-16
<i>/rtems/event/val/mem-snd-rcv</i>	+1392	+0	+16	+0	+16
<i>/rtems/fatal/val/mem-fatal</i>	+32	+0	+0	+0	+32
<i>/rtems/message/val/mem-bcst-rcv</i>	+4880	+0	+64	+0	+112

continues on next page

Table 1 – continued from previous page

Specification	.text	.rodata	.data	.bss	.noinit
/rtems/message/val/mem-snd-rcv	+5040	+0	+64	+0	+80
/rtems/message/val/mem-snd-rcv-del	+5232	+0	+64	+0	+80
/rtems/message/val/mem-ugt-rcv	+5040	+0	+64	+0	+80
/rtems/part/val/mem-get-ret	+800	+0	+64	+0	+96
/rtems/part/val/mem-get-ret-del	+992	+0	+64	+0	+96
/rtems/ratemon/val/mem-period	+2160	+0	+48	+0	+208
/rtems/ratemon/val/mem-period-del	+2400	+0	+48	+0	+224
/rtems/val/mem-smp-1	+18608	+0	+0	-3008	+16
/rtems/val/mem-smp-global-2	+18624	+0	+0	-2496	+9088
/rtems/val/mem-smp-global-4	+18640	+0	+0	-1408	+27248
/rtems/val/mem-smp-part-2	+18736	+0	+0	-2384	+9744
/rtems/val/mem-smp-part-4	+18976	+0	+0	-960	+30496
/rtems/scheduler/val/mem-add-cpu	+19120	+0	+0	-3008	+16
/rtems/scheduler/val/mem-rm-cpu	+19888	+0	+0	-3008	+16
/rtems/sem/val/mem-obt-rel	+9456	+0	+48	+0	+80
/rtems/sem/val/mem-obt-rel-del	+9824	+0	+48	+0	+96
/rtems/signal/val/mem-catch-snd	+1264	+0	+16	+0	+16
/rtems/task/val/mem-delete	+960	+0	+16	+0	+0
/rtems/task/val/mem-exit	+112	+0	+16	+0	+16
/rtems/task/val/mem-get-affinity	+432	+0	+0	+0	+16
/rtems/task/val/mem-get-priority	+672	+0	+0	+0	+32
/rtems/task/val/mem-get-scheduler	+176	+0	+0	+0	+16
/rtems/task/val/mem-mode	+720	+0	+16	+0	-16
/rtems/task/val/mem-restart	+1248	+0	+16	+0	+32
/rtems/task/val/mem-set-affinity	+496	+0	+16	+0	+16
/rtems/task/val/mem-set-priority	+1056	+0	+16	+0	+32
/rtems/task/val/mem-set-scheduler	+1824	+0	+16	+0	+32
/rtems/task/val/mem-sus-res	+272	+0	+16	+0	-16
/rtems/task/val/mem-wake-after	+512	+0	+16	+0	+0
/rtems/task/val/mem-wake-when	+1104	+0	+16	+0	-16
/rtems/timer/val/mem-after	+912	+0	+48	+0	+112
/rtems/timer/val/mem-cancel	+464	+0	+48	+0	+112
/rtems/timer/val/mem-delete	+528	+0	+48	+0	+112
/rtems/timer/val/mem-reset	+784	+0	+48	+0	+112
/rtems/timer/val/mem-srv-after	+1456	+0	+48	+0	+80
/rtems/timer/val/mem-srv-init	+1632	+0	+64	+32	+96
/rtems/timer/val/mem-srv-when	+2064	+0	+64	+0	+112
/rtems/timer/val/mem-when	+1552	+0	+64	+0	+112
/rtems/userext/val/mem-create	+256	+0	+64	+0	+128
/rtems/userext/val/mem-delete	+832	+0	+64	+0	+128

## 4.8.2 Benchmarks Based on: spec:/rtems/val/mem-smp-1

The following static memory benchmarks are based on the reference memory benchmark specified by `spec:/rtems/val/mem-smp-1`. The numbers of the first row represent the section sizes of the reference memory benchmark program in bytes. The numbers in the following rows indicate the change in bytes of the section sizes with respect to the reference memory benchmark program of the first row. A + indicates a size increase and a - indicates a size decrease. This hints how the static memory usage changes when the feature set changes with respect to the reference memory benchmark.

Specification	.text	.rodata	.data	.bss	.noinit
<code>/rtems/val/mem-smp-1</code>	54320	96	560	1072	14064
<code>/rtems/val/mem-smp-global-2</code>	+16	+0	+0	+512	+9072
<code>/rtems/val/mem-smp-global-4</code>	+32	+0	+0	+1600	+27232
<code>/rtems/val/mem-smp-part-2</code>	+128	+0	+0	+624	+9728
<code>/rtems/val/mem-smp-part-4</code>	+368	+0	+0	+2048	+30480
<code>/rtems/scheduler/val/mem-add-cpu</code>	+512	+0	+0	+0	+0
<code>/rtems/scheduler/val/mem-rm-cpu</code>	+1280	+0	+0	+0	+0

## 4.8.3 Benchmark: spec:/rtems/val/mem-basic

This static memory usage benchmark program facilitates a basic application configuration.

This resource benchmark is configured for exactly one processor, no clock driver, no Newlib reentrancy support, and no file system.

.text	.rodata	.data	.bss	.noinit
35712	96	560	4080	14048

## 4.8.4 Benchmark: spec:/bsp/val/mem-clock

This static memory usage benchmark program facilitates a basic application configuration with the clock driver enabled (`CONFIGURE_APPLICATION_NEEDS_CLOCK_DRIVER`).

.text	.rodata	.data	.bss	.noinit
38384	96	608	4112	14064

## 4.8.5 Benchmark: spec:/rtems/barrier/val/mem-wait-rel

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_BARRIERS` defined to one and calls to `rtems_barrier_create()`, `rtems_barrier_wait()`, and `rtems_barrier_release()`.

.text	.rodata	.data	.bss	.noinit
37264	96	624	4080	14096

#### 4.8.6 Benchmark: spec:/rtems/barrier/val/mem-wait-rel-del

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_BARRIERS` defined to one and calls to `rtems_barrier_create()`, `rtems_barrier_wait()`, `rtems_barrier_release()`, and `rtems_barrier_delete()`.

.text	.rodata	.data	.bss	.noinit
37424	96	624	4080	14128

#### 4.8.7 Benchmark: spec:/rtems/clock/val/mem-get-uptime

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_clock_get_uptime()`.

.text	.rodata	.data	.bss	.noinit
36048	96	576	4080	14032

#### 4.8.8 Benchmark: spec:/rtems/clock/val/mem-set

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_clock_set()`.

.text	.rodata	.data	.bss	.noinit
38880	96	624	4096	14080

#### 4.8.9 Benchmark: spec:/rtems/clock/val/mem-set-get-tod

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_clock_set()` and `rtems_clock_get_tod()`.

.text	.rodata	.data	.bss	.noinit
41040	96	624	4096	14032

#### 4.8.10 Benchmark: spec:/rtems/event/val/mem-snd-rcv

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_event_send()` and `rtems_event_receive()`.

.text	.rodata	.data	.bss	.noinit
37104	96	576	4080	14064

#### 4.8.11 Benchmark: spec:/rtems/fatal/val/mem-fatal

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_fatal()`.

.text	.rodata	.data	.bss	.noinit
35744	96	560	4080	14080

#### 4.8.12 Benchmark: spec:/rtems/message/val/mem-bcst-rcv

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_message_queue_construct()`, `rtems_message_queue_broadcast()`, and `rtems_message_queue_receive()`.

.text	.rodata	.data	.bss	.noinit
40592	96	624	4080	14160

#### 4.8.13 Benchmark: spec:/rtems/message/val/mem-snd-rcv

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_message_queue_construct()`, `rtems_message_queue_send()`, and `rtems_message_queue_receive()`.

.text	.rodata	.data	.bss	.noinit
40752	96	624	4080	14128

#### 4.8.14 Benchmark: spec:/rtems/message/val/mem-snd-rcv-del

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_message_queue_construct()`, `rtems_message_queue_send()`, `rtems_message_queue_receive()`, and `rtems_message_queue_delete()`.

.text	.rodata	.data	.bss	.noinit
40944	96	624	4080	14128

#### 4.8.15 Benchmark: spec:/rtems/message/val/mem-ugt-rcv

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_message_queue_construct()`, `rtems_message_queue_urgent()`, and `rtems_message_queue_receive()`.

.text	.rodata	.data	.bss	.noinit
40752	96	624	4080	14128

#### 4.8.16 Benchmark: spec:/rtems/part/val/mem-get-ret

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PARTITIONS` defined to one and calls to `rtems_partition_create()`, `rtems_partition_get_buffer()`, and `rtems_partition_return_buffer()`.

.text	.rodata	.data	.bss	.noinit
36512	96	624	4080	14144

#### 4.8.17 Benchmark: spec:/rtems/part/val/mem-get-ret-del

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PARTITIONS` defined to one and calls to `rtems_partition_create()`, `rtems_partition_get_buffer()`, `rtems_partition_return_buffer()`, and `rtems_partition_delete()`.

.text	.rodata	.data	.bss	.noinit
36704	96	624	4080	14144

#### 4.8.18 Benchmark: spec:/rtems/ratemon/val/mem-period

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PERIODS` defined to one and calls to `rtems_rate_monotonic_create()` and `rtems_rate_monotonic_period()`.

.text	.rodata	.data	.bss	.noinit
37872	96	608	4080	14256

#### 4.8.19 Benchmark: spec:/rtems/ratemon/val/mem-period-del

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PERIODS` defined to one and calls to `rtems_rate_monotonic_create()`, `rtems_rate_monotonic_period()`, and `rtems_rate_monotonic_delete()`.

.text	.rodata	.data	.bss	.noinit
38112	96	608	4080	14272

#### 4.8.20 Benchmark: spec:/rtems/val/mem-smp-1

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PROCESSORS` defined to one using the SMP EDF scheduler (`CONFIGURE_SCHEDULER_EDF_SMP`).

.text	.rodata	.data	.bss	.noinit
54320	96	560	1072	14064



#### 4.8.21 Benchmark: spec:/rtems/val/mem-smp-global-2

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PROCESSORS` defined to two using the global SMP EDF scheduler (`CONFIGURE_SCHEDULER_EDF_SMP`).

.text	.rodata	.data	.bss	.noinit
54336	96	560	1584	23136

#### 4.8.22 Benchmark: spec:/rtems/val/mem-smp-global-4

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PROCESSORS` defined to four using the global SMP EDF scheduler (`CONFIGURE_SCHEDULER_EDF_SMP`).

.text	.rodata	.data	.bss	.noinit
54352	96	560	2672	41296

#### 4.8.23 Benchmark: spec:/rtems/val/mem-smp-part-2

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PROCESSORS` defined to two using one SMP EDF scheduler for each configured processor (`CONFIGURE_SCHEDULER_EDF_SMP`).

.text	.rodata	.data	.bss	.noinit
54448	96	560	1696	23792

#### 4.8.24 Benchmark: spec:/rtems/val/mem-smp-part-4

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_PROCESSORS` defined to four using one SMP EDF scheduler for each configured processor (`CONFIGURE_SCHEDULER_EDF_SMP`).

.text	.rodata	.data	.bss	.noinit
54688	96	560	3120	44544

#### 4.8.25 Benchmark: spec:/rtems/scheduler/val/mem-add-cpu

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_scheduler_add_processor()`.

.text	.rodata	.data	.bss	.noinit
54832	96	560	1072	14064

#### 4.8.26 Benchmark: spec:/rtems/scheduler/val/mem-rm-cpu

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_scheduler_remove_processor()`.

.text	.rodata	.data	.bss	.noinit
55600	96	560	1072	14064

#### 4.8.27 Benchmark: spec:/rtems/sem/val/mem-obt-rel

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_SEMAPHORES` defined to one and calls to `rtems_semaphore_create()`, `rtems_semaphore_obtain()`, and `rtems_semaphore_release()`.

.text	.rodata	.data	.bss	.noinit
45168	96	608	4080	14128

#### 4.8.28 Benchmark: spec:/rtems/sem/val/mem-obt-rel-del

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_SEMAPHORES` defined to one and calls to `rtems_semaphore_create()`, `rtems_semaphore_obtain()`, `rtems_semaphore_release()`, and `rtems_semaphore_delete()`.

.text	.rodata	.data	.bss	.noinit
45536	96	608	4080	14144

#### 4.8.29 Benchmark: spec:/rtems/signal/val/mem-catch-snd

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_signal_catch()` and `rtems_signal_send()`.

.text	.rodata	.data	.bss	.noinit
36976	96	576	4080	14064

#### 4.8.30 Benchmark: spec:/rtems/task/val/mem-delete

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_delete()`.

.text	.rodata	.data	.bss	.noinit
36672	96	576	4080	14048

#### 4.8.31 Benchmark: spec:/rtems/task/val/mem-exit

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_exit()`.

.text	.rodata	.data	.bss	.noinit
35824	96	576	4080	14064

#### 4.8.32 Benchmark: spec:/rtems/task/val/mem-get-affinity

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_get_affinity()`.

.text	.rodata	.data	.bss	.noinit
36144	96	560	4080	14064

#### 4.8.33 Benchmark: spec:/rtems/task/val/mem-get-priority

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_get_priority()`.

.text	.rodata	.data	.bss	.noinit
36384	96	560	4080	14080

#### 4.8.34 Benchmark: spec:/rtems/task/val/mem-get-scheduler

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_get_scheduler()`.

.text	.rodata	.data	.bss	.noinit
35888	96	560	4080	14064

#### 4.8.35 Benchmark: spec:/rtems/task/val/mem-mode

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_mode()`.

.text	.rodata	.data	.bss	.noinit
36432	96	576	4080	14032

#### 4.8.36 Benchmark: spec:/rtems/task/val/mem-restart

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_restart()`.

.text	.rodata	.data	.bss	.noinit
36960	96	576	4080	14080

#### 4.8.37 Benchmark: spec:/rtems/task/val/mem-set-affinity

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_set_affinity()`.

.text	.rodata	.data	.bss	.noinit
36208	96	576	4080	14064

#### 4.8.38 Benchmark: spec:/rtems/task/val/mem-set-priority

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_set_priority()`.

.text	.rodata	.data	.bss	.noinit
36768	96	576	4080	14080

#### 4.8.39 Benchmark: spec:/rtems/task/val/mem-set-scheduler

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_set_scheduler()`.

.text	.rodata	.data	.bss	.noinit
37536	96	576	4080	14080

#### 4.8.40 Benchmark: spec:/rtems/task/val/mem-sus-res

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_task_suspend()` and `rtems_task_resume()`.

.text	.rodata	.data	.bss	.noinit
35984	96	576	4080	14032

#### 4.8.41 Benchmark: spec:/rtems/task/val/mem-wake-after

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_wake_after()`.

.text	.rodata	.data	.bss	.noinit
36224	96	576	4080	14048

#### 4.8.42 Benchmark: spec:/rtems/task/val/mem-wake-when

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_task_wake_when()`.

.text	.rodata	.data	.bss	.noinit
36816	96	576	4080	14032

#### 4.8.43 Benchmark: spec:/rtems/timer/val/mem-after

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_fire_after()`.

.text	.rodata	.data	.bss	.noinit
36624	96	608	4080	14160

#### 4.8.44 Benchmark: spec:/rtems/timer/val/mem-cancel

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_cancel()`.

.text	.rodata	.data	.bss	.noinit
36176	96	608	4080	14160

#### 4.8.45 Benchmark: spec:/rtems/timer/val/mem-delete

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_delete()`.

.text	.rodata	.data	.bss	.noinit
36240	96	608	4080	14160

#### 4.8.46 Benchmark: spec:/rtems/timer/val/mem-reset

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_reset()`.

.text	.rodata	.data	.bss	.noinit
36496	96	608	4080	14160

#### 4.8.47 Benchmark: spec:/rtems/timer/val/mem-srv-after

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_server_fire_after()`.

.text	.rodata	.data	.bss	.noinit
37168	96	608	4080	14128

#### 4.8.48 Benchmark: spec:/rtems/timer/val/mem-srv-init

This static memory usage benchmark program facilitates a basic application configuration with a call to `rtems_timer_initiate_server()`.

.text	.rodata	.data	.bss	.noinit
37344	96	624	4112	14144

#### 4.8.49 Benchmark: spec:/rtems/timer/val/mem-srv-when

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_server_fire_when()`.

.text	.rodata	.data	.bss	.noinit
37776	96	624	4080	14160

#### 4.8.50 Benchmark: spec:/rtems/timer/val/mem-when

This static memory usage benchmark program facilitates a basic application configuration with calls to `rtems_timer_create()` and `rtems_timer_fire_when()`.

.text	.rodata	.data	.bss	.noinit
37264	96	624	4080	14160

#### 4.8.51 Benchmark: spec:/rtems/userext/val/mem-create

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_USER_EXTENSIONS` defined to one and a call to `rtems_extension_create()`.

.text	.rodata	.data	.bss	.noinit
35968	96	624	4080	14176

#### 4.8.52 Benchmark: spec:/rtems/userext/val/mem-delete

This static memory usage benchmark program facilitates a basic application configuration with `CONFIGURE_MAXIMUM_USER_EXTENSIONS` defined to one and calls to `rtems_extension_create()` and `rtems_extension_delete()`.

.text	.rodata	.data	.bss	.noinit
36544	96	624	4080	14176

### 4.9 Memory Usage of Objects

This section gives an overview of the application configuration dependent memory requirements of RTEMS provided objects.

#### 4.9.1 Barrier Manager

If the Barrier Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 52 bytes.

#### 4.9.2 Message Manager

If the Message Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 88 bytes. The memory area used for the messages managed by a message queue object is user-provided.

#### 4.9.3 Partition Manager

If the Partition Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 60 bytes. The memory area managed by a partition object is user-provided.

#### 4.9.4 Rate Monotonic Manager

If the Rate Monotonic Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 188 bytes.

#### 4.9.5 Schedulers

The memory used for global scheduler data structures depends on the application configuration. Each scheduler has different memory requirements.

Each configured scheduler needs 112 bytes of read-only data.

The Deterministic Priority Scheduler needs 48 bytes. In addition, it needs 12 bytes for each configured priority level.

The Earliest Deadline First SMP Scheduler needs 76 bytes. In addition, it needs 20 bytes for each configured processor.

#### 4.9.6 Semaphore Manager

If the Semaphore Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager depends on the application configuration. Let  $S$  be the count of configured schedulers. Each object of this manager has a size of  $\max\{76, 68 + 8S\}$  bytes.

#### 4.9.7 Task Manager

There are 60 bytes required to maintain the objects of this manager. The size of an object of this manager depends on the application configuration. Each object of this manager has at least a size of 648 bytes.

Additional 64 bytes are required for each configured scheduler.

If at least one user extension is configured, then additional 4 bytes are required for each configured user extension plus one.

Let  $N$  be the maximum of

- 144, if the Deterministic Priority Scheduler is configured, and
- 152, if the Earliest Deadline First SMP Scheduler is configured.

Additional  $N$  bytes are required for each configured scheduler.

Due to alignment requirements of the individual components additional memory is required for structure internal padding. The memory area used for the task storage used by a task object is user-provided.



## 4.9.8 Timer Manager

If the Timer Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 76 bytes.

## 4.9.9 User Extensions Manager

If the User Extensions Manager is used by the application, then 48 bytes are required to maintain the objects of this manager. The size of an object of this manager is independent of the application configuration. Each object of this manager has a size of 76 bytes.

## 4.10 Migration Hints for Applications

This section covers some topics which need to be considered when migrating an application from a previous RTEMS versions to the RTEMS version delivered by the QDP. The focus is on a migration from RTEMS 4.8 and the EDISOFT RTEMS Improvement. For migration help from other versions, see also the [RTEMS User Manual](#).

### 4.10.1 No -specs bsp\_specs GCC Option

The `-spec bsp_specs` GCC Option is no longer needed to build RTEMS applications and there is no `bsp_specs` file installed. If you use this option, then you get an error like this:

```
sparc-rtems6-gcc: fatal error: cannot read spec file 'bsp_specs': No such file or ↵
↵directory
```

You can remove this GCC option from your build to fix this error. Alternatively, you can add an empty `bsp_specs` file.

### 4.10.2 No Manager Stubs

Older RTEMS versions provided stub files for some RTEMS Managers. These stub files are no longer needed and they are not installed. Remove the support for them in your build system.

### 4.10.3 `rtems_task_create()` vs. `rtems_task_construct()`

The `rtems_task_create()` directive is pre-qualified, however, it is only available if a custom stack allocator is configured. It is recommended to use `rtems_task_construct()` instead, for example:

```
#define MAX_TLS_SIZE RTEMS_ALIGN_UP( 64, RTEMS_TASK_STORAGE_ALIGNMENT )

#define TASK_ATTRIBUTES RTEMS_DEFAULT_ATTRIBUTES

RTEMS_ALIGNED( RTEMS_TASK_STORAGE_ALIGNMENT )
static char task_storage[
    RTEMS_TASK_STORAGE_SIZE(
```

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```

    MAX_TLS_SIZE + RTEMS_MINIMUM_STACK_SIZE,
    TASK_ATTRIBUTES
)
];

static const rtems_task_config task_config = {
    .name = rtems_build_name( 'T', 'A', 'S', 'K' ),
    .initial_priority = 123,
    .storage_area = task_storage,
    .storage_size = sizeof( task_storage ),
    .maximum_thread_local_storage_size = MAX_TLS_SIZE,
    .initial_modes = RTEMS_DEFAULT_MODES,
    .attributes = TASK_ATTRIBUTES
};

void construct( void )
{
    rtems_status_code sc;
    rtems_id          id;

    sc = rtems_task_construct( &task_config, &id );
    if ( sc != RTEMS_SUCCESSFUL ) {
        oops();
    }
}

```

#### 4.10.4 Task Storage Area for Initialization Task

Since the `rtems_task_create()` directive is not supported without a custom stack allocator in the pre-qualified feature set of RTEMS, the task storage area for the initialization task shall be provided by the application. The application shall define the application configuration option `CONFIGURE_INIT_TASK_CONSTRUCT_STORAGE_SIZE` and the related options:

```

#define MAX_TLS_SIZE RTEMS_ALIGN_UP( 64, RTEMS_TASK_STORAGE_ALIGNMENT )

#define TASK_ATTRIBUTES RTEMS_DEFAULT_ATTRIBUTES

#define TASK_STORAGE_SIZE \
    RTEMS_TASK_STORAGE_SIZE( \
        MAX_TLS_SIZE + RTEMS_MINIMUM_STACK_SIZE, \
        TASK_ATTRIBUTES \
    )

#define CONFIGURE_MAXIMUM_THREAD_LOCAL_STORAGE_SIZE MAX_TLS_SIZE

#define CONFIGURE_RTEMS_INIT_TASKS_TABLE

#define CONFIGURE_INIT_TASK_ATTRIBUTES TASK_ATTRIBUTES

```

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```
#define CONFIGURE_INIT_TASK_CONSTRUCT_STORAGE_SIZE TASK_STORAGE_SIZE
```

The maximum thread-local storage size of the application and the initialization task must be consistent. In the example above, this is ensured by using `MAX_TLS_SIZE` for all definitions. For your application, replace the example value of 64 with the maximum thread-local storage size required by your application. The task attributes of the initialization task shall be consistent with the task attributes used to define the initialization task storage area. In the example above, this is ensured by using `TASK_ATTRIBUTES` for all definitions. Your application may use different attributes.

For an example which uses these application configuration options, see *Build an Example Application*.

#### 4.10.5 `rtems_message_queue_create()` vs. `rtems_message_queue_construct()`

The `rtems_message_queue_create()` directive is not pre-qualified. As a pre-qualified alternative use `rtems_message_queue_construct()` instead, for example:

```
#define MSG_SIZE sizeof( int )

static RTEMS_MESSAGE_QUEUE_BUFFER( MSG_SIZE ) msg_buffers[ 13 ];

static const rtems_message_queue_config msg_queue_config = {
    .name = rtems_build_name( 'M', 'S', 'G', 'Q' ),
    .maximum_pending_messages = RTEMS_ARRAY_SIZE( msg_buffers ),
    .maximum_message_size = MSG_SIZE,
    .storage_area = msg_buffers,
    .storage_size = sizeof( msg_buffers ),
    .attributes = RTEMS_DEFAULT_ATTRIBUTES
};

void construct( void )
{
    rtems_status_code sc;
    rtems_id          id;

    sc = rtems_message_queue_construct( &msg_queue_config, &id );
    if ( sc != RTEMS_SUCCESSFUL ) {
        oops();
    }
}
```

#### 4.10.6 How to install interrupt handlers?

Do not use `rtems_interrupt_catch()`, `set_vector()`, or `_CPU_ISR_install_vector()` to install an interrupt handler. Instead, use `rtems_interrupt_entry_install()`.

#### 4.10.7 No free()

You can allocate memory using the `rtems_malloc()`, `rtems_calloc()`, and `posix_memalign()` functions. However, the `free()` function is not pre-qualified. There is also no `malloc()`, `calloc()`, `realloc()`, and `aligned_alloc()` available since these functions depend on `errno` which is not pre-qualified.

#### 4.10.8 No Filesystem Support

The file systems supported by RTEMS are not pre-qualified. Therefore, the application configuration options `CONFIGURE_MAXIMUM_FILE_DESCRIPTOR` and `CONFIGURE_APPLICATION_DISABLE_FILESYSTEM` are mandatory for each application which is restricted to only use pre-qualified interfaces of RTEMS:

```
#define CONFIGURE_MAXIMUM_FILE_DESCRIPTOR 0  
  
#define CONFIGURE_APPLICATION_DISABLE_FILESYSTEM
```

If you do not have these option defined, then you get linker errors for an undefined reference to `rtems_filesystem_initialize`. For an example which uses these application configuration options, see *Build an Example Application*.

#### 4.10.9 No Newlib Reentrancy Support

The Newlib reentrancy support is not pre-qualified. Therefore, the application configuration option `CONFIGURE_DISABLE_NEWLIB_REENTRANCY` is mandatory for each application which is restricted to only use pre-qualified interfaces of RTEMS:

```
#define CONFIGURE_DISABLE_NEWLIB_REENTRANCY
```

If you do not have this option defined, then you get linker errors for undefined references to `newlib_create_hook` and `newlib_terminate_hook`. For an example which uses this application configuration option, see *Build an Example Application*.

#### 4.10.10 Linker Command File Requirements

The RTEMS version of the QDP supports thread-local storage (*TLS*) and uses a linker set based system initialization. For this some linker output section definitions are required to be present in the linker command file. It is recommended to use the linker command file installed by the BSP.

By default, RTEMS is compiled with function and data sections enabled (`-ffunction-sections` and `-fdata-sections`). Applications should be linked with the linker garbage collection enabled (`-Wl,--gc-sections`). For this it is necessary that some linker input sections (for example the static constructor and destructor sections) use the `KEEP()` directive. For a reference, see the

linker command file installed by the BSP. Previous RTEMS versions did not use these options, so the KEEP() directive may be missing in custom linker command files.

The linker output section definitions presented next are mandatory in linker command files used for the RTEMS version delivered by the QDP and may be missing in custom linker command files which worked with previous RTEMS version. There shall be the following linker output section definition in a read-only memory area to support thread-local storage:

```
.tdata : {
  _TLS_Data_begin = .;
  *(.tdata .tdata.* .gnu.linkonce.td.*)
  _TLS_Data_end = .;
}
.tbss : {
  _TLS_BSS_begin = .;
  *(.tbss .tbss.* .gnu.linkonce.tb.*) *(.tcommon)
  _TLS_BSS_end = .;
}
_TLS_Data_size = _TLS_Data_end - _TLS_Data_begin;
_TLS_Data_begin = _TLS_Data_size != 0 ? _TLS_Data_begin : _TLS_BSS_begin;
_TLS_Data_end = _TLS_Data_size != 0 ? _TLS_Data_end : _TLS_BSS_begin;
_TLS_BSS_size = _TLS_BSS_end - _TLS_BSS_begin;
_TLS_Size = _TLS_BSS_end - _TLS_Data_begin;
_TLS_Alignment = MAX (ALIGNOF (.tdata), ALIGNOF (.tbss));
```

The section for the thread-local storage data can and should be read-only since it contains only loadable initialization data. This data is used to initialize the thread-local storage area of a thread during its creation.

There shall be the following linker output section definition in a read-only memory area to support the read-only RTEMS linker sets:

```
.rtemsroset : {
  KEEP (*(SORT(.rtemsroset.*)))
}
```

There shall be the following linker output section definition in a read-write memory area to support the read-write RTEMS linker sets:

```
.rtemsrwset : {
  KEEP (*(SORT(.rtemsrwset.*)))
}
```

There shall be the following linker output section definition in an uninitialized read-write memory area to support the statically allocated RTEMS tasks:

```
.rtemsstack (NOLOAD) : {
  *(SORT_BY_ALIGNMENT (SORT_BY_NAME (.rtemsstack*)))
}
```

The NOLOAD output section type just marks the section as not loadable. This section is similar to the .bss section except that the content of the .rtemsstack section is not zero initialized. It is not initialized at all and may have arbitrary content. This reduces the time to boot the

application. The section still uses memory space and shall not overlap with other sections. Make sure that your MMU initialization covers the new sections.

#### 4.10.11 No EDISOFT RTEMS Improvement Error Reporting

A unique feature of EDISOFT RTEMS Improvement is that fatal and non-fatal errors can be reported, stored, and retrieved. The error reporting is done by all directives. Applications can report errors with the `rtems_error_report()` directive and retrieve reported errors through the `rtems_error_get_latest_non_fatal_by_offset()` and `rtems_error_get_latest_fatal_by_offset()` directives. These directives are not supported by any RTEMS version of the RTEMS Project. They are also not supported by the RTEMS version delivered by the QDP. Applications should do the error reporting if needed on their own. The RTEMS Project offers alternative tracing solutions, see also the [RTEMS User Manual](#).

#### 4.10.12 Customize the Inter-Processor Interrupt Number

For the SMP support of RTEMS, an inter-processor interrupt is required. By default, interrupt number 14 is used for the inter-processor interrupt on the LEON3 BSPs. You can define the interrupt number in your application configuration with this code, for example if the default value conflicts with one of your device drivers. The inter-processor interrupt should have a low priority since it performs no timing critical activities.

```
#include <bsp.h>

const unsigned char LEON3_mp_irq = 13;

/* Your application configuration options */

#include <rtems/confdefs.h>
```

#### 4.10.13 Hardware Errata

The pre-qualified items provided by the QDP address all hardware errata published before 2021-12-10. It is recommended to consult the documentation provided by the hardware vendor with respect to hardware errata workarounds and limitations.

### 4.11 Pre-Qualified Interfaces

The following sections list the pre-qualified functions, macros, and application configuration options which may be directly used by applications.

### 4.11.1 Application Configuration Information

- `rtems_configuration_get_idle_task()`
- `rtems_configuration_get_idle_task_stack_size()`
- `rtems_configuration_get_interrupt_stack_size()`
- `rtems_configuration_get_maximum_barriers()`
- `rtems_configuration_get_maximum_extensions()`
- `rtems_configuration_get_maximum_message_queues()`
- `rtems_configuration_get_maximum_partitions()`
- `rtems_configuration_get_maximum_periods()`
- `rtems_configuration_get_maximum_ports()`
- `rtems_configuration_get_maximum_processors()`
- `rtems_configuration_get_maximum_regions()`
- `rtems_configuration_get_maximum_semaphores()`
- `rtems_configuration_get_maximum_tasks()`
- `rtems_configuration_get_maximum_timers()`
- `rtems_configuration_get_microseconds_per_tick()`
- `rtems_configuration_get_milliseconds_per_tick()`
- `rtems_configuration_get_nanoseconds_per_tick()`
- `rtems_configuration_get_stack_allocate_for_idle_hook()`
- `rtems_configuration_get_stack_allocate_hook()`
- `rtems_configuration_get_stack_allocator_avoids_work_space()`
- `rtems_configuration_get_stack_free_hook()`
- `rtems_configuration_get_ticks_per_timeslice()`

### 4.11.2 Barrier Manager

- `rtems_barrier_create()`
- `rtems_barrier_delete()`
- `rtems_barrier_ident()`
- `rtems_barrier_release()`
- `rtems_barrier_wait()`

### 4.11.3 Base Definitions

- RTEMS\_ALIAS()
- RTEMS\_ALIGN\_DOWN()
- RTEMS\_ALIGN\_UP()
- RTEMS\_ALIGNED()
- RTEMS\_ALIGNOF()
- RTEMS\_ALLOC\_ALIGN()
- RTEMS\_ALLOC\_SIZE()
- RTEMS\_ALLOC\_SIZE\_2()
- RTEMS\_ARRAY\_SIZE()
- RTEMS\_COMPILER\_MEMORY\_BARRIER()
- RTEMS\_CONCAT()
- RTEMS\_CONTAINER\_OF()
- RTEMS\_DECLARE\_GLOBAL\_SYMBOL()
- RTEMS\_DECONST()
- RTEMS\_DEFINE\_GLOBAL\_SYMBOL()
- RTEMS\_DEQUALIFY()
- RTEMS\_DEQUALIFY\_DEPTHX()
- RTEMS\_DEVOLATILE()
- RTEMS\_EXPAND()
- RTEMS\_HAVE\_MEMBER\_SAME\_TYPE()
- RTEMS\_OBFUSCATE\_VARIABLE()
- RTEMS\_PREDICT\_FALSE()
- RTEMS\_PREDICT\_TRUE()
- RTEMS\_PRINTFLIKE()
- RTEMS\_RETURN\_ADDRESS()
- RTEMS\_SECTION()
- RTEMS\_STATIC\_ASSERT()
- RTEMS\_STRING()
- RTEMS\_SYMBOL\_NAME()
- RTEMS\_TYPEOF\_REFX()
- RTEMS\_UNREACHABLE()
- RTEMS\_WEAK\_ALIAS()
- RTEMS\_XCONCAT()



- RTEMS\_XSTRING()

#### 4.11.4 CPU Usage Reporting

- rtems\_cpu\_usage\_reset()

#### 4.11.5 Cache Manager

- rtems\_cache\_disable\_data()
- rtems\_cache\_disable\_instruction()
- rtems\_cache\_enable\_data()
- rtems\_cache\_enable\_instruction()
- rtems\_cache\_flush\_entire\_data()
- rtems\_cache\_flush\_multiple\_data\_lines()
- rtems\_cache\_get\_data\_line\_size()
- rtems\_cache\_get\_data\_cache\_size()
- rtems\_cache\_get\_instruction\_line\_size()
- rtems\_cache\_get\_instruction\_cache\_size()
- rtems\_cache\_get\_maximal\_line\_size()
- rtems\_cache\_instruction\_sync\_after\_code\_change()
- rtems\_cache\_invalidate\_entire\_data()
- rtems\_cache\_invalidate\_entire\_instruction()
- rtems\_cache\_invalidate\_multiple\_data\_lines()
- rtems\_cache\_invalidate\_multiple\_instruction\_lines()

#### 4.11.6 Classic API Configuration

- CONFIGURE\_MAXIMUM\_BARRIERS
- CONFIGURE\_MAXIMUM\_MESSAGE\_QUEUES
- CONFIGURE\_MAXIMUM\_PARTITIONS
- CONFIGURE\_MAXIMUM\_PERIODS
- CONFIGURE\_MAXIMUM\_SEMAPHORES
- CONFIGURE\_MAXIMUM\_TASKS
- CONFIGURE\_MAXIMUM\_TIMERS
- CONFIGURE\_MAXIMUM\_USER\_EXTENSIONS
- CONFIGURE\_MINIMUM\_TASKS\_WITH\_USER\_PROVIDED\_STORAGE

### 4.11.7 Classic API Initialization Task Configuration

- CONFIGURE\_INIT\_TASK\_ARGUMENTS
- CONFIGURE\_INIT\_TASK\_ATTRIBUTES
- CONFIGURE\_INIT\_TASK\_CONSTRUCT\_STORAGE\_SIZE
- CONFIGURE\_INIT\_TASK\_ENTRY\_POINT
- CONFIGURE\_INIT\_TASK\_INITIAL\_MODES
- CONFIGURE\_INIT\_TASK\_NAME
- CONFIGURE\_INIT\_TASK\_PRIORITY
- CONFIGURE\_RTEMS\_INIT\_TASKS\_TABLE

### 4.11.8 Clock Manager

- rtems\_clock\_get\_boot\_time()
- rtems\_clock\_get\_boot\_time\_bintime()
- rtems\_clock\_get\_boot\_time\_timeval()
- rtems\_clock\_get\_monotonic()
- rtems\_clock\_get\_monotonic\_bintime()
- rtems\_clock\_get\_monotonic\_coarse()
- rtems\_clock\_get\_monotonic\_coarse\_bintime()
- rtems\_clock\_get\_monotonic\_coarse\_timeval()
- rtems\_clock\_get\_monotonic\_sbintime()
- rtems\_clock\_get\_monotonic\_timeval()
- rtems\_clock\_get\_realtime()
- rtems\_clock\_get\_realtime\_bintime()
- rtems\_clock\_get\_realtime\_coarse()
- rtems\_clock\_get\_realtime\_coarse\_bintime()
- rtems\_clock\_get\_realtime\_coarse\_timeval()
- rtems\_clock\_get\_realtime\_timeval()
- rtems\_clock\_get\_ticks\_per\_second()
- rtems\_clock\_get\_ticks\_since\_boot()
- rtems\_clock\_get\_tod()
- rtems\_clock\_get\_uptime()
- rtems\_clock\_set()

#### 4.11.9 Device Driver Configuration

- CONFIGURE\_APPLICATION\_DOES\_NOT\_NEED\_CLOCK\_DRIVER
- CONFIGURE\_APPLICATION\_NEEDS\_CLOCK\_DRIVER

#### 4.11.10 Directive Status Codes

- rtems\_are\_statuses\_equal()
- rtems\_is\_status\_successful()
- rtems\_status\_text()

#### 4.11.11 Dynamic Memory Allocation

- rtems\_calloc()
- rtems\_malloc()

#### 4.11.12 Event Manager

- rtems\_event\_receive()
- rtems\_event\_send()

#### 4.11.13 Fatal Error Manager

- rtems\_fatal()

#### 4.11.14 Filesystem Configuration

- CONFIGURE\_APPLICATION\_DISABLE\_FILESYSTEM

#### 4.11.15 General Scheduler Configuration

- CONFIGURE\_MAXIMUM\_PRIORITY
- RTEMS\_SCHEDULER\_ASSIGN
- CONFIGURE\_SCHEDULER\_ASSIGNMENTS
- RTEMS\_SCHEDULER\_EDF\_SMP
- RTEMS\_SCHEDULER\_PRIORITY
- CONFIGURE\_SCHEDULER\_EDF\_SMP
- CONFIGURE\_SCHEDULER\_NAME
- CONFIGURE\_SCHEDULER\_PRIORITY
- CONFIGURE\_SCHEDULER\_TABLE\_ENTRIES

#### 4.11.16 General System Configuration

- CONFIGURE\_DISABLE\_BSP\_SETTINGS
- CONFIGURE\_DISABLE\_NEWLIB\_REENTRANCY
- CONFIGURE\_INIT
- CONFIGURE\_INITIAL\_EXTENSIONS
- CONFIGURE\_INTERRUPT\_STACK\_SIZE
- CONFIGURE\_MAXIMUM\_FILE\_DESCRIPTOR
- CONFIGURE\_MAXIMUM\_PROCESSORS
- CONFIGURE\_MAXIMUM\_THREAD\_LOCAL\_STORAGE\_SIZE
- CONFIGURE\_MICROSECONDS\_PER\_TICK
- CONFIGURE\_MINIMUM\_TASK\_STACK\_SIZE
- CONFIGURE\_TICKS\_PER\_TIMESLICE

#### 4.11.17 Idle Task Configuration

- CONFIGURE\_IDLE\_TASK\_BODY
- CONFIGURE\_IDLE\_TASK\_INITIALIZES\_APPLICATION
- CONFIGURE\_IDLE\_TASK\_STACK\_SIZE
- CONFIGURE\_IDLE\_TASK\_STORAGE\_SIZE

#### 4.11.18 Interrupt Manager

- rtems\_interrupt\_clear()
- rtems\_interrupt\_entry\_initialize()
- RTEMS\_INTERRUPT\_ENTRY\_INITIALIZER()
- rtems\_interrupt\_entry\_install()
- rtems\_interrupt\_entry\_remove()
- rtems\_interrupt\_get\_affinity()
- rtems\_interrupt\_get\_attributes()
- rtems\_interrupt\_handler\_iterate()
- rtems\_interrupt\_is\_pending()
- rtems\_interrupt\_local\_disable()
- rtems\_interrupt\_local\_enable()
- rtems\_interrupt\_lock\_acquire()
- rtems\_interrupt\_lock\_acquire\_isr()
- RTEMS\_INTERRUPT\_LOCK\_DECLARE()

- RTEMS\_INTERRUPT\_LOCK\_DEFINE()
- rtems\_interrupt\_lock\_destroy()
- rtems\_interrupt\_lock\_initialize()
- RTEMS\_INTERRUPT\_LOCK\_INITIALIZER()
- rtems\_interrupt\_lock\_interrupt\_disable()
- RTEMS\_INTERRUPT\_LOCK\_MEMBER()
- RTEMS\_INTERRUPT\_LOCK\_REFERENCE()
- rtems\_interrupt\_lock\_release()
- rtems\_interrupt\_lock\_release\_isr()
- rtems\_interrupt\_raise()
- rtems\_interrupt\_raise\_on()
- rtems\_interrupt\_set\_affinity()
- rtems\_interrupt\_vector\_disable()
- rtems\_interrupt\_vector\_enable()
- rtems\_interrupt\_vector\_is\_enabled()

#### 4.11.19 Kernel Character I/O Support

- getchark()
- rtems\_put\_char()
- rtems\_putc()

#### 4.11.20 Message Manager

- rtems\_message\_queue\_broadcast()
- RTEMS\_MESSAGE\_QUEUE\_BUFFER()
- rtems\_message\_queue\_construct()
- rtems\_message\_queue\_delete()
- rtems\_message\_queue\_flush()
- rtems\_message\_queue\_get\_number\_pending()
- rtems\_message\_queue\_ident()
- rtems\_message\_queue\_receive()
- rtems\_message\_queue\_send()
- rtems\_message\_queue\_urgent()

#### 4.11.21 Object Services

- `rtems_build_name()`
- `rtems_object_get_local_node()`

#### 4.11.22 Partition Manager

- `rtems_partition_create()`
- `rtems_partition_delete()`
- `rtems_partition_get_buffer()`
- `rtems_partition_ident()`
- `rtems_partition_return_buffer()`

#### 4.11.23 Rate-Monotonic Manager

- `rtems_rate_monotonic_cancel()`
- `rtems_rate_monotonic_create()`
- `rtems_rate_monotonic_delete()`
- `rtems_rate_monotonic_get_status()`
- `rtems_rate_monotonic_ident()`
- `rtems_rate_monotonic_period()`

#### 4.11.24 Scheduler Manager

- `rtems_scheduler_add_processor()`
- `rtems_scheduler_get_maximum_priority()`
- `rtems_scheduler_get_processor()`
- `rtems_scheduler_get_processor_maximum()`
- `rtems_scheduler_get_processor_set()`
- `rtems_scheduler_ident()`
- `rtems_scheduler_ident_by_processor()`
- `rtems_scheduler_ident_by_processor_set()`
- `rtems_scheduler_remove_processor()`

#### 4.11.25 Semaphore Manager

- `rtems_semaphore_create()`
- `rtems_semaphore_delete()`
- `rtems_semaphore_flush()`
- `rtems_semaphore_ident()`
- `rtems_semaphore_obtain()`
- `rtems_semaphore_release()`
- `rtems_semaphore_set_priority()`

#### 4.11.26 Signal Manager

- `rtems_signal_catch()`
- `rtems_signal_send()`

#### 4.11.27 Support Services

- `rtems_is_name_valid()`
- `rtems_name_to_characters()`

#### 4.11.28 Task Manager

- `rtems_task_construct()`
- `rtems_task_create()`
- `rtems_task_delete()`
- `rtems_task_exit()`
- `rtems_task_get_affinity()`
- `rtems_task_get_priority()`
- `rtems_task_get_scheduler()`
- `rtems_task_ident()`
- `rtems_task_is_suspended()`
- `rtems_task_iterate()`
- `rtems_task_mode()`
- `rtems_task_restart()`
- `rtems_task_resume()`
- `rtems_task_self()`
- `rtems_task_set_affinity()`
- `rtems_task_set_priority()`

- `rtems_task_set_scheduler()`
- `rtems_task_start()`
- `RTEMS_TASK_STORAGE_SIZE()`
- `rtems_task_suspend()`
- `rtems_task_wake_after()`
- `rtems_task_wake_when()`

#### 4.11.29 Task Modes

- `RTEMS_INTERRUPT_LEVEL()`

#### 4.11.30 Task Stack Allocator Configuration

- `CONFIGURE_TASK_STACK_ALLOCATOR`
- `CONFIGURE_TASK_STACK_ALLOCATOR_FOR_IDLE`
- `CONFIGURE_TASK_STACK_DEALLOCATOR`
- `CONFIGURE_TASK_STACK_ALLOCATOR_AVOIDS_WORK_SPACE`

#### 4.11.31 Timer Manager

- `rtems_timer_cancel()`
- `rtems_timer_create()`
- `rtems_timer_delete()`
- `rtems_timer_fire_after()`
- `rtems_timer_fire_when()`
- `rtems_timer_ident()`
- `rtems_timer_initiate_server()`
- `rtems_timer_reset()`
- `rtems_timer_server_fire_after()`
- `rtems_timer_server_fire_when()`



### 4.11.32 User Extensions Manager

- `rtems_extension_create()`
- `rtems_extension_delete()`
- `rtems_extension_ident()`

### 4.11.33 `spec:/c/if/group`

- `clock_nanosleep()`
- `flsl()`
- `memcpy()`
- `memset()`
- `offsetof`
- `posix_memalign()`

### 4.11.34 `spec:/newlib/if/group`

- `_Futex_Wait()`
- `_Futex_Wake()`
- `_Mutex_Acquire()`
- `_Mutex_Acquire_timed()`
- `_Mutex_recursive_Acquire()`
- `_Mutex_recursive_Acquire_timed()`
- `_Mutex_recursive_Release()`
- `_Mutex_recursive_Try_acquire()`
- `_Mutex_Release()`
- `_Mutex_Try_acquire()`

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CHAPTER

FIVE

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INVENTORY OF MATERIALS

There are no physical media included in the QDP. In particular, the boards used to perform the test runs are not included.



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## CHAPTER SIX

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### BASELINE DOCUMENTS

The QDP contains all project-specific baseline documents. Please refer to *ECSS Software Documentation Overview*, *Technical Notes Overview*, *RTEMS Documentation Overview*, *Formal Methods Documentation Overview*, and *ISVV Documentation Overview*.

# RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]

Release 7

This document relates to ESA Contract No. 4000140680/23/NL/AS.

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## CHAPTER SEVEN

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### INVENTORY OF SOFTWARE CONFIGURATION ITEM

This document may be digitally signed. Check that the signatures are valid and trustworthy. This document corresponds to the QDP archive file `rtems-6-sparc-gr712rc-smp-6.tar.xz` which has an SHA512 digest of `a59c59817faa0f4e01709d116bd71124ba6450b9210b27f2aea7ebc3bfd35768077cd0ad30fbbc122bcc221139bb3537cf0bf0b6a3a2eaf49d2f3b188089e849`. You should have obtained the archive file from the same distribution channel as this document. Check that the SHA512 digest of the QDP archive file matches with the SHA512 digest documented in this document. If the digests do not match, then the archive file is not the right one.

```
$ sha512sum rtems-6-sparc-gr712rc-smp-6.tar.xz
a59c59817faa0f4e01709d116bd71124ba6450b9210b27f2aea7ebc3bfd35768077cd0ad30fbbc122b
cc221139bb3537cf0bf0b6a3a2eaf49d2f3b188089e849
```

For an overview of the QDP archive content, see [Software Configuration Item Overview](#). The QDP archive contains the package verification script `verify_package.py` which has an SHA512 digest of `48df8e5cb524bc335f962441d47597df661f847987a0bfd06b282280a79248d2a55004863c32a5e7492f52f941dcb62f959459bfa1379e31dd34badcb0833593`. This script may be used to verify the files of the QDP after unpacking the archive. It may also be used to list the files of the QDP or to list the files of the QDP with an SHA512 hash value of each file content.

```
$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6
$ ./verify_package.py --help
usage: verify_package.py [-h]
                        [--log-level {DEBUG,INFO,WARNING,ERROR,CRITICAL}]
                        [--log-file LOG_FILE] [--list-files]
                        [--list-files-and-hashes]

options:
  -h, --help            show this help message and exit
  --log-level {DEBUG,INFO,WARNING,ERROR,CRITICAL}
                        log level
  --log-file LOG_FILE  log to this file
  --list-files          list the files of the package
  --list-files-and-hashes
                        list the files of the package with the SHA512 digest
                        of each file
```

## RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]

Release 7

This document relates to ESA Contract No. 4000140680/23/NL/AS.

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## CHAPTER

## EIGHT

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### MEANS NECESSARY FOR THE SOFTWARE CONFIGURATION ITEM

The QDP needs a host computer or a Docker container, see [Prepare the Host Computer](#) and [Use QDP in a Docker solution](#). The QDP can be used to build applications using RTEMS for the target system. You have to provide the target system and any means to deploy executables on it.



# RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]

Release 7

This document relates to ESA Contract No. 4000140680/23/NL/AS.

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## CHAPTER NINE

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# INSTALLATION INSTRUCTIONS

The getting started section gives you step by step instructions which enable you to build a simple example application using the QDP.

## 9.1 Prepare the Host Computer

The QDP contains a binary distribution of tools such as the cross *GNU Binutils* and *GCC*. The tools were built on a *Debian 10* machine. The tools should run on any Linux distribution which provides a *glibc 2.27*.

### 9.1.1 Debian

The following packages are required:

```
$ apt-get install libncurses5 make pkg-config
```

### 9.1.2 openSUSE

On *openSUSE* distributions install the *C/C++ Development* pattern.

## 9.2 Check the QDP Integrity

This document may be digitally signed. Check that the signatures are valid and trustworthy. This document corresponds to the QDP archive file *rtems-6-sparc-gr712rc-smp-6.tar.xz* which has an SHA512 digest of *a59c59817faa0f4e01709d116bd71124ba6450b9210b27f2aea7ebc3bfd35768077cd0ad30fbbc122bcc221139bb3537cf0bf0b6a3a2eaf49d2f3b188089e849*. You should have obtained the archive file from the same distribution channel as this document. Check that the SHA512 digest of the QDP archive file matches with the SHA512 digest documented in this document. If the digests do not match, then the archive file is not the right one.

```
$ sha512sum rtems-6-sparc-gr712rc-smp-6.tar.xz  
a59c59817faa0f4e01709d116bd71124ba6450b9210b27f2aea7ebc3bfd35768077cd0ad30fbbc122b  
cc221139bb3537cf0bf0b6a3a2eaf49d2f3b188089e849
```

## 9.3 Unpack the QDP Archive

It is recommended to unpack the QDP archive in /opt/rtems. Other locations may work, but this use case was not tested and is not documented.

```
$ sudo mkdir -p /opt/rtems
$ cd /opt/rtems
$ sudo tar xf rtems-6-sparc-gr712rc-smp-6.tar.xz
```

## 9.4 Build an Example Application

The QDP contains an example application for the pre-qualified BSP. Build it to check that the tools work on your host computer.

```
$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example
$ make
```

This should produce the following output:

```
make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example'
mkdir b-gr712rc-qual-only
sparc-rtems6-gcc -MT b-gr712rc-qual-only/init.o -MD -MP -MF b-gr712rc-qual-only/
↪init.d -Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/sparc-rtems6/gr712rc-qual-only/lib/include -O2 -g -ffunction-
↪sections -fdata-sections -c init.c -o b-gr712rc-qual-only/init.o
sparc-rtems6-gcc -MT b-gr712rc-qual-only/app.exe -MD -MP -MF b-gr712rc-qual-only/
↪app.d -Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/sparc-rtems6/gr712rc-qual-only/lib/include -O2 -g -ffunction-
↪sections -fdata-sections -Wl,-Map,b-gr712rc-qual-only/app.map b-gr712rc-qual-
↪only/init.o -B/opt/rtems/rtems-6-sparc-gr712rc-smp-6/sparc-rtems6/gr712rc-qual-
↪only/lib -qrtems -nodefaultlibs -Wl,--start-group -lrtemsbsp -lrtemscpu -lgcc -
↪Wl,--end-group -Wl,--gc-sections -o b-gr712rc-qual-only/app.exe
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example'
```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

Try to run the example application b-gr712rc-qual-only/app.exe on a simulator or a target platform. The QDP provides a simulator, which can be used to run this application as follows:

```
$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example
$ make run
```

This should produce the following output:

```
make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example'
sparc-rtems6-sis -leon3 -extirq 12 -dumbio -r b-gr712rc-qual-only/app.exe

SIS - SPARC/RISCV instruction simulator 2.30, copyright Jiri Gaisler 2020
Bug-reports to jiri@gaisler.se
```

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```

LEON3 emulation enabled, 1 cpus online, delta 50 clocks

Loaded b-gr712rc-qual-only/app.exe, entry 0x40000000
Hello, world!
cpu 0 in error mode (tt = 0x80)
    77687 4000a040: 91d02000 ta 0x0
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example'

```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

## 9.5 Build a C++ Example Application

The QDP contains a C++ example application for the pre-qualified BSP. Build it to check that the tools work on your host computer.

```

$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++
$ make

```

This should produce the following output:

```

make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++'
mkdir b-gr712rc-qual-only
sparc-rtems6-g++ -MT b-gr712rc-qual-only/init.o -MD -MP -MF b-gr712rc-qual-only/
↪init.d -Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/sparc-rtems6/gr712rc-qual-only/lib/include -O2 -g -ffunction-
↪sections -fdata-sections -fno-exceptions -c init.cc -o b-gr712rc-qual-only/init.
↪o
sparc-rtems6-g++ -MT b-gr712rc-qual-only/app.exe -MD -MP -MF b-gr712rc-qual-only/
↪app.d -Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/sparc-rtems6/gr712rc-qual-only/lib/include -O2 -g -ffunction-
↪sections -fdata-sections -fno-exceptions -Wl,-Map,b-gr712rc-qual-only/app.map b-
↪gr712rc-qual-only/init.o -B/opt/rtems/rtems-6-sparc-gr712rc-smp-6/sparc-rtems6/
↪gr712rc-qual-only/lib -qrtems -nodefaultlibs -Wl,--start-group -lrtemsbsp -
↪lrtemscpu -lgcc -Wl,--end-group -Wl,--gc-sections -o b-gr712rc-qual-only/app.exe
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++'

```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

Try to run the example application `b-gr712rc-qual-only/app.exe` on a simulator or a target platform. The QDP provides a simulator, which can be used to run this application as follows:

```

$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++
$ make run

```

This should produce the following output:

```

make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++'
sparc-rtems6-sis -leon3 -extirq 12 -dumbio -r b-gr712rc-qual-only/app.exe

  SIS - SPARC/RISCV instruction simulator 2.30,  copyright Jiri Gaisler 2020
  Bug-reports to jiri@gaisler.se

  LEON3 emulation enabled, 1 cpus online, delta 50 clocks

  Loaded b-gr712rc-qual-only/app.exe, entry 0x40000000
  Hello, C++ world!
  cpu 0 in error mode (tt = 0x80)
    14704 400061e0: 91d02000  ta 0x0
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example++'

```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

## 9.6 Build an Ada Example Application

The Ada runtime library requires some features which are not available in the pre-qualified feature set provided by the QDP. For example, the Ada tasking is implemented using the *POSIX* API. The QDP contains an Ada example application for the pre-qualified BSP with extras. Build it to check that the tools work on your host computer.

```

$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada
$ make

```

This should produce the following output:

```

make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-
↳ ada'
mkdir b-gr712rc-extra
sparc-rtems6-gcc -MT b-gr712rc-extra/init.o -MD -MP -MF b-gr712rc-extra/init.d -
↳ Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-gr712rc-
↳ smp-6/sparc-rtems6/gr712rc-extra/lib/include -O2 -g -ffunction-sections -fdata-
↳ sections -c init.c -o b-gr712rc-extra/init.o
sparc-rtems6-gnatmake -D b-gr712rc-extra -bargs -Mada_main -margs \
-args -MT b-gr712rc-extra/app.exe -MD -MP -MF b-gr712rc-extra/app.d -Wall -
↳ Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-gr712rc-smp-6/
↳ sparc-rtems6/gr712rc-extra/lib/include -O2 -g -ffunction-sections -fdata-
↳ sections -largrs b-gr712rc-extra/init.o -B/opt/rtems/rtems-6-sparc-gr712rc-smp-6/
↳ sparc-rtems6/gr712rc-extra/lib -qrtems -Wl,--gc-sections \
-margs -a hello.adb -o b-gr712rc-extra/app.exe
sparc-rtems6-gcc -c -MT b-gr712rc-extra/app.exe -MD -MP -MF b-gr712rc-extra/app.d -
↳ Wall -Wextra -mcpu=leon3 -mfix-gr712rc -isystem/opt/rtems/rtems-6-sparc-
↳ gr712rc-smp-6/sparc-rtems6/gr712rc-extra/lib/include -O2 -g -ffunction-sections -
↳ fdata-sections --RTS=leon3/gr712rc -o /opt/rtems/rtems-6-sparc-gr712rc-smp-6/
↳ src/example-ada/b-gr712rc-extra/hello.o hello.adb
sparc-rtems6-gnatbind -a0/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada/b-

```

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```

↪gr712rc-extra -Mada_main --RTS=leon3/gr712rc -x /opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/src/example-ada/b-gr712rc-extra/hello.ali
sparc-rtems6-gnatlink /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada/b-
↪gr712rc-extra/hello.ali b-gr712rc-extra/init.o -B/opt/rtems/rtems-6-sparc-
↪gr712rc-smp-6/sparc-rtems6/gr712rc-extra/lib -qrtems -Wl,--gc-sections -o b-
↪gr712rc-extra/app.exe
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada
↪ '

```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

Try to run the example application `b-gr712rc-extra/app.exe` on a simulator or a target platform. The QDP provides a simulator, which can be used to run this application as follows:

```

$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada
$ make run

```

This should produce the following output:

```

make[1]: Entering directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-
↪ada'
sparc-rtems6-sis -leon3 -extirq 12 -dumbio -r b-gr712rc-extra/app.exe

SIS - SPARC/RISCV instruction simulator 2.30,  copyright Jiri Gaisler 2020
Bug-reports to jiri@gaisler.se

LEON3 emulation enabled, 1 cpus online, delta 50 clocks

Loaded b-gr712rc-extra/app.exe, entry 0x40000000
Hello, Ada world!
cpu 0 in error mode (tt = 0x80)
  823547 4003dc20: 91d02000  ta 0x0
make[1]: Leaving directory '/opt/rtems/rtems-6-sparc-gr712rc-smp-6/src/example-ada
↪ '

```

If you get a different output, then there is something wrong with the unpacked QDP or your host computer setup.

## 9.7 Use QDP in a Docker solution

This section explains how to set-up a dockerized solution to use the QDP, which allows the usage of the QDP in any operating system. The following steps shall be followed for this set up:

1. Extract the QDP archive file `rtems-6-sparc-gr712rc-smp-6.tar.xz` into a folder, ex: `docker-for-rtems`.

```

$ ~/docker-for-rtems

```

2. Place the dockerfile on the above directory, on the same level as the QDP extracted directory.

```
$ ~/docker-for-rtems$ ls
Dockerfile.rtems-qdp  rtems-6-sparc-gr712rc-sparc-gr712rc-smp-6-6
```

The Dockerfile.rtems-qdp file has the following content:

```
FROM debian:buster
RUN apt-get update
RUN apt-get -y install libncurses5
RUN apt-get -y install pkg-config
RUN apt-get -y install make
RUN mkdir -p /opt/rtems/rtems-6-sparc-gr712rc-smp-6
```

**Note:** This Dockerfile will allow to use the QDP, but not running the RTEMS qualification as presented in *Guidance for RTEMS Qualification in User's Environment*. The necessary Dockerfile to do qualification activity is described in the mentioned section.

3. Open the command line in the ~/docker-for-rtems folder and process the Dockerfile with

```
$ ~/docker-for-rtems$ docker build -f Dockerfile.rtems-qdp -t rtems_qdp .
```

4. Run the docker image with

```
$ ~/docker-for-rtems$ docker run --rm -v ~/docker-for-rtems/rtems-6-sparc-gr712rc-
↳sparc-gr712rc-smp-6-6:/opt/rtems/rtems-6-sparc-gr712rc-smp-6 -it rtems_qdp /bin/
↳bash
```

5. The above command will map the QDP content on ~/docker-for-rtems/rtems-6-sparc-gr712rc-sparc-gr712rc-smp-6-6 to the /opt/rtems/rtems-6-sparc-gr712rc-smp-6 inside docker. This means that the operations with QDP done on /opt/rtems/rtems-6-sparc-gr712rc-smp-6 will be available to the host system. Additionally, the user can create a another folder inside rtems-6-sparc-gr712rc-smp-6-6, to contain the user's work:

```
$ root@c5cf83823b8f:/opt/rtems/rtems-6-sparc-gr712rc-smp-6# ls
bin doc include lib libexec make share sparc-rtems6 src verify_package.
↳py workdir
```

6. Compile and execute the example as described in the previous section. If everything runs as expected, the docker set up is correct.

---

## CHAPTER TEN

---

### CHANGE LIST

The following sections describe the changes for each released package version. The latest package version is presented first.

#### 10.1 Package Version 6

The sixth version of the QDP contains the final release issued for project *RTEMS SMP SINGLE-CORE* with ESA Contract No. 4000140680/23/NL/AS. The following changes were implemented:

- The RTEMS baseline changed. In package version 5, we had about 55 QDP-specific patches on top of the RTEMS baseline. Now, there are only 24 patches left. These patches fall into two categories
  - static memory benchmarks and formal methods tests, and
  - changes in the build system to support building the pre-qualified only feature set.

In particular, all BSP-specific patches were reviewed by Frontgrade Gaisler and integrated in the RTEMS baseline. The current RTEMS baseline is expected to be close to the RTEMS 6.1 release version. See *Annex B* of the SVR for a comparison of the RTEMS sources of this package version to the previous package version for the files contributing to the pre-qualified feature set of RTEMS.

- Applications using only the pre-qualified feature set of RTEMS, should configure the task storage area of *IDLE tasks* using the new application configuration option `CONFIGURE_IDLE_TASK_STORAGE_SIZE`.
- For the *GR712RC*, the clock driver and CPU counter support use now the time tag register of the Debug Support Unit (DSU). In general, using the DSU is not recommended for the clock driver and CPU counter implementation. However, for the *GR712RC*, the DSU cannot be disabled and is always available in flight models. The time tag register is implemented in radiation hardened flip-flops. The version 2.16 of the *GR712RC User Manual* contains some updates with respect to the DSU usage.
- The specification was updated to fully cover the uniprocessor configuration of RTEMS for the pre-qualified feature set. With the new validation tests, the 100% branch and code coverage goal is met also for the uniprocessor configuration.
- QDPs for several other targets were built by embedded brains. They are available on request. This work exposed some shortcomings in the functional specification of RTEMS which were fixed for this package version. See *Annex C* of the SVR for a detailed list of specification changes.



- In the SVR section 4.6.1.1 *Software Validation Specifications to TS*, the rules to determine if a requirement or interface is *validated* were clarified. The specification and the qualification toolchain was restructured, to use this simple rule set. The table in this section was modified to show for each requirement or interface, the validation status, the associated refinements or validations, and the role of the refinement or validation.
- As a preparation to pre-qualify *POSIX* interfaces, Newlib was modified to use thread-local storage objects for its internal data structures instead of one giant thread-specific object.
- GCC was updated to version 13.2. This update includes a fix for the critical bug [PR 107248](#) which is not fixed in previous package versions. This GCC release includes a significantly improved support to get [profiling and test coverage in freestanding environments](#). This new GCC feature was specifically added for this activity. The qualification toolchain was updated to use it.
- GCC was configured with Ada language support.
- Binutils was updated to version 2.41 as a maintenance activity.
- GDB was updated to version 13.2 as a maintenance activity.
- Doxygen 1.9.7 was used to build the QDP. To improve the traceability between the specification and the software design several Doxygen improvements were implemented: [#9926](#), [#9948](#), [#9952](#), and [#9965](#). The improvements are included in this release.
- The QDP host environment changed from Debian to Ubuntu 22.04 LTS.
- The RTEMS Software Engineering manual contains now a *Formal Verification* chapter [[con21e](#)].

### 10.1.1 New issues

When the QDP of this package version was produced, there were the following new issues associated:

Database	Identifier	Subject
RTEMS Ticket	4920	libdl does not support TLS
RTEMS Ticket	4961	Document and test CONFIG-URE_JFFS2_DELAYED_WRITE_TASK_PRIORITY
RTEMS Ticket	4963	New build configuration option RTEMS_QUALIFIED

### 10.1.2 Open issues

When the QDP of this package version was produced, there were the following open issues associated:

Database	Identifier	Subject
ESA Issue	742	QDP and Coverity Results contain personal information
ESA Issue	803	RTEMS-SMP-REQ-VER-004 - Incomplete Requirements

continues on next page

Table 2 – continued from previous page

Database	Identifier	Subject
ESA Issue	804	RTEMS-SMP-REQ-VER-032 - Incorrect definition of inner elements of structs
ESA Issue	805	RTEMS-SMP-REQ-VER-037 - Missing interfaces
ESA Issue	806	RTEMS-SMP-TS-VER-001 - No Test cases descriptions
ESA Issue	807	RTEMS-SMP-REQ-VER-001 - SRS typos and small mistakes
ESA Issue	808	RTEMS-SMP-REQ-VER-002 - Contradictory constraints
ESA Issue	809	RTEMS-SMP-REQ-VER-003 - Time margins
ESA Issue	810	RTEMS-SMP-REQ-VER-005 - “Will” verb within requirements
ESA Issue	811	RTEMS-SMP-REQ-VER-006 - Confusing wording
ESA Issue	812	RTEMS-SMP-REQ-VER-007 - Unclear connections
ESA Issue	813	RTEMS-SMP-REQ-VER-009 - Too many dependent requirements
ESA Issue	814	RTEMS-SMP-REQ-VER-011 - Differing wording between GR740 and GR712
ESA Issue	815	RTEMS-SMP-REQ-VER-012 - Typos/small mistakes
ESA Issue	816	RTEMS-SMP-REQ-VER-013 - Formatting of parameters and directives
ESA Issue	817	RTEMS-SMP-REQ-VER-014 - Missing references in bibliography and links
ESA Issue	818	RTEMS-SMP-REQ-VER-015 - Incorrect verb for a requirement
ESA Issue	819	RTEMS-SMP-REQ-VER-016 - Directive not specified
ESA Issue	820	RTEMS-SMP-REQ-VER-017 - Inconsistent dates
ESA Issue	821	RTEMS-SMP-REQ-VER-019 - Repeated descriptions
ESA Issue	822	RTEMS-SMP-REQ-VER-020 - Colliding descriptions
ESA Issue	823	RTEMS-SMP-REQ-VER-021 - Bibliography references
ESA Issue	824	RTEMS-SMP-REQ-VER-023 - Inconsistency between requirements sections
ESA Issue	825	RTEMS-SMP-REQ-VER-025 - ICD references
ESA Issue	826	RTEMS-SMP-REQ-VER-026 - Constraints sections
ESA Issue	827	RTEMS-SMP-REQ-VER-027 - Missing presentations
ESA Issue	828	RTEMS-SMP-REQ-VER-028 - HW documentation
ESA Issue	829	RTEMS-SMP-REQ-VER-029 - Too many conditions / very complex requirement
ESA Issue	830	RTEMS-SMP-REQ-VER-030 - ICD typos/small mistakes
ESA Issue	831	RTEMS-SMP-REQ-VER-031 - Merge requirements
ESA Issue	832	RTEMS-SMP-REQ-VER-034 - Duplicated line
ESA Issue	833	RTEMS-SMP-REQ-VER-035 - ICD undefined acronyms
ESA Issue	834	RTEMS-SMP-REQ-VER-036 - Undescribed interface enumerator definitions
ESA Issue	835	RTEMS-SMP-REQ-VER-038 - Unspecified interface-types
ESA Issue	836	RTEMS-SMP-REQ-VER-039 - Sentence construction

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Table 2 – continued from previous page

Database	Identifier	Subject
ESA Issue	837	RTEMS-SMP-REQ-VER-040 - ICD is very tied to a specific C compiler
ESA Issue	838	RTEMS-SMP-DESIGN-VER-001 - Document vs QDP releases
ESA Issue	839	RTEMS-SMP-DESIGN-VER-002 - RTEMS version from which QDPs have been derived
ESA Issue	840	RTEMS-SMP-DESIGN-VER-003 - Unclear SUM
ESA Issue	841	RTEMS-SMP-DESIGN-VER-004 - No SUM which follows ECSS clauses
ESA Issue	842	RTEMS-SMP-DESIGN-VER-005 - SCF missing acronyms
ESA Issue	843	RTEMS-SMP-DESIGN-VER-006 - SCF typos
ESA Issue	844	RTEMS-SMP-DESIGN-VER-007 - SCF conflicting information
ESA Issue	845	RTEMS-SMP-DESIGN-VER-008 - Memory usage benchmarks
ESA Issue	847	RTEMS-SMP-DESIGN-VER-011 - Requirements not traced to design
ESA Issue	848	RTEMS-SMP-DESIGN-VER-012 - No abbreviations/acronym list
ESA Issue	849	RTEMS-SMP-DESIGN-VER-013 - Unclear traced requirements
ESA Issue	850	RTEMS-SMP-DESIGN-VER-014 - No tracing matrix
ESA Issue	851	RTEMS-SMP-DESIGN-VER-015 - No verification method
ESA Issue	852	RTEMS-SMP-DESIGN-VER-017 - Missing descriptions
ESA Issue	853	RTEMS-SMP-DESIGN-VER-019 - Incorrect macro
ESA Issue	854	RTEMS-SMP-DESIGN-VER-020 - Untraced requirement
ESA Issue	855	RTEMS-SMP-DESIGN-VER-021 - Requirement wording
ESA Issue	856	RTEMS-SMP-DESIGN-VER-022 - Incomplete/empty design
ESA Issue	857	RTEMS-SMP-DESIGN-VER-023 - Unexplained text
ESA Issue	858	RTEMS-SMP-DESIGN-VER-024 - Complex requirement
ESA Issue	859	RTEMS-SMP-DESIGN-VER-025 - Untraced requirements
ESA Issue	860	RTEMS-SMP-DESIGN-VER-026 - Incomplete requirements
ESA Issue	861	RTEMS-SMP-DESIGN-VER-028 - Design element names
ESA Issue	862	RTEMS-SMP-DESIGN-VER-029 - Empty section
ESA Issue	863	RTEMS-SMP-DESIGN-VER-030 - Requirement naming
ESA Issue	864	RTEMS-SMP-DESIGN-VER-031 - Incomplete

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Table 2 – continued from previous page

Database	Identifier	Subject
ESA Issue	865	RTEMS-SMP-DESIGN-VER-032 - Naming of design elements
ESA Issue	866	RTEMS-SMP-DESIGN-VER-033 - Unspecified elements
ESA Issue	867	RTEMS-SMP-DESIGN-VER-034 - Language and compiler requirements
ESA Issue	868	RTEMS-SMP-DESIGN-VER-035 - Untraced design components
ESA Issue	869	RTEMS-SMP-DESIGN-VER-036 - Hyperlinks not working
ESA Issue	870	RTEMS-SMP-DESIGN-VER-037 - Multiple traced Requirements
ESA Issue	871	RTEMS-SMP-VAL-001 - “Timer Server” not directly usable
ESA Issue	872	RTEMS-SMP-VAL-003 - Some functions are listed as unspecified on ICD
ESA Issue	873	RTEMS-SMP-VAL-004 - Documentation refers undefined behaviour on cases where an error is to be expected
ESA Issue	874	RTEMS-SMP-VAL-005 - Missing NULL pointer check for clock manager directives
ESA Issue	875	RTEMS-SMP-TS-VER-002 - Potential typing error
ESA Issue	876	RTEMS-SMP-TS-VER-003 - Testcase 7.13 not found in test matrix
ESA Issue	877	RTEMS-SMP-TS-VER-004 - Testcase 7.31 too long
ESA Issue	878	RTEMS-SMP-TS-VER-005 - Testcase 7.32 too long
ESA Issue	879	RTEMS-SMP-TS-VER-007 - Linking between testcases and test requirements
ESA Issue	880	RTEMS-SMP-TS-VER-008 - Testcase dependency on Detailed Design
ESA Issue	881	RTEMS-SMP-TS-VER-015 - Non-human readable test report
ESA Issue	882	RTEMS-SMP-TS-VER-016 - Document Identifiers not available
ESA Issue	883	RTEMS-SMP-TS-VER-018 - Analysis, inspection or review testcases not reported
ESA Issue	884	RTEMS-SMP-CODE-VER-004 - No SPDX License
ESA Issue	885	RTEMS-SMP-CODE-VER-005 - SPDX License misplaced
ESA Issue	886	RTEMS-SMP-CODE-VER-006 - Header Files Format “extern C” missing
ESA Issue	887	RTEMS-SMP-CODE-VER-007 - Two paragraphs
ESA Issue	888	RTEMS-SMP-CODE-VER-008 - Format of “if”, “while” or “for” statements are not properly defined
ESA Issue	889	RTEMS-SMP-CODE-VER-009 - Format of “!” statements might not be properly defined

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Table 2 – continued from previous page

Database	Identifier	Subject
ESA Issue	890	RTEMS-SMP-CODE-VER-010 - TODO section left un-done
ESA Issue	891	RTEMS-SMP-CODE-VER-011 - FIXME
ESA Issue	892	RTEMS-SMP-CODE-VER-013 - Macro defined but magic number used instead
ESA Issue	893	RTEMS-SMP-CODE-VER-014 - Macros wrongly de-fined
ESA Issue	894	RTEMS-SMP-CODE-VER-018 - Deprecated Functions
ESA Issue	895	RTEMS-SMP-CODE-VER-021 - Unclear comments
ESA Issue	896	RTEMS-SMP-CODE-VER-022 - Comments not in ac-cordance with template
ESA Issue	897	RTEMS-SMP-CODE-VER-023 - Code not in accor-dance with comments
ESA Issue	898	RTEMS-SMP-CODE-VER-024 - Inaccurate comments at the beginning of file
ESA Issue	899	RTEMS-SMP-CODE-VER-025 - Incorrect Copyright Li- cense Information
ESA Issue	900	RTEMS-SMP-CODE-VER-026 - Function defined in header file
ESA Issue	901	RTEMS-SMP-CODE-VER-028 - Unused input parame- ter
ESA Issue	902	RTEMS-SMP-CODE-VER-029 - Input validity unchecked
ESA Issue	903	RTEMS-SMP-CODE-VER-030 - Wrong data type
ESA Issue	904	RTEMS-SMP-CODE-VER-032 - Output value not as- signed
ESA Issue	905	RTEMS-SMP-CODE-VER-033 - Wrong output type
ESA Issue	908	RTEMS-SMP-CODE-VER-044 - Code for test software
ESA Issue	909	RTEMS-SMP-CODE-VER-052 - #pragmas to ignore warnings
ESA Issue	910	RTEMS-SMP-CODE-VER-062 - CLANG flagged error
ESA Issue	911	RTEMS-SMP-CODE-VER-063 - Missing design details
ESA Issue	912	RTEMS-SMP-CODE-VER-071 - Confusing #IF 1 clause
ESA Issue	913	RTEMS-SMP-CODE-VER-073 - Low power Power- down workaround
ESA Issue	914	RTEMS-SMP-CODE-VER-078 - Bitwise operator ap- plied to a signed operand
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3923	Add traceability information to the application config- uration options
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4805	SPDX Licenses and Header File Formatting
RTEMS Ticket	4806	Header Source files format “extern C” missing

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Table 2 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4807	Two consecutive paragraphs
RTEMS Ticket	4808	Incorrect Formatting of “if”, “while”, or “for” Statements
RTEMS Ticket	4809	Incorrect Formatting of “!” Statements
RTEMS Ticket	4810	Unfinished TODO section
RTEMS Ticket	4811	Non-compliant Comments with Templates
RTEMS Ticket	4812	Discrepancy between Code and Comments
RTEMS Ticket	4813	Inaccurate comments at the beginning of file
RTEMS Ticket	4814	Incorrect Copyright License Information
RTEMS Ticket	4815	Function defined in header file
RTEMS Ticket	4816	Wrong data type
RTEMS Ticket	4819	Unclear #IF 1 Clause in File: Possible Error
RTEMS Ticket	4827	Section left to be fixed in kern_tc.c and tls.h (FIXME)
RTEMS Ticket	4829	Unclear comments
RTEMS Ticket	4830	Output value not assigned
RTEMS Ticket	4831	#pragmas to ignore warnings
RTEMS Ticket	4844	Unchecked boundaries
RTEMS Ticket	4846	Code for test software
RTEMS Ticket	4849	“Timer Server” Cannot be Used in Systems with Static Memory Allocation
RTEMS Ticket	4852	Deprecated Functions
RTEMS Ticket	4862	score/ & bsp/: Unused input parameters
RTEMS Ticket	4864	Bitwise operator applied to a signed operand
RTEMS Ticket	4875	LEON3FT - Power-down workaround
RTEMS Ticket	4918	Some functions are listed as unspecified on ICD
RTEMS Ticket	4925	Deal with GR740 errata: Level-2 Cache Issues H1 2023 (GRLIB-TN-0021)
RTEMS Ticket	4928	Upgrade Version of Sphinx to 7
RTEMS Ticket	4932	Monitor GCC Bug 108658
RTEMS Ticket	4936	Building sphinx 7.0.1 fails (cloned)
RTEMS Ticket	4953	Use of symbol addresses for arbitrary values may not work for some code models

### 10.1.3 Closed issues

The following issues were closed for this package version.

Database	Identifier	Subject
RTEMS Ticket	2348	Timecounter: Add NTP support
RTEMS Ticket	2349	Timecounter: Add PPS support
RTEMS Ticket	3456	Add support for CPU counter timestamps
RTEMS Ticket	3704	Review and update Doxygen recommendations
RTEMS Ticket	3705	Software Design Document (SDD) for space profile
RTEMS Ticket	3706	Create a hierarchy of RTEMS software components using Doxygen groups
RTEMS Ticket	3707	Assign each code file to a Doxygen group

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Table 3 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	3715	Add Requirements Engineering chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3717	Add test guidelines chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3719	Update libcrypt to latest FreeBSD to address Coverity Scan Issues
RTEMS Ticket	3935	Remove use of RTEMS_INLINE_ROUTINE in the RTEMS sources
RTEMS Ticket	4267	Add rtems_get_target_hash()
RTEMS Ticket	4269	Add rtems_get_build_label()
RTEMS Ticket	4560	Use thread-local storage for Newlib reentrancy objects
RTEMS Ticket	4662	Fix GCC 12 warnings
RTEMS Ticket	4667	include/sys/_bitset.h defines struct bitset, pollutes namespace
RTEMS Ticket	4668	Use thread-local storage in libstdc++
RTEMS Ticket	4669	clock_nanosleep() uses the wrong clock to determine the start time point
RTEMS Ticket	4672	Thread-local storage should be usable once an idle thread exists
RTEMS Ticket	4677	incorrect handling of “inactive_per_block” from “Objects_Information” structure (cloned)
RTEMS Ticket	4678	System initialization time increased compared to RTEMS 4.11
RTEMS Ticket	4679	Use priority inheritance for thread join
RTEMS Ticket	4680	POSIX tasks cancelled through rtems_task_delete() should have an exit value of PTHREAD_CANCELED
RTEMS Ticket	4690	CLOCK_REALTIME thread queue not updated as part of clock_settime call
RTEMS Ticket	4691	Add support for FACE Technical Standard Restriction on POSIX Absolute Timers
RTEMS Ticket	4706	Installed header break C++
RTEMS Ticket	4741	Fix GCC PR 107248
RTEMS Ticket	4817	Wrong output type
RTEMS Ticket	4818	Incomplete Statement in “cpu->heir”
RTEMS Ticket	4820	Hazardous cast
RTEMS Ticket	4822	Function returning unchanged function input
RTEMS Ticket	4828	Macro defined but magic number used instead
RTEMS Ticket	4832	CLANG flagged error
RTEMS Ticket	4842	SPARC/gplib - Registers definitions wrongly defined when there are reserved bits
RTEMS Ticket	4843	Output value not assigned
RTEMS Ticket	4845	Global variable declared/defined in the wrong file
RTEMS Ticket	4847	Goto statements
RTEMS Ticket	4850	LEON3 - Variable not initialized in any file / missing #ifdefs
RTEMS Ticket	4851	Variable not initialized in any file / missing #ifdefs
RTEMS Ticket	4854	Deprecated Functions

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Table 3 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4855	Input validity unchecked
RTEMS Ticket	4863	Operations evaluation order.
RTEMS Ticket	4874	Undefined behaviour
RTEMS Ticket	4900	PowerPC score warnings in score headers
RTEMS Ticket	4909	Multiple Protected Heap Functions are Unused
RTEMS Ticket	4915	Building sphinx 7.0.1 fails
RTEMS Ticket	4954	sparc: Simplify the clock driver and CPU counter support
RTEMS Ticket	4955	sparc: Potential stack corruption in uniprocessor configurations during start multitasking

## 10.2 Package Version 5

The fifth version of the Qualification Data Package (QDP) adds several corrections as a result of the Independent Software Verification and Validation (ISVV) activities as in the table below:

Table 4: Findings already addressed

ISVV Finding <sup>Page 75, 2</sup>	Finding Title	Notes
REQ-VER-008	Undefined behaviour	Following the independent validation, requirements related with qualified items were updated as to better describe behaviour upon invalid inputs/combinations.
REQ-VER-010	No requirements	Default text improved.
REQ-VER-022	Performance limits	Added units and filtered performance limits according to board.
REQ-VER-024	References to incorrect board	Updated section 5 of the SRS.
REQ-VER-041	Units for data representing a physical quantity	Added units for the values referring to size.
REQ-VER-043	Indexed bookmarks	Added indexed bookmarks to QDP documents.
FM-001	Invalid Thread wait flags used	Corrected sources.
FM-002	Run function prototype name not matching with call	Corrected sources.
FM-003	Unfinished work is deployed and causing compilation issues	Corrected sources.
TS-VER-009	Boundary tests for TS validation	Updated sections 5.1 and 7.1 of the SUITP and section 5.1 of the SVS as to clarify the approach.
TS-VER-010	Validation Plan contains limited elaboration	Addressed as part of the IVA test campaign.

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Table 4 – continued from previous page

ISVV Finding <sup>Page 75, 2</sup>	Finding Title	Notes
TS-VER-011	Testing multiple task interactions	Addressed as part of the IVA test campaign.
TS-VER-013	Incomplete SUI TP strategy	Updated sections 5.1 and 7.1 of the SUI TP and section 5.1 of the SVS as to clarify the approach.
TS-VER-019	Unit test objectives reached through TS tests	Updated sections 5.1 and 7.1 of the SUI TP and section 5.1 of the SVS as to clarify the approach.
DESIGN-VER-010	No architectural design	SDD now contains an Architectural Design section rather than just the Detailed Design generated from Doxygen.
CODE-VER-014	Macros wrongly defined	<b>Partially addressed.</b> <i>The generation (from RTEMS specifications) of <code>ftmctrl-regs.h</code>, <code>grgpio-regs.h</code>, <code>spwnpnp-regs.h</code>, and <code>spwrmmap-regs.h</code> is fixed. Eventual issues in <code>dsu4-regs.h</code> and <code>gr1553b-regs.h</code> are, as of the time of writing, still under discussion/clarification – please refer to <a href="#">#4842 - Registers definitions wrongly defined when there are reserved bits</a>.</i>
CODE-VER-032	Output value not assigned	<b>Partially addressed.</b> <i>For <code>bsp_interrupt_*</code> functions, it has been clarified that the presence of error conditions is implementation-defined. Still to be addressed for <code>leon3_install_inter_processor_interrupt</code>.</i>
CODE-VER-036	Unchecked boundaries	Added note within <code>rtems_message_queue_send</code> specification/ICD and added new <code>_Assert()</code> in the code.
CODE-VER-041	Variable not initialized in any file	Implemented the proposed correction.
CODE-VER-043	Global variable declared/defined in the wrong file	Moved the definition of this object to <code>start.S</code> and used a local symbol <code>.Lbootcpuindex</code> for it. Use a compare-and-swap instruction to assign the boot CPU. This allows a concurrent initialization.
CODE-VER-057	Function returning unchanged function input	Removed unused return values from functions' signatures.
CODE-VER-058	Incomplete statement	Not used a chained assignment for code clarity.
CODE-VER-074	goto statements	The goto label was directly after the loop, so it has been replaced with a break.
CODE-VER-076	"!", "&&" or "  " operand should have type "bool"	Simplified <code>_Objects_Is_api_valid</code> .

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Table 4 – continued from previous page

ISVV Finding <sup>Page 75, 2</sup>	Finding Title	Notes
CODE-VER-079	Hazardous cast	Added TM27_USE_VECTOR_HANDLER to select the interrupt handler type used by the <tm27.h> implementation, avoiding function pointer casts.
CODE-VER-083	Requirement not fully implemented	Condition excluding nested usage removed from requirement.
VAL-002	Use of macros not in the pre-qualified set	Removed directive-not-pre-qualified from these interfaces/macros and improved requirements specifications of these clock manager directives.
VAL-004	Documentation refers to undefined behaviour on cases where an error is to be expected	Following the independent validation, documentation has been updated as to better describe behaviour upon invalid inputs/combinations.

Moreover a new set of ISVV related documents were added, namely verification and validation plans and reports and the overall list of ISVV findings.

In a nutshell, the previous Qualification Data Package (QDP) release 4 (which was already an outcome of the RTEMS qualification efforts) has been used as the baseline for the improvements identified during the ISVV activities. Although these QDPs have been based on the RTEMS 6, other meanwhile changes (not related to ISVV outcomes) on the RTEMS public mainline have not been integrated into the QDP not to compromise/jeopardise the QDP qualification that has been performed using this baseline.

It must be noticed that not all of the identified and confirmed ISVV Findings have been corrected. Please refer to *Possible Problems and Known Errors* for the list of known problems not addressed.

For further details one can also refer to the RTEMS SMP ISVV Verification Report [F+23] within the QDP.

### 10.2.1 New issues

When the QDP of this package version was produced, there were the following new issues associated:

Database	Identifier	Subject
ESA Issue	803	RTEMS-SMP-REQ-VER-004 - Incomplete Requirements
ESA Issue	804	RTEMS-SMP-REQ-VER-032 - Incorrect definition of inner elements of structs
ESA Issue	805	RTEMS-SMP-REQ-VER-037 - Missing interfaces
ESA Issue	806	RTEMS-SMP-TS-VER-001 - No Test cases descriptions
ESA Issue	807	RTEMS-SMP-REQ-VER-001 - SRS typos and small mistakes

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<sup>2</sup> Consider these Findings' IDs preceded by "RTEMS-SMP-".

Table 5 – continued from previous page

Database	Identifier	Subject
ESA Issue	808	RTEMS-SMP-REQ-VER-002 - Contradictory constraints
ESA Issue	809	RTEMS-SMP-REQ-VER-003 - Time margins
ESA Issue	810	RTEMS-SMP-REQ-VER-005 - “Will” verb within requirements
ESA Issue	811	RTEMS-SMP-REQ-VER-006 - Confusing wording
ESA Issue	812	RTEMS-SMP-REQ-VER-007 - Unclear connections
ESA Issue	813	RTEMS-SMP-REQ-VER-009 - Too many dependent requirements
ESA Issue	814	RTEMS-SMP-REQ-VER-011 - Differing wording between GR740 and GR712
ESA Issue	815	RTEMS-SMP-REQ-VER-012 - Typos/small mistakes
ESA Issue	816	RTEMS-SMP-REQ-VER-013 - Formatting of parameters and directives
ESA Issue	817	RTEMS-SMP-REQ-VER-014 - Missing references in bibliography and links
ESA Issue	818	RTEMS-SMP-REQ-VER-015 - Incorrect verb for a requirement
ESA Issue	819	RTEMS-SMP-REQ-VER-016 - Directive not specified
ESA Issue	820	RTEMS-SMP-REQ-VER-017 - Inconsistent dates
ESA Issue	821	RTEMS-SMP-REQ-VER-019 - Repeated descriptions
ESA Issue	822	RTEMS-SMP-REQ-VER-020 - Colliding descriptions
ESA Issue	823	RTEMS-SMP-REQ-VER-021 - Bibliography references
ESA Issue	824	RTEMS-SMP-REQ-VER-023 - Inconsistency between requirements sections
ESA Issue	825	RTEMS-SMP-REQ-VER-025 - ICD references
ESA Issue	826	RTEMS-SMP-REQ-VER-026 - Constraints sections
ESA Issue	827	RTEMS-SMP-REQ-VER-027 - Missing presentations
ESA Issue	828	RTEMS-SMP-REQ-VER-028 - HW documentation
ESA Issue	829	RTEMS-SMP-REQ-VER-029 - Too many conditions / very complex requirement
ESA Issue	830	RTEMS-SMP-REQ-VER-030 - ICD typos/small mistakes
ESA Issue	831	RTEMS-SMP-REQ-VER-031 - Merge requirements
ESA Issue	832	RTEMS-SMP-REQ-VER-034 - Duplicated line
ESA Issue	833	RTEMS-SMP-REQ-VER-035 - ICD undefined acronyms
ESA Issue	834	RTEMS-SMP-REQ-VER-036 - Undescribed interface enumerator definitions
ESA Issue	835	RTEMS-SMP-REQ-VER-038 - Unspecified interface-types
ESA Issue	836	RTEMS-SMP-REQ-VER-039 - Sentence construction
ESA Issue	837	RTEMS-SMP-REQ-VER-040 - ICD is very tied to a specific C compiler
ESA Issue	838	RTEMS-SMP-DESIGN-VER-001 - Document vs QDP releases
ESA Issue	839	RTEMS-SMP-DESIGN-VER-002 - RTEMS version from which QDPs have been derived

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Table 5 – continued from previous page

Database	Identifier	Subject
ESA Issue	840	RTEMS-SMP-DESIGN-VER-003 - Unclear SUM
ESA Issue	841	RTEMS-SMP-DESIGN-VER-004 - No SUM which follows ECSS clauses
ESA Issue	842	RTEMS-SMP-DESIGN-VER-005 - SCF missing acronyms
ESA Issue	843	RTEMS-SMP-DESIGN-VER-006 - SCF typos
ESA Issue	844	RTEMS-SMP-DESIGN-VER-007 - SCF conflicting information
ESA Issue	845	RTEMS-SMP-DESIGN-VER-008 - Memory usage benchmarks
ESA Issue	847	RTEMS-SMP-DESIGN-VER-011 - Requirements not traced to design
ESA Issue	848	RTEMS-SMP-DESIGN-VER-012 - No abbreviations/acronym list
ESA Issue	849	RTEMS-SMP-DESIGN-VER-013 - Unclear traced requirements
ESA Issue	850	RTEMS-SMP-DESIGN-VER-014 - No tracing matrix
ESA Issue	851	RTEMS-SMP-DESIGN-VER-015 - No verification method
ESA Issue	852	RTEMS-SMP-DESIGN-VER-017 - Missing descriptions
ESA Issue	853	RTEMS-SMP-DESIGN-VER-019 - Incorrect macro
ESA Issue	854	RTEMS-SMP-DESIGN-VER-020 - Untraced requirement
ESA Issue	855	RTEMS-SMP-DESIGN-VER-021 - Requirement wording
ESA Issue	856	RTEMS-SMP-DESIGN-VER-022 - Incomplete/empty design
ESA Issue	857	RTEMS-SMP-DESIGN-VER-023 - Unexplained text
ESA Issue	858	RTEMS-SMP-DESIGN-VER-024 - Complex requirement
ESA Issue	859	RTEMS-SMP-DESIGN-VER-025 - Untraced requirements
ESA Issue	860	RTEMS-SMP-DESIGN-VER-026 - Incomplete requirements
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ESA Issue	862	RTEMS-SMP-DESIGN-VER-029 - Empty section
ESA Issue	863	RTEMS-SMP-DESIGN-VER-030 - Requirement naming
ESA Issue	864	RTEMS-SMP-DESIGN-VER-031 - Incomplete
ESA Issue	865	RTEMS-SMP-DESIGN-VER-032 - Naming of design elements
ESA Issue	866	RTEMS-SMP-DESIGN-VER-033 - Unspecified elements
ESA Issue	867	RTEMS-SMP-DESIGN-VER-034 - Language and compiler requirements

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Table 5 – continued from previous page

Database	Identifier	Subject
ESA Issue	868	RTEMS-SMP-DESIGN-VER-035 - Untraced design components
ESA Issue	869	RTEMS-SMP-DESIGN-VER-036 - Hyperlinks not working
ESA Issue	870	RTEMS-SMP-DESIGN-VER-037 - Multiple traced Requirements
ESA Issue	871	RTEMS-SMP-VAL-001 - “Timer Server” not directly usable
ESA Issue	872	RTEMS-SMP-VAL-003 - Some functions are listed as unspecified on ICD
ESA Issue	873	RTEMS-SMP-VAL-004 - Documentation refers undefined behaviour on cases where an error is to be expected
ESA Issue	874	RTEMS-SMP-VAL-005 - Missing NULL pointer check for clock manager directives
ESA Issue	875	RTEMS-SMP-TS-VER-002 - Potential typing error
ESA Issue	876	RTEMS-SMP-TS-VER-003 - Testcase 7.13 not found in test matrix
ESA Issue	877	RTEMS-SMP-TS-VER-004 - Testcase 7.31 too long
ESA Issue	878	RTEMS-SMP-TS-VER-005 - Testcase 7.32 too long
ESA Issue	879	RTEMS-SMP-TS-VER-007 - Linking between testcases and test requirements
ESA Issue	880	RTEMS-SMP-TS-VER-008 - Testcase dependency on Detailed Design
ESA Issue	881	RTEMS-SMP-TS-VER-015 - Non-human readable test report
ESA Issue	882	RTEMS-SMP-TS-VER-016 - Document Identifiers not available
ESA Issue	883	RTEMS-SMP-TS-VER-018 - Analysis, inspection or review testcases not reported
ESA Issue	884	RTEMS-SMP-CODE-VER-004 - No SPDX License
ESA Issue	885	RTEMS-SMP-CODE-VER-005 - SPDX License misplaced
ESA Issue	886	RTEMS-SMP-CODE-VER-006 - Header Files Format “extern C” missing
ESA Issue	887	RTEMS-SMP-CODE-VER-007 - Two paragraphs
ESA Issue	888	RTEMS-SMP-CODE-VER-008 - Format of “if”, “while” or “for” statements are not properly defined
ESA Issue	889	RTEMS-SMP-CODE-VER-009 - Format of “!” statements might not be properly defined
ESA Issue	890	RTEMS-SMP-CODE-VER-010 - TODO section left undone
ESA Issue	891	RTEMS-SMP-CODE-VER-011 - FIXME
ESA Issue	892	RTEMS-SMP-CODE-VER-013 - Macro defined but magic number used instead

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Table 5 – continued from previous page

Database	Identifier	Subject
ESA Issue	893	RTEMS-SMP-CODE-VER-014 - Macros wrongly defined
ESA Issue	894	RTEMS-SMP-CODE-VER-018 - Deprecated Functions
ESA Issue	895	RTEMS-SMP-CODE-VER-021 - Unclear comments
ESA Issue	896	RTEMS-SMP-CODE-VER-022 - Comments not in accordance with template
ESA Issue	897	RTEMS-SMP-CODE-VER-023 - Code not in accordance with comments
ESA Issue	898	RTEMS-SMP-CODE-VER-024 - Inaccurate comments at the beginning of file
ESA Issue	899	RTEMS-SMP-CODE-VER-025 - Incorrect Copyright License Information
ESA Issue	900	RTEMS-SMP-CODE-VER-026 - Function defined in header file
ESA Issue	901	RTEMS-SMP-CODE-VER-028 - Unused input parameter
ESA Issue	902	RTEMS-SMP-CODE-VER-029 - Input validity unchecked
ESA Issue	903	RTEMS-SMP-CODE-VER-030 - Wrong data type
ESA Issue	904	RTEMS-SMP-CODE-VER-032 - Output value not assigned
ESA Issue	905	RTEMS-SMP-CODE-VER-033 - Wrong output type
ESA Issue	908	RTEMS-SMP-CODE-VER-044 - Code for test software
ESA Issue	909	RTEMS-SMP-CODE-VER-052 - #pragmas to ignore warnings
ESA Issue	910	RTEMS-SMP-CODE-VER-062 - CLANG flagged error
ESA Issue	911	RTEMS-SMP-CODE-VER-063 - Missing design details
ESA Issue	912	RTEMS-SMP-CODE-VER-071 - Confusing #IF 1 clause
ESA Issue	913	RTEMS-SMP-CODE-VER-073 - Low power Power-down workaround
ESA Issue	914	RTEMS-SMP-CODE-VER-078 - Bitwise operator applied to a signed operand
RTEMS Ticket	3923	Add traceability information to the application configuration options
RTEMS Ticket	4560	Use thread-local storage for Newlib reentrancy objects
RTEMS Ticket	4668	Use thread-local storage in libstdc++
RTEMS Ticket	4669	clock_nanosleep() uses the wrong clock to determine the start time point
RTEMS Ticket	4672	Thread-local storage should be usable once an idle thread exists
RTEMS Ticket	4679	Use priority inheritance for thread join
RTEMS Ticket	4680	POSIX tasks cancelled through rtems_task_delete() should have an exit value of PTHREAD_CANCELED
RTEMS Ticket	4690	CLOCK_REALTIME thread queue not updated as part of clock_settime call
RTEMS Ticket	4741	Fix GCC PR 107248
RTEMS Ticket	4805	SPDX Licenses and Header File Formatting

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Table 5 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4806	Header Source files format “extern C” missing
RTEMS Ticket	4807	Two consecutive paragraphs
RTEMS Ticket	4808	Incorrect Formatting of “if”, “while”, or “for” Statements
RTEMS Ticket	4809	Incorrect Formatting of “!” Statements
RTEMS Ticket	4810	Unfinished TODO section
RTEMS Ticket	4811	Non-compliant Comments with Templates
RTEMS Ticket	4812	Discrepancy between Code and Comments
RTEMS Ticket	4813	Inaccurate comments at the beginning of file
RTEMS Ticket	4814	Incorrect Copyright License Information
RTEMS Ticket	4815	Function defined in header file
RTEMS Ticket	4816	Wrong data type
RTEMS Ticket	4817	Wrong output type
RTEMS Ticket	4818	Incomplete Statement in “cpu->heir”
RTEMS Ticket	4819	Unclear #IF 1 Clause in File: Possible Error
RTEMS Ticket	4820	Hazardous cast
RTEMS Ticket	4822	Function returning unchanged function input
RTEMS Ticket	4827	Section left to be fixed in kern_tc.c and tls.h (FIXME)
RTEMS Ticket	4828	Macro defined but magic number used instead
RTEMS Ticket	4829	Unclear comments
RTEMS Ticket	4830	Output value not assigned
RTEMS Ticket	4831	#pragmas to ignore warnings
RTEMS Ticket	4832	CLANG flagged error
RTEMS Ticket	4842	SPARC/grlib - Registers definitions wrongly defined when there are reserved bits
RTEMS Ticket	4843	Output value not assigned
RTEMS Ticket	4844	Unchecked boundaries
RTEMS Ticket	4845	Global variable declared/defined in the wrong file
RTEMS Ticket	4846	Code for test software
RTEMS Ticket	4847	Goto statements
RTEMS Ticket	4849	“Timer Server” Cannot be Used in Systems with Static Memory Allocation
RTEMS Ticket	4850	LEON3 - Variable not initialized in any file / missing #ifdefs
RTEMS Ticket	4851	Variable not initialized in any file / missing #ifdefs
RTEMS Ticket	4852	Deprecated Functions
RTEMS Ticket	4854	Deprecated Functions
RTEMS Ticket	4855	Input validity unchecked
RTEMS Ticket	4862	score/ & bsp/: Unused input parameters
RTEMS Ticket	4863	Operations evaluation order.
RTEMS Ticket	4864	Bitwise operator applied to a signed operand
RTEMS Ticket	4874	Undefined behaviour
RTEMS Ticket	4875	LEON3FT - Power-down workaround
RTEMS Ticket	4915	Building sphinx 7.0.1 fails
RTEMS Ticket	4918	Some functions are listed as unspecified on ICD
RTEMS Ticket	4925	Deal with GR740 errata: Level-2 Cache Issues H1 2023 (GRLIB-TN-0021)

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Table 5 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4928	Upgrade Version of Sphinx to 7
RTEMS Ticket	4932	Monitor GCC Bug 108658
RTEMS Ticket	4936	Building sphinx 7.0.1 fails (cloned)
RTEMS Ticket	4953	Use of symbol addresses for arbitrary values may not work for some code models
RTEMS Ticket	4954	sparc: Simplify the clock driver and CPU counter support
RTEMS Ticket	4955	sparc: Potential stack corruption in uniprocessor configurations during start multitasking

### 10.2.2 Open issues

When the QDP of this package version was produced, there were the following open issues associated:

Database	Identifier	Subject
ESA Issue	742	QDP and Coverity Results contain personal information
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3704	Review and update Doxygen recommendations
RTEMS Ticket	3705	Software Design Document (SDD) for space profile
RTEMS Ticket	3706	Create a hierarchy of RTEMS software components using Doxygen groups
RTEMS Ticket	3707	Assign each code file to a Doxygen group
RTEMS Ticket	3715	Add Requirements Engineering chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3717	Add test guidelines chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4267	Add rtems_get_target_hash()
RTEMS Ticket	4269	Add rtems_get_build_label()

### 10.2.3 Closed issues

The following issues were closed for this package version.

Database	Identifier	Subject
ESA Issue	846	RTEMS-SMP-DESIGN-VER-010 - No architectural design
ESA Issue	906	RTEMS-SMP-CODE-VER-036 - Unchecked boundaries

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Table 7 – continued from previous page

Database	Identifier	Subject
ESA Issue	907	RTEMS-SMP-CODE-VER-041 - Variable not initialized in any file
RTEMS Ticket	3540	How To Use SPARC memscrub

## 10.3 Package Version 4

The fourth version of the QDP contains a warranty release issued for project *Qualification of RTEMS Symmetric Multiprocessing (SMP)* ESA Contract No. 4000125572/18/NL/GLC/as. There are the following changes compared to package version 3:

- The RTEMS baseline changed. In package version 3, we had about 120 QDP-specific patches on top of the RTEMS baseline. Now, there are only 46 patches left. These patches fall roughly into three categories
  - BSP-specific changes,
  - changes in the build system to support building the pre-qualified only feature set,
  - performance and formal methods tests.
- Most of the validation tests are now included in the RTEMS baseline. Test runs on ARM and PowerPC platforms were performed showing good results comparable to the current QDP platforms.
- The relicensing to BSD-2-Clause of the RTEMS sources by the RTEMS Project progressed significantly compared to package version 3.
- The previous RTEMS baseline contained a bug which could result in a non-monotonic CLOCK\_MONOTONIC. This bug is fixed in this package version. See also RTEMS ticket #4617.
- The specification and validation of some application configuration options was improved. Now only test cases and validations by inspections are used as validation methods for application configuration options. Entire test suites are no longer used as a validation evidence for a particular requirement.
- Significant changes in the Software Requirement Specification (SRS) [[HK+23b](#)] and Software Verification Report (SVR) [[HK+23e](#)], see the change log of the documents.

### 10.3.1 New issues

When the QDP of this package version was produced, there were no new issues associated.

### 10.3.2 Open issues

When the QDP of this package version was produced, there were the following open issues associated:

Database	Identifier	Subject
ESA Issue	742	QDP and Coverity Results contain personal information
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3540	How To Use SPARC memscrub
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3704	Review and update Doxygen recommendations
RTEMS Ticket	3705	Software Design Document (SDD) for space profile
RTEMS Ticket	3706	Create a hierarchy of RTEMS software components using Doxygen groups
RTEMS Ticket	3707	Assign each code file to a Doxygen group
RTEMS Ticket	3715	Add Requirements Engineering chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3717	Add test guidelines chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4267	Add rtems_get_target_hash()
RTEMS Ticket	4269	Add rtems_get_build_label()

### 10.3.3 Closed issues

The following issues were closed for this package version.

Database	Identifier	Subject
RTEMS Ticket	4572	Improve Clarity for New Clock Manager Directives
RTEMS Ticket	4617	Potential non-monotonic CLOCK_MONOTONIC
RTEMS Ticket	4627	Multitasking start is broken on SMP targets which do not restore the interrupt state during context switching

## 10.4 Package Version 3

The third version of the QDP contains the final release issued for project *Qualification of RTEMS Symmetric Multiprocessing (SMP)* ESA Contract No. 4000125572/18/NL/GLC/as.

### 10.4.1 New issues

When the QDP of this package version was produced, there were no new issues associated.

### 10.4.2 Open issues

When the QDP of this package version was produced, there were the following open issues associated:

Database	Identifier	Subject
ESA Issue	742	QDP and Coverity Results contain personal information
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3540	How To Use SPARC memscrub
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3704	Review and update Doxygen recommendations
RTEMS Ticket	3705	Software Design Document (SDD) for space profile
RTEMS Ticket	3706	Create a hierarchy of RTEMS software components using Doxygen groups
RTEMS Ticket	3707	Assign each code file to a Doxygen group
RTEMS Ticket	3715	Add Requirements Engineering chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3717	Add test guidelines chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4267	Add rtems_get_target_hash()
RTEMS Ticket	4269	Add rtems_get_build_label()

### 10.4.3 Closed issues

The following issues were closed for this package version.

Database	Identifier	Subject
ESA Issue	176	63
ESA Issue	509	DDR-CJ-16 Validation methods not understood
ESA Issue	511	DDR-CJ-18 Validation requirements table incomplete
ESA Issue	571	DDR2-JFS-01 : static analysis of RTEMS space subset source code
ESA Issue	635	Finding: SPAMR: Fix relevant Coverity issues
ESA Issue	636	Finding: SPAMR: Fix issue 7. Dereference of null pointer
ESA Issue	637	Finding: SPAMR: Fix CppCheck issues
ESA Issue	638	Finding: SPAMR: Missing validation test for some requirements

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Table 11 – continued from previous page

Database	Identifier	Subject
ESA Issue	640	Finding: SPAMR: ICD: Some interfaces miss specifications; tests not in plan
ESA Issue	641	Finding: SPAMR: Source code does not comply with cyclomatic number, nesting or lines of code
ESA Issue	643	Finding: SPAMR: Not 100% decision coverage; failed tests used
ESA Issue	644	Finding: SPAMR: No regular coverage analysis feedback to developers
ESA Issue	645	Finding: SVR: SRS & ICD incomplete
ESA Issue	648	CDR-MV-03 : unclear flow-down of RS-10
ESA Issue	652	CDR-MV-07 : QDP RTEMS SRS and ICD reading guide
ESA Issue	656	CDR-MV-11 : QDP toolchain SUM needs major improvement
ESA Issue	659	SVR: QDP SVR needs text and performance data on “budgets and margins computation”
ESA Issue	660	Finding: SVR: Table 1 does not list all requirements
ESA Issue	662	Finding: SVR: ICD contains interface specifications not in the Space Profile
ESA Issue	664	Finding: SVR: SDD: Function <code>rtems_rate_monotonic_deadline()</code> missing
ESA Issue	665	Finding: SVR: Binary library content does not match Space Profile
ESA Issue	671	Finding: SVR: Configuration management of QDP documents does not follow SCMP rules
ESA Issue	701	Finding: SPAMR: SCF Incomplete
ESA Issue	704	Finding: SVR: Verification test <code>rtems_semaphore_obtain()</code> misses error conditions
ESA Issue	711	QR1-CJ-05: Open issues reported in SPAMR
ESA Issue	715	QR1-CJ-09: Open issues reported in SVR
ESA Issue	717	QR1-CJ-11: Document not ready
ESA Issue	718	QR1-JF-01 The ICD document is uncomplete
ESA Issue	719	QR1-JF-02 The ICD, SRS and SDD should be trazable
ESA Issue	721	QR1-MV-02 Space Profile document versus SVR findings
ESA Issue	733	Finding: SVR: Inconsistent test results of formal method tests
ESA Issue	736	Finding: SVR: FVR missing
ESA Issue	737	Finding: SVR: Documents are incomplete (SUITP, SRelD, ICD, SVS)
ESA Issue	738	Todos in SDD
ESA Issue	754	QR2-CJ-04 QDP document versioning strategy
ESA Issue	755	QR2-CJ-05 Only draft versions issued
ESA Issue	756	QR2-CJ-06 no versioning information
ESA Issue	759	QR2-CJ-07 project status outdated
ESA Issue	760	QR2-CJ-08 planning open points
ESA Issue	761	QR2-CJ-09 CppCheck error assessment
ESA Issue	762	QR2-CJ-10 check for null pointer dereferences

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Table 11 – continued from previous page

Database	Identifier	Subject
ESA Issue	763	QR2-CJ-11 confusing reference
ESA Issue	770	Finding: SVR: Failed timing benchmarks
ESA Issue	771	Finding: SPAMR: Optional Requirements
ESA Issue	772	QDP Build on Boards Analysis
ESA Issue	773	Finding: SVR: Some Formal Methods Tests fail.
ESA Issue	775	Finding: SPAMR: Verification tests fail on the hardware
ESA Issue	776	Finding: SVR: Test without traced requirements
ESA Issue	779	QDP Build Error
RTEMS Ticket	2548	Problematic integer conversion in rtems_clock_get_tod()
RTEMS Ticket	3702	Space profile for RTEMS SMP
RTEMS Ticket	3923	Add traceability information to the application configuration options
RTEMS Ticket	4035	Reserved identifier “time” re-used in rtems_clock_get_tod_timeval()
RTEMS Ticket	4265	Add rtems_get_build_hash()
RTEMS Ticket	4356	rtems_semaphore_set_priority() uses an invalid SMP lock
RTEMS Ticket	4459	Handling of unexpected traps is unreliable on SPARC
RTEMS Ticket	4522	Optimize red-black tree insert/extract
RTEMS Ticket	4524	Re-add lost capability for custom stack allocator to allocate IDLE thread stacks
RTEMS Ticket	4528	rate monotonic: reset of CPU usage time not always detected
RTEMS Ticket	4531	Data corruption in SMP schedulers
RTEMS Ticket	4532	Priority inversion issues with MrsP locking protocol implementation
RTEMS Ticket	4534	SMP EDF scheduler violates priority group ordering
RTEMS Ticket	4544	The last processor must not be removed if it is owned by a helping scheduler
RTEMS Ticket	4545	The SMP EDF scheduler can only support more restricted affinity sets of a thread
RTEMS Ticket	4546	A thread restart does not update the priority of related threads
RTEMS Ticket	4551	Workaround for GRLIB-TN-0011 required for sparc/leon3 BSPs in SMP configuration
RTEMS Ticket	4566	Atomic store does not use the order parameter for C++

## 10.5 Package Version 2

The second version of the QDP contains a development snapshot which was issued for the *QR/2*.

### 10.5.1 New issues

When the QDP of this package version was produced, there were the following new issues associated:

Database	Identifier	Subject
ESA Issue	176	63
ESA Issue	509	DDR-CJ-16 Validation methods not understood
ESA Issue	511	DDR-CJ-18 Validation requirements table incomplete
ESA Issue	571	DDR2-JFS-01 : static analysis of RTEMS space subset source code
ESA Issue	635	Finding: SPAMR: Fix relevant Coverity issues
ESA Issue	636	Finding: SPAMR: Fix issue 7. Dereference of null pointer
ESA Issue	637	Finding: SPAMR: Fix CppCheck issues
ESA Issue	638	Finding: SPAMR: Missing validation test for some requirements
ESA Issue	640	Finding: SPAMR: ICD: Some interfaces miss specifications; tests not in plan
ESA Issue	641	Finding: SPAMR: Source code does not comply with cyclomatic number, nesting or lines of code
ESA Issue	643	Finding: SPAMR: Not 100% decision coverage; failed tests used
ESA Issue	644	Finding: SPAMR: No regular coverage analysis feedback to developers
ESA Issue	645	Finding: SVR: SRS & ICD incomplete
ESA Issue	648	CDR-MV-03 : unclear flow-down of RS-10
ESA Issue	652	CDR-MV-07 : QDP RTEMS SRS and ICD reading guide
ESA Issue	656	CDR-MV-11 : QDP toolchain SUM needs major improvement
ESA Issue	659	SVR: QDP SVR needs text and performance data on "budgets and margins computation"
ESA Issue	660	Finding: SVR: Table 1 does not list all requirements
ESA Issue	662	Finding: SVR: ICD contains interface specifications not in the Space Profile
ESA Issue	664	Finding: SVR: SDD: Function <code>rtems_rate_monotonic_deadline()</code> missing
ESA Issue	665	Finding: SVR: Binary library content does not match Space Profile
ESA Issue	671	Finding: SVR: Configuration management of QDP documents does not follow SCMP rules
ESA Issue	701	Finding: SPAMR: SCF Incomplete
ESA Issue	704	Finding: SVR: Verification test <code>rtems_semaphore_obtain()</code> misses error conditions

continues on next page

Table 12 – continued from previous page

Database	Identifier	Subject
ESA Issue	711	QR1-CJ-05: Open issues reported in SPAMR
ESA Issue	715	QR1-CJ-09: Open issues reported in SVR
ESA Issue	717	QR1-CJ-11: Document not ready
ESA Issue	718	QR1-JF-01 The ICD document is uncomplete
ESA Issue	719	QR1-JF-02 The ICD, SRS and SDD should be trazable
ESA Issue	721	QR1-MV-02 Space Profile document versus SVR find-ings
ESA Issue	733	Finding: SVR: Inconsitent test results of formal method tests
ESA Issue	736	Finding: SVR: FVR missing
ESA Issue	737	Finding: SVR: Documents are incomplete (SUITP, SReID, ICD, SVS)
ESA Issue	738	Todos in SDD
ESA Issue	742	QDP and Coverity Results contain personal informa-tion
RTEMS Ticket	2548	Problematic integer conversion in rtems_clock_get_tod()
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3540	How To Use SPARC memscrub
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3702	Space profile for RTEMS SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3704	Review and update Doxygen recommendations
RTEMS Ticket	3705	Software Design Document (SDD) for space profile
RTEMS Ticket	3706	Create a hierarchy of RTEMS software components using Doxygen groups
RTEMS Ticket	3707	Assign each code file to a Doxygen group
RTEMS Ticket	3715	Add Requirements Engineering chapter to RTEMS Software Engineering Handbook
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3717	Add test guidelines chapter to RTEMS Software Engi-neering Handbook
RTEMS Ticket	3923	Add traceability information to the application config-uration options
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4035	Reserved identifier “time” re-used in rtems_clock_get_tod_timeval()
RTEMS Ticket	4265	Add rtems_get_build_hash()
RTEMS Ticket	4267	Add rtems_get_target_hash()
RTEMS Ticket	4269	Add rtems_get_build_label()
RTEMS Ticket	4356	rtems_semaphore_set_priority() uses an invalid SMP lock
RTEMS Ticket	4459	Handling of unexpected traps is unreliable on SPARC

## 10.5.2 Open issues

When the QDP of this package version was produced, there were no open issues associated.

## 10.5.3 Closed issues

The following issues were closed for this package version.

Database	Identifier	Subject
ESA Issue	10	AI 31-2018104
ESA Issue	13	AI 43-20190201
ESA Issue	21	AI 53
ESA Issue	22	AI 22-2018104
ESA Issue	23	AI 23-2018104
ESA Issue	424	67
ESA Issue	468	73
ESA Issue	508	DDR-CJ-15 Document not ready
ESA Issue	629	Finding: SPAMR: New Functions not in Space Profile and API Guide
ESA Issue	634	Finding: SPAMR: Fix User Manual inconsistencies
ESA Issue	639	SPAMR: Missing content in section V&V Coverage - Unit/Integration Level
ESA Issue	663	Finding: SVR: SDD: Todos and missing software architecture description
ESA Issue	668	Finding: SVR: Verification test partition manager misses one error condition
ESA Issue	669	Finding: SVR: Boundaries at n-1, n, n+1 not always tested
ESA Issue	670	Finding: SVR: QDP missing documents (SReID, SUITP, SUITR)
ESA Issue	7	AI 21-2018104
ESA Issue	700	Finding: SPAMR: CppCheck not correctly configured
ESA Issue	706	Single Core QDPs cannot be build
ESA Issue	712	QR1-CJ-06 Test coverage problem not understood
ESA Issue	713	QR1-CJ-07 RIDs are missing
ESA Issue	714	QR1-CJ-08 Progress report info outdated
ESA Issue	716	QR1-CJ-10 SCF contains personal information
ESA Issue	730	Single Core QDPs cannot be build
ESA Issue	731	Seldom spontaneous RSB bug lead to QDP build failure
ESA Issue	8	AI 25-2018104
RTEMS Ticket	2189	Insufficient documentation for <code>rtems_clock_get_tod()</code>
RTEMS Ticket	2365	Task pre-emption disable is broken due to pseudo ISR tasks
RTEMS Ticket	2985	Add documentation for <code>printk()</code>
RTEMS Ticket	3199	New test framework
RTEMS Ticket	3250	Remove Use of <code>bsp_specs</code>
RTEMS Ticket	3269	Make the IRQ extensions API a standard API

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Table 13 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	3319	SPARC: Constructors/destructors with priority are not called
RTEMS Ticket	3436	Remove clock driver Clock_driver_support_shutdown_hardware() hook
RTEMS Ticket	3459	Rework initialization and interrupt stack support
RTEMS Ticket	3480	CONFIGURE_MINIMUM_TASK_STACK_SIZE may affect CONFIGURE_INTERRUPT_STACK_SIZE
RTEMS Ticket	3482	Relax the buffer alignment required by rtems_partition_create()
RTEMS Ticket	3486	Use uintptr_t and size_t instead of uint32_t in rtems_partition_create()
RTEMS Ticket	3488	Remove CONFIGURE_HAS_OWN_MOUNT_TABLE
RTEMS Ticket	3489	Obsolete CONFIGURE_HAS_OWN_CONFIGURATION_TABLE
RTEMS Ticket	3490	Remove CONFIGURE_HAS_OWN_CONFIGURATION_TABLE
RTEMS Ticket	3520	Remove CONFIGURE_HAS_OWN_FILESYSTEM_TABLE
RTEMS Ticket	3533	Add rtems_task_exit()
RTEMS Ticket	3539	Remove CPU_PROVIDES_IDLE_THREAD_BODY
RTEMS Ticket	3551	Move default configuration to separate library
RTEMS Ticket	3583	Add rtems_malloc() and rtems_calloc()
RTEMS Ticket	3584	Remove types which are only available if RTEMS_DEPRECATED_TYPES is defined
RTEMS Ticket	3585	Deprecate proc_ptr
RTEMS Ticket	3586	Remove deprecated proc_ptr definition
RTEMS Ticket	3587	Deprecate rtems_context
RTEMS Ticket	3588	Remove deprecated rtems_context
RTEMS Ticket	3589	Deprecate rtems_context_fp
RTEMS Ticket	3590	Remove deprecated rtems_context_fp
RTEMS Ticket	3591	Deprecate region_information_block
RTEMS Ticket	3592	Remove deprecated region_information_block
RTEMS Ticket	3593	Deprecate rtems_thread_cpu_usage_t
RTEMS Ticket	3594	Remove deprecated rtems_thread_cpu_usage_t
RTEMS Ticket	3595	Deprecate rtems_rate_monotonic_period_time_t
RTEMS Ticket	3596	Remove deprecated rtems_rate_monotonic_period_time_t
RTEMS Ticket	3598	Move internal types of API objects to separate header file
RTEMS Ticket	3603	Remove support for 16-bit object identifiers
RTEMS Ticket	3621	Statically initialize object information structures
RTEMS Ticket	3636	Add rtems_scheduler_get_maximum_priority()
RTEMS Ticket	3637	Fix rtems_task_restart() argument type
RTEMS Ticket	3659	LEON3 kernel entry point is overwritten - secondary processors may enter into spurious handler
RTEMS Ticket	3666	Add support for C++17 std::aligned_alloc
RTEMS Ticket	3708	Remove Doxygen comments from confdefs.h
RTEMS Ticket	3718	Add support for test plans
RTEMS Ticket	3726	Select a requirements engineering tool
RTEMS Ticket	3731	Add rtems_scheduler_get_processor()
RTEMS Ticket	3732	Add rtems_scheduler_get_processor_maximum()

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Table 13 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	3734	Add RTEMS_CONST attribute
RTEMS Ticket	3818	New build system
RTEMS Ticket	3833	Simplify RTEMS semaphore configuration
RTEMS Ticket	3834	Simplify clock driver
RTEMS Ticket	3835	Support statically allocated threads
RTEMS Ticket	3836	Specify the application configuration options
RTEMS Ticket	3837	Rename CONFIGURE_LIBIO_MAXIMUM_FILE_DESCRIPTOR
RTEMS Ticket	3838	Rework work area initialization
RTEMS Ticket	3840	Add CONFIGURE_IMFS_ENABLE_MKFIFO
RTEMS Ticket	3841	Add rtems_object_get_local_node()
RTEMS Ticket	3843	Add CONFIGURE_DIRTY_MEMORY
RTEMS Ticket	3844	Remove CONFIGURE_HAS_OWN_DEVICE_DRIVER_TABLE
RTEMS Ticket	3845	Remove Ada-specific configuration options
RTEMS Ticket	3846	Build system does not track the dependencies of start.o files
RTEMS Ticket	3853	Add and use project-wide glossary to documentation
RTEMS Ticket	3861	Add CONFIGURE_VERBOSE_SYSTEM_INITIALIZATION
RTEMS Ticket	3862	Canonicalize CONFIGURE_ZERO_WORKSPACE_AUTOMATICALLY
RTEMS Ticket	3863	Remove support for the BSP_ZERO_WORKSPACE_AUTOMATICALLY BSP option
RTEMS Ticket	3865	Fix linker set item declarations for small data area targets
RTEMS Ticket	3866	Add support for GCC 10 noinit attribute
RTEMS Ticket	3871	Remove rtems_configuration_get_posix_api_configuration()
RTEMS Ticket	3873	Remove CONFIGURE_HAS_OWN_INIT_TASK_TABLE
RTEMS Ticket	3874	Remove CONFIGURE_POSIX_HAS_OWN_INIT_THREAD_TABLE
RTEMS Ticket	3875	Split up confdefs.h in component based header files
RTEMS Ticket	3876	Remove CONFIGURE_DISABLE_SMP_CONFIGURATION
RTEMS Ticket	3885	Context switch extension is broken in SMP configurations
RTEMS Ticket	3898	Remove CONFIGURE_MAXIMUM_DEVICES
RTEMS Ticket	3900	New template for boolean feature defines
RTEMS Ticket	3901	New template for configuration options with a value
RTEMS Ticket	3937	Move content of bsp_specs to GCC
RTEMS Ticket	3953	rtems_extensions_create() accepts a NULL pointer table
RTEMS Ticket	3959	Add rtems_task_construct()
RTEMS Ticket	3970	Deprecate use _RTEMS_version at API level
RTEMS Ticket	3971	Deprecate use of RTEMS_MAXIMUM_NAME_LENGTH
RTEMS Ticket	3972	Deprecate <rtems/system.h>
RTEMS Ticket	3973	Add rtems_get_copyright_notice() and deprecate _Copyright_Notice
RTEMS Ticket	3978	Move _RTEMS_version to implementation header file
RTEMS Ticket	3979	Remove RTEMS_MAXIMUM_NAME_LENGTH
RTEMS Ticket	3980	Remove deprecated <rtems/system.h>

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Table 13 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	3981	Remove <code>_Copyright_Notice</code> from API header file
RTEMS Ticket	3988	Remove deprecated <code>rtems_extension</code>
RTEMS Ticket	3989	Remove deprecated <code>rtems_get_current_processor()</code>
RTEMS Ticket	3990	Remove deprecated <code>rtems_get_processor_count()</code>
RTEMS Ticket	3991	Remove deprecated Thread typedef
RTEMS Ticket	3993	Specify the RTEMS Classic API
RTEMS Ticket	3994	Generate Doxygen markup for the application configuration options
RTEMS Ticket	4005	Remove <code>RTEMS_MP_NOT_CONFIGURED</code> error condition
RTEMS Ticket	4007	Add <code>rtems_message_queue_construct()</code>
RTEMS Ticket	4032	Make deferred free in <code>malloc()</code> support optional
RTEMS Ticket	4054	<code>RTEMS_BARRIER_AUTOMATIC_RELEASE</code> and <code>RTEMS_BINARY_SEMAPHORE</code> options have the same value
RTEMS Ticket	4060	The reworked <code>&lt;rtems/confdefs.h&gt;</code> has a cyclic dependency with <code>RTEMS_MULTIPROCESSING</code> enabled
RTEMS Ticket	4074	Add <code>CONFIGURE_MAXIMUM_THREAD_LOCAL_STORAGE_SIZE</code>
RTEMS Ticket	4080	build: Add <code>start.o</code> dependency to the executable link step
RTEMS Ticket	4105	Add <code>RTEMS_PARTITION_ALIGNMENT</code>
RTEMS Ticket	4122	Change <code>RTEMS_NO_RETURN</code> to use C11 and C++11 standard means
RTEMS Ticket	4154	Improve the workaround for the LEON3FT store-store errata: TN-0009
RTEMS Ticket	4155	Add a workaround for the LEON3FT RETT Restart errata: TN-0018
RTEMS Ticket	4157	<code>pthread_spin_unlock()</code> may corrupt the thread stack if <code>RTEMS_PROFILING</code> and <code>RTEMS_SMP</code> is enabled
RTEMS Ticket	4181	Add <code>CONFIGURE_INIT_TASK_STORAGE_SIZE</code>
RTEMS Ticket	4195	Add gr740 support available in SIS 2.25 to the RTEMS Tester
RTEMS Ticket	4196	Improve gcov support provided by GCC for RTEMS
RTEMS Ticket	4217	Change status code for nested obtain of MrsP semaphores
RTEMS Ticket	4223	Missing “extern” in <code>RTEMS_LINKER_ROSET_ITEM_ORDERED_DECLA</code>
RTEMS Ticket	4228	<code>rtems_build_name()</code> depends on the signedness of char type
RTEMS Ticket	4230	Timeout for automatic barriers is broken
RTEMS Ticket	4244	Possible infinite recursion in Classic API Signal handling
RTEMS Ticket	4270	A failing task extension produces zombi objects and resource leaks
RTEMS Ticket	4338	<code>rtems_clock_set()</code> : Cannot set future dates later than approximately 2105
RTEMS Ticket	4346	Require <code>RTEMS_PRIORITY</code> for MrsP semaphores
RTEMS Ticket	4347	Allow <code>RTEMS_PRIORITY</code> for MrsP semaphores

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Table 13 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4358	Priority discipline is broken for semaphores and message queues in SMP configurations
RTEMS Ticket	4389	Undefined behaviour if the area size calculation in <code>calloc()</code> and <code>rtems_calloc()</code> overflows
RTEMS Ticket	4390	Make zero size allocation result consistent across directives
RTEMS Ticket	4392	rtems: Constify timer fire when directives
RTEMS Ticket	4393	rtems: Change <code>rtems_task_get_affinity()</code> status
RTEMS Ticket	4401	rtems: Change <code>rtems_scheduler_get_processor_set()</code> status
RTEMS Ticket	4406	rtems: Constify <code>rtems_task_wake_when()</code>
RTEMS Ticket	4409	<code>rtems_task_start()</code> does not check that the entry point is not equal to NULL
RTEMS Ticket	4411	<code>rtems_task_restart()</code> should set the real priority to the initial priority
RTEMS Ticket	4412	Unexpected <code>rtems_task_restart()</code> behaviour if called from within interrupt context
RTEMS Ticket	4413	Allow <code>pthread_cancel()</code> from within interrupt context
RTEMS Ticket	4414	Return <code>RTEMS_CALLED_FROM_ISR</code> in <code>rtems_task_delete()</code>
RTEMS Ticket	4426	<code>clock_nanosleep()</code> may use wrong clock for relative times
RTEMS Ticket	4435	Thread cancellation may produce ready threads with an active thread timer
RTEMS Ticket	4458	Simplify trap table initialization
RTEMS Ticket	4482	Document kernel character I/O support in Classic API Guide
RTEMS Ticket	4490	<code>rtems_partition_return_buffer()</code> wrongly accepts buffers which are exactly at the buffer area end
RTEMS Ticket	4508	<code>rtems_message_queue_receive(): flush()</code> does not release waiting tasks
RTEMS Ticket	4509	Message queue priority discipline is broken in SMP configurations
RTEMS Ticket	4511	Count of postponed jobs is not set to zero for a newly created rate-monotonic period object
RTEMS Ticket	4513	Document parts of the Cache Manager in the Classic API Guide

## 10.6 Package Version 1

The first version of the QDP contains a development snapshot which was issued for the *CDR*.

### 10.6.1 New issues

When the QDP of this package version was produced, there were no new issues associated.

### 10.6.2 Open issues

When the QDP of this package version was produced, there were no open issues associated.

### 10.6.3 Closed issues

When the QDP of this package version was produced, there were no closed issues associated.

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## CHAPTER ELEVEN

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## AUXILIARY INFORMATION

### 11.1 QDP Service and Maintenance

Software and hardware of a certain complexity needs maintenance in order to keep and improve its quality with the experience of using it.

The pre-qualified feature set of RTEMS is thoroughly specified and validated. It is implemented by a code base which experienced more than 30 years of evolution and continuous improvement. However, experience shows that there might be still some bugs, shortcomings, and documentation issues left over to get fixed. If you would like to report an issue related to the QDP, please have a look at: <https://embedded-brains.de/qdp-bugs>.

[embedded brains](#) is providing ongoing commercial QDP maintenance services complementary to the project structured ESA activities. In the context of these services, the reported issues will be reviewed, fixed (if applicable) and reported in an anonymized form to the corresponding upstream projects such as the [RTEMS Project](#) or the [GCC](#).

Additionally, these services include handling of issues related to the QDP as well as new chip errata, which both need workarounds swiftly. See <https://embedded-brains.de/qdp-support>.

[embedded brains](#) offers a wide range of RTEMS expert support services. This includes training, consulting, and development services for RTEMS as well as for the entire tool suite (for example Binutils, GDB, Newlib, GCC). The company experts are active members in the RTEMS community. [embedded brains](#) is a major contributor to the RTEMS Project and leading in the design and development of the SMP support for RTEMS.

### 11.2 Frequently Asked Questions

#### 11.2.1 How can I adopt the QDP to a new BSP, for example leon2?

The QDP provides you with everything to adopt it to a new *BSP*. The main RTEMS repositories are included in the QDP. This gives you full access to the project history in all details. With the *RSB* you are able to build the RTEMS tool suite for other targets or make updates of the tools. RTEMS and its ecosystem is documented in the RTEMS documentation shipped with the QDP, see [RTEMS Documentation Overview](#). The tool chain to build a customized QDP is also available with sources and documentation under open source licenses. However, you should think twice whether it is your core business to build up expert knowledge in this domain. It is probably faster and more cost effective to contract an experienced service provider, see also [QDP Service and Maintenance](#). The QDP and its generation process is complicated enough to require expert knowledge and training.

### 11.2.2 Is C++ supported?

C++ is supported in general, however, for a more complete C++ runtime and standard library support, more *POSIX APIs* need to be pre-qualified. In particular, support for condition variables is recommended. For a basic C++ example application, see *Build a C++ Example Application*.

### 11.2.3 Is OpenMP supported?

*OpenMP* provided by *GCC* is excellently supported by mainline RTEMS. For a pre-qualified RTEMS support for OpenMP, more *POSIX APIs* need to be pre-qualified. Also some restructuring in the Newlib C library is necessary to avoid a dependency on the C file streams. The major work is done, see *QDP Service and Maintenance* to get it supported.

### 11.2.4 Is Ada supported?

For a proper Ada support, more features need to be pre-qualified. For example, the Ada tasking support requires parts of the *POSIX* API such as threads, mutexes, and condition variables. Unfortunately, signals are also used. If Ada is used for serious applications, then the use of signals should be eliminated. The Ada runtime depends on C library file streams. In general, it should be assessed if the Ada runtime library can be reorganized to better support static linking. See *QDP Service and Maintenance* to get it supported by the pre-qualified feature set. For a basic Ada example application, see *Build an Ada Example Application*.

## 11.3 Targets

Validation tests for items provided by the QDP were executed on the following targets.

### 11.3.1 GR712RC Dual-Core LEON3-FT Development Board

The GR712RC development board has been designed to support the development and fast prototyping of systems based on the GR712RC dual-core 32-bit fault tolerant LEON3FT SPARC V8 processor.

The GR712RC development board comprises a custom designed PCB in a Double Eurocard format (233.5 mm x 160 mm) making the board suitable for stand-alone bench top development, or suitable for mounting in a housing. The principle interfaces and functions are accessible on the front and back edges of the the board.

The GR712RC device incorporates an internal programmable switch matrix which means that the same input/output pin can be used for multiple functions. This board therefore has a large number of configuration features in order to be able to exercise and configure the functions of the device.

Features:

- GR712RC dual-core 32-bit fault tolerant LEON3-FT SPARC V8 processor
- On-board memory:

- SDRAM SODIMM (supports up to 512 Mbyte devices. Delivered with 256 Mbyte module - 128 Mbyte 32-bit wide data & 64 Mbyte BCH 8-bit wide or Reed-Solomon 16-bit wide checksum)
- SRAM (1 bank x 2 Mword x 40 bit, optional second bank not fitted as standard)
- FLASH PROM (8 Mword x 8 bit)
- Additional memory via memory expansion connector
- Power, reset, clock and auxiliary circuits
- Interfaces at front edge of board:
  - Two serial UART interfaces (RS232) with DSUB9 connectors
  - Ethernet 10/100 Mbps RMI interface with RJ45 connector
  - Two CAN bus interfaces (ISO 11898) with DSUB9 connectors
  - Two SpaceWire interfaces with MDM9 connectors
  - Four optional SpaceWire interfaces with MDM9 connectors
  - JTAG debug interface
- Interfaces at back edge of board:
  - +5 V power connector
  - 26 input and 38 input/output general purpose pins
  - 20 RS422 transmit pairs
  - 20 RS422 receiver pairs
- Interfaces on-board:
  - Dual MIL-STD-1553B communication interfaces on DSUB9 connector
  - I2C master interface on pin headers
  - SPI master interface on pin headers
  - Headers and jumpers
  - Reset push button and LED indicators

### 11.3.2 SIS configured to simulate the GR712RC

SIS is a SPARC V7/V8 and RISC-V RV32IMACFD architecture simulator.

The `gr712rc` configuration of *SIS* simulates a configurable amount of LEON3 *SPARC* V8 cores and a subset of the *GR712RC* peripherals.



## 11.4 Guidance for RTEMS Qualification in User's Environment

The RTEMS software product included in the QDP is provided with pre-qualification tests already performed. However, it does not have baseline requirements, so the product assurance should assess the mission requirements. RTEMS is provided with a test package run (using the ESA hardware), however, after downloading the QDP, the user needs to repeat the testsuite execution and check the new report (Software Verification Report (SVR)), to make sure that the with its own hardware all tests pass, all performance requirements are still met and the coverage is still 100%. Once this is done, the QDP can be considered as qualified for the user hardware and can be used for its application.

The next sub-section will describe the activities that should be performed by both engineering team and PA to qualify the QDP on the users hardware. In case of any problem (ex: a test failure), please have a look at *QDP Service and Maintenance*.

### 11.4.1 Engineering activities

The QDP provides the set of the necessary qualification tools to regenerate the Software Verification Report (SVR) in the *qual-tool* folder of the QDP. The first step that needs to be done by the user is to connect the hardware the PC where the QDP is installed or prepare its own set-up (ex: a remote connection using the gdb). The file *grmon\_command\_gr712rc\_sparc-gr712rc-smp-6.sh* should contain the command which is used to connect to the board. For a direct connection of the hardware to the PC, an example is:

```
#!/bin/bash
grmon -nb -nswb -abaud 115200 -ftdi -u -e "load $1;run;quit"
```

For a gdb connection, an example is as follows:

```
#!/bin/bash
/opt/rtems/rtems-6-sparc-gr712rc-smp-6/bin/sparc-rtems6-gdb --batch --command /
↪opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool/batch.gdb --args $1
```

Where the *batch.gdb* script is as follows:

```
load
run
quit
```

Another alternative to run the *qual-tool* with a gdb connection is to adapt *config-variants/sparc-gr712rc-sparc-gr712rc-smp-6-user-qual.yml* by adding the following blocks in **post-process-items** items field:

```
- uid: /steps/run-local-board-target-qual-only
  path: /config-values
  action: set
  value:
    - key: bsp
      value: ${../variant:/bsp}
    - key: arch
      value: ${../variant:/arch}
```

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```

- key: tester
  value: '%{_rtscripts}/gdb.cfg'
- key: gdb_script
  value: 'bsp_gdb_script'
- key: bsp_gdb_script
  value: |
    target extended-remote 10.128.9.126:2222
                mon reset
                load
                run
- key: max_test_period
  value: '3600'

```

```

- uid: /steps/run-local-board-target-qual-only-coverage
  path: /config-values
  action: set
  value:
- key: bsp
  value: '${../variant:/bsp}'
- key: arch
  value: '${../variant:/arch}'
- key: tester
  value: '%{_rtscripts}/gdb.cfg'
- key: gdb_script
  value: 'bsp_gdb_script'
- key: bsp_gdb_script
  value: |
    target extended-remote 10.128.9.126:2222
                mon reset
                load
                run
- key: max_test_period
  value: '3600'

```

The following files contain the configuration for executing the testsuite run:

- config/steps/run-local-board-target-qual-only.yml - configuration for standard run
- config/steps/run-local-board-target-qual-only-coverage.yml - configuration for coverage run

The most relevant fields that the user might want to customize in this configuration files are the **commands**, which is the RTEMS Tester command, **config-values**, which is the RTEMS Tester .ini file (as shown above to set up the .ini file for testsuite runs with gdb), or the **ignore-tests**, which is the ignore pattern for test executables (for example the coverage does not run the performance tests). As already shown, to change these values the user should use the *config-variants/sparc-gr712rc-sparc-gr712rc-smp-6-user-qual.yml*, which is the file used to change the default configuration. Example to change the maximum test timeout (from the default 1 hour to 2 hours) you would need to add the following blocks in **post-process-items** items field:

```
- uid: /steps/run-local-board-target-qual-only
  path: /commands
  action: set
  value:
  - - '${..}/variant:/deployment-directory}/bin/rtems-test'
  - - '--user-config=${.:config-directory}/${.:config-file}'
  - - '--rtems-bsp=${.:config-variant}'
  - - '.'
  - - '--log-mode=all'
  - - '--jobs=1'
  - - '--timeout=7200'
  - - '--report-format=yaml'
  - - '--report-path=${.:executables-directory}/log-run-rtems-qual-only-board'
```

```
- uid: /steps/run-local-board-target-qual-only-coverage
  path: /commands
  action: set
  value:
  - - '${..}/variant:/deployment-directory}/bin/rtems-test'
  - - '--user-config=${.:config-directory}/${.:config-file}'
  - - '--rtems-bsp=${.:config-variant}'
  - - '.'
  - - '--log-mode=all'
  - - '--jobs=1'
  - - '--timeout=7200'
  - - '--report-format=yaml'
  - - '--report-path=${.:executables-directory}/log-run-rtems-qual-only-board-cov'
```

```
- uid: /steps/run-local-board-target-qual-only
  path: /config-values[5]/value
  action: set
  value: '7200'
```

```
- uid: /steps/run-local-board-target-qual-only-coverage
  path: /config-values[5]/value
  action: set
  value: '7200'
```

The new SVR document will be generated in the folder *user\_doc*, as configured in *config-variants/sparc-gr712rc-sparc-gr712rc-smp-6-user-qual.yml* (which means that the original SVR will not be overridden). Note also, the production of the SVR, will also produce the Software Design Document (SDD) document due to a necessary dependency (but it will be exactly the same as the already QDP provided SDD). Since this *qual-tool* folder is a sub-set of the Qualification Toolchain used to generate the QDP, in case of doubts about the configuration files, see the Qualification Toolchain User Manual, [EDI20], which contains the complete explanation about the configuration. Additionally, the user might also want to change some manual parts of the document. An example could be to include the company logo (this user SVR is generated with no logos by default) or to complete the change records or authors table. In such a case, the *config\_user.yml* and *.rst* files in *docs/rtems/djf/svr* should be updated accordingly and also, to include logos and update the document header/footer, the *docs/common/rtemssmp\_user.sty*

shall be updated (see as example the originals *config.yml* and *docs/common/rtemssmp\_user.sty*, which are used to generate the QDP delivered SVR). Again, more details in the Qualification Toolchain User Manual (also available in *qual-tool* folder, under *docs/qt/SUM-303/delivery*).

As already referred, the *qual-tool* is a subset of the Qualification Toolchain used to produce the QDP. Hence, the user needs to install the same packages as referred in the Software Reuse File (SRF), [ED119]:

- gcc
- python3-pip
- python3-sphinx
- texlive
- texlive-latex-extra
- texlive-fonts-extra
- pdftk
- doxygen
- python3-xlrd
- git
- pkg-config
- git-lfs
- clang-tools
- cppcheck
- python3-venv
- libpython2.7-dev
- latexmk
- flex
- bison
- texinfo
- graphviz
- libncurses5
- xz-utils

Note that above are listed the packages for Debian 10. If another Operating System is used, the user needs to install the same packages, but for the respective Operating System.

It may be the case that the Operating System of the user is not compatible with the *qual-tool*, for example, Ubuntu 18.04 (LTS version) is known that does not work with the tool. In that situation the user shall use a docker solution. To run the *qual-tool*, the user will need the same packages as for the Qualification Toolchain, hence the Dockerfile to use shall be as follows (to set up the Docker environment, please follow the instructions described in *Use QDP in a Docker solution*):

```
FROM debian:buster
RUN apt-get update
RUN apt-get -y install netcat net-tools wget lsb-release
RUN echo "Acquire::http::Pipeline-Depth 0;" >> /etc/apt/apt.conf.d/30proxy
RUN echo "Acquire::http::No-Cache true;" >> /etc/apt/apt.conf.d/30proxy
RUN echo "Acquire::BrokenProxy true;\n" >> /etc/apt/apt.conf.d/30proxy
RUN apt-get update
RUN apt-get -y install gcc python3-pip python3-sphinx texlive texlive-latex-extra_
↳ texlive-fonts-extra pdftk
RUN apt-get -y install doxygen python3-xlrd git pkg-config git-lfs clang-tools_
↳ cppcheck python3-venv libpython2.7-dev
RUN apt-get -y install latexmk
RUN apt-get -y install flex bison texinfo
RUN apt-get -y install graphviz libncurses5 pkg-config xz-utils
RUN chmod -R 777 /opt/rtems
```

After all this configuration is set, the tool is ready to be run, to re-execute the RTEMS testsuite and generate the user Software Verification Report (SVR). The following commands shall be executed:

```
$ cd /opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool/
```

```
/opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool$ make env
```

```
/opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool$ . env/bin/activate
```

```
/opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool$ ./qdp_config.py config-variants/
↳ sparc-gr712rc-sparc-gr712rc-smp-6-user-qual.yml
```

```
/opt/rtems/rtems-6-sparc-gr712rc-smp-6/qual-tool$ ./qdp_build.py --log-
↳ level=DEBUG build-sparc-gr712rc-sparc-gr712rc-smp-6-user-qual/ 2>&1 | tee log.
↳ txt
```

The first commands will install and activate the python3 virtual environment, the *qdp\_config* command will configure the tool for the chosen configuration (*config-variants/sparc-gr712rc-sparc-gr712rc-smp-6-user-qual.yml*) and the *qdp\_build* command will execute the tool and produce the SVR. Due to the coverage testsuite execution, this will take about 5 hours. During the tool execution, the following output will be produced:

- *build-sparc-gr712rc-sparc-gr712rc-smp-6-user-qual*: will contain sub-products of the tool execution (see Qualification Toolchain User Manual for more details).
- *log.txt*: will contain the logging of the execution

In addition to running the tests, re-generate the report and verifying that in the user hardware execution everything is OK, the QDP users will need to make the traceability of the project requirements to the RTEMS requirements.

## 11.4.2 Product Assurance activities

Taking into account the specifics for the RTEMS pre-qualification project, the EDISOFT product assurance team suggests the following activities.

Verify if there are changes in the original plans (record tracking). Verify if the changes are in accordance with the original plans and, if not, they are justified. The PA should look at the following documents, considered as plans for the RTEMS pre-qualification project:

- ECSS documentation (ECSS-E-ST-40C [ECS09a], ECSS-Q-ST-80C Rev. 1 [ECS17], ECSS-M-ST-40C Rev.1 [ECS09b]) – Always applicable for ESA projects
- Software Development Plan (SDP)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/sdp/SDP-000.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/sdp/html/index.html
- Software Configuration Management Plan (SCMP)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/scmp/SCMP-001.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/mgt/scmp/html/index.html
- Software Product Assurance Plan (SPAP)
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spap/SPAP-002.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spap/html/index.html
- QT-109 Technical Note RTEMS SMP Qualification Target
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/technical-notes/tn-qt/QT-109.pdf

The technical note contains the tailoring of ECSS documents for the RTEMS pre-qualification project (chapter 4) and other relevant technical information that could be used by the PA:

- Requirements, interfaces and test plans format (see chapter 6)
- ECSS statement of compliance (see chapter 9)

Verify the affected parts of the QDP deliverables, according below:

- General verifications (transversal to all documentation):
  - Verify document correctness against ECSS and QT-109
  - Verify proper tracking update (change records)
  - Verify traceability (for example requirements to tests)
- Verifications specific to the SRS:
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/srs/srs.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/srs/html/index.html
  - Verification following the SDP, section 5.3 (for requirement specifications)
  - Verification following the SPAP, section 6.7.1
- Verifications specific to the ICD:
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/icd/icd.pdf

- /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ts/icd/html/index.html
- Verification following SDP, section 5.3 (for interface specifications)
- Verification following SPAP, section 6.7.1
- Verifications specific to the SDD:
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/ddf/sdd/html/index.html
  - Verification following SDP, section 5.3
  - Verification following SPAP, section 6.7.2
- Verifications specific to the SVS and SUITP:
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svs/svs.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svs/html/index.html
  - Verification following SDP, section 5.3 (for test specifications)
  - Verification following SDP, chapter 6 (only the parts applicable to RTEMS)
  - Verification following SPAP, section 6.7.4
- Verifications specific to the software product source code and test suite:
  - Verification following SPAP, section 6.7.3
- Verifications specific to the SVR - **the one generated for the own hardware, according with the previous section:**
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svr/svr.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/djf/svr/html/index.html
  - Verification following SDP, section 10 (only the parts applicable to RTEMS)
  - Verification following SPAP, section 6.7.3
  - Verification following SPAP, section 6.7.4
  - Verification of test results
- Verifications specific to the SRelD:
  - Verify if the delta closes any software problem reports.
- Verifications specific to the SPAMR:
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spamr/spamr.pdf
  - /opt/rtems/rtems-6-sparc-gr712rc-smp-6/doc/paf/spamr/html/index.html
  - Verification following SPAP, section 6.5
  - Verification following SPAP, section 5.5 (verification of software metrics)
  - Verification following SPAP, section 6.7.4.1
- Verifications regarding Independent Software Verification and Validation (ISVV):
  - Revisit and re-assess as needed the documentation listed within *ISVV Documentation Overview* regarding the ISVV performed as part of the RTEMS SMP pre-qualification, namely in what respects ISVV postponed findings that might have been addressed in the meanwhile (e.g. by the RTEMS community)

- Verifications specific to this document:
  - Follow the instructions and try to replicate the software utilization, specifically the PA should be able to decompress the QDP and correctly compile the RTEMS example application.
  - Assess the possible impacts of the listed *Possible Problems and Known Errors*
- Other verifications:
  - Verify if updates on Sphinx documentation are according with SDP, section 8
  - Perform the activities as described in SPAP sections 6.2.1 and 6.4
  - Verification of Certificate of Conformance, according with SPAP, section 6.7.4.2
  - Verification of audits (functional and physical configuration verification), according with SCMP, section 5.8

## 11.5 Use of Externally Provided Items

In order to build the BSP of this QDP and finally also the application, various tools and reusable software components are required. Notable tools are the C preprocessor, the compiler, the assembler, and the linker. The compiler and the C library provide standard header files. These tools and interfaces are essential to build BSPs, third-party libraries, and applications. However, they are outside the responsibility scope of the activity delivering this QDP and provided as is. For QDP package version 6, an analysis was carried out to investigate which externally provided functions are required by the pre-qualified feature set of RTEMS and what can be done to ensure that these components have an acceptable quality. The analysis and the results are presented in this section.

Since QDP package version 6, applications could use the following linker options to link with the operating system:

- `-nodefaultlibs`
- `-Wl,--start-group`
- `-lrtemscpu`
- `-lrtemsbsp`
- `-Wl,--end-group`

The `librtemsbsp.a` and `librtemscpu.a` libraries contain the pre-qualified RTEMS feature set. In previous QDP package versions, linking to the `libgcc.a` library provided by GCC was required. This library is not covered by the pre-qualification activities. It contains runtime support for programming languages such as C and C++. This includes software implementations of integer operations if the *target architecture* does not support them in hardware. For example, consider the following source code:

```
uint64_t mul( uint64_t a, uint64_t b )
{
    return a * b;
}
```

For a 32-bit target, this may get compiled into the following assembly code:



```
mul:
    save    %sp, -96, %sp
    mov     %i2, %o2
    mov     %i3, %o3
    mov     %i0, %o0
    call    __muldi3, 0
    mov     %i1, %o1
    mov     %o0, %i0
    jmp     %i7+8
    restore %g0, %o1, %o1
```

Here a call to `__muldi3` is issued. This function is provided by `libgcc.a`. However, for a 64-bit target, this may get compiled into the following assembly code:

```
mul:
    mulld 3, 3, 4
    blr
```

So, it is target-specific if the `libgcc.a` is required. Some programming languages have features requiring complex runtime libraries. An example is the C++ exception handling which may require a stack unwinder. The stack unwinder is a complex piece of software.

For the 32-bit SPARC target, which `libgcc.a` components are required for the pre-qualified feature set? To figure this out, we built the validation tests without linking to `libgcc.a` and checked for undefined references:

- `__clzsi2`
- `__divdi3`
- `__moddi3`
- `__udivdi3`
- `__umoddi3`

These are integer operations implemented in `libgcc/libgcc2.c` of the GCC sources. Due to the wide spread use of these functions on various GCC targets, the maturity of GCC, and the competence the GCC developers contributing to this area of GCC, it is reasonable to accept these functions as proven in use. However, we should not have the same level of confidence in other components included in `libgcc.a`, for example the stack unwinder. Since we linked to this library as a whole, there was a risk that applications may pick up something which does not meet the quality expectations or has undesirable dependencies, for example use of dynamic memory.

One option is to simply copy the file from GCC, strip it down to what is needed, and then ship it with the pre-qualified RTEMS. However, this file is covered by a license which hinders this approach. It could result in applications having to meet [GPLv3](#) requirements, see also [COPYING.RUNTIME](#) of the GCC sources. To overcome the license issues, we reviewed the implementations from the `compiler-rt` package of the [LLVM](#) Project. The goal was to remove the need to link against `libgcc.a`.

The above option is a minimalistic solution. More useful for application developers would be a somewhat trustworthy compiler with thoroughly tested libraries. A trustworthy compiler is a very hard project, however, thoroughly tested libraries is just a bit of work. For the parts provided by `libgcc.a` and `compiler-rt`, this work would be easy to integrate in GCC and LLVM

as a shared component. LLVM has already unit tests for this component. Doing this work in isolation just for the ESA community would be a questionable. The QDP build process could be enhanced with a run of the compiler test suite.

For the QDP package version 6, the budget only allowed the minimalistic solution. The compiler builtins using library routines for integer arithmetic, integer comparison, and bit operations were added from the LLVM compiler-rt component to the pre-qualified RTEMS feature set, see also the [GCC routines for integer arithmetic](#). Unit tests were added to achieve the code and branch coverage goals. No functional specification and validation tests are provided. As a result, linking to `libgcc.a` is no longer required for the pre-qualified feature set of RTEMS. In the linker flags exported by the BSP, the `libgcc.a` is still listed for backward compatibility. In particular, for some floating point operations `libgcc.a` is required. Application designers should review the linker map file to check which functions are used from `libgcc.a`.

## 11.6 Available and On Request QDPs for RTEMS

An RTEMS QDP is not only available for the *target* of this package. A QDP can be made available for every *target architecture* and *BSP* supported by RTEMS. For the creation of an RTEMS QDP for a particular target the following items are required:

- Support for the target architecture (for example AArch64, ARMv7-ARM, PowerPC, RISC-V, SPARC)
- Basic BSP with a *Clock Driver* and a character output device driver (to get the test reports)
- Specification and validation of the target architecture support and the basic BSP
- Related engineering and product assurance activities
- Qualification toolchain to run the tests, generate the documents, and package the artifacts; this includes a test runner to run the tests on the specific target (this could be an *OBC*)
- A QDP configuration so that the toolchain produces the desired results

The specification and validation are the main engineering activities necessary to deliver a QDP. Large parts of RTEMS are architecture-independent. For these parts, the specification of existing QDPs can be easily reused. An adoption to the target architecture requires a specification of the thread context switching and interrupt processing with the associated validation tests. Other components are the initialization of clock domains, IO pins, processor modes, memory controllers, cache controllers, power management controllers, bus systems, memory management units, memory protection units, watchdogs, etc. A clock driver and a character output device driver are mandatory. An important work is gathering of all relevant hardware errata, a review of the errata, and the implementation of errata workarounds. For the mentioned tasks, personnel with a deep understanding of target architecture and *system-on-chip* is required.

Once the specification and validation tasks are finished, a QDP configuration needs to be assembled and processed by the toolchain to generate the QDP for the target. This configurability of the qualification toolchain was a design goal. Unfortunately, the toolchain delivered to ESA does not meet this design goal. *embedded brains* has an enhanced in-house version of the toolchain which allows an easy and flexible configuration to produce QDPs for any desired RTEMS target, see *QDP Service and Maintenance*.

### 11.6.1 AMD Xilinx

On request, QDPs can be made available by embedded brains for the following product lines from [AMD Xilinx](#):

- Zynq 7000 SoC
- Zynq UltraScale+ MPSoC
- Zynq UltraScale+ RFSoc
- Versal Adaptive SoC

### 11.6.2 fentISS Hypervisors

[fentISS](#) provides hypervisor products (XtratuM and XNG) which can be used together with RTEMS as a guest system. On request, QDPs can be made available by embedded brains for the following products from [fentISS](#):

- ARMv7-A: Virtualization through TrustZone support, clock and timer through hypercalls, interrupt controller through hypercalls:
  - Xilinx Zynq 7000 SoC: 2 x ARM Cortex-A9 (SMP model)
- ARMv7-R: Para-virtualization, clock & timer through hypercalls, Interrupt controller through hypercalls:
  - Texas Instruments TMS570LC4357: 1 x ARM Cortex-R5
  - Xilinx UltraScale+ MPSoC: 2 x ARM Cortex-R5 (SMP model)
  - NanoXplore NG-LARGE: 1 x ARM Cortex-R5
- ARMv8-A: Virtualization through virtualization extensions, clock and timer through ARM Generic Timer, interrupt controller through hypercalls:
  - Xilinx UltraScale+ MPSoC: 4 x ARM Cortex-A53 (SMP model)
  - Renesas R-Car V3U: 8 x ARM Cortex-A76 (SMP model)
- ARMv8-R: Virtualization through virtualization extensions, clock and timer through ARM Generic Timer, interrupt controller through hypercalls:
  - NanoXplore NG-ULTRA: 4 x ARM Cortex-R52 (SMP model)
- RISC-V (64-bit): Virtualization through virtualization extensions, clock and timer through hypercalls, interrupt controller through hypercalls
  - Frontgrade Gaisler NOEL-XCKU: 4 x 64-bit NOEL-V (SMP model)
- SPARCv8: Para-virtualization, clock and timer through hypercalls, interrupt controller through hypercalls:
  - Frontgrade Gaisler GR712RC: 2 x LEON3 (SMP model)
  - Frontgrade Gaisler GR740: 4 x LEON4 (SMP model)

[ECSS](#) criticality category B is the goal for the [fentISS](#) hypervisor products:

- XNG for ARMv7-A on Xilinx Zynq 7000 SoC and XNG for ARMv7R on Texas Instruments TMS570LC4357: qualification completed targeting ECSS criticality category B.

- XNG for ARMv8-R NanoXplore NG-ULTRA, XNG for Frontgrade Gaisler GR740 and XNG for Frontgrade Gaisler NOEL-V: qualification on-going targeting ECSS criticality category B.
- Any other version is considered as a prototype, being candidate for future delta-qualification campaigns.

### 11.6.3 Frontgrade Gaisler

QDPs are already available for the [Frontgrade Gasiler](#) GR712RC and GR740. On request, QDPs can be made available by embedded brains for the following components:

- GR716A and GR716B
- GR765
- UT699/UT699E/UT700

### 11.6.4 Microchip

On request, QDPs can be made available by embedded brains for the following products and product lines from [Microchip](#):

- PolarFire SoC
- SAMRH707 - Radiation Hardness
- SAMRH71 - Radiation Hardened
- SAMV71Q21RT - Radiation Tolerance
- SAM V MCUs
- SAM E MCUs
- SAM S MCUs

### 11.6.5 Teledyne e2v Semiconductors

On request, QDPs can be made available by embedded brains for the following products and product lines from [Teledyne e2v Semiconductors](#):

- LS1046-Space: Radiation Tolerant Quad ARM Cortex-A72
- Products based on NXP Layerscape
- Products based on NXP QorIQ P-Series
- Products based on NXP QorIQ T-Series

## 11.6.6 Texas Instruments

On request, QDPs can be made available by embedded brains for the following products from **Texas Instruments**:

- TMS570LC4357
- TMS570LS3137

## 11.7 License information

All directories and file paths in this section are relative to `/opt/rtems/rtems-6-sparc-gr712rc-smp-6`.

### 11.7.1 Directory - src/binutils-2.41

The Binutils sources are used to provide host tools such as the *target architecture* assembler and linker.

#### 11.7.1.1 File - COPYING

The license file `src/binutils-2.41/COPYING` is applicable to this directory or parts of the directory:

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```
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```

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```
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```

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```
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```

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```

```
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"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

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- c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.
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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

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If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

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However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License.

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Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)
- b) Use a suitable shared library mechanism for linking with the

Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.

c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.

d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.

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It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

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a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.

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```
<one line to give the library's name and a brief idea of what it does.>  
Copyright (C) <year> <name of author>
```

```
This library is free software; you can redistribute it and/or  
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version 2.1 of the License, or (at your option) any later version.
```

```
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but WITHOUT ANY WARRANTY; without even the implied warranty of  
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU  
Lesser General Public License for more details.
```

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You should have received a copy of the GNU Lesser General Public  
License along with this library; if not, write to the Free Software  
Foundation, Inc., 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA
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Also add information on how to contact you by electronic and paper mail.

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<signature of Ty Coon>, 1 April 1990  
Ty Coon, President of Vice

That's all there is to it!

#### 11.7.4.3 File - COPYING.RUNTIME

The license file `src/gcc-13.2.0/COPYING.RUNTIME` is applicable to this directory or parts of the directory:

GCC RUNTIME LIBRARY EXCEPTION

Version 3.1, 31 March 2009

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When you use GCC to compile a program, GCC may combine portions of certain GCC header files and runtime libraries with the compiled program. The purpose of this Exception is to allow compilation of non-GPL (including proprietary) programs to use, in this way, the header files and runtime libraries covered by this Exception.

0. Definitions.

A file is an "Independent Module" if it either requires the Runtime Library for execution after a Compilation Process, or makes use of an interface provided by the Runtime Library, but is not otherwise based on the Runtime Library.

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The "Compilation Process" transforms code entirely represented in non-intermediate languages designed for human-written code, and/or in Java Virtual Machine byte code, into Target Code. Thus, for example, use of source code generators and preprocessors need not be considered part of the Compilation Process, since the Compilation Process can be understood as starting with the output of the generators or preprocessors.

A Compilation Process is "Eligible" if it is done using GCC, alone or with other GPL-compatible software, or if it is done without using any work based on GCC. For example, using non-GPL-compatible Software to optimize any GCC intermediate representations would not qualify as an Eligible Compilation Process.

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#### 11.7.4.4 File - COPYING3

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Version 3, 29 June 2007

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Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

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A "covered work" means either the unmodified Program or a work based on the Program.

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#### 1. Source Code.

The "source code" for a work means the preferred form of the work for making modifications to it. "Object code" means any non-source form of a work.

A "Standard Interface" means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The "System Libraries" of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A "Major Component", in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The "Corresponding Source" for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those

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```

```
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the Free Software Foundation; either version 2 of the License, or
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```
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This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.
```

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```
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`Gnomovision' (which makes passes at compilers) written by James Hacker.

<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice
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## 11.7.6 Directory - src/gmp-6.3.0

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Preamble

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```
<one line to give the program's name and a brief idea of what it does.>
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```

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```
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```

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## 11.7.9 Directory - src/mpfr-4.2.0

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iconv (Charset Conversion Library) v2.0

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**CHAPTER  
TWELVE**

## POSSIBLE PROBLEMS AND KNOWN ERRORS

### 12.1 Open issues

When the QDP of this package version was produced, there were the following open issues associated:

Database	Identifier	Subject
ESA Issue	742	QDP and Coverity Results contain personal information
ESA Issue	803	RTEMS-SMP-REQ-VER-004 - Incomplete Requirements
ESA Issue	804	RTEMS-SMP-REQ-VER-032 - Incorrect definition of inner elements of structs
ESA Issue	805	RTEMS-SMP-REQ-VER-037 - Missing interfaces
ESA Issue	806	RTEMS-SMP-TS-VER-001 - No Test cases descriptions
ESA Issue	807	RTEMS-SMP-REQ-VER-001 - SRS typos and small mistakes
ESA Issue	808	RTEMS-SMP-REQ-VER-002 - Contradictory constraints
ESA Issue	809	RTEMS-SMP-REQ-VER-003 - Time margins
ESA Issue	810	RTEMS-SMP-REQ-VER-005 - “Will” verb within requirements
ESA Issue	811	RTEMS-SMP-REQ-VER-006 - Confusing wording
ESA Issue	812	RTEMS-SMP-REQ-VER-007 - Unclear connections
ESA Issue	813	RTEMS-SMP-REQ-VER-009 - Too many dependent requirements
ESA Issue	814	RTEMS-SMP-REQ-VER-011 - Differing wording between GR740 and GR712
ESA Issue	815	RTEMS-SMP-REQ-VER-012 - Typos/small mistakes
ESA Issue	816	RTEMS-SMP-REQ-VER-013 - Formatting of parameters and directives
ESA Issue	817	RTEMS-SMP-REQ-VER-014 - Missing references in bibliography and links
ESA Issue	818	RTEMS-SMP-REQ-VER-015 - Incorrect verb for a requirement
ESA Issue	819	RTEMS-SMP-REQ-VER-016 - Directive not specified
ESA Issue	820	RTEMS-SMP-REQ-VER-017 - Inconsistent dates
ESA Issue	821	RTEMS-SMP-REQ-VER-019 - Repeated descriptions

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Table 1 – continued from previous page

Database	Identifier	Subject
ESA Issue	822	RTEMS-SMP-REQ-VER-020 - Colliding descriptions
ESA Issue	823	RTEMS-SMP-REQ-VER-021 - Bibliography references
ESA Issue	824	RTEMS-SMP-REQ-VER-023 - Inconsistency between requirements sections
ESA Issue	825	RTEMS-SMP-REQ-VER-025 - ICD references
ESA Issue	826	RTEMS-SMP-REQ-VER-026 - Constraints sections
ESA Issue	827	RTEMS-SMP-REQ-VER-027 - Missing presentations
ESA Issue	828	RTEMS-SMP-REQ-VER-028 - HW documentation
ESA Issue	829	RTEMS-SMP-REQ-VER-029 - Too many conditions / very complex requirement
ESA Issue	830	RTEMS-SMP-REQ-VER-030 - ICD typos/small mistakes
ESA Issue	831	RTEMS-SMP-REQ-VER-031 - Merge requirements
ESA Issue	832	RTEMS-SMP-REQ-VER-034 - Duplicated line
ESA Issue	833	RTEMS-SMP-REQ-VER-035 - ICD undefined acronyms
ESA Issue	834	RTEMS-SMP-REQ-VER-036 - Undescribed interface enumerator definitions
ESA Issue	835	RTEMS-SMP-REQ-VER-038 - Unspecified interface-types
ESA Issue	836	RTEMS-SMP-REQ-VER-039 - Sentence construction
ESA Issue	837	RTEMS-SMP-REQ-VER-040 - ICD is very tied to a specific C compiler
ESA Issue	838	RTEMS-SMP-DESIGN-VER-001 - Document vs QDP releases
ESA Issue	839	RTEMS-SMP-DESIGN-VER-002 - RTEMS version from which QDPs have been derived
ESA Issue	840	RTEMS-SMP-DESIGN-VER-003 - Unclear SUM
ESA Issue	841	RTEMS-SMP-DESIGN-VER-004 - No SUM which follows ECSS clauses
ESA Issue	842	RTEMS-SMP-DESIGN-VER-005 - SCF missing acronyms
ESA Issue	843	RTEMS-SMP-DESIGN-VER-006 - SCF typos
ESA Issue	844	RTEMS-SMP-DESIGN-VER-007 - SCF conflicting information
ESA Issue	845	RTEMS-SMP-DESIGN-VER-008 - Memory usage benchmarks
ESA Issue	847	RTEMS-SMP-DESIGN-VER-011 - Requirements not traced to design
ESA Issue	848	RTEMS-SMP-DESIGN-VER-012 - No abbreviations/acronym list
ESA Issue	849	RTEMS-SMP-DESIGN-VER-013 - Unclear traced requirements
ESA Issue	850	RTEMS-SMP-DESIGN-VER-014 - No tracing matrix
ESA Issue	851	RTEMS-SMP-DESIGN-VER-015 - No verification method
ESA Issue	852	RTEMS-SMP-DESIGN-VER-017 - Missing descriptions
ESA Issue	853	RTEMS-SMP-DESIGN-VER-019 - Incorrect macro

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Table 1 – continued from previous page

Database	Identifier	Subject
ESA Issue	854	RTEMS-SMP-DESIGN-VER-020 - Untraced requirement
ESA Issue	855	RTEMS-SMP-DESIGN-VER-021 - Requirement wording
ESA Issue	856	RTEMS-SMP-DESIGN-VER-022 - Incomplete/empty design
ESA Issue	857	RTEMS-SMP-DESIGN-VER-023 - Unexplained text
ESA Issue	858	RTEMS-SMP-DESIGN-VER-024 - Complex requirement
ESA Issue	859	RTEMS-SMP-DESIGN-VER-025 - Untraced requirements
ESA Issue	860	RTEMS-SMP-DESIGN-VER-026 - Incomplete requirements
ESA Issue	861	RTEMS-SMP-DESIGN-VER-028 - Design element names
ESA Issue	862	RTEMS-SMP-DESIGN-VER-029 - Empty section
ESA Issue	863	RTEMS-SMP-DESIGN-VER-030 - Requirement naming
ESA Issue	864	RTEMS-SMP-DESIGN-VER-031 - Incomplete
ESA Issue	865	RTEMS-SMP-DESIGN-VER-032 - Naming of design elements
ESA Issue	866	RTEMS-SMP-DESIGN-VER-033 - Unspecified elements
ESA Issue	867	RTEMS-SMP-DESIGN-VER-034 - Language and compiler requirements
ESA Issue	868	RTEMS-SMP-DESIGN-VER-035 - Untraced design components
ESA Issue	869	RTEMS-SMP-DESIGN-VER-036 - Hyperlinks not working
ESA Issue	870	RTEMS-SMP-DESIGN-VER-037 - Multiple traced Requirements
ESA Issue	871	RTEMS-SMP-VAL-001 - “Timer Server” not directly usable
ESA Issue	872	RTEMS-SMP-VAL-003 - Some functions are listed as unspecified on ICD
ESA Issue	873	RTEMS-SMP-VAL-004 - Documentation refers undefined behaviour on cases where an error is to be expected
ESA Issue	874	RTEMS-SMP-VAL-005 - Missing NULL pointer check for clock manager directives
ESA Issue	875	RTEMS-SMP-TS-VER-002 - Potential typing error
ESA Issue	876	RTEMS-SMP-TS-VER-003 - Testcase 7.13 not found in test matrix
ESA Issue	877	RTEMS-SMP-TS-VER-004 - Testcase 7.31 too long
ESA Issue	878	RTEMS-SMP-TS-VER-005 - Testcase 7.32 too long
ESA Issue	879	RTEMS-SMP-TS-VER-007 - Linking between testcases and test requirements

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Table 1 – continued from previous page

Database	Identifier	Subject
ESA Issue	880	RTEMS-SMP-TS-VER-008 - Testcase dependency on Detailed Design
ESA Issue	881	RTEMS-SMP-TS-VER-015 - Non-human readable test report
ESA Issue	882	RTEMS-SMP-TS-VER-016 - Document Identifiers not available
ESA Issue	883	RTEMS-SMP-TS-VER-018 - Analysis, inspection or review testcases not reported
ESA Issue	884	RTEMS-SMP-CODE-VER-004 - No SPDX License
ESA Issue	885	RTEMS-SMP-CODE-VER-005 - SPDX License misplaced
ESA Issue	886	RTEMS-SMP-CODE-VER-006 - Header Files Format ""extern C"" missing
ESA Issue	887	RTEMS-SMP-CODE-VER-007 - Two paragraphs
ESA Issue	888	RTEMS-SMP-CODE-VER-008 - Format of ""if"", ""while"" or ""for"" statements are not properly defined
ESA Issue	889	RTEMS-SMP-CODE-VER-009 - Format of ""!"" statements might not be properly defined
ESA Issue	890	RTEMS-SMP-CODE-VER-010 - TODO section left undone
ESA Issue	891	RTEMS-SMP-CODE-VER-011 - FIXME
ESA Issue	892	RTEMS-SMP-CODE-VER-013 - Macro defined but magic number used instead
ESA Issue	893	RTEMS-SMP-CODE-VER-014 - Macros wrongly defined
ESA Issue	894	RTEMS-SMP-CODE-VER-018 - Deprecated Functions
ESA Issue	895	RTEMS-SMP-CODE-VER-021 - Unclear comments
ESA Issue	896	RTEMS-SMP-CODE-VER-022 - Comments not in accordance with template
ESA Issue	897	RTEMS-SMP-CODE-VER-023 - Code not in accordance with comments
ESA Issue	898	RTEMS-SMP-CODE-VER-024 - Inaccurate comments at the beginning of file
ESA Issue	899	RTEMS-SMP-CODE-VER-025 - Incorrect Copyright License Information
ESA Issue	900	RTEMS-SMP-CODE-VER-026 - Function defined in header file
ESA Issue	901	RTEMS-SMP-CODE-VER-028 - Unused input parameter
ESA Issue	902	RTEMS-SMP-CODE-VER-029 - Input validity unchecked
ESA Issue	903	RTEMS-SMP-CODE-VER-030 - Wrong data type
ESA Issue	904	RTEMS-SMP-CODE-VER-032 - Output value not assigned
ESA Issue	905	RTEMS-SMP-CODE-VER-033 - Wrong output type
ESA Issue	908	RTEMS-SMP-CODE-VER-044 - Code for test software

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Table 1 – continued from previous page

Database	Identifier	Subject
ESA Issue	909	RTEMS-SMP-CODE-VER-052 - #pragmas to ignore warnings
ESA Issue	910	RTEMS-SMP-CODE-VER-062 - CLANG flagged error
ESA Issue	911	RTEMS-SMP-CODE-VER-063 - Missing design details
ESA Issue	912	RTEMS-SMP-CODE-VER-071 - Confusing #IF 1 clause
ESA Issue	913	RTEMS-SMP-CODE-VER-073 - Low power Power-down workaround
ESA Issue	914	RTEMS-SMP-CODE-VER-078 - Bitwise operator applied to a signed operand
RTEMS Ticket	2986	Convert Coding Style to Sphinx Document
RTEMS Ticket	3700	Add rtems_rate_monotonic_deadline()
RTEMS Ticket	3701	RTEMS Pre-Qualification (ECSS) for SMP
RTEMS Ticket	3703	Technical Specification (TS) for space profile
RTEMS Ticket	3716	Unit, integration and validation tests for space profile
RTEMS Ticket	3923	Add traceability information to the application configuration options
RTEMS Ticket	3963	Add build specification item verification
RTEMS Ticket	4805	SPDX Licenses and Header File Formatting
RTEMS Ticket	4806	Header Source files format “extern C” missing
RTEMS Ticket	4807	Two consecutive paragraphs
RTEMS Ticket	4808	Incorrect Formatting of “if”, “while”, or “for” Statements
RTEMS Ticket	4809	Incorrect Formatting of “!” Statements
RTEMS Ticket	4810	Unfinished TODO section
RTEMS Ticket	4811	Non-compliant Comments with Templates
RTEMS Ticket	4812	Discrepancy between Code and Comments
RTEMS Ticket	4813	Inaccurate comments at the beginning of file
RTEMS Ticket	4814	Incorrect Copyright License Information
RTEMS Ticket	4815	Function defined in header file
RTEMS Ticket	4816	Wrong data type
RTEMS Ticket	4819	Unclear #IF 1 Clause in File: Possible Error
RTEMS Ticket	4827	Section left to be fixed in kern_tc.c and tls.h (FIXME)
RTEMS Ticket	4829	Unclear comments
RTEMS Ticket	4830	Output value not assigned
RTEMS Ticket	4831	#pragmas to ignore warnings
RTEMS Ticket	4844	Unchecked boundaries
RTEMS Ticket	4846	Code for test software
RTEMS Ticket	4849	“Timer Server” Cannot be Used in Systems with Static Memory Allocation
RTEMS Ticket	4852	Deprecated Functions
RTEMS Ticket	4862	score/ & bsp/: Unused input parameters
RTEMS Ticket	4864	Bitwise operator applied to a signed operand
RTEMS Ticket	4875	LEON3FT - Power-down workaround
RTEMS Ticket	4918	Some functions are listed as unspecified on ICD
RTEMS Ticket	4920	libdl does not support TLS
RTEMS Ticket	4925	Deal with GR740 errata: Level-2 Cache Issues H1 2023 (GRLIB-TN-0021)

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Table 1 – continued from previous page

Database	Identifier	Subject
RTEMS Ticket	4928	Upgrade Version of Sphinx to 7
RTEMS Ticket	4932	Monitor GCC Bug 108658
RTEMS Ticket	4936	Building sphinx 7.0.1 fails (cloned)
RTEMS Ticket	4953	Use of symbol addresses for arbitrary values may not work for some code models
RTEMS Ticket	4961	Document and test CONFIG-URE_JFFS2_DELAYED_WRITE_TASK_PRIORITY
RTEMS Ticket	4963	New build configuration option RTEMS_QUALIFIED

## 12.2 Postponed ISVV Findings

There were Independent Software Verification and Validation (ISVV) Findings that although confirmed as such, were not yet addressed. The table below summarises the most relevant ones (for full details, please refer to the documentation listed within *ISVV Documentation Overview*).

While using the upcoming RTEMS SMP Qualification Data Package (QDP) release 5, one shall be aware of these know issues, and assess the risk they impose to the scope/mission/application on which the RTEMS SMP QDP is being used on.

Table 2: Most relevant postponed Findings

ISVV Finding <sup>2</sup>	Finding Title	Further Details
REQ-VER-004	Incomplete requirements	The requirements/specifications of “functional-type: action” have an incomplete text for these to really be understood as such and represent RTEMS implementation.
REQ-VER-037	Missing interfaces	One needs to check if interfaces within spec:/rtems/type/if/group needs to be updated not to mention interfaces not described in the ICD, or if the missing interfaces need to be added to ICD.
DESIGN-VER-004	No SW User Manual (SUM) which follows ECSS clauses	Some typical SUM sections/information might be missing, which might be due to the generic nature of RTEMS. Further assessment is needed.
DESIGN-VER-008	Memory usage benchmarks	Within section 4.8 of SW Configuration File (SCF)/SUM, one needs to add units for the values, and further contextualising information, otherwise one can’t interpret the values.

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Table 2 – continued from previous page

ISVV Finding <sup>2</sup>	Finding Title	Further Details
VAL-001	“Timer Server” not directly usable	For the current pre-qualified feature set of RTEMS, if one wants to use <code>rtems_timer_initiate_server()</code> , then it has to provide a custom stack allocator. This makes it inconvenient to use. One would need to provide a new directive to construct the timer server, e.g., <code>rtems_timer_server_construct()</code> .
VAL-003	Some functions are listed as unspecified on ICD	One needs to improve the specification of some interfaces which are currently set to unspecified interface-type.
VAL-005	Missing NULL pointer check for clock manager directives	Although it might be considered as user responsibility, one could add logic that tests for NULL pointers within the clock manager directives, returning <code>RTEMS_INVALID_ADDRESS</code> where applicable.
TS-VER-001	No test cases descriptions	Through out all the SVS, several test cases do not have a description. A testcase description should be added for each test case.
QT-QTU-SIM-008	SPAMR - Fixed date and signature for variable data	There is variable data on a signed document with fixed date.
QT-QTU-SIM-015	sphinxbuilder.py - bsp names with underscore	If the BSP name contains underscores, then the document build process will fail because the underscore, due to its special meaning in latex. This is most noticeable on the document titles.
QT-QTU-SIM-016	ARM architecture’s documents populated with SPARC specific text	When building an ARM QDP, the ICD, SRS and SDD documents are populated with SPARC specific text. This is most noticeable on the document titles.
CODE-VER-010	TODO section left undone	#4810 - Unfinished TODO section
CODE-VER-011	FIXME	#4827 - Section left to be fixed in <code>kern_tc.c</code> and <code>tls.h</code> (FIXME)
CODE-VER-014 <sup>3</sup>	Macro wrongly defined	#4842 - Registers definitions wrongly defined when there are reserved bits
CODE-VER-018	Deprecated Functions	#4852 - Deprecated Functions
CODE-VER-023	Code not in accordance with comments	#4812 - Discrepancy between Code and Comments
CODE-VER-026	Function defined in header file	#4815 - Function defined in header file
CODE-VER-028	Unused input parameter	#4862 - Unused input parameters
CODE-VER-029	Input validity unchecked	#4855 - Input validity unchecked
CODE-VER-030	Wrong data type	#4816 - Wrong data type
CODE-VER-032 <sup>Page 312, 3</sup>	Output value not assigned	#4830 - Output value not assigned
CODE-VER-044	Code for test software	#4846 - Code for test software

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Table 2 – continued from previous page

ISVV Finding <sup>2</sup>	Finding Title	Further Details
CODE-VER-052	#pragmas to ignore warnings	#4831 - #pragmas to ignore warnings
CODE-VER-071	Confusing #IF 1 clause	#4819 - Unclear #IF 1 Clause in File: Possible Error
CODE-VER-073	Power-down workaround	#4875 - Power-down workaround
CODE-VER-078	Bitwise operator applied to a signed operand	#4864 - Bitwise operator applied to a signed operand

All of the Postponed ISVV Findings have already been fully discussed with ESA and the actions to address these are already fully defined within the Excel files where these are listed. For further details, one can refer to the documentation listed within *ISVV Documentation Overview*.

## 12.3 Waiver

The following requests for waivers were issued and accepted.

<sup>3</sup> Findings RTEMS-SMP-CODE-VER-014 and RTEMS-SMP-CODE-VER-032 are partially addressed. Please refer to section 3 of the RTEMS SMP ISVV Verification Report [F+23] for details.

## Request for Waiver

Request for waiver as defined in ECSS-M-ST-40C Rev. 1 from 6 March 2009. See table J-1 on page 75 for a description of fields.

<b>Organization:</b> embedded brains GmbH	<b>Number:</b> RfW-QDP-01
<b>Project:</b> Qualification of RTEMS Symmetric Multiprocessing (SMP)	<b>Issue:</b> 1
<b>Business agreement:</b> 4000125572/18/NL/GLC/as	<b>Date:</b> 2021-Nov-17
<b>Order:</b>	<b>Item designation:</b> Directive rtems_rate_monotonic_deadline() as mentioned in the Space Profile
<b>Originator site:</b> embedded brains GmbH, Dornierstr. 4, 82178 Puchheim, Germany	<b>Affected item(s):</b> Pre-qualified RTEMS SMP operating system software
<b>Classification:</b> Minor	<b>Effectivity:</b> Affected versions: All
<b>Affected document:</b> Technical Note Space Profile, release 5, section 3.14	
<b>Short description:</b> Function rtems_rate_monotonic_deadline() missing	
<b>Detailed description:</b> The directive rtems_rate_monotonic_deadline() shall not be implemented in the pre-qualified RTEMS SMP operating system despite it is required by the Space Profile.	
<b>Reason for request:</b> No such directive exists in the public RTEMS OSS project. It would be a completely new directive which has no documentation, specification, implementation, and tests yet. Moreover, it is not required for the use case of Jena-Optronik.	
<b>NCR:</b> ESTEC GitLab Issue #664 < <a href="https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/664">https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/664</a> >	
<b>NRB:</b> 240900028-20211015-01.MOM ("QR#2 Minutes of Meeting")	
<b>Adverse effects:</b> rtems_rate_monotonic_deadline() directive not available in the API.	
<b>Limitation of use:</b> The directive was historically envisioned for a special use case which never surfaced in practice. Consequently, there is currently no known impact on usage.	
<b>Proposed disposition:</b> The software should be used without the rtems_rate_monotonic_deadline() function (use-as-is).	

<b>embedded brains:</b>	<b>EDISOFT Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected		<b>ESA Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected	
<b>Submitter:</b>	<b>Project Manager:</b>	<b>Product Assurance and Safety Manager:</b>	<b>Technical Officer:</b>	<b>Product Assurance and Safety Manager:</b>
Frank Kühndel <b>Date:</b> 2021-Dec-01	Nuno Ramos <b>Date:</b>	Rute Mateus <b>Date:</b>	Javier F. Salgado <b>Date:</b>	Cora Janse <b>Date:</b>



## Request for Waiver

Request for waiver as defined in ECSS-M-ST-40C Rev. 1 from 6 March 2009. See table J-1 on page 75 for a description of fields.

<b>Organization:</b> embedded brains GmbH	<b>Number:</b> RfW-QDP-02
<b>Project:</b> Qualification of RTEMS Symmetric Multiprocessing (SMP)	<b>Issue:</b> 1
<b>Business agreement:</b> 4000125572/18/NL/GLC/as	<b>Date:</b> 2021-Nov-17
<b>Order:</b>	<b>Item designation:</b> Source code of pre-qualified RTEMS
<b>Originator site:</b> embedded brains GmbH, Dornierstr. 4, 82178 Puchheim, Germany	<b>Affected item(s):</b> Pre-qualified RTEMS SMP operating system software
<b>Classification:</b> Minor	<b>Effectivity:</b> Affected versions: All
<b>Affected document:</b> ECSS-Q-HB-80-04A, 30 March 2011, annex A.3.3.11 till A.3.3.13 Software Product Assurance Plan, Release 7, Chapter 7	
<b>Short description:</b> Source code does not comply with cyclomatic number, nesting or lines of code	
<b>Detailed description:</b> From 383 files, 13 have too many lines of code. From 2090 functions, 16 do not meet the required cyclomatic number of this metric.	
<b>Reason for request:</b> The code is not newly written. The time tested software stems from the public RTEMS OSS project. The 16 functions have been visually inspected. Those originating from RTEMS are all false positives. Those originating from external libraries/FreeBSD (strchr.c, qsort.c, iovprintf.c, kern_tc.c) should not be changed to warrant compatibility with the original for updates and bug fixes.	
<b>NCR:</b> ESTEC GitLab Issue #641 < <a href="https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/641">https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/641</a> >	
<b>NRB:</b> 240900028-20211015-01.MOM ("QR#2 Minutes of Meeting")	
<b>Adverse effects:</b> No adverse effects. The code from external libraries/FreeBSD is not expected to be maintained by RTEMS and through its heavy use in other projects well tested.	
<b>Limitation of use:</b> There is no limitation of use.	
<b>Proposed disposition:</b> The pre-qualified RTEMS source code should be used as provided (use-as-is).	

<b>embedded brains:</b>	<b>EDISOFT Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected		<b>ESA Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected	
<b>Submitter:</b>	<b>Project Manager:</b>	<b>Product Assurance and Safety Manager:</b>	<b>Technical Officer:</b>	<b>Product Assurance and Safety Manager:</b>
Frank Kühndel <b>Date:</b> 2021-Dec-01	Nuno Ramos <b>Date:</b>	Rute Mateus <b>Date:</b>	Javier F. Salgado <b>Date:</b>	Cora Janse <b>Date:</b>

## Request for Waiver

Request for waiver as defined in ECSS-M-ST-40C Rev. 1 from 6 March 2009. See table J-1 on page 75 for a description of fields.

<b>Organization:</b> embedded brains GmbH	<b>Number:</b> RfW-QDP-03
<b>Project:</b> Qualification of RTEMS Symmetric Multiprocessing (SMP)	<b>Issue:</b> 1
<b>Business agreement:</b> 4000125572/18/NL/GLC/as	<b>Date:</b> 2021-Nov-17
<b>Order:</b>	<b>Item designation:</b> Application Programming Interface (API) of pre-qualified RTEMS
<b>Originator site:</b> embedded brains GmbH, Dornierstr. 4, 82178 Puchheim, Germany	<b>Affected item(s):</b> Pre-qualified RTEMS SMP operating system software
<b>Classification:</b> Minor	<b>Effectivity:</b> Affected versions: All
<b>Affected document:</b> Technical Note Space Profile, release 5, chapters 3 and 4 Interface Control Document (ICD), release 1, chapter 5 Software Design Document (SDD), release 1	
<b>Short description:</b> ICD contains interface specifications not in the Space Profile	
<b>Detailed description:</b> The ICD and the SDD define and describe functions and <b>#defines</b> which are not part of the Space Profile. A few of them are explicitly excluded by Space Profile section 4.5.3. Furthermore, linker symbols for such functions appear in the pre-qualified library.	
<b>Reason for request:</b> Some functions/managers were explicitly excluded in the hope to ease the realization of the project at the beginning. During the project it turned out that it was easier to include some of them than to exclude them. Yet, most functions were added because without them it would not be possible to reach 100% code coverage.	
<b>NCR:</b> ESTEC GitLab Issue #662 < <a href="https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/662">https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/662</a> > ESTEC GitLab Issue #665 < <a href="https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/665">https://gitrepos.estec.esa.int/external/rtems-smp-qualification/-/issues/665</a> >	
<b>NRB:</b> 240900028-20211015-01.MOM ("QR#2 Minutes of Meeting")	
<b>Adverse effects:</b> No adverse effects. The future user of pre-qualified RTEMS SMP will have more API functions available than initially planned. Functions not used by a programmer are not linked to the application. Hence the executable code size does not increase by these additional functions.	
<b>Limitation of use:</b> There is no limitation of use. A few of these additional functions are not pre-qualified. Their descriptions in the ICD and SDD contain a "constraint" noting that they are not pre-qualified. Any attempt to use such a non-pre-qualified function from within an application build with the pre-qualified RTEMS library will result in a linker error.	
<b>Proposed disposition:</b> The software should be used with these additional functions (use-as-is).	

<b>embedded brains:</b>	<b>EDISOFT Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected		<b>ESA Approval:</b> <input type="checkbox"/> approved <input type="checkbox"/> rejected	
<b>Submitter:</b>  Frank Kühndel <b>Date:</b> 2021-Dec-01	<b>Project Manager:</b>  Nuno Ramos <b>Date:</b>	<b>Product Assurance and Safety Manager:</b>  Rute Mateus <b>Date:</b>	<b>Technical Officer:</b>  Javier F. Salgado <b>Date:</b>	<b>Product Assurance and Safety Manager:</b>  Cora Janse <b>Date:</b>

# RTEMS Qualification Data Package Software Configuration File [sparc/gr712rc/smp/6]

Release 7

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