Document Title	**Specification of RAM Test**
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	076
Document Classification	Standard

Document Version	1.5.0
Document Status	Final
Part of Release	4.0
Revision	3

Document Change History

Date	Version	Changed by	Change Description
27.09.2011	1.5.0	AUTOSAR Administration	• Clarification of some requirements. • Typos correction. • Added a new requirement for DET error reporting
14.10.2010	1.4.0	AUTOSAR Administration	• Clarification on some configuration parameters • Clarification of some types used in API • Improvement of error reporting
30.11.2009	1.3.0	AUTOSAR Administration	• Foreground tests added • Allow more than one configuration per test algorithm • Further maintenance for R4.0: see chapter 11 • Legal disclaimer revised
23.06.2008	1.2.2	AUTOSAR Administration	Legal disclaimer revised
22.01.2008	1.2.1	AUTOSAR Administration	• Correction of figures in Chapter 1 and Chapter 9.
11.12.2007	1.2.0	AUTOSAR Administration	• RAM test concept documented and included; • Requirements tables updated; • Wording/grammar changes; • Sequence diagram changes; • Generated content corrected/modified. • Document meta information extended • Small layout adaptations made
24.01.2007	1.1.1	AUTOSAR Administration	• "Advice for users" revised • "Revision Information" added

Document Change History			
Date	**Version**	**Changed by**	**Change Description**
15.12.2006	1.1.0	AUTOSAR Administration	• File include structure updated • “Modified Hamming code” test removed • RamTst_Stop() & RamTst_Continue() changed to “asynchronous” • Dem API updated • Configuration description corrected • descriptions optimized • Legal disclaimer revised
18.05.2006	1.0.0	AUTOSAR Administration	Initial release

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1 Introduction and Functional Overview

This document specifies the functionality, API and configuration of the AUTOSAR Basic Software module “RAM Test”.

The RAM Test is a test of the physical health of the RAM cells. It is not intended to test the contents of the RAM. RAM used for registers is also tested.

Within this document, a RAM cell is understood as the unit of memory, which can be individually addressed by the processor. Thus the cell size in bits is for example 16 for a 16-bit processor.

There are several RAM Test algorithms available. These RAM Test algorithms are chosen based upon the IEC 61508 specification. The different RAM Test algorithms are divided into 3 groups of diagnostic coverage rates:

Group 1 (Low):	Diagnostic coverage rate = <60%
Group 2 (Medium):	Diagnostic coverage rate = 60% – 90%
Group 3 (High):	Diagnostic coverage rate = 90% – ≤99%.

It should be noted, that these coverage rates are only rough estimates, which in the concrete case depend on the fault model for the specific hardware and on the detailed implementation of the test algorithm.

An ECU safety analysis must be performed to determine which RAM Test diagnostic coverage rate (Low, Medium or High) is required. Appropriate RAM Test algorithms and further configuration parameters are then selected at compile time. At run time, the application software may choose between the compiled algorithms (and between further parameters).

A RAM Test may be called synchronously by the test environment (hereafter called “foreground test”) or may be called in a cyclic manner by an OS task or other cyclic calling method (hereafter called “background test”). The test environment may select test parameters, start and stop the test, and get status reports. Development errors are reported to the Development Error Tracer (DET) and production errors are reported to the Diagnostic Event Manager (DEM).

The RamTst module consists of a RamTst_MainFunction() for background testing, the API's for foreground testing, several configuration and status API's (Application Programming Interface), and several configuration containers.

TEST FUNCTION API's	***DEFINITION***
RamTst_Init	Prepare resources for testing as necessary. Initialize the test execution state as necessary. Proceed to "test stopped" state after initialization is complete.
RamTst_DeInit	Reset all used registers to reset values, and release all used resources.
RamTst_Allow	Permit the RamTst_MainFunction() to perform testing at its next scheduled call.
RamTst_Stop	Prohibit the RamTst_MainFunction() from performing tests at its next scheduled call. When RamTst_Stop is called, testing stops after the current atomic sequence. Test status is retained, but test parameters (block number, loop count, etc.) are discarded.
RamTst_Suspend	Temporarily prohibit the RamTst_MainFunction() from performing tests at its next scheduled call. When RamTst_Suspend is called, testing stops after the current atomic sequence. Test status and test parameters are retained.
RamTst_Resume	Permits the RamTst_MainFunction() to continue testing at the point where it was suspended, at its next scheduled call. Testing continues according to the saved test parameters.
RamTst_RunFullTest	Test the entire RAM space without interruption. RamTst_Stop must be called prior to calling this API.
RamTst_RunPartialTest	Test the portion of the RAM defined by the API. RamTst_Stop or RamTst_Suspend must be called prior to calling this API.

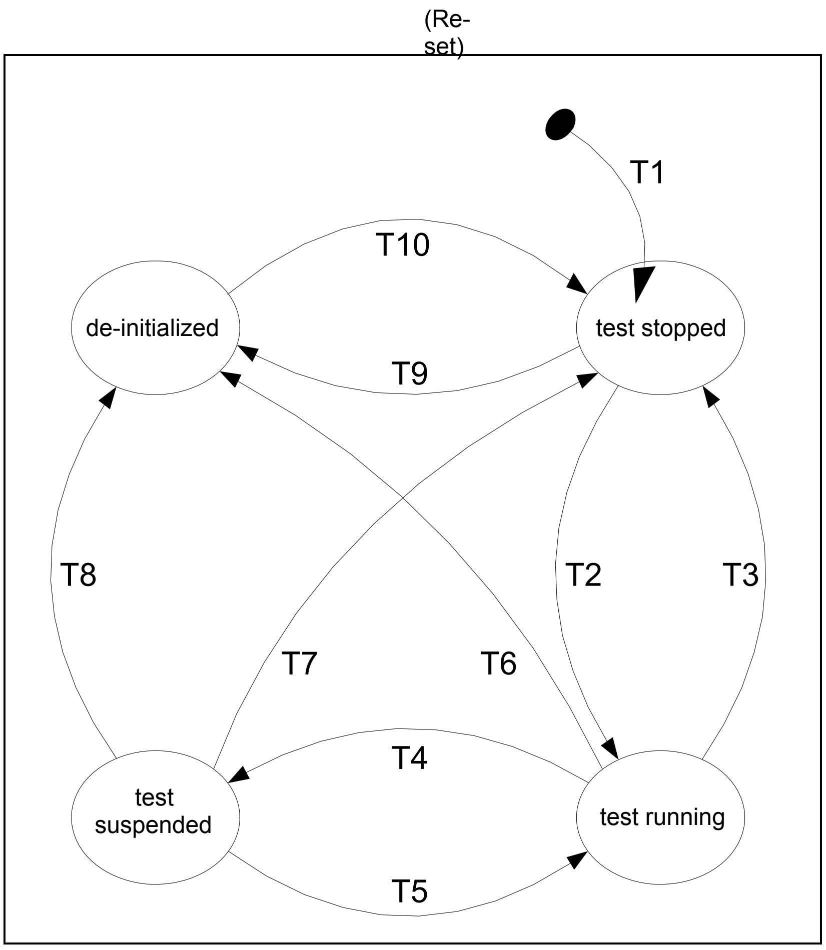
TEST PARAMETER AND FEEDBACK API's
RamTst_GetVersionInfo
RamTst_GetExecutionStatus
RamTst_GetTestResult
RamTst_GetTestResultPerBlock
RamTst_GetAlgParams
RamTst_GetTestAlgorithm
RamTst_GetNumberOfTestedCells
RamTst_SelectAlgParams
RamTst_ChangeNumberOfTestedCells

RamTst_MainFunction() is the scheduled function for background testing.

- For background testing, RamTst_MainFunction() is called periodically by a scheduler, and is interruptible. One complete test consists of testing with one algorithm over the memory space defined by the currently selected configuration. This complete test is split up over many scheduled calls.

- For foreground testing, RamTst_RunFullTest() or RamTst_RunPartialTest() is called once, and is not interruptible by routines which access the tested memory area (this has to be controlled by the test environment). It tests with one algorithm over the memory space (or a subset in case of partial test) defined by the selected configuration.

The state chart below shows the various states of the test execution.



Event	Event Trigger
T1	API: RamTst_Init
T2	API: RamTst_RunFullTest API: RamTst_RunPartialTest API: RamTst_Allow
T3	API: RamTst_Stop (or end of RamTst_RunFullTest) (or end of RamTst_RunPartialTest)
T4	API: RamTst_Suspend (or end of RamTst_RunPartialTest)
T5	API: RamTst_Resume API: RamTst_RunPartialTest
T6	API: RamTst_DeInit
T7	API: RamTst_Stop
T8	API: RamTst_DeInit
T9	API: RamTst_DeInit
T10	API: RamTst_Init

Note: The state “test running” does not necessarily mean that testing is continuously being performed. For foreground testing, it does mean that the test is directly performed by an API call and RamTst_MainFunction() is not scheduled. For background testing, it only means that RamTst_MainFunction() is permitted to test a small portion of the RAM when it is called periodically by the scheduler.

In the actual specification, this state is further divided into “test allowed” and “test running”. The state “test allowed” is only used in the initial phase of a background test; for the big picture given in this overview this difference has been neglected

All API’s and configuration variables are fully defined elsewhere within this document.

The following table shows which API’s are allowed to be called in each state. For any cell in the table where there is an “N”, there should be a corresponding DET error assigned (except that no DET errors are reported in the “De-Initialized” State).

API: Application Programming Interface

	API allowable in this State?				
API’s which cause a change of state in the state chart	**Test Stopped**	**Test Running (or Allowed)**	**Test Suspended**	**Test De-initialized**	
RamTst_Init	N	N	N	Y	
RamTst_RunFullTest	Y	N	N	N	
RamTst_RunPartialTest	Y	N	Y	N	
RamTst_Suspend [1]	N	Y	N	N	
RamTst_Resume	N	N	Y	N	
RamTst_Stop	N	Y	Y	N	
RamTst_Allow [2]	Y	N	N	N	
RamTst_DeInit	Y	Y	Y	N	

	API allowable in this State?				
API's which do not cause a change of state	**Test Stopped**	**Test Running (or Allowed)**	**Test Suspended**	**Test De-initialized**	
RamTst_GetVersionInfo	Y	Y	Y	Y	
RamTst_GetExecutionStatus	Y	Y	Y	N	
RamTst_GetTestResult	Y	Y	Y	N	
RamTst_GetTestResultPerBlock	Y	Y	Y	N	
RamTst_GetAlgParams	Y	Y	Y	N	
RamTst_GetTestAlgorithm	Y	Y	Y	N	
RamTst_GetNumberOfTestedCells	Y	Y	Y	N	
RamTst_SelectAlgParams [3]	Y	N	N	N	
RamTst_ChangeNumberOfTestedCells [4]	Y	N	N	N	

NOTES:

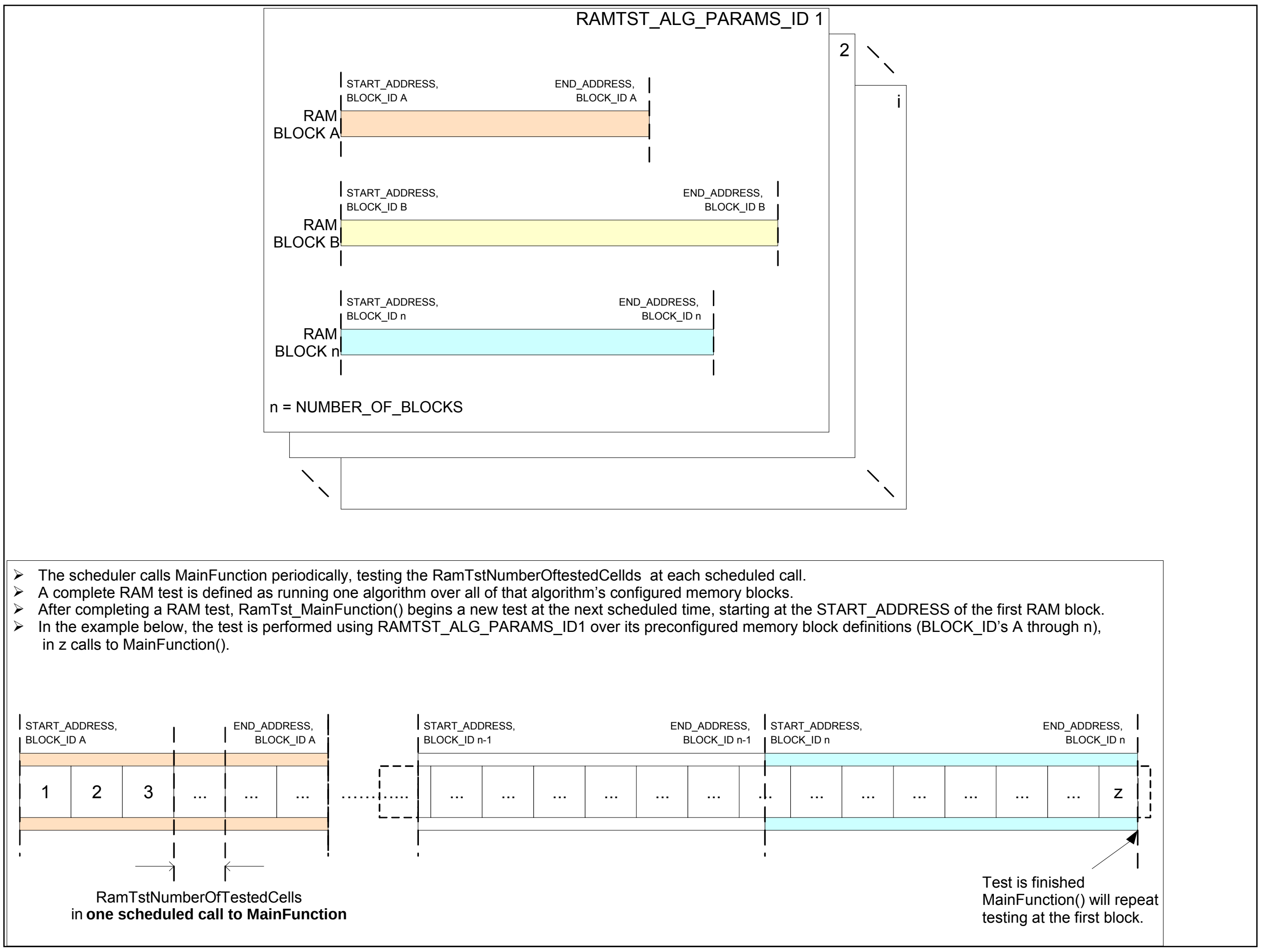
[1] RamTst_Suspend causes a state change to "test suspended" at the end of the current RamTst_MainFunction() atomic sequence if RamTst_MainFunction() is actively testing.

[2] RamTst_Allow is called to permit the RamTst_MainFunction() to test when called, it does not initiate any test itself.

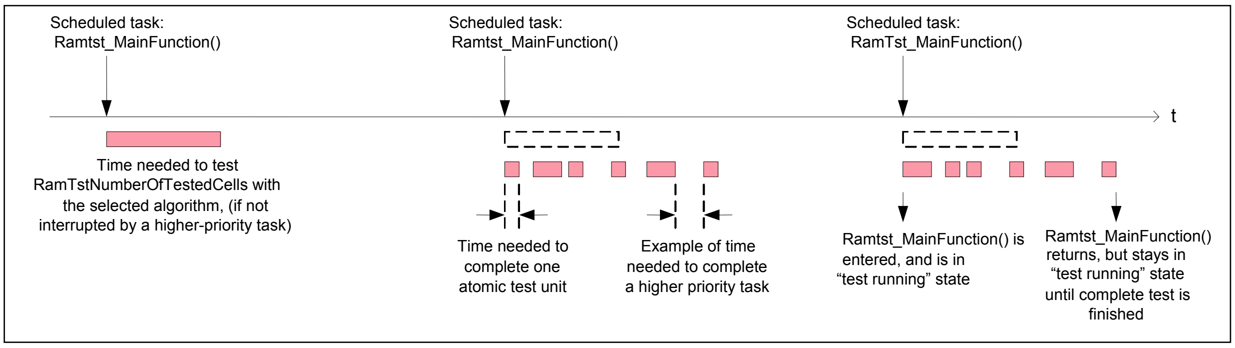
[3] RamTst_Stop must first be called before selecting another configuration parameter set by RamTst_SelectAlgParams.

[4] RamTst_ChangeNumberOfTestedCells operates at the end of the current RamTst_MainFunction() atomic sequence if RamTst_MainFunction() is actively testing. For a foreground test, RamTst_ChangeNumberOfTestedCells is not relevant.

The following figure shows how blocks are configured for an algorithm, and how RamTst_MainFunction() then tests the memory cells for each block in a background test.


RAMTST_ALG_PARAMS_ID 1
2
i
START_ADDRESS, BLOCK_ID A
END_ADDRESS, BLOCK_ID A
RAM BLOCK A
START_ADDRESS, BLOCK_ID B
END_ADDRESS, BLOCK_ID B
RAM BLOCK B
START_ADDRESS, BLOCK_ID n
END_ADDRESS, BLOCK_ID n
RAM BLOCK n
n = NUMBER_OF_BLOCKS
➢ The scheduler calls MainFunction periodically, testing the RamTstNumberOftestedCellds at each scheduled call.
➢ A complete RAM test is defined as running one algorithm over all of that algorithm's configured memory blocks.
➢ After completing a RAM test, RamTst_MainFunction() begins a new test at the next scheduled time, starting at the START_ADDRESS of the first RAM block.
➢ In the example below, the test is performed using RAMTST_ALG_PARAMS_ID1 over its preconfigured memory block definitions (BLOCK_ID's A through n), in z calls to MainFunction().
START_ADDRESS, BLOCK_ID A
END_ADDRESS, BLOCK_ID A
START_ADDRESS, BLOCK_ID n-1
END_ADDRESS, BLOCK_ID n-1
START_ADDRESS, BLOCK_ID n
END_ADDRESS, BLOCK_ID n
1
2
3
z
RamTstNumberOfTestedCells in one scheduled call to MainFunction
Test is finished MainFunction() will repeat testing at the first block.

The following figure shows how RamTst_MainFunction() is called by the scheduler, and how it can be interrupted between atomic pieces by higher priority tasks.


Scheduled task: Ramtst_MainFunction()
Scheduled task: Ramtst_MainFunction()
Scheduled task: RamTst_MainFunction()
t
Time needed to test RamTstNumberOfTestedCells with the selected algorithm, (if not interrupted by a higher-priority task)
Time needed to complete one atomic test unit
Example of time needed to complete a higher priority task
Ramtst_MainFunction() is entered, and is in "test running" state
Ramtst_MainFunction() returns, but stays in "test running" state until complete test is finished

RamTstNumberOfTestedCells

The RamTstNumberOfTestedCells default is set by configuration (pre-compile or link) in the RamTstAlgParams container and applies to every block defined within an algorithm, but can be different for each RamTstAlgParams, thus can be different for different algorithms or for different parameter sets for the same algorithm. RamTstNumberOfTestedCells can be changed during runtime using the API RamTst_ChangeNumberOfTestedCells. This capability, for example, could be used to reduce the duration of the RAM test task before running some other high-bandwidth task in order to prevent task overruns. Such a situation could occur when unusual conditions in a vehicle cause a normally dormant special algorithm to become active.

RamTstNumberOfTestedCells is only applicable to background testing.

RamTstNumberOfTestedCells may not exceed RamTstMaxNumberOfTestedCells.

The absolute maximum size of RamTstNumberOfTestedCells for a given RamTstAlgParams container is defined and documented by the implementer. This maximum should be equal to the sum of the block sizes as defined by the block descriptions. The integrator sets RamTstExtNumberOfTestedCells to this absolute maximum value (pre-compile or link) in the RamTstAlgParams container. RamTstExtNumberOfTestedCells is not changeable during run time.

The integrator also configures (pre-compile or link) the RamTstMaxNumberOfTestedCells for each RamTstAlgParams container. The integrator must carefully select RamTstMaxNumberOfTestedCells such that it puts an upper limit on the run time of RamTst_MainFunction() in a background task according to the system needs for throughput. In no case should RamTstMaxNumberOfTestedCells be set to a value greater than RamTstExtNumberOfTestedCells. RamTstMaxNumberOfTestedCells is not changeable during run time.

The minimum value of RamTstNumberOfTestedCells is defined and documented by the implementer. The minimum should be defined as one cell unless there is some physical reason for a larger minimum. The integrator configures (pre-compile or link) the RamTstMinNumberOfTestedCells to be greater than or equal to the minimum defined by the implementer. RamTstMinNumberOfTestedCells applies to the entire RAM test module, and not to individual algorithms or parameter sets. It is configured in the RamTstConfigParams container. RamTstMinNumberOfTestedCells is not changeable during run time.

The cell size (in terms of bits) is also defined by the implementer and cannot be changed at integration time, as it should be a fixed value for a given processor. Therefore the corresponding parameter is specified as a published parameter (see chapter0).

No matter how many blocks or partial blocks are tested in one RamTst_MainFunction() scheduled call, test status information must be maintained for each block separately.

RamTst_MainFunction() .
A **background** test is performed by the scheduler periodically calling the RamTst_MainFunction() to test a RamTstNumberOfTestedCells of memory using the selected algorithm, until the entire defined area of RAM is tested. This RamTst_MainFunction() can be interrupted at the end of each atomic sequence during a scheduled call.

RamTst_MainFunction():
- Is made up of one or more atomic (i.e. uninterruptable) pieces of code. The number of cells that can be tested in one atomic sequence is considered as implementation specific, thus it is not determined by any (standardized) configuration parameter. However, it is expected that at least RamTstMinNumberOfTestedCells are completely tested during one atomic sequence. It should be noted, that in general the detection of coupling faults between cells is limited to those cells which are tested together in the same atomic sequence.
- At the end of each atomic piece, internal flags are checked to see if an OS task has changed any parameter of the state chart, and to respond to question-type API's.
- Knows inherently:
  - which algorithm it is using;
  - which memory blocks must be tested for this algorithm,
  - start and end addresses of each block;
  - number of cells to test at each call
  - further parameters for the test (see chapter 0)
- Remembers:
  - which block it is in;
  - which address to start at in the next call;
  - status of the test;
  - overall test results;
  - test results for each block.
- When RamTstNumberOfTestedCells is reached, RamTst_MainFunction() ends testing for that scheduled call, and starts testing in the next scheduled call at the next (saved) address.
- When the end of a block is reached during a scheduled call, RamTst_MainFunction() continues testing at the beginning of the next block, and continues until RamTstNumberOfTestedCells is reached. (Note: The atomic test sequence should be careful to take into account any issues regarding crossing into the next block.)
- When all blocks are fully tested, RamTst_MainFunction() issues a notification and repeats testing at the first block.
- If there is an error during testing, RamTst_MainFunction() issues a notification (if configured) and continues testing.

RamTst_RunFullTest, RamTst_RunPartialTest
"Full" and "Partial" refers to full or partial memory, and **not** the full or partial set of algorithms over the memory space. The test is performed over the specified memory area using only one algorithm. The desired parameter set (which includes the algo-

rithm) is selected by calling the API RamTst_SelectAlgParams before calling the foreground test API.

Note that due to the possibility of testing larger memory areas without interruption the fault coverage of foreground tests is in general better than of background test for the same algorithm.

RamTst_RunFullTest API:
The user calls RamTst_RunFullTest with no arguments (the test parameter set is selected before). This test is normally used for a full RAM check at system startup or shutdown.

```
Sequence:
    RamTst_Stop
    RamTst_SelectAlgParams to chose the desired parameter set
    RamTst_RunFullTest
```

RamTst_RunPartialTest API:
The user calls RamTst_RunPartialTest with one argument specifying the desired block to be tested. This test is used for example to check a specified memory section immediately before using that memory. This capability is to enable a system safety concept.

```
Sequence:
    RamTst_Stop
    RamTst_SelectAlgParams to chose the desired parameter set
    RamTst_RunPartialTest (ChosenBlock)

or if background test shall continue afterwards:
    RamTst_Suspend
    RamTst_RunPartialTest (ChosenBlock)
```

2 Acronyms and Abbreviations

Abbreviation / Acronym:	***Description:***
API	Application Programming Interface
CRC	Cyclic Redundancy Check
DEM	Diagnostic Event Manager
DET	Development Error Tracer
DMA	Direct Memory Access
ECC	Error Correction Code
NMI	Non Maskable Interrupt
RAM	Random Access Memory

Definitions
Note: These definition are copied from the AUTOSAR_Glossary.doc

Synchronous: A communication is synchronous when the calling software entity is blocked until the called operation is evaluated. The calling software entity continues its operation by getting the result. Synchronous communication between distributed functional units has to be implemented as remote procedure call.

Asynchronous: Asynchronous communication does not block the sending software entity. The sending software entity continues its operation without getting a response from the communication partner(s). There could be an acknowledgement by the communication system about the sending of the information. A later response to the sending software entity is possible.

3 Related Documentation

Input Documents

[1] List of Basic Software Modules
AUTOSAR_TR_BSWModuleLis.pdf

[2] Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

[3] General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[4] General Requirements on SPAL
AUTOSAR_SRS_SPALGeneral.pdf

[5] Requirements on RAM Test
AUTOSAR_SRS_RAMTest.pdf

[6] Basic Software Module Description Template
AUTOSAR_TPS_BSWModuleDescriptionTemplate.pdf

[7] Specification of Multi-Core OS Architecture
AUTOSAR_SWS_MultiCoreOS.pdf

Related Standards and Norms

[8] D1.5-General Architecture; ITEA/EAST-EEA, Version 1.0; chapter 3, page 72 et seq.

[9] D2.1-Embedded Basic Software Structure Requirements; ITEA/EAST-EEA, Version 1.0 or higher.

[10] D2.2-Description of existing solutions; ITEA/EAST-EEA, Version 1.0 or higher.

[11] CEI/IEC 61508-2:2000: Requirements for electrical/electronic/programmable electronic safety-related systems

[12] CEI/IEC 61508-7:2000: Requirements for electrical/electronic/programmable electronic safety-related systems

4 Constraints and Assumptions

Note: To achieve IEC certification (SIL1, SIL2, SIL3), the software implementation must be according to the requirements of IEC61508-3.

Limitations

[RamTst002] ⌈ During the execution of a RAM test algorithm, no other software shall be allowed to modify the RAM area under test. ⌋()

In case of background test, the testing code shall be implemented in small atomic pieces in order to accomplish this.

In case of foreground test, it is assumed that the test environment provides the conditions for exclusive access to the tested RAM area.

The rationale behind this requirement is the incapability of the RAM test module to ensure data consistency (e.g. during an NMI, or during a DMA transfer).

[RamTst082] ⌈ The implementer shall provide integration hints for each algorithm, e.g. “do not use in parallel with a DMA”. ⌋()

When testing shared memory in a multi-core system it might not be possible get exclusive access to more than one memory cell via interrupt locking. In this case, the usage of a test configuration for shared memory blocks must be restricted to foreground tests and to specific ECU states, see [7] and RamTst203 for additional information.

Applicability to Car Domains

No restrictions.

5 Dependencies to Other Modules

An actual selected parameter set for a RAM test basically consists of a set of RAM bocks and a test algorithm.

The available parameter sets for the RAM blocks and test algorithms must be configured at pre-compile time. The software responsible for monitoring the RAM state of health must then select an appropriate parameter set (can also switch between several ones at runtime), according to the results of the ECU safety analysis.

Within each parameter set, the detailed definition of the blocks to be tested, e.g. their start/end address, must be configured at pre-compile or link time. Further parameters controlling the details of the test are explained later in the document (see 0).

If the test environment calls a RAM Test API to test all or part of the RAM immediately (in the foreground), then the test environment is responsible to mask interrupts as desired or to call the test in a particular situation, where the tested blocks are not accessed by other modules.

For background testing, the ECU State Manager or the BSW Scheduler must schedule the RAM Test main function. The number of cells tested in one cycle is set as a default at pre-compile or link time based upon the needs of the scheduler. This size may be changed during runtime to accommodate a change in the schedule. In addition, the parameter set used for the background test may be switched during runtime, so that e.g. certain critical blocks can be tested in certain ECU states with higher coverage than in other ECU states or uncritical blocks can be excluded from tests in certain ECU states.

In development mode the error-hook function of module DET will be called.

File Structure

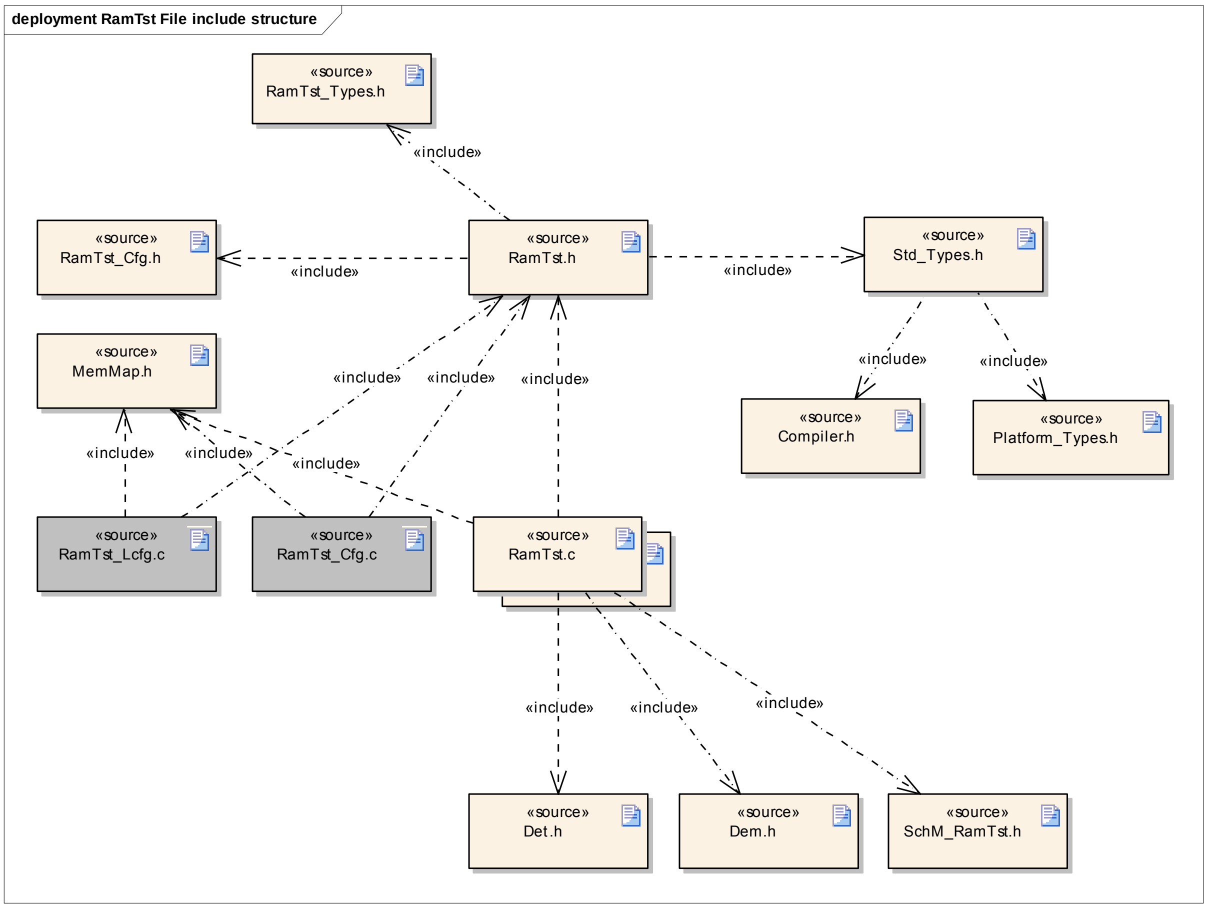
5.1.1 Code File Structure

[RamTst086] ⌈ The code file structure for the RAM Test module shall not be defined within this specification completely. At this point, it shall be pointed out that the code-file structure shall include the following files named:

- `RamTst_Cfg.c` for compile time configurable parameters, which need source code (e.g. tables)
- `RamTst_Lcfg.c` for link time configurable parameters ⌋(BSW00380, BSW00419, BSW158, BSW00346)

5.1.2 Header File Structure

[RamTst003] ⌈ The include structure for the source code of the RAM Test module shall be as follows:



⌋(BSW00346, BSW00415, BSW00435, BSW00436, BSW00447)

[RamTst072] ⌈ The module shall include the `Dem.h` file. ⌋(BSW00384)

Hint: By this inclusion, the APIs to report errors as well as the required Event Id symbols are included. This specification defines the name of the Event Id symbols which are provided by XML to the DEM configuration tool. The DEM configuration tool assigns ECU dependent values to the Event Id symbols and publishes the symbols in `Dem_IntErrId.h`.

[RamTst087] ⌈ Pre-compile configuration macros as well as references to c-configuration parameters (compile time or link time) shall be placed into the `RamTst_Cfg.h` file. ⌋(BSW00381, BSW00412)

[RamTst208] ⌈ Module specific types shall be declared in file `RamTst_Types.h.` ⌋ ()

5.1.3 Version Check

[RamTst080]⌈ The RAM Test Module shall avoid the integration of incompatible files by the following pre-processor checks:

For included (external) header files:

- <MODULENAME>_AR_RELEASE_MAJOR_VERSION
- <MODULENAME>_AR_ RELEASE_MINOR_VERSION

shall be verified. ⌋(BSW004, BSW00402, BSW003, BSW00318)

If the values are not identical to the values expected by the RAM Test Module, an error shall be reported.

6 Requirements Traceability

Requirement	Satisfied by
-	RamTst149
-	RamTst191
-	RamTst002
-	RamTst189
-	RamTst174
-	RamTst147
-	RamTst034
-	RamTst014
-	RamTst212
-	RamTst082
-	RamTst202
-	RamTst148
-	RamTst188
-	RamTst047
-	RamTst204
-	RamTst005
-	RamTst112
-	RamTst171
-	RamTst217
-	RamTst190
-	RamTst196
-	RamTst206
-	RamTst085
-	RamTst173
-	RamTst194
-	RamTst203
-	RamTst169
-	RamTst089
-	RamTst215
-	RamTst009
-	RamTst193
-	RamTst208
-	RamTst150
-	RamTst197
-	RamTst098
-	RamTst094
-	RamTst211
-	RamTst021

-	RamTst096
-	RamTst207
-	[RamTst093]
-	RamTst018
-	RamTst192
-	RamTst100
-	RamTst101
-	RamTst106
-	RamTst198
BSW003	RamTst080, RamTst117
BSW00301	RamTst999
BSW00302	RamTst999
BSW00306	RamTst999
BSW00308	RamTst999
BSW00309	RamTst999
BSW00312	RamTst999
BSW00314	RamTst221
BSW00318	RamTst080
BSW00321	RamTst999
BSW00323	RamTst210, RamTst214, RamTst115, RamTst097, RamTst095, RamTst068, RamTst040, RamTst033, RamTst172, RamTst170, RamTst039, RamTst037
BSW00325	RamTst221
BSW00326	RamTst221
BSW00328	RamTst999
BSW00330	RamTst117
BSW00331	RamTst103, RamTst102
BSW00333	RamTst999
BSW00336	RamTst999
BSW00337	RamTst067
BSW00338	RamTst084, RamTst116, RamTst097, RamTst068, RamTst067, RamTst069
BSW00339	RamTst213, RamTst011, RamTst111, RamTst067, RamTst076, RamTst071, RamTst073, RamTst216
BSW00341	RamTst999
BSW00345	RamTst068, RamTst079, RamTst058
BSW00346	RamTst086, RamTst003
BSW00347	RamTst999
BSW00350	RamTst068
BSW00353	RamTst999
BSW00357	RamTst074
BSW00358	RamTst099
BSW00361	RamTst999
BSW00370	RamTst999

BSW00373	RamTst110
BSW00374	RamTst999
BSW00375	RamTst999
BSW00376	RamTst110
BSW00378	RamTst999
BSW00379	RamTst999
BSW00380	RamTst086
BSW00381	RamTst087
BSW00383	RamTst999
BSW00384	RamTst072
BSW00385	RamTst067
BSW00386	RamTst999
BSW00399	RamTst999
BSW004	RamTst080
BSW00400	RamTst999
BSW00402	RamTst080
BSW00404	RamTst999
BSW00405	RamTst999
BSW00406	RamTst013, RamTst012, RamTst006
BSW00407	RamTst109, RamTst079, RamTst078
BSW00409	RamTst073
BSW00411	RamTst079
BSW00412	RamTst087
BSW00413	RamTst999
BSW00415	RamTst003
BSW00416	RamTst999
BSW00417	RamTst999
BSW00419	RamTst086
BSW00422	RamTst999
BSW00423	RamTst999
BSW00424	RamTst999
BSW00425	RamTst999
BSW00426	RamTst999
BSW00427	RamTst221
BSW00428	RamTst999
BSW00429	RamTst999
BSW00432	RamTst999
BSW00434	RamTst999
BSW00435	RamTst003
BSW00436	RamTst003
BSW00437	RamTst999
BSW00438	RamTst999

BSW00439	RamTst221
BSW00440	RamTst999
BSW00441	RamTst999
BSW00442	RamTst155, RamTst153, RamTst159, RamTst157, RamTst158, RamTst164, RamTst161, RamTst162, RamTst163
BSW00443	RamTst999
BSW00444	RamTst999
BSW00447	RamTst003
BSW00449	RamTst999
BSW00450	RamTst175
BSW005	RamTst999
BSW006	RamTst999
BSW009	RamTst999
BSW010	RamTst999
BSW101	RamTst099
BSW12056	RamTst043, RamTst044
BSW12063	RamTst999
BSW12064	RamTst999
BSW12067	RamTst999
BSW12068	RamTst999
BSW12069	RamTst999
BSW12075	RamTst999
BSW12078	RamTst999
BSW12092	RamTst999
BSW12125	RamTst999
BSW12129	RamTst221
BSW12265	RamTst999
BSW12267	RamTst999
BSW12448	RamTst084, RamTst095, RamTst040, RamTst033, RamTst039, RamTst037
BSW12461	RamTst999
BSW12462	RamTst999
BSW12463	RamTst999
BSW13800	RamTst107, RamTst036
BSW13803	RamTst063
BSW13804	RamTst083
BSW13805	RamTst050
BSW13806	RamTst052
BSW13807	RamTst051
BSW13808	RamTst053
BSW13809	RamTst107, RamTst108, RamTst008, RamTst059
BSW13810	RamTst011, RamTst010, RamTst104, RamTst024, RamTst019, RamTst038
BSW13811	RamTst200, RamTst060, RamTst061

BSW13812	RamTst201, RamTst061
BSW13813	RamTst055
BSW13816	RamTst062
BSW13818	RamTst054
BSW13820	RamTst114, RamTst113, RamTst043, RamTst044, RamTst045, RamTst046
BSW13821	RamTst052, RamTst053, RamTst050, RamTst051, RamTst054, RamTst055
BSW157	RamTst043, RamTst044, RamTst045, RamTst046
BSW158	RamTst086
BSW161	RamTst999
BSW162	RamTst999
BSW164	RamTst999
BSW168	RamTst999
BSW170	RamTst999
BSW172	RamTst999

Document: General Requirements on Basic Software Modules, [3]

Requirement	***Satisfied by***
Functional Requirements	
[BSW101] Initialization interface	RamTst007, [RamTst099
[BSW004] Version check	RamTst080
[BSW159] Tool-based configuration	Both static and runtime configuration parameters are located outside the source code of the module. This is the prerequisite for automatic configuration.
[BSW167] Static configuration checking	Constraints are partially stated in the configuration parameter description.
[BSW168] Diagnostic interface of SW components	Not applicable (not a SW-Component)
[BSW170] Data for reconfiguration of AUTOSAR SW-Components	Not applicable (not a SW-Component)
[BSW171] Configurability of optional functionality	RamTst065
[BSW00323] API parameter checking	RamTst033, RamTst037, RamTst039, RamTst040, RamTst068, RamTst095, [RamTst115, [RamTst097, RamTst170, RamTst172, RamTst210, RamTst214
[BSW00336] Shutdown interface	Not applicable (this module does not need such a function)
[BSW00337] Classification of errors	RamTst067
[BSW00338] Detection and reporting of development errors	RamTst067, RamTst068, RamTst069, RamTst070, [RamTst084, [RamTst097, [RamTst116
[BSW00339] Reporting of production relevant error status	RamTst073, RamTst067, RamTst076, RamTst071, [RamTst111, RamTst011, RamTst213, RamTst216
[BSW00344] Reference to link-time configuration	RamTst026, RamTst027, RamTst066, RamTst090, RamTst091
[BSW00345] Pre-compile-time configuration	RamTst065, RamTts058, RamTst066, RamTst068, RamTst070, RamTst079, RamTst090, RamTst091
[BSW00369] Do not return development error codes via API	Satisfied by all API's

[BSW00375] Notification of wake-up reason	Not applicable (wakeups are not supported by this module)
[BSW00380] Separate C-files for configuration parameters	RamTst086
[BSW00381] Separate configuration header file for pre-compile time parameters	RamTst087
[BSW00383] List dependencies of configuration files	Not applicable (there are no dependencies to other configuration files)
[BSW00384] List dependencies to other modules	RamTst072
[BSW00385] List possible error notifications	RamTst067
[BSW00386] Configuration for detecting an error	Not applicable (no configuration for error detection)
[BSW00387] Specify the configuration class of callback function	RamTst138_Conf, RamTst139_Conf
[BSW00388] Introduce containers	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091
[BSW00389] Containers shall have names	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091
[BSW00390] Parameter content shall be unique within the module	RamTst065, , RamTst070, RamTst090, RamTst091
[BSW00391] Parameter shall have unique names	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091 Prefix “RamTst” added to each parameter
[BSW00392] Parameters shall have a type	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091
[BSW00393] Parameters shall have a range	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091
[BSW00394] Specify the scope of the parameters	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091 “Local” marked as Module (template and SRS General are inconsistent)
[BSW00395] List the required parameters (per parameter)	All parameter in section 0 Containers and configuration parameters are required.
[BSW00396] Configuration classes	See section 10.1.4 Variants
[BSW00397] Pre-compile-time parameters	RamTst065, RamTst066, RamTst070, RamTst090, RamTst091
[BSW00398] Link-time parameters	RamTst066, RamTst090, RamTst091
[BSW00399] Loadable post-build time parameters	Not applicable (post build time configuration is not supported)
[BSW00400] Selectable post-build time parameters	Not applicable (post build time configuration is not supported)
[BSW00402] Published information	[RamTst080, [RamTst081, RamTst186_Conf
[BSW00404] Reference to post build time configuration	Not applicable (post build time configuration is not supported)
[BSW00405] Reference to multiple configuration sets	Not applicable (post build time is not supported)
[BSW00406] Check module initialization	RamTst006, [RamTst012, [RamTst013
[BSW00407] Function to read out published parameters	RamTst078, RamTst079, [RamTst109
[BSW00409] Header files for production code error IDs	RamTst073
[BSW00412] Separate H-file for configuration parameters	RamTst087
[BSW00416] Sequence of Initialization	Not applicable (this is a general software integration requirement)
[BSW00417] Reporting of error events by non-basic software	Not applicable (this is a basic software module)

[BSW00419] Separate C-files for pre-compile time configuration parameters	RamTst086
[BSW00422] Debouncing of production relevant error status	Not applicable (it makes no sense to debounce a Ram error)
[BSW00423] Usage of SW-C template to describe BSW modules with AUTOSAR interfaces	Not applicable (this module has no connection to the RTE)
[BSW00424] BSW main processing function task allocation	Not applicable (the scheduling of a BSW is not part of this SWS)
[BSW00425] Trigger conditions for schedulable objects	Not applicable (requirement for the implementer)
[BSW00426] Exclusive areas in BSW modules	Not applicable (requirement for the implementer), but mentioned as a hint to RamTst_MainFunction
[BSW00427] ISR description for BSW modules	RamTst221
[BSW00428] Execution order dependencies of main processing functions	Not applicable (requirement for the implementer and integrator)
[BSW00429] Restricted BSW OS functionality access	Not applicable (this module does not use OS services)
[BSW00432] Modules should have separate main processing functions for read/receive and write/transmit data path	Not applicable (this module does not have send/receive functionality)
[BSW00433] Calling of main processing functions	Requirement for the test environment. Made possible by separate APIs for foreground test.
[BSW00434] The Schedule Module shall provide an API for exclusive areas	Not applicable (this is a special requirement for the BSW scheduler)
[BSW00437] No-init area in RAM	Not applicable (this is a requirement on the memory manager)
[BSW00438] Post-build configuration data structure	Not applicable (post build time configuration is not supported)
Non-functional Requirements	
[BSW003] Version identification	[RamTst080, [RamTst117
[BSW005] No hard coded horizontal interfaces within MCAL	Not applicable (this is a requirement on architecture)
[BSW006] Platform independency	Not applicable to MCAL
[BSW007] HIS MISRA C	Common AUTOSAR non-functional requirement for the implementer.
[BSW009] Module User Documentation	Not applicable (requirement for the implementer)
[BSW010] Memory resource documentation	Not applicable (requirement for the implementer)
[BSW158] Separation of configuration from implementation	RamTst086
[BSW160] Human-readable configuration data	Common AUTOSAR non-functional requirement; fulfilled by using XML
[BSW161] Microcontroller abstraction	Not applicable (this is a requirement on architecture)
[BSW162] ECU layout abstraction	Not applicable (this is a requirement on architecture)
[BSW164] Implementation of interrupt service routines	Not applicable (this is a requirement on architecture)
[BSW172] Compatibility and documentation of scheduling strategy	Not applicable (requirement for the implementer)
[BSW00300] Module naming convention	Common AUTOSAR non-functional requirement for the implementer.
[BSW00301] Limit imported information	Not applicable (requirement for the implementer)
[BSW00302] Limit exported information	Not applicable (requirement for the implementer)

[BSW00304] AUTOSAR integer data types	See section 0 Imported types
[BSW00305] Self-defined data types naming convention	See section 0 Type definitions
[BSW00306] Avoid direct use of compiler and platform specific keywords	Not applicable (requirement for the implementer)
[BSW00307] Global variables naming convention	Common AUTOSAR non functional requirement for the implementer.
[BSW00308] Definition of global data	Not applicable (requirement for the implementer)
[BSW00309] Global data with read-only constraint	Not applicable (requirement for the implementer)
[BSW00310] API naming convention	See chapter 8 API specification
[BSW00312] Shared code shall be reentrant	Not applicable (requirement for the implementer)
[BSW00314] Separation of interrupt frames and service routines	RamTst221
[BSW00318] Format of module version numbers	[RamTst080
[BSW00321] Enumeration of module version numbers	Not applicable (requirement for the implementer)
[BSW00325] Runtime of interrupt service routines	RamTst221
[BSW00326] Transition from ISRs to OS tasks	RamTst221
[BSW00327] Error values naming convention	See section 0 Error classification
[BSW00328] Avoid duplication of code	Not applicable (requirement for the implementer)
[BSW00329] Avoidance of generic interfaces	See chapter 8 API specification
[BSW00330] Usage of macros / inline functions instead of functions	[RamTst117
[BSW00331] Separation of error and status values	[RamTst102, [RamTst103 8.1.1 RamTst_ExecutionStatusType and 8.1.2 RamTst_TestResultType
[BSW00333] Documentation of callback function context	Not applicable (requirement for the implementer)
[BSW00334] Provision of XML file	Not applicable (requirement for the implementer)
[BSW00335] Status values naming convention	See section 0 Type definitions
[BSW00341] Microcontroller compatibility documentation	Not applicable (requirement for the implementer)
[BSW00342] Usage of source code and object code	Common AUTOSAR non-functional requirement for the implementer.
[BSW00343] Specification and configuration of time	Common AUTOSAR non-functional requirement for the implementer.
[BSW00346] Basic set of module files	RamTst086, RamTst003
[BSW00347] Naming separation of different instances of BSW drivers	Not applicable (only one instance of this module)
[BSW00348] Standard type header	See chapter 8.1Imported types
[BSW00350] Development error detection keyword	RamTst068, RamTst070
[BSW00353] Platform specific type header	Not applicable (requirement for the implementer)
[BSW00355] Do not redefine AUTOSAR integer data types	See section 0 Type definitions
[BSW00357] Standard API return type	[RamTst074 See section 0 Imported types
[BSW00358] Return type of init() functions	[RamTst099 See section 8.1.5 RamTst_Init
[BSW00359] Return type of callback functions	See section 8.1.25 Configurable interfaces
[BSW00360] Parameters of callback functions	See section 8.1.25 Configurable interfaces
[BSW00361] Compiler specific language	Not applicable

extension header	(requirement for the implementer)
[BSW00370] Separation of callback interface from API	Not applicable, because callbacks are configured as function pointers
[BSW00371] Do not pass function pointers via API	Satisfied by the APIs
[BSW00373] Main processing function naming convention	[RamTst110 See section 8.1.22 RamTst_MainFunction
[BSW00374] Module vendor identification	Not applicable (requirement for the implementer)
[BSW00376] Return type and parameters of main processing functions	[RamTst110 See section 8.1.22 RamTst_MainFunction
[BSW00377] Module specific API return types	See sections 0 Imported types and 0 Type definitions
[BSW00378] AUTOSAR boolean type	Not applicable (requirement for the implementer)
[BSW00379] Module identification	Not applicable (requirement for the implementer)
[BSW00401] Documentation of multiple instances of configuration parameters	See section 0 Containers and configuration parameters
[BSW00408] Configuration parameter naming convention	See section 0 Containers and configuration parameters
[BSW00410] Compiler switches shall have defined values	See section 0 Containers and configuration parameters
[BSW00411] Get version info keyword	RamTst070, RamTst079
[BSW00413] Accessing instances of BSW modules	Not applicable (instances makes no sense for this module)
[BSW00414] Parameter of init function	RamTst093 See section 8.1.5 RamTst_Init
[BSW00415] User dependent include files	RamTst003
[BSW00435] Module header file structure for the basic software scheduler	RamTst003
[BSW00436] Module header file structure for the basic software memory mapping	RamTst003
[BSW00438] Post Build Configuration Data Structure	Not applicable (no post-build configuration)
[BSW00439] Declaration of interrupt handlers and ISRs	RamTst221
[BSW00440] Function prototype for callback functions of AUTOSAR Services	Not applicable
[BSW00441] Enumeration literals and #define naming convention	Not applicable (requirement for the implementer)
[BSW00442] Debugging Support in Modules	RamTst153,RamTst155,RamTst157,RamTst158, RamTst159,RamTst161,RamTst162,RamTst163, RamTst164,RamTst165
[BSW00443] Enabling / disabling defensive behavior of BSW	Not applicable
BSW00444] Error reporting and logging for defensive	Not applicable
[BSW00445] Protection against untimely call of BSW initialization	Valid, but not explicitly mentioned
[BSW00446] Protection against untimely call of BSW de-initialization	Valid, but not explicitly mentioned
[BSW00447] Standardizing Include file structure of BSW	RamTst003
[BSW00448] Module SWS shall not contain requirements from Other Modules	Satisfied in general
[BSW00449] BSW Service APIs used by Autosar Application Software shall return a	Not applicable

Std_ReturnType	
[BSW00450] Main Function Processing for Un-Initialized Modules	RamTst175

Document: General Requirements on SPAL, [4]

Requirement	*Satisfied by*
General Requirements	
[BSW157] Notification mechanisms of drivers and handlers	RamTst042RamTst043, RamTst044, RamTst045, RamTst046, RamTst066
[BSW12056] Configuration of notification mechanisms	RamTst042RamTst043, RamTst044, RamTst045, RamTst046, RamTst066
[BSW12057] Driver module initialization	RamTst007, RamTst026, RamTst027, RamTst066
[BSW12063] Raw value mode	Not applicable (this module does not provide physical signals)
[BSW12064] Change of operation mode during running operation	Not applicable (only one operation mode available)
[BSW12067] Setting of wake-up conditions	Not applicable (this module has no wakeup sources)
[BSW12068] MCAL initialization sequence	Not applicable (this is a requirement for the implementer)
[BSW12069] Wake-up notification of ECU State Manager	Not applicable (this module has no wakeup sources)
[BSW12075] Use of application buffers	Not applicable (no use of a buffering mechanism)
[BSW12125] Initialization of hardware resources	Not applicable (this module accesses only RAM, so no hardware resource initialization is necessary)
[BSW12129] Resetting of interrupt flags	RamTst221
[BSW12163] Driver module deinitialization	RamTst146
[BSW12169] Control of operation mode	If the test execution status is called an operation mode, then this is satisfied by the APIs to stop/allow/suspend/resume test execution
[BSW12263] Object code compatible configuration concept	RamTst026, RamTst027, RamTst066
[BSW12267] Configuration of wake-up sources	Not applicable (this module has no wakeup sources)
[BSW12448] Behavior after development error detection	RamTst033, RamTst037, RamTst039, RamTst040, [RamTst084, RamTst095
[BSW12461] Responsibility for register initialization	Not applicable (this module uses no registers)
[BSW12462] Provide settings for register initialization	Not applicable (this module uses no registers)
[BSW12463] Combine and forward settings for register initialization	Not applicable (this module uses no registers)
Non-Functional Requirements	
[BSW12077] Non-blocking implementation	Fulfilled by background test (main function). The foreground test APIs are an exception from this requirement.
[BSW12078] Runtime and memory efficiency	Not applicable (requirement for the implementer)
[BSW12092] Access to drivers	Not applicable
[BSW12264] Specification of configuration items	See chapter 10.2 Containers and configuration parameters
[BSW12265] Configuration data shall be kept constant	Not applicable (requirement for the implementer)

Document: Requirements on RAM Test, [5]

Requirement	***Satisfied by***
[BSW13800] Number of tested cells shall be changeable at runtime	RamTst036, [RamTst107
[BSW13801] Test cell size shall be a published parameter	RamTst187_Conf
[BSW13802] Multiple RAM areas shall be configurable at post build/ link time	RamTst026, RamTst091_Conf
[BSW13803] A subset of available RAM Test algorithms shall be selectable at pre-compile time	RamTst026, RamTst027, RamTst063, RamTst065, RamTst083, RamTst084, RamTst085, [RamTst097, RamTst105
[BSW13804] A subset of the pre-compile time selected RAM Test algorithms shall be selectable at runtime	[RamTst083, RamTst105
[BSW13805] Checkerboard test algorithm shall be available	RamTst050 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13806] Walk path test algorithm shall be available	RamTst052 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13807] March test algorithm shall be available	RamTst051 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13808] Galpat test algorithm shall be available	RamTst053 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13809] RAM Test execution management	RamTst008, [RamTst026, RamTst059, RamTst070, RamTst090, RamTst091, [RamTst107, [RamTst108
[BSW13810] Current status of RAM Test execution per block shall be available through a get status interface	[RamTst010, [RamTst011, RamTst019, RamTst024, RamTst038, [RamTst104
[BSW13811] Non-destructive RAM Test	RamTst060, RamTst061, RamTst200
[BSW13812] Destructive RAM Test	RamTst061, RamTst201
[BSW13813] Abraham test algorithm shall be available	RamTst055 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13816] Effects of instruction / data queue shall be taken into account	RamTst062
[BSW13818] Transparent Galpat test algorithm shall be available	RamTst054 See sections 8.1.2 RamTst_AlgorithmType and section 0 Containers and Configuration Parameters
[BSW13820] RAM Test execution status shall be provided by a notification mechanism	RamTst042RamTst043, RamTst044, RamTst045, RamTst046, [RamTst113, [RamTst114
[BSW13821] The RAM Test Module shall be designed to fulfill SIL3 Requirements	RamTst050, RamTst051, RamTst052, RamTst053, RamTst054, RamTst055

Implementation requirements originating within this SWS document.

Requirement
[RamTst002
[RamTst005
RamTst200
[RamTst018
[RamTst047
[RamTst082
[RamTst096 (should be a general requirement?)
[RamTst100 (should be an SRS requirement)
[RamTst101 (should be an SRS requirement)
RamTst195 (should be an SRS requirement)
RamTst197 (should be an SRS requirement)
RamTst204 (should be an SRS requirement)
RamTst221

7 Functional Specification

Requirements

[RamTst005] ⌈ The RAM Test module shall provide the background RAM test as an asynchronous service. ⌋()

[RamTst206] ⌈ The RAM Test module shall provide the foreground RAM test as an synchronous service. ⌋()

[RamTst063] ⌈ The configuration process for the RAM Test module shall allow the selection of a subset of different RAM Test algorithms during pre-compile time. ⌋ (BSW13803)

This subset is to be chosen from the different RAM Test algorithms as specified in RamTst050, RamTst051, RamTst052, RamTst053, RamTst054, RamTst055, RamTst204

[RamTst060] ⌈ If non-destructive RAM Test is chosen, the RAM Test module shall save the RAM area to be tested before the module modifies it. The RAM Test module shall execute the complete procedure (saving, changing, restoring) without interruption. ⌋(BSW13811)

Note: "Saving" and "restoring" does not necessarily mean explicit copying actions. If the test algorithm is "transparent" it restores the original content in the tested cells after the test without needing additional memory for saving.

[RamTst061] ⌈ For both the destructive and non-destructive options, the RAM Test module shall ensure that the test algorithm does not overwrite the RAM Test internal variables. ⌋(BSW13811, BSW13812)

[RamTst062] ⌈ After writing to a cell and before reading back, the RAM Test module shall provide the possibility to inject instruction(s) forcing the controller to clear its CPU internal cache. ⌋(BSW13816)

[RamTst050] ⌈ The RAM Test module shall provide a checkerboard test algorithm as stated in [12] , A.5.1. ⌋(BSW13805, BSW13821)

[RamTst051] ⌈ The RAM Test module shall provide a March test algorithm as stated in [12], A.5.1. ⌋(BSW13807, BSW13821)

[RamTst052] ⌈ The RAM Test module shall provide a WalkPath test algorithm as stated in [12], A.5.2. ⌋(BSW13806, BSW13821)

[RamTst053] ⌈ The RAM Test module shall provide a Galpat test algorithm as stated in [12], A.5.3. ⌋(BSW13808, BSW13821)

[RamTst054] ⌈ The RAM Test module shall provide a Transparent Galpat test algorithm as stated in, [12], A.5.3. ⌋(BSW13818, BSW13821)

[RamTst055] ⌈ The RAM Test module shall provide an Abraham test algorithm as stated in [12], A.5.4. ⌋(BSW13813, BSW13821)

In general, this set of test algorithms might be still too restrictive to meet the required fault coverage and performance in all cases. In addition, there are different varieties of a certain test algorithm like the “March” test, which might to be distinguished in the configuration. Therefore the following two requirements have been added:

[RamTst204] ⌈ If appropriate, the RAM Test module may provide additional vendor or hardware specific test algorithms or different variants of the algorithms listed above. These algorithms must be clearly documented by the implementer, especially their fault coverage (for vendor specific configuration parameters see RamTst205). ⌋ ()

[RamTst221] ⌈ A processor specific test algorithm is allowed to make use of hardware macros and/or interrupts supporting the detection of data loss (like CRC, ECC) if appropriate. The implementer must describe any interrupt routine in the Basic Software Module Description and the implementation must follow the general requirements for interrupt handling (see BSW00427, BSW12129, BSW00325, BSW00326, BSW00439, BSW00314). ⌋ (BSW00427, BSW00314, BSW00325, BSW00326, BSW00439, BSW12129)

Error Classification

[RamTst073] ⌈ Values for production code Event Ids are assigned externally by the configuration of the DEM. They are published in the file `Dem_IntErrId.h` and included via `Dem.h`. ⌋(BSW00339, BSW00409)

[RamTst074] ⌈ Development error values are of type uint8. ⌋(BSW00357)

[RamTst067] ⌈ The following errors and exceptions shall be detectable by the RAM Test depending on its build version (development/production mode):

Type or error	*Relevance*	*Related error code*	*Value [hex]*	*Requirement*
A particular API is called in an unexpected state	Development	`RAMTST_E_STATUS_FAILURE`	`0x01`	[RamTst033, [RamTst037, [RamTst095, [RamTst097, RamTst170, RamTst172, RamTst210, RamTst214,
API parameter out of specified range	Development	`RAMTST_E_OUT_OF_RANGE`	`0x02`	[RamTst039, [RamTst040, [RamTst084, Ramtst223
API service used without module initialization	Development	`RAMTST_E_UNINIT`	`0x03`	[RamTst089
API service called with a NULL pointer	Development	`RAMTST_E_PARAM_POINTER`	`0x04`	Ramtst222
RAM failure	Production	`RAMTST_E_RAM_FAILURE`	`Assigned by DEM`	[RamTst011, RamTst213, RamTst216

⌋(BSW00337, BSW00338, BSW00339, BSW00385)

Error Detection

[RamTst068] ⌈ The detection of development errors is configurable (*ON* / *OFF*) at pre-compile time. The switch `RamTstDevErrorDetect` (see RamTst121_Conf) shall activate or deactivate the detection of all development errors. ⌋(BSW00323, BSW00338, BSW00345, BSW00350)

[RamTst115] ⌈ If the `RamTstDevErrorDetect` switch is enabled, API parameter checking is enabled. The detailed description of the detected errors can be found in section 7.2 and chapter 8. ⌋(BSW00323)

[RamTst076] ⌈ The detection of production code errors cannot be switched off. ⌋ (BSW00339)

[RamTst089] ⌈ The function `RamTst_Init` shall be called first before calling any other RAM test functions. If this sequence is not respected, the error code `RAMTST_E_UNINIT` shall be reported to the Development Error Tracer (if development error detection is enabled). ⌋()

Error Notification

[RamTst069] ⌈ Additional errors that are detected because of specific implementation and/or specific hardware properties shall be added in the RAM Test device specific implementation specification. The classification and enumeration shall be compatible to the errors listed above in RamTst067. ⌋(BSW00338)

[RamTst071] ⌈ Production errors shall be reported to Diagnostic Event Manager (DEM) via the `Dem_ReportErrorStatus` API. ⌋(BSW00339)

[RamTst116] ⌈ Detected development errors shall be reported to the `Det_ReportError` service of the Development Error Tracer (DET) if the pre-processor switch `RamTstDevErrorDetect` is set (see RamTst121_Conf). ⌋(BSW00338)

Debugging

[RamTst153] ⌈ Each variable that shall be accessible by AUTOSAR Debugging shall be defined as global variable. ⌋(BSW00442)

[RamTst155] ⌈ All type definitions of variables which shall be debugged shall be accessible by the header file RamTst.h. ⌋(BSW00442)

[RamTst157] ⌈ The declaration of variables in the header file shall be such, that it is possible to calculate the size of the variables by C-"`sizeof`". ⌋(BSW00442)

[RamTst158] ⌈ Variables available for debugging shall be described in the respective Basic Software Module Description. ⌋(BSW00442)

[RamTst159] ⌈ The internal variable holding the current test execution status shall be available for debugging. ⌋(BSW00442)

[RamTst161] ⌈ The internal variable holding the current overall test result shall be available for debugging. ⌋(BSW00442)

[RamTst162] ⌈ The internal variables holding the current test results per block shall be available for debugging. ⌋(BSW00442)

[RamTst163] ⌈ The internal variable holding the ID for the currently selected test algorithm parameter set shall be available for debugging. ⌋(BSW00442)

[RamTst164] ⌈ The internal variable holding the current number of cells to be tested per cycle shall be available for debugging. ⌋(BSW00442)

General Test Behavior

This sections contains detailed specifications items which hold for the foreground test and the background test as well.

Both foreground of background tests are controlled by the currently selected parameter set `RamTstAlgParams` which defines the test algorithm, the set of memory blocks to be tested and several attributes controlling the behavior of the test.

Note that the same test algorithm can be used as part of several different `RamTstAlgParams,` that none of the `RamTstAlgParams` must necessarily contain all memory blocks and that (in general) for foreground and background tests different `RamTstAlgParams` can be selected. This allows for a flexible approach of usings the tests differently in specific ECU modes or for different types of memory.

[RamTst200] ⌈ If the configuration parameter `RamTstTestPolicy` for a block is set to RAMTEST_NON_DESTRUCTIVE, the test algorithm shall restore the original memory content of the tested cells of this block after the test (given that no error is detected). ⌋(BSW13811)

Hint: For a transparent test algorithm, this behavior is automatically fulfilled without additional overhead. For a non-transparent test algorithm, this option means overhead in runtime/memory in order to save and restore the content.

[RamTst201] ⌈ If the configuration parameter `RamTstTestPolicy` for a block is set to RAMTEST_DESTRUCTIVE, the test algorithm shall fill the tested cells after the test with the bit pattern defined for this block by parameter `RamTst_FillPattern` (given that no error is detected). ⌋(BSW13812)

This requirement shall ensure reproducible behavior.

Hint: For a transparent test algorithm, specifying this option would mean runtime overhead. For a non-transparent algorithm, the runtime overhead can be minimized, if the fill pattern corresponds to a constant value left behind by the algorithm anyhow.

[RamTst202] ⌈ The overall test result – for the set of blocks in the current `RamTstAlgParams` – shall be

- `RAMTST_RESULT_NOT_TESTED` if no test was started yet (after reset or de-init).
- `RAMTST_RESULT_UNDEFINED` if a test was started, not all blocks have yet been tested and no block result is `RAMTST_RESULT_NOT_OK.`
- `RAMTST_RESULT_OK` if all blocks have been tested with result status `RAMTST_RESULT_OK`.

- `RAMTST_RESULT_NOT_OK` if at least one block test result is `RAMTST_RESULT_NOT_OK` regardless whether all blocks have been already tested or not. ⌋()

[RamTst207] ⌈ The test result for a specific block (identified in the given `RamTstAl-gParams`) – shall be

- `RAMTST_RESULT_NOT_TESTED` if this block is considered as not yet tested.
- `RAMTST_RESULT_UNDEFINED` if a test on this block is running.
- `RAMTST_RESULT_OK` if all memory cells in this block have been tested sucessfully.
- `RAMTST_RESULT_NOT_OK` if a failure has been detected for at least one memory cell in this block. ⌋()

For a given processor type, memory layout and fault model, not all possible combinations of test algorithms, block configurations and their attributes make sense. For example:

- The implementer might want to exclude a certain combination of test algorithm and `RamTstTestPolicy`.
- A certain test algorithm might have to be excluded from background tests due to performance reason.
- Some memory blocks might have to be excluded from background tests due to performance reasons or because an exclusive access cannot be guaranteed under normal operation (e.g. for shared memory).

This leads to the following requirement:

[RamTst203] ⌈ The implementer shall document possible restrictions for the combination of configuration parameters and for their usage in background/foreground tests. Where applicable, he shall support this by the definition of predefined or recommended configuration parameter values attached to the BSW Module Description. ⌋()

8 API Specification

Imported Types

This chapter lists data type definitions for the included variables and constants.

[RamTst098] ⌈

Module	***Imported Type***
Dem	Dem_EventIdType
	Dem_EventStatusType
Std_Types	Std_ReturnType
	Std_VersionInfoType

⌋()

Type Definitions

8.1.1 RamTst_ExecutionStatusType

[RamTst189] ⌈

Name:	`RamTst_ExecutionStatusType`	
Type:	`Enumeration`	
Range:	`RAMTST_EXECUTION_UNINIT`	The RAM Test is not initialized or not usable.
	`RAMTST_EXECUTION_STOPPED`	The RAM Test is stopped and ready to be started in foreground or to be allowed in back-ground.
	`RAMTST_EXECUTION_RUNNING`	The RAM Test is currently running.
	`RAMTST_EXECUTION_SUSPENDED`	The background RAM Test is waiting to be re-sumed.
Description:	This is a status value returned by the API service RamTst_GetExecutionStatus().	

⌋()

[RamTst006] ⌈ For the type `RamTst_ExecutionStatusType`, the enumeration value `RAMTST_EXECUTION_UNINIT` shall be the default value after a reset. This enumeration value shall have the numeric value 0. ⌋(BSW00406)

8.1.2 RamTst_TestResultType

[RamTst190] ⌈

Name:	`RamTst_TestResultType`	
Type:	`Enumeration`	
Range:	`RAMTST_RESULT_NOT_TESTED`	The RAM Test is not executed.
	`RAMTST_RESULT_OK`	The RAM Test has been tested with OK result
	`RAMTST_RESULT_NOT_OK`	The RAM Test has been tested with NOT-OK result.
	`RAMTST_RESULT_UNDEFINED`	The RAM Test is currently running.

Description:	This is a status value returned by the API service RamTst_GetTestResult().

⌋()

[RamTst012] ⌈ For the type `RamTst_TestResultType` (of the overall test result), the enumeration value `RAMTST_RESULT_NOT_TESTED` shall be the default value after a reset. This enumeration value shall have the numeric value 0. ⌋(BSW00406)

For more details on the usage of this status see chapter 0.

8.1.1 RamTst_AlgParamsIdType

[RamTst191] ⌈

Name:	RamTst_AlgParamsIdType		
Type:	uint8		
Range:	0...255	--	--
Description:	Data type used to identify a set of configuration parameters for a test algorithm.		

⌋()

[RamTst188] ⌈ For the type `RamTst_AlgParamsIdType`, the value 0 shall indicate, that no test parameters (and thus no test algorithm) is selected. This shall be the default value of the corresponding variable after reset. ⌋()

8.1.2 RamTst_AlgorithmType

[RamTst192] ⌈

Name:	RamTst_AlgorithmType	
Type:	Enumeration	
Range:	RAMTST_ALGORITHM_UNDEFINED	Undefined algorithm (uninitialized value)
	RAMTST_CHECKERBOARD_TEST	Checkerboard test algorithm
	RAMTST_MARCH_TEST	March test algorithm
	RAMTST_WALK_PATH_TEST	Walk path test algorithm
	RAMTST_GALPAT_TEST	Galpat test algorithm
	RAMTST_TRANSP_GALPAT_TEST	Transparent Galpat test algorithm
	RAMTST_ABRAHAM_TEST	Abraham test algorithm
Description:	This is a value returned by the API service RamTst_GetTestAlgorithm().	

⌋()

[RamTst013] ⌈ For the type `RamTst_AlgorithmType`, the enumeration value `RAMTST_ALGORITHM_UNDEFINED` shall be the default value after reset. This enumeration value shall have the numeric value 0. ⌋(BSW00406)

[RamTst058] ⌈ The type `RamTst_AlgorithmType` shall contain only the enumerations of the algorithms selected at pre-compile time. ⌋(BSW00345)

Note that if vendor specific algorithms were defined (see RamTst205), the enumeration fields of `RamTst_AlgorithmType` should be extended accordingly by the implementer (or by a code generator).

8.1.3 RamTst_NumberOfTestedCellsType

[RamTst173] ⌈

Name:	`RamTst_NumberOfTestedCellsType`		
Type:	`uint32`		
Range:	`1...(2^32-1)`	`--`	--
Description:	Data type of number of tested RAM cells		

⌋()

8.1.4 RamTst_NumberOfBlocksType

[RamTst174] ⌈

Name:	`RamTst_NumberOfBlocksType`		
Type:	`uint16`		
Range:	`1...65535`	`--`	--
Description:	Data type used to identify or count RAM blocks given in the test configuration parameters.		

⌋()

Function Definitions

This is a list of functions provided for upper layer modules.

8.1.5 RamTst_Init

[RamTst099] ⌈

Service name:	RamTst_Init

Syntax:	`void RamTst_Init(`
	`    void`
	`)`

Service ID[hex]:	0x00
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (inout):	None

Parameters (out):	None
Return value:	None
Description:	Service for RAM Test initialization.

⌋(BSW101, BSW00358)

Note: See also [RamTst093] in 10.1.4 Variants.

[RamTst007] ⌈ The function `RamTst_Init` shall initialize all RAM Test relevant registers and global variables and change the execution status to `RAMTST_EXECUTION_STOPPED`. The test is initialized to use the default test parameter set (`RamTstDefaultAlgParamsId`) as configured by its RamTstAlgParams container. ⌋(BSW101, BSW12057)

[RamTst096] ⌈ If the DET is enabled and the execution status of the RAM Test is not `RAMTST_EXECUTION_UNINIT`, the function `RamTst_Init` shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET, and then immediately return. ⌋()

8.1.6 RamTst_DeInit

[RamTst146:] ⌈

Service name:	RamTst_DeInit
Syntax:	`void RamTst_DeInit( void )`
Service ID[hex]:	0x0c
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	Service for RAM Test deinitialization.

⌋(BSW12163)

[RamTst147] ⌈ The function `RamTst_DeInit` shall deinitialize all RAM Test relevant registers and global variables that were initialized by `RamTst_Init` and change the execution status to `RAMTST_EXECUTION_UNINIT`. ⌋()

If the RAM Test is in the `RAMTST_EXECUTION_UNINIT` state after a `RamTst_DeInit` call, a call to any RamTst Module function (except `RamTst_Init`) may result in unknown software behavior.

8.1.7 RamTst_Stop

[RamTst100] ⌈

Service name:	RamTst_Stop

Syntax:	`void RamTst_Stop(`
	`    void`
	`)`

Service ID[hex]:	0x02
Sync/Async:	Asynchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	Service for stopping the RAM Test.

⌋()

[RamTst014] ⌈ When the `RamTst_Stop` function is called, `RamTst_MainFunction` shall still finish the current atomic sequence (if it is executing), afterward the status shall be set to `RAMTST_EXECUTION_STOPPED`. The test result is retained, but test parameters and loop data are not. ⌋()

[RamTst148] ⌈ After a `RamTst_Stop` call, `RamTst_MainFunction` shall not begin testing again when called by the scheduler until after a `RamTst_Allow` call. ⌋()

[RamTst033] ⌈ If the DET is enabled and the execution status of the RAM Test is not `RAMTST_EXECUTION_RUNNING or RAMTST_EXECUTION_SUSPENDED,` the function `RamTst_Stop` shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET, and then immediately return. ⌋(BSW00323, BSW12448)

The `RamTst_Stop` API can be enabled or disabled by the configuration parameter `RamTstStopApi` within the container `RamTstCommon`.

8.1.8 RamTst_Allow

[RamTst149] ⌈

Service name:	RamTst_Allow

Syntax:	`void RamTst_Allow(`
	`    void`
	`)`

Service ID[hex]:	0x03
Sync/Async:	Asynchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None

Return value:	None
Description:	Service for continuing the RAM Test after calling 'RamTst_Stop.

⌋()

[RamTst169] ⌈ The function `RamTst_Allow` shall permit the `RamTst_MainFunction` to perform testing at its next scheduled call, if it had been stopped. Therefore, it shall change the execution status to `RAMTST_EXECUTION_RUNNING,` if it has been `RAMTST_EXECUTION_STOPPED.` ⌋
()

[RamTst170] ⌈ If DET is enabled and the execution status is not `RAMTST_EXECUTION_STOPPED`, the function `RamTst_Allow` shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET, and then immediately return. ⌋
(BSW00323)

The `RamTst_Allow` API can be enabled or disabled by the configuration parameter `RamTstAllowApi` within the container `RamTstCommon.`

8.1.9 RamTst_Suspend

[RamTst150] ⌈

Service name:	RamTst_Suspend

Syntax:	`void RamTst_Suspend(`
	`    void`
	`)`

Service ID[hex]:	0x0d
Sync/Async:	Asynchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	Service for suspending current operation of background RAM Test, until RESUME is called.

⌋()

[RamTst171] ⌈ The function `RamTst_Suspend` shall temporarily prohibit the `RamTst_MainFunction` from performing tests at its next scheduled call. When `RamTst_Suspend` is called and the execution status is `RAMTST_EXECUTION_RUNNING`, testing stops after the current atomic sequence, test result and current test states are retained and the execution status is changed to `RAMTST_EXECUTION_SUSPENDED.` ⌋()

[RamTst172] ⌈ If DET is enabled and the execution status is not RAMTST_EXECUTION_RUNNING, the function RamTst_Suspend shall report the error value RAMTST_E_STATUS_FAILURE to the DET, and then immediately return. ⌋(BSW00323)

The RamTst_Suspend API can be enabled or disabled by the configuration parameter RamTstSuspendApi within the container RamTstCommon.

8.1.10 RamTst_Resume

[RamTst101] ⌈

Service name:	RamTst_Resume

Syntax:	`void RamTst_Resume(`
	`    void`
	`)`

Service ID[hex]:	0x0e
Sync/Async:	Asynchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	Service for allowing to continue the background RAM Test at the point is was suspended.

⌋()

[RamTst018] ⌈ The function RamTst_Resume shall permit
the RamTst_MainFunction to continue testing at the point where it was suspended, at its next scheduled call. Testing continues according to the saved test states. The function RamTst_Resume shall change the execution status to RAMTST_EXECUTION_RUNNING if it has been RAMTST_EXECUTION_SUSPENDED .
⌋()

[RamTst037] ⌈ If DET is enabled and the execution status of the RAM Test module is not RAMTST_EXECUTION_SUSPENDED, the function RamTst_Resume shall report the error value RAMTST_E_STATUS_FAILURE to the DET, and then immediately return. ⌋(BSW00323, BSW12448)

The RamTst_Resume API can be enabled or disabled by the configuration parameter RamTstResumeApi within the container RamTstCommon.

8.1.11 RamTst_GetExecutionStatus

[RamTst102]

⌈

Service name:	RamTst_GetExecutionStatus	
Syntax:	`RamTst_ExecutionStatusType RamTst_GetExecutionStatus( void )`	
Service ID[hex]:	0x04	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	None	
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	RamTst_ExecutionStatusType	See type definition
Description:	Service returns the current RAM Test execution status.	

⌋(BSW00331)

[RamTst019] ⌈ The function `RamTst_GetExecutionStatus` shall return the current RAM Test execution status. ⌋(BSW13810)

The `RamTst_GetExecutionStatus` API can be enabled or disabled by the configuration parameter RamTst `GetExecutionStatusApi` within the container `RamTstCommon`.

8.1.12 RamTst_GetTestResult

[RamTst103] ⌈

Service name:	RamTst_GetTestResult	
Syntax:	`RamTst_TestResultType RamTst_GetTestResult( void )`	
Service ID[hex]:	0x05	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	None	
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	RamTst_TestResultType	See type definition
Description:	Service returns the current RAM Test result.	

⌋(BSW00331)

[RamTst024] ⌈ The function `RamTst_GetTestResult` shall return the current RAM test result. ⌋(BSW13810)

The test result is determined according to RamTst202.

The `RamTst_GetTestResult` API can be enabled or disabled by the configuration parameter `RamTstGetTestResultApi` within the container `RamTstCommon`.

8.1.13 RamTst_GetTestResultPerBlock

[RamTst104] ⌈

Service name:	RamTst_GetTestResultPerBlock	

Syntax:	`RamTst_TestResultType RamTst_GetTestResultPerBlock(`
	`    RamTst_NumberOfBlocksType BlockID`
	`)`	

Service ID[hex]:	0x06	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	BlockID	Identifies the block
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	RamTst_TestResultType	See type definition
Description:	Service returns the current RAM Test result for the specified block.	

⌋(BSW13810)

[RamTst038] ⌈ The function `RamTst_GetTestResultPerBlock` shall return the current RAM test result for the specified block. ⌋(BSW13810)

The test result per block is determined according to RamTst207.

[RamTst039] ⌈ If DET is enabled and the BlockID is out of range, the function `RamTst_GetTestResultPerBlock` shall report the error value `RAMTST_E_OUT_OF_RANGE` to the DET and return the test result value `RAMTST_RESULT_UNDEFINED`. ⌋(BSW00323, BSW12448)

Hint: “Out of range” means here, that the BlockID does not match to one of the values configured for the currently selected `RamTstAlgParams/ RamtstBlockParams/ RamTstBlockId`, see RamTst143_Conf.
The `RamTst_GetTestResultPerBlock` API can be enabled or disabled by the configuration parameter `RamTstGetTestResultPerBlockApi` within the container `RamTstCommon.`

8.1.14 RamTst_GetVersionInfo

[RamTst109]⌈

Service name:	RamTst_GetVersionInfo

Syntax:	`void RamTst_GetVersionInfo(`
	`    Std_VersionInfoType* versioninfo`
	`)`

Service ID[hex]:	0x0a	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	None	
Parameters (in-out):	None	
Parameters (out):	versioninfo	Pointer to the location / address where to store the version information of this module.
Return value:	None	
Description:	Service returns the version information of this module.	

⌋(BSW00407)

[RamTst078]⌈ The function `RamTst_GetVersionInfo` shall return the version information of this module. The version information includes:
- Module Id
- Vendor Id
- Vendor specific version numbers (BSW00407). ⌋(BSW00407)

[RamTst079] ⌈ The function `RamTst_GetVersionInfo` shall be configurable at pre-compile time (On/Off) by the configuration parameter `RamTstVersionInfoApi` in the container `RamTstCommon.` ⌋(BSW00345, BSW00407, BSW00411)

[RamTst117] ⌈ If source code for caller and callee of `RamTst_GetVersionInfo` is available, the RAM test module should realize `RamTst_GetVersionInfo` as a macro, defined in the module's header file. ⌋(BSW003, BSW00330)

[RamTst222] ⌈ If the function `RamTst_GetVersionInfo` is called with a NULL pointer as parameter, it shall return immediately without any further action, and If DET is enabled, this function shall report the error value `RAMTST_E_PARAM_POINTER` to the DET module. ⌋()

8.1.15 RamTst_GetAlgParams

[RamTst193]⌈

Service name:	RamTst_GetAlgParams	

Syntax:	`RamTst_AlgParamsIdType RamTst_GetAlgParams(`
	`    void`
	`)`	

Service ID[hex]:	0x12	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	None	
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	RamTst_AlgParamsIdType	See type definition.

Description:	Service returns the ID of the current RAM Test algorithm parameter set.

⌋()

[RamTst194] ⌈ The function `RamTst_GetAlgParams` shall return the ID of the currently selected test algorithm parameter set (i.e. the ID of the currently selected `RamTstAlgParams` in the container `RamTstConfigParams`). ⌋()

The function `RamTst_GetAlgParams` requires the configuration parameter `RamTstGetAlgParamsApi` within the container `RamTstCommon.`

8.1.16 RamTst_GetTestAlgorithm

[RamTst106] ⌈

Service name:	RamTst_GetTestAlgorithm	

Syntax:	`RamTst_AlgorithmType RamTst_GetTestAlgorithm(`
	`    void`
	`)`	

Service ID[hex]:	0x07	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	None	
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	RamTst_AlgorithmType	See type definition
Description:	Service returns the current RAM Test algorithm.	

⌋()

[RamTst021] ⌈ The function `RamTst_GetTestAlgorithm` shall return the current RAM Test algorithm. ⌋()

The function `RamTst_GetTestAlgorithm` requires the configuration parameter `RamTstGetTestAlgorithmApi` within the container `RamTstCommon.`

8.1.17 RamTst_GetNumberOfTestedCells

[RamTst108]⌈

Service name:	RamTst_GetNumberOfTestedCells

Syntax:	`RamTst_NumberOfTestedCellsType RamTst_GetNumberOfTestedCells(`
	`    void`
	`)`

Service ID[hex]:	0x09
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-	None

out):		
Parameters (out):	None	
Return value:	RamTst_NumberOfTestedCellsType	Number of currently tested cells per cycle.
Description:	Service returns the current number of tested cells per main-function cycle.	

⌋(BSW13809)

[RamTst034] ⌈ The function `RamTst_GetNumberofTestedCells` shall read the current number of tested cells per cycle. ⌋()

The function `RamTst_GetNumberOfTestedCells` requires the configuration parameter `RamTstGetNumberOfTestedCellsApi` in the container `RamTstCommon.`

8.1.18 RamTst_SelectAlgParams

RamTst105: ⌈

Service name:	RamTst_SelectAlgParams	

Syntax:	`void RamTst_SelectAlgParams(`
	`    RamTst_AlgParamsIdType NewAlgParamsId`
	`)`	

Service ID[hex]:	0x0b	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	NewAlgParamsId	Identifies the parameter set to be used.
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service used to set the test algorithm and its parameter set.	

⌋(BSW13804)

[RamTst083] ⌈ The function `RamTst_SelectAlgParams` shall select the test parameter set (i.e. one of the `RamTstAlgParams` in the container `RamTstConfigParams)` to be used by the RAM Test module. ⌋(BSW13804)

Note: Depending on the configured content of `RamTstAlgParams`, this function may be used to select a different test algorithm. But the function may also be used to select a different set of blocks (e.g. for foreground testing) for the same test algorithm.

[RamTst085] ⌈ The function `RamTst_SelectAlgParams` shall re-initialize all RAM Test relevant registers and global variables with the values for the “`NewAlgParamsId`”. ⌋()

[RamTst084] ⌈ If DET is enabled and the parameter "`NewAlgParamsId`" is out of range, the function `RamTst_SelectAlgParams` shall report the error value `RAMTST_E_OUT_OF_RANGE` to the DET, leaving the current `RamTstAlgParams` unchanged. ⌋(BSW00338, BSW12448)

Hint: "Out of range" means, that the "`NewAlgParamsId`" does not match to one of the configured values for `RamTstAlgParams/RamTstAlgParamsId`, see RamTst179_Conf.

[RamTst097] ⌈ If DET is enabled and the execution status of the RAM Test module is not `RAMTST_EXECUTION_STOPPED`, the function `RamTst_SelectAlgParams` shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET, then immediately return from the function. ⌋(BSW00323, BSW00338)

[RamTst094] ⌈ The function `RamTst_SelectAlgParams` shall initialize the test result status (according to RamTst207 and RamTst202). ⌋()

Hint: It makes no sense to keep the previous test results at this point (as it was specified in former version of this document), since the block structure might change due to the selected parameter set, so the previous result could no longer be interpreted. If the test environment wants to save the previous results, it can easily retrieve them via `RamTst_GetTestResult` or `RamTst_GetTestResultPerBlock` before calling `RamTst_SelectAlgParams`.

The function `RamTst_SelectAlgParams` also requires the configuration parameter `RamTstSelectAlgParams Api` within the container `RamTstCommon.`

8.1.19 RamTst_ChangeNumberOfTestedCells

[RamTst107] ⌈

Service name:	RamTst_ChangeNumberOfTestedCells	

Syntax:	`void RamTst_ChangeNumberOfTestedCells(`
	`    RamTst_NumberOfTestedCellsType NewNumberOfTestedCells`
	`)`	

Service ID[hex]:	0x08	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	NewNumberOfTestedCells	See type definition
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	None	

Description:	Service changes the current number of tested cells.

⌋(BSW13800, BSW13809)

[RamTst036] ⌈ The function `RamTst_ChangeNumberOfTestedCells` shall change the current number of tested cells (for background tests). ⌋(BSW13800)

[RamTst040] ⌈ If DET is enabled and the parameter `NewNumberOfTestedCells` is out of range ⌋(BSW00323, BSW12448)
(min= `MinNumberOfTestedCells` / max = `MaxNumberOfTestedCells`),
the function `RamTst_ChangeNumberOfTestedCells` shall report the error value `RAMTST_E_OUT_OF_RANGE` to the DET. The function shall leave the number of tested cells unchanged.

[RamTst095] ⌈ If the execution status of the RAM Test module is not in the status `RAMTST_EXECUTION_STOPPED`, the function `RamTst_ChangeNumberOfTestedCells` shall not change the current number of tested cells and (if DET is enabled) shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET. ⌋(BSW00323, BSW12448)

The function `RamTst_ChangeNumberOfTestedCells` also requires the configuration parameter `RamTstChangeNumOfTestedCellsApi` in the container `RamTstCommon.`

8.1.20 RamTst_RunFullTest

RamTst195: ⌈

Service name:	RamTst_RunFullTest

Syntax:	`void RamTst_RunFullTest(`
	`    void`
	`)`

Service ID[hex]:	0x10
Sync/Async:	Synchronous
Reentrancy:	Non Reentrant
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	Service for executing the full RAM Test in the foreground.

⌋()

[RamTst196] ⌈ If the RAM Test execution status is `RAMTST_EXECUTION_STOPPED`, the function `RamTst_RunFullTest` shall test all RAM blocks defined in the selected `RamTstAlgParams.` ⌋()

[RamTst210] ⌈ If DET is enabled and the execution status of the RAM Test module is not RAMTST_EXECUTION_STOPPED, the function RamTst_RunFullTest shall report the error value RAMTST_E_STATUS_FAILURE to the DET, and then immediately return. ⌋(BSW00323)

[RamTst211] ⌈ If the RAM Test execution status is RAMTST_EXECUTION_STOPPED, the function RamTst_RunFullTest shall set the execution status to RAMTST_EXECUTION_RUNNING during the test and set it back to RAMTST_EXECUTION_STOPPED before returning. ⌋()

[RamTst212] ⌈ The function RamTst_RunFullTest shall update the test result status of single blocks according to RamTst207. ⌋()

[RamTst213] ⌈ The function RamTst_RunFullTest shall update the overall test result status according to RamTst202. If at least one block test result is RAMTST_RESULT_NOT_OK, then the function shall report the production error RAMTST_E_RAM_FAILURE to the DEM. ⌋(BSW00339)

The function RamTst_RunFullTest requires the configuration parameter RamTstRunFullTestApi in the container RamTstCommon.

Destruction or restoration of the memory content are handled according to the requirements RamTst200 and RamTst201.

For pre-conditions on the function RamTst_RunFullTest, see requirement RamTst002.

Implementation Hints:

For reasons of effiency and optimum fault coverage, the implementation of RamTst_RunFullTest shall assume, that it has exclusive access to all memory blocks contained in its RamTstAlgParams during the call. This allows to apply the test algorithm on a wider range of memory than in background test, which increases the fault coverage especially for coupling faults.

Thus it is the responsibility of the test environment, to either provide appropriate resource locking, or to call the function in an ECU mode, where the memory blocks of the selected RamTstAlgParams are not in use. The test environment must also ensure, that RamTst_MainFunction is not scheduled during the foreground test.

A test algorithm usually requires various write and read cycles over a given range of memory. Some algorithms also require multiple walks through this range. It is up to the implementation, whether such a tested range corresponds to one block (which means, that the full test is split into several ranges) or even includes several or all blocks. This depends on performance issues and the assumed fault model. In any case, the test behavior must be clearly documented.

8.1.21 RamTst_RunPartialTest

[RamTst197] ⌈

Service name:	RamTst_RunPartialTest	

Syntax:	`void RamTst_RunPartialTest(`
	`    RamTst_NumberOfBlocksType BlockId`
	`)`	

Service ID[hex]:	0x11	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	BlockId	Identifies the single RAM block to be tested in the selected set of RamTstAlgParams.
Parameters (in-out):	None	
Parameters (out):	None	
Return value:	None	
Description:	Service for testing one RAM block in the foreground.	

⌋()

[RamTst198] ⌈ If the RAM Test execution status is `RAMTST_EXECUTION_STOPPED` or `RAMTST_EXECUTION_SUSPENDED`, the function `RamTst_RunPartialTest` shall test the specified RAM block. ⌋()

[RamTst214] ⌈ If DET is enabled and the RAM test execution status is neither `RAMTST_EXECUTION_STOPPED` nor `RAMTST_EXECUTION_SUSPENDED`, the function `RamTst_RunPartialTest` shall report the error value `RAMTST_E_STATUS_FAILURE` to the DET, and then immediately return. ⌋ (BSW00323)

[RamTst215] ⌈ If the RAM Test execution status is `RAMTST_EXECUTION_STOPPED` or `RAMTST_EXECUTION_SUSPENDED`, the function `RamTst_RunPartialTest` shall set the execution status to `RAMTST_EXECUTION_RUNNING` during the test, and after the test shall set it back to the previous state (the state when the function was called). ⌋()

[RamTst216] ⌈ The function `RamTst_RunPartialTest` shall update the test result status of the tested block according to RamTst207. If this block test result is `RAMTST_RESULT_NOT_OK`, then the function shall report the production error `RAMTST_E_RAM_FAILURE` to the DEM. ⌋(BSW00339)

[RamTst217] ⌈ A successful partial foreground test shall set the block specific result to `RAMTST_RESULT_OK`. It shall not modify the overall test result. A failing partial foreground test shall set both, the block specific as well as the overall test result to `RAMTST_RESULT_NOT_OK.` ⌋()

[RamTst223] ⌈ If DET is enabled and the `BlockId` is out of range, the function `RamTst_RunPartialTest` shall report the error value `RAMTST_E_OUT_OF_RANGE` to the DET and then immediately return. ⌋()

Notes:

'Out of range' in [**Ramtst223**] means that the `BlockId` does not match to one of the configured values for the currently selected `Block Identifier` (RamTstAlgParams/ RamtstBlockParams/ RamTstBlockId).

Updating the test results will overwrite the result from a previous test of this block and the overall test result in case of failure, including the result from a suspended background test.

The function `RamTst_RunPartialTest` requires the configuration parameter `RamTstRunPartialTestApi` in the container `RamTstCommon.`

Destruction or restoration of the memory content is handled according to the requirements RamTst200 and RamTst201.

For pre-conditions on the function `RamTst_RunPartialTest`, see requirement RamTst002.

Implementation Hints:

The implementation hints given for `RamTst_RunFullTest` also apply here, as far as applicable to one single block.

Callback Notifications

Since the RAM Test is a driver module, it does not implement any callback functions from lower layer modules.

Scheduled Functions

The Basic Software Scheduler calls these functions directly. The following functions shall have no return value and no parameter. All functions shall be non-reentrant.

Terms and definitions:

Fixed cyclic: Fixed cyclic means that one cycle time is defined at configuration and shall not be changed because functionality is requiring that fixed timing (e.g. filters).

Variable cyclic: Variable cyclic means that the cycle times are defined at configuration but might be mode dependent and therefore vary during runtime.

On pre-condition: On pre-condition means that no cycle time can be defined. The function is called when the conditions are fulfilled. Alternatively, the function may be called cyclically, however the cycle time is assigned dynamically during runtime by other modules.

8.1.22 RamTst_MainFunction

[RamTst110] ⌈

Service name:	RamTst_MainFunction

Syntax:	`void RamTst_MainFunction(`
	`    void`
	`)`

Service ID[hex]:	0x01
Timing:	VARIABLE_CYCLIC_OR_ON_PRECONDITION
Description:	Scheduled function for executing the RAM Test in the background.

⌋(BSW00373, BSW00376)

[RamTst008] ⌈ If the RAM Test execution status is `RAMTST_EXECUTION_RUNNING`, the function `RamTst_MainFunction` shall continue to test the RAM blocks defined in the selected `RamTstAlgParams` . ⌋(BSW13809)

[RamTst009] ⌈ If the RAM Test execution status is `RAMTST_EXECUTION_RUNNING`, the function `RamTst_MainFunction` shall start testing with the first RAM block in the selected `RamTstAlgParams`. ⌋()

[RamTst175] ⌈ If the RAM Test execution status is not `RAMTST_EXECUTION_RUNNING when this API is called,` the function `RamTst_MainFunction` shall return immediately without any actions. ⌋(BSW00450)

[RamTst010] ⌈ The function `RamTst_MainFunction` shall update the test result status of single blocks according to RamTst207. ⌋(BSW13810)

[RamTst011] ⌈ The function `RamTst_MainFunction` shall update the overall test result status according to RamTst202. If at least one block test result is `RAMTST_RESULT_NOT_OK`, then the function shall report the production error `RAMTST_E_RAM_FAILURE` to the DEM. ⌋(BSW00339, BSW13810)

[RamTst047] ⌈ After the function `RamTst_MainFunction` has completed testing all RAM blocks configured in the selected `RamTstAlgParams`, the next call of the function `RamTst_MainFunction` shall restart the test from the beginning. ⌋()

[RamTst059] ⌈ The function `RamTst_MainFunction` shall test the defined number of RAM cells within one call. The defined number is specified by the function `RamTst_ChangeNumberOfTestedCells` or by initialization. ⌋(BSW13809)

Notes:

Updating the test results will overwrite the result from a previous test of the current block and the overall test result, including the case that the background test was resumed after a partial foreground test of the current block.

Destruction or restoration of the memory content are handled according to the requirements RamTst200 and RamTst201.

For pre-conditions on the function `RamTst_MainFunction`, see requirement RamTst002.

Implementation Hints:

In general, the actual test algorithm within one call of `RamTst_MainFunction` must be performed within one or more atomic sequences. Only within one atomic sequence, the memory written by the algorithm is allowed to be corrupted during the test. This means, that the algorithm can be applied only to those cells accessed within one atomic sequence, so that the detection of coupling faults between cells (by background test) is restricted to those cells which are included in one atomic sequence.

An atomic sequence can either be declared as exclusive area via the BSW module description (see [3], BSW00426), leaving the actual locking method to the BSW Scheduler, or be directly implemented via interrupt locking (see [3], BSW00429). The latter is allowed, because the RAM test module belongs to the MCAL layer.

Expected Interfaces

In this chapter, all interfaces required from other modules are listed.

8.1.23 Mandatory Interfaces

This chapter defines all interfaces which are required to fulfill the core functionality of the module.

[RamTst111] ⌈

API function	*Description*

Dem_ReportErrorStatus	Queues the reported events from the BSW modules (API is only used by BSW modules). The interface has an asynchronous behavior, because the processing of the event is done within the Dem main function.

⌋(BSW00339)

8.1.24 Optional Interfaces

This chapter defines all interfaces, which are required to fulfill an optional functionality of the module.

[RamTst112] ⌈

API function	*Description*
Det_ReportError	Service to report development errors.

⌋()

8.1.25 Configurable Interfaces

In this chapter, all interfaces are listed where the target function could be configured. The target function is usually a callback function.

Terms and definitions:
Reentrant: interface is expected to be reentrant

Don't care: reentrancy of interface not relevant for this module (in general, it is in this case not reentrant).

[RamTst043] ⌈ The callback notifications shall have no parameters and no return value. ⌋(BSW157, BSW12056, BSW13820)

[RamTst044] ⌈ If a callback notification is configured as null pointer, the RAM Test module shall not execute the callback. ⌋(BSW157, BSW12056, BSW13820)

8.1.25.1 RamTst_TestCompletedNotification

[RamTst113]⌈

Service name:	RamTst_TestCompletedNotification

Syntax:	`void RamTst_TestCompletedNotification(`
	`    void`
	`)`

Sync/Async:	--
Reentrancy:	Don't care
Parameters (in):	None
Parameters (in-	None

out):	
Parameters (out):	None
Return value:	None
Description:	The function RamTst_TestCompleted shall be called every time when all RAM blocks of the current test configuration have been tested in the background.

⌋(BSW13820)

[RamTst045] ⌈ The RAM Test module shall call the callback `RamTst_TestCompletedNotification` every time when it has tested all RAM blocks of the selected parameter set in a background test. ⌋(BSW157, BSW13820)

The callback notification `RamTst_TestCompleted` requires configuration of the parameter `RamTstTestCompletedNotification` within the container `RamTstConfigParams`.

8.1.25.2 RamTst_ErrorNotification

[RamTst114] ⌈

Service name:	RamTst_ErrorNotification

Syntax:	`void RamTst_ErrorNotification(`
	`    void`
	`)`

Sync/Async:	--
Reentrancy:	Don't care
Parameters (in):	None
Parameters (in-out):	None
Parameters (out):	None
Return value:	None
Description:	The function RamTst_Error shall be called every time when a RAM failure has been detected by the selected test algorithm in the background.

⌋(BSW13820)

[RamTst046] ⌈ The RAM test module shall call the callback `RamTst_ErrorNotification` every time when the test algorithm of the selected parameter set has detected a RAM failure in a background test. ⌋(BSW157, BSW13820)

The callback notification `RamTst_Error_Notification` requires configuration of the parameter `RamTstTestErrorNotification` within the container `RamTstConfigParams.`

9 Sequence Diagrams

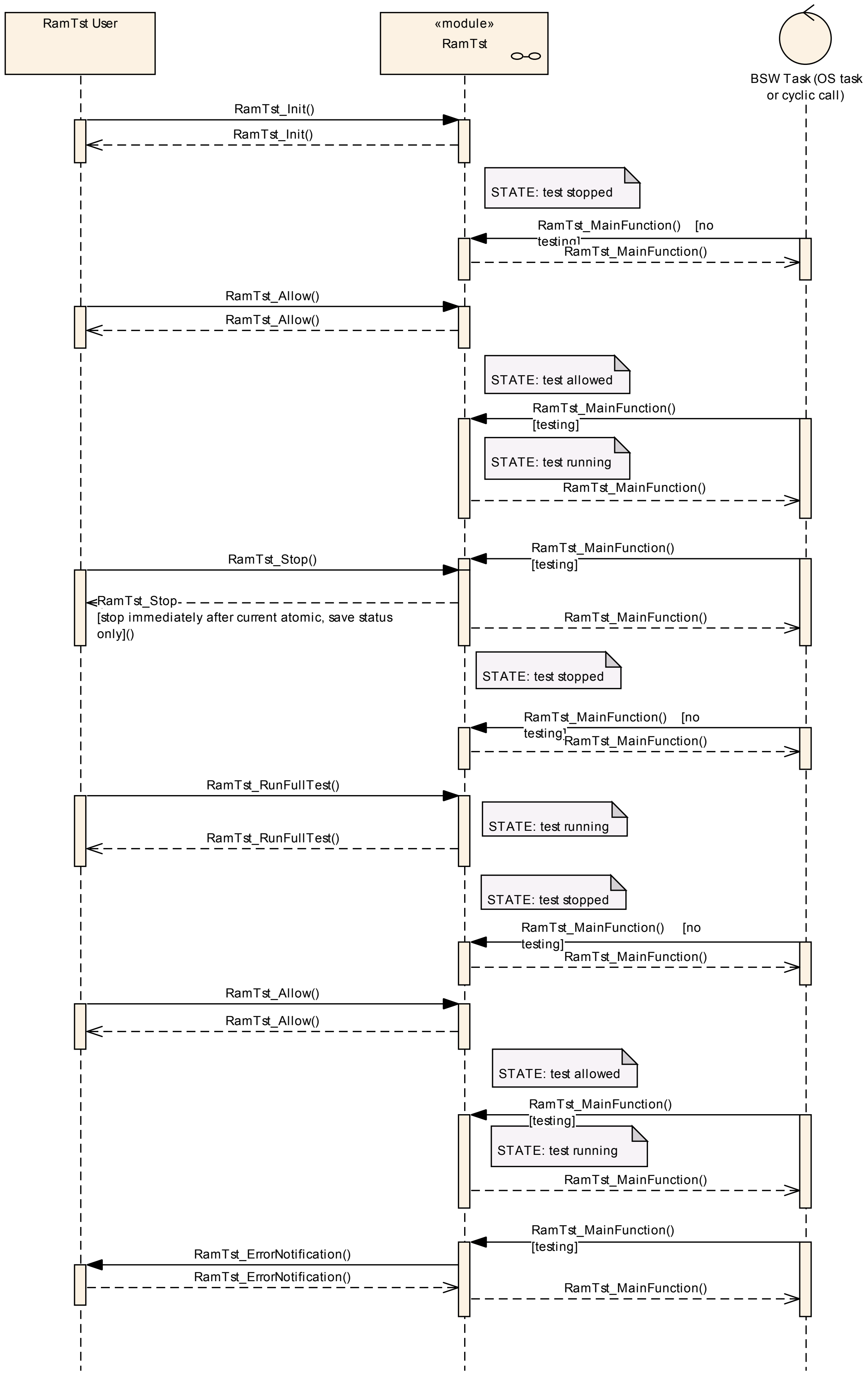
RamTst_MainFunction (Examples)

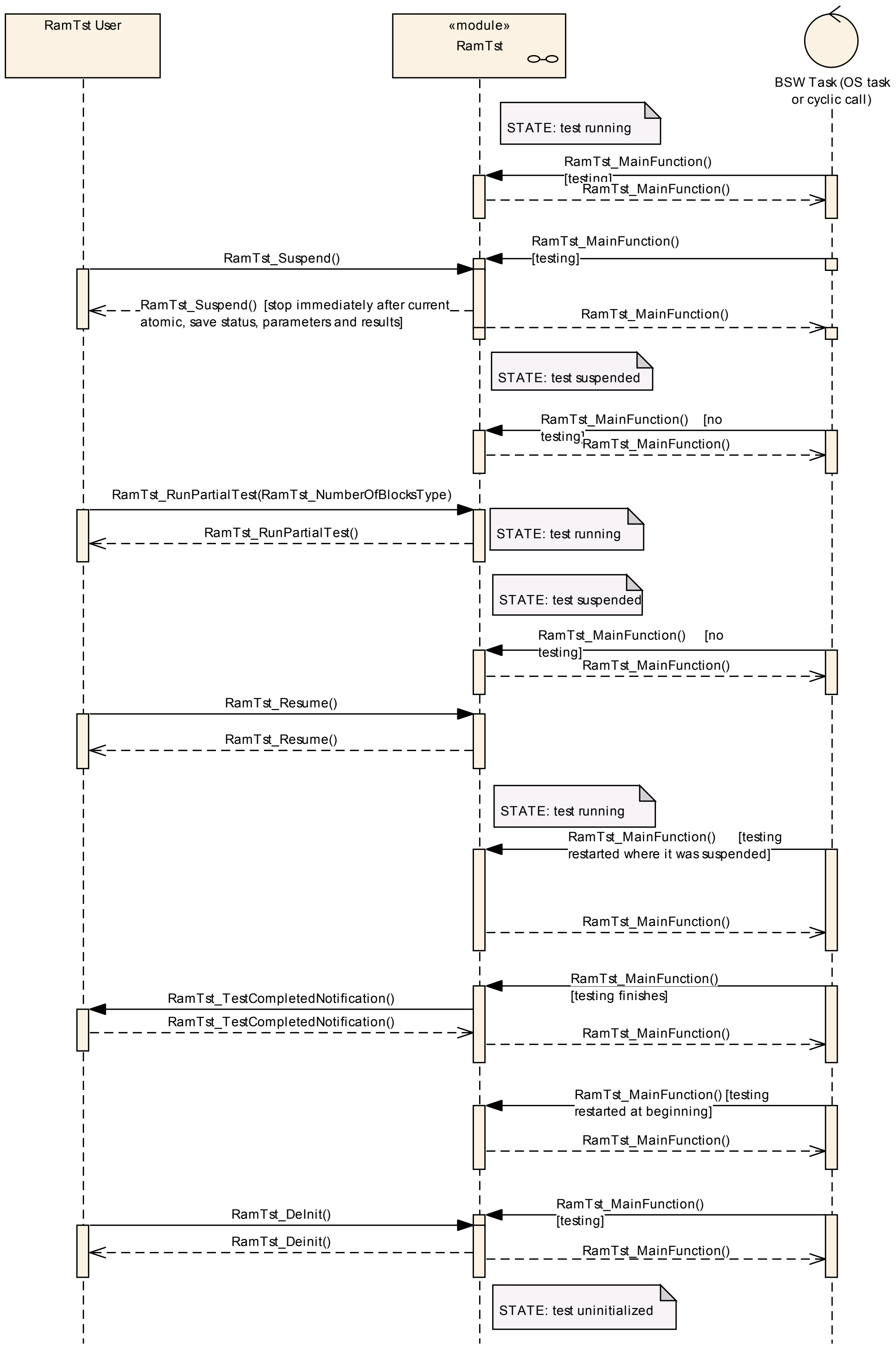
The first example sequence shows the initialization of the RAM Test module, a foreground Run Full Test request, error notification, and the cyclic call background testing.

A cyclic background task called by a scheduler consists of several small atomic sequences in succession. At the end of each atomic sequence, the command variables are checked to see if any command has been received, and corresponding actions are taken.

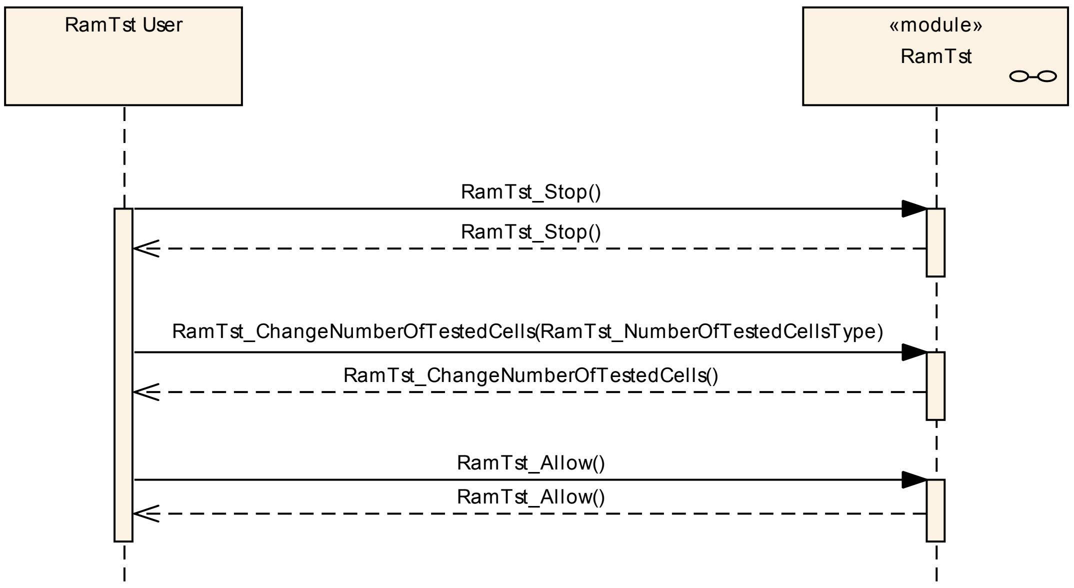
The stop request is handled following the currently running atomic sequence of the main routine, or at the next cyclic call of the main routine if it is not currently running. The allow request is handled at the next cyclic call of the main routine.

The second example shows the Suspend and Resume commands, a foreground Run Partial Test request, a Test Completed notification, and the DeInit command.

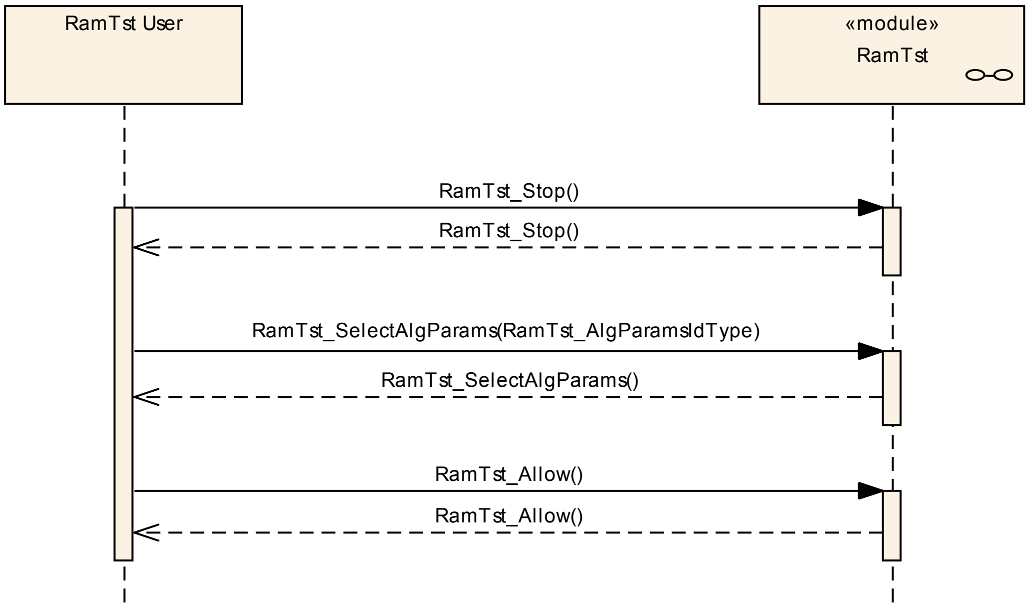

RamTst User
«module»
RamTst
BSW Task (OS task or cyclic call)
RamTst_Init()
RamTst_Init()
STATE: test stopped
RamTst_MainFunction() [no testing]
RamTst_MainFunction()
RamTst_Allow()
RamTst_Allow()
STATE: test allowed
RamTst_MainFunction() [testing]
STATE: test running
RamTst_MainFunction()
RamTst_MainFunction() [testing]
RamTst_Stop()
RamTst_Stop [stop immediately after current atomic, save status only]()
RamTst_MainFunction()
STATE: test stopped
RamTst_MainFunction() [no testing]
RamTst_MainFunction()
RamTst_RunFullTest()
STATE: test running
RamTst_RunFullTest()
STATE: test stopped
RamTst_MainFunction() [no testing]
RamTst_MainFunction()
RamTst_Allow()
RamTst_Allow()
STATE: test allowed
RamTst_MainFunction() [testing]
STATE: test running
RamTst_MainFunction()
RamTst_MainFunction() [testing]
RamTst_ErrorNotification()
RamTst_ErrorNotification()
RamTst_MainFunction()


RamTst User
«module»
RamTst
BSW Task (OS task or cyclic call)
STATE: test running
RamTst_MainFunction() [testing]
RamTst_MainFunction()
RamTst_MainFunction() [testing]
RamTst_Suspend()
RamTst_Suspend() [stop immediately after current atomic, save status, parameters and results]
RamTst_MainFunction()
STATE: test suspended
RamTst_MainFunction() [no testing]
RamTst_MainFunction()
RamTst_RunPartialTest(RamTst_NumberOfBlocksType)
RamTst_RunPartialTest()
STATE: test running
STATE: test suspended
RamTst_MainFunction() [no testing]
RamTst_MainFunction()
RamTst_Resume()
RamTst_Resume()
STATE: test running
RamTst_MainFunction() [testing restarted where it was suspended]
RamTst_MainFunction()
RamTst_MainFunction() [testing finishes]
RamTst_TestCompletedNotification()
RamTst_TestCompletedNotification()
RamTst_MainFunction()
RamTst_MainFunction() [testing restarted at beginning]
RamTst_MainFunction()
RamTst_MainFunction() [testing]
RamTst_DeInit()
RamTst_Deinit()
RamTst_MainFunction()
STATE: test uninitialized

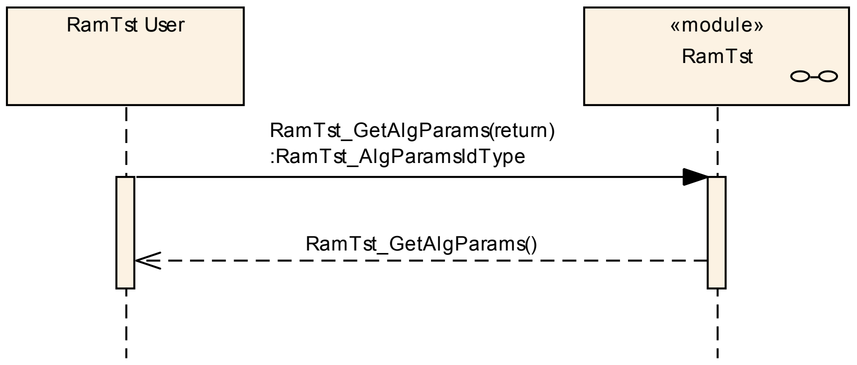
RamTst_ChangeNumberOfTestedCells


RamTst User
«module»
RamTst
RamTst_Stop()
RamTst_Stop()
RamTst_ChangeNumberOfTestedCells(RamTst_NumberOfTestedCellsType)
RamTst_ChangeNumberOfTestedCells()
RamTst_Allow()
RamTst_Allow()

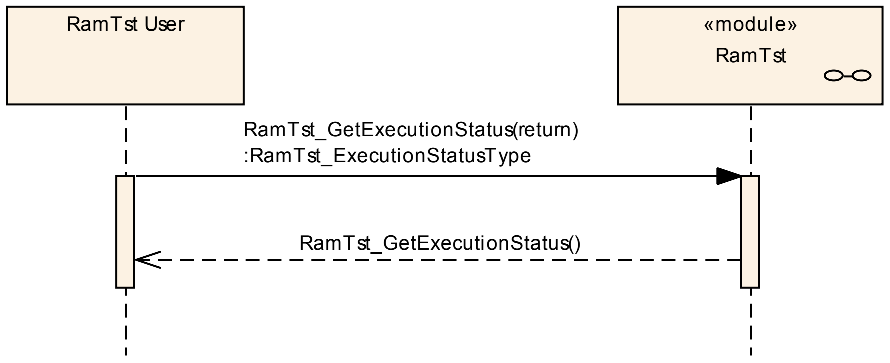
RamTst_SelectAlgParams



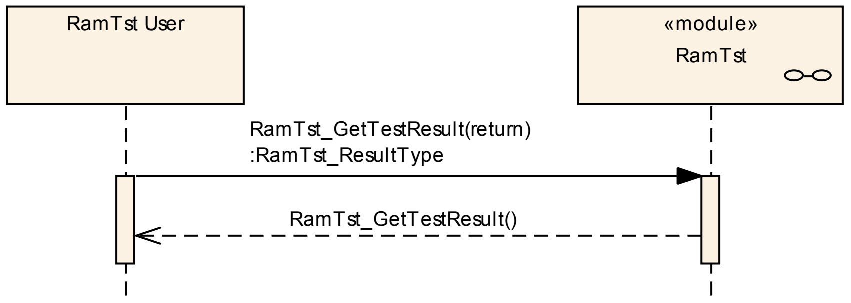
RamTst_GetAlgParams



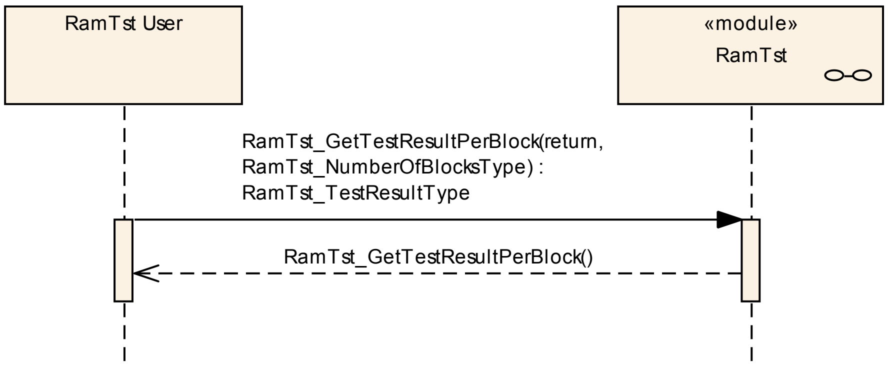
RamTst_GetExecutionStatus


RamTst User
«module»
RamTst
RamTst_GetExecutionStatus(return)
:RamTst_ExecutionStatusType
RamTst_GetExecutionStatus()

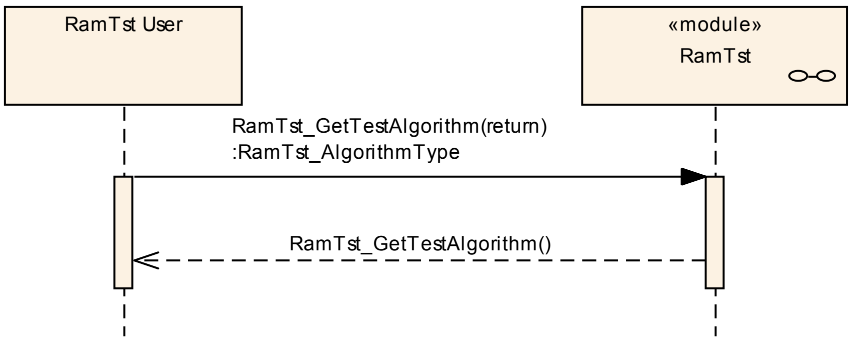
RamTst_GetTestResult



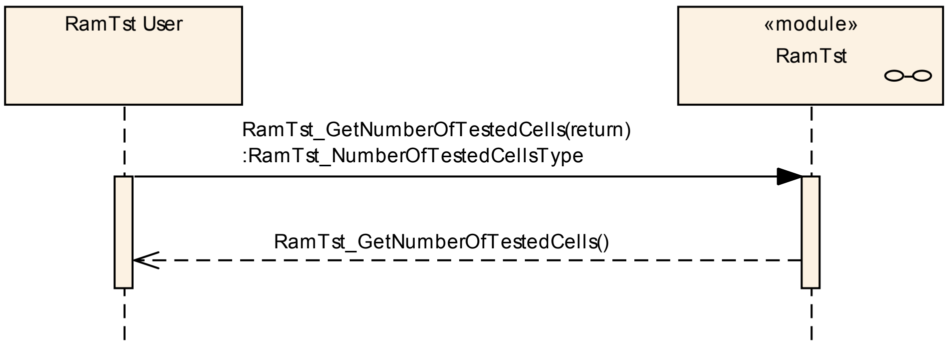
RamTst_GetTestResultPerBlock


RamTst User
«module»
RamTst
RamTst_GetTestResultPerBlock(return, RamTst_NumberOfBlocksType) : RamTst_TestResultType
RamTst_GetTestResultPerBlock()

RamTst_GetTestAlgorithm


RamTst User
«module»
RamTst
RamTst_GetTestAlgorithm(return) :RamTst_AlgorithmType
RamTst_GetTestAlgorithm()

RamTst_GetNumberOfTestedCells


RamTst User
«module»
RamTst
RamTst_GetNumberOfTestedCells(return) :RamTst_NumberOfTestedCellsType
RamTst_GetNumberOfTestedCells()

10 Configuration Specification

In general, this chapter defines configuration parameters and their clustering into containers. In order to support the specification, Chapter 10.1 describes fundamentals. It also specifies a template (table) that shall be used for the parameter specification. It is intended to leave Chapter 10.1 in the specification to guarantee comprehension.

Chapter 10.2 specifies the structure (containers) and the parameters of the module RAM Test.

Chapter 10.3 specifies published information of the module RAM Test.

Chapter 10.4 contains additional information for the module RAM Test.

How to read this chapter

In addition to this section, it is highly recommended to read the documents:

- AUTOSAR Layered Software Architecture [2]
- AUTOSAR ECU Configuration Specification [5]
    - o This document describes the AUTOSAR configuration methodology and the AUTOSAR configuration metamodel in detail.

The following is only a short survey of the topic and it will not replace the ECU Configuration Specification document.

10.1.1 Configuration and configuration parameters

Configuration parameters define the variability of the generic part(s) of an implementation of a module. This means that only generic or configurable module implementation can be adapted to the environment (software/hardware) in use during system and/or ECU configuration.

The configuration of parameters can be achieved at different times during the software process: before compile time, before link time or after build time. In the following, the term “configuration class” (of a parameter) shall be used in order to refer to a specific configuration point in time.

10.1.2 Containers

Containers structure the set of configuration parameters. This means:

- *all* configuration parameters are kept in containers.
- (sub-) containers can reference (sub-) containers. It is possible to assign a multiplicity to these references. The multiplicity then defines the possible number of instances of the contained parameters.

10.1.3 Specification template for configuration parameters

The following tables consist of three sections:
- the general section
- the configuration parameter section
- the section of included/referenced containers

Pre-compile time	- specifies whether the configuration parameter shall be of configuration class *Pre-compile time* or not

Label	**Description**
x	The configuration parameter shall be of configuration class *Pre-compile time*.
--	The configuration parameter shall never be of configuration class *Pre-compile time*.

Link time	- specifies whether the configuration parameter shall be of configuration class *Link time* or not

Label	**Description**
x	The configuration parameter shall be of configuration class *Link time*.
--	The configuration parameter shall never be of configuration class *Link time*.

Post Build	- specifies whether the configuration parameter shall be of configuration class *Post Build* or not

Label	**Description**
x	The configuration parameter shall be of configuration class *Post Build* and no specific implementation is required.
L	*Loadable* - the configuration parameter shall be of configuration class *Post Build* and only one configuration parameter set resides in the ECU.
M	*Multiple* - the configuration parameter shall be of configuration class *Post Build* and is selected out of a set of multiple parameters by passing a dedicated to the init function of the module.
--	The configuration parameter shall never be of configuration class *Post Build*.

Containers and Configuration Parameters

The following sections summarize the containers of RAM Test configuration parameters. The detailed descriptions of the configuration parameters are described in Chapter 8 API Specification.

[RamTst026] ⌈ Within the configuration data for the RAM Test module, there shall be a set of configuration containers named `RamTstAlgParams.` Each one defines a possible test parameter set to be selected at runtime, which includes an algorithm. The algorithms included in `RamTstAlgParams` are restricted to those that were pre-compile selected to be available to the user via the container `RamTstAlgorithms.` ⌋(BSW00344, BSW12057, BSW12263, BSW13802, BSW13803, BSW13809)

[RamTst027] ⌈ Within the configuration data for the RAM Test module, each parameter set of type `RamTstAlgParams` (as required in RamTst026) shall also have memory block configuration containers. The memory block configuration container is defined in `RamTstBlockParams`. The number of memory block configuration containers is defined by the integrator according to the RAM test strategy. ⌋(BSW00344, BSW12057, BSW12263, BSW13803)

10.1.4 Variants

[RamTst167] ⌈ This module shall support the configuration variant VARIANT-PRE-COMPILE. Only parameters with "Pre-compile time" configuration are allowed in this variant. The intention of this variant is to optimize the parameter configuration for a source code delivery. See BSW00397. ⌋()

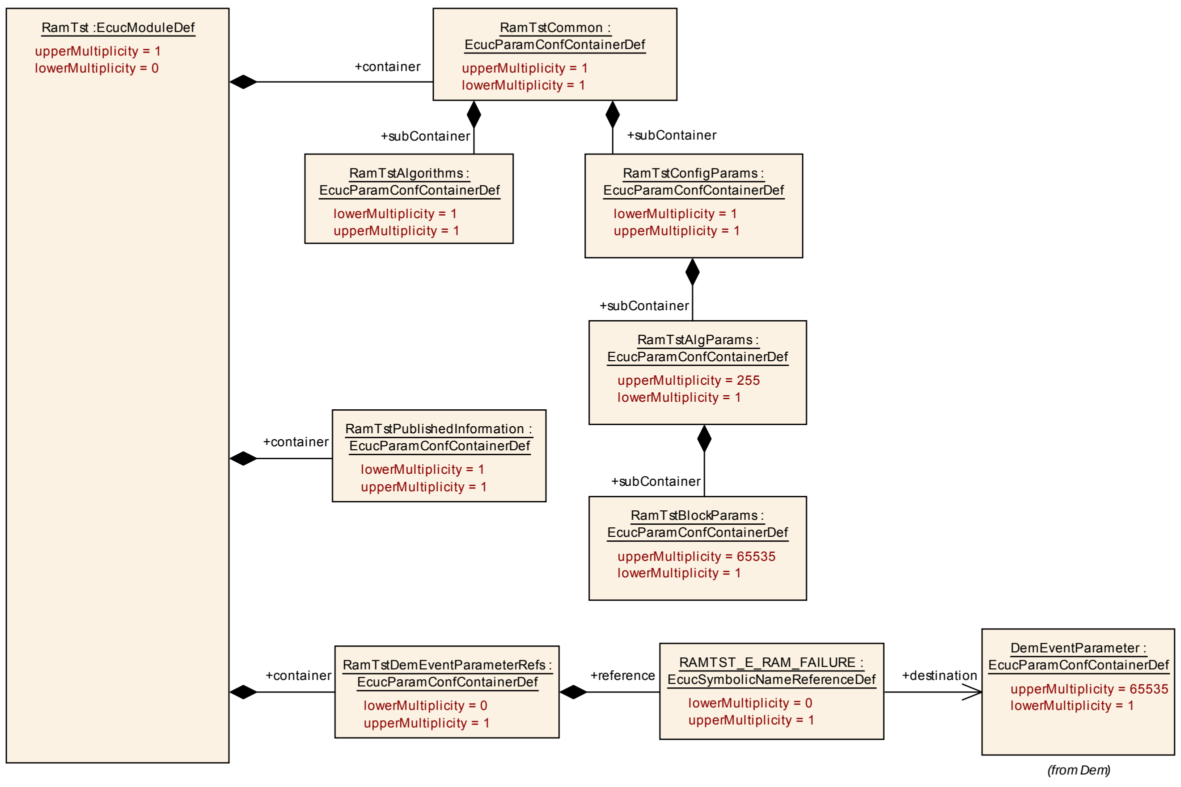
[RamTst168] ⌈ This module shall support the configuration variant VARIANT-LINK-TIME. Parameters with "Pre-compile time" and "Link time" are allowed in this variant. The intention of this variant is to optimize the parameter configuration for an object code delivery. See BSW00398. ⌋()

[RamTst093] ⌈ The initialization function of this module shall always have a “void” as parameter. This means that, in contradiction to BSW00414 only one interface for initialization shall be implemented and it shall not depend on the modules configuration which interface the calling software module shall use. ⌋(BSW00414)

10.1.5 RamTst

SWS Item	**RamTst150_Conf :**
Module Name	*RamTst*
Module Description	Configuration of the RamTst module.

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
RamTstCommon	1	This container holds a list of all available functions in the RamTst module. Each function is turned ON or OFF before compiling so that only the desired functions and test algorithms are in the compiled code.
RamTstDemEventParameter-Refs	0..1	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value. The standardized errors are provided in the container and can be extended by vendor-specific error references.
RamTstPublishedInformation	1	Container holding all RamTst specific published information parameter.



10.1.6 RamTstDemEventParameterRefs

SWS Item	**RamTst188_Conf :**
Container Name	RamTstDemEventParameterRefs
Description	Container for the references to DemEventParameter elements which shall be invoked using the API Dem_ReportErrorStatus in case the corresponding error occurs. The EventId is taken from the referenced DemEventParameter's DemEventId value. The standardized errors are provided in the container and can be extended by vendor-specific error references.
Configuration Parameters	

SWS Item	**RamTst189_Conf :**		
Name	RAMTST_E_RAM_FAILURE		
Description	Reference to the DemEventParameter which shall be issued when the error "RAM failure" has occurred.		
Multiplicity	0..1		
Type	Reference to [DemEventParameter]		
ConfigurationClass	*Pre-compile time*	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency			

No Included Containers

10.1.7 RamTstCommon

SWS Item	**RamTst070_Conf :**
Container Name	RamTstCommon{RamTst_Common}
Description	This container holds a list of all available functions in the RamTst module. Each function is turned ON or OFF before compiling so that only the desired functions and test algorithms are in the compiled code.
Configuration Parameters	

SWS Item	**RamTst120_Conf :**		
Name	RamTstAllowApi {RAMTST_ALLOW_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_Allow".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst118_Conf :**		
Name	RamTstChangeNumOfTestedCellsApi {RAMTST_CHANGE_NUMBER_OF_TESTED_CELLS_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_ChangeNumberOfTestedCells".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst121_Conf :**		
Name	RamTstDevErrorDetect {RAMTST_DEV_ERROR_DETECT}		
Description	Preprocessor switch to select the development error tracer (DET) ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst183_Conf :**		
Name	RamTstGetAlgParamsApi {RAMTST_GET_ALG_PARAMS_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetAlgParams".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	

	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst122_Conf :**		
Name	RamTstGetExecutionStatusApi {RAMTST_GET_EXECUTION_STATUS_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetExecutionStatus"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst123_Conf :**		
Name	RamTstGetNumberOfTestedCellsApi {RAMTST_GET_NUMBER_OF_TESTED_CELLS_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetNumberOfTestedCells".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst124_Conf :**		
Name	RamTstGetTestAlgorithmApi {RAMTST_GET_TEST_ALGORITHM_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetTestAlgorithm"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst125_Conf :**		
Name	RamTstGetTestResultApi {RAMTST_GET_TEST_RESULT_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetTestResult"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst126_Conf :**

Name	RamTstGetTestResultPerBlockApi {RAMTST_GET_TEST_RESULT_PER_BLOCK_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetTestResultPerBlock"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst128_Conf :**		
Name	RamTstGetVersionInfoApi {RAMTST_GET_VERSION_INFO_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_GetVersionInfo"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst155_Conf :**		
Name	RamTstResumeApi {RAMTST_RESUME_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_Resume".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst184_Conf :**		
Name	RamTstRunFullTestApi {RAMTST_RUN_FULL_TEST_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_RunFullTest"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst185_Conf :**
Name	RamTstRunPartialTestApi {RAMTST_RUN_PARTIAL_TEST_API}
Description	Preprocessor switch to disable / enable the function "RamTst_RunPartialTest"
Multiplicity	1
Type	EcucBooleanParamDef
Default value	--

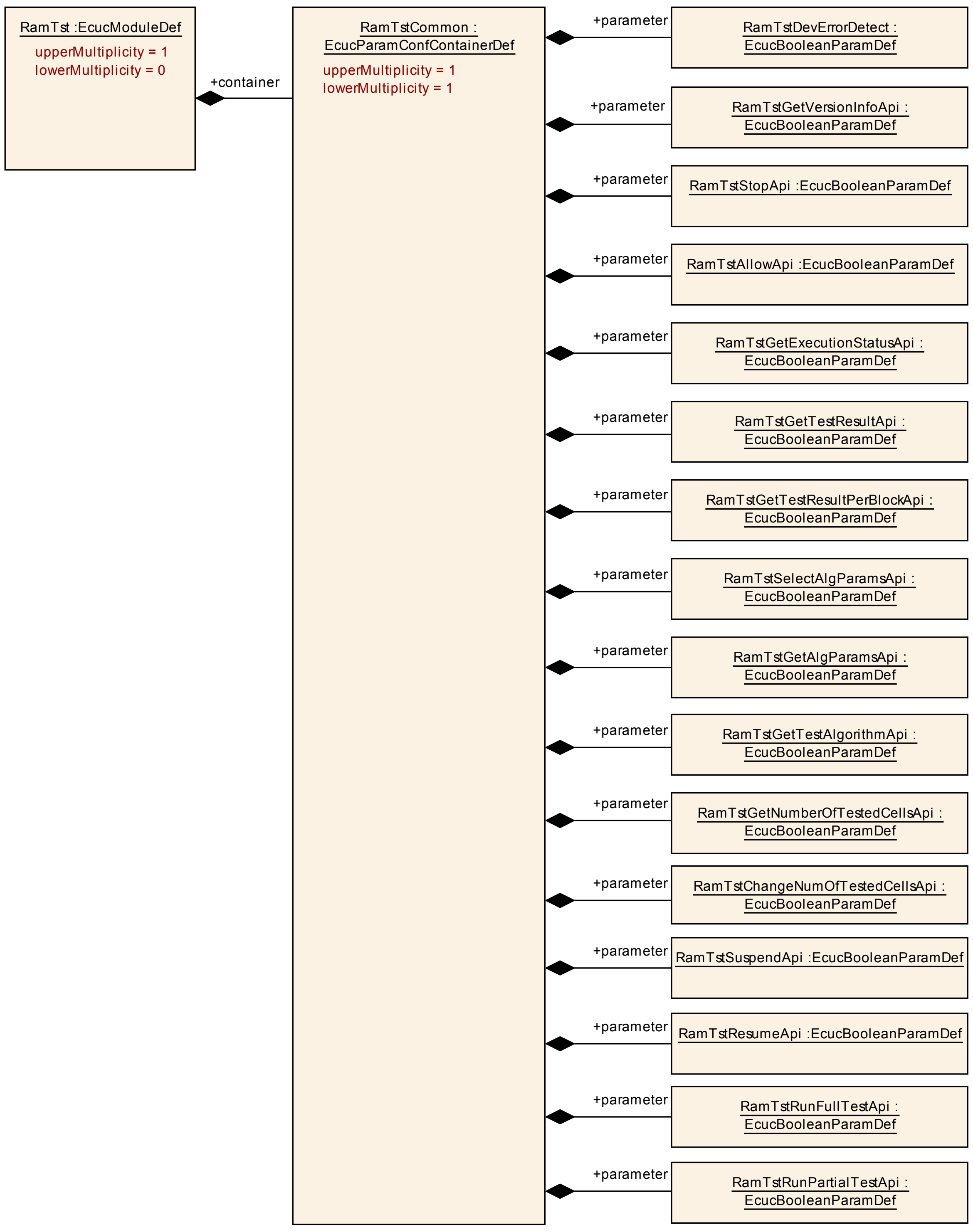
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst182_Conf :**		
Name	RamTstSelectAlgParamsApi {RAMTST_SELECT_ALG_PARAMS_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_SelectAlgParams".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst127_Conf :**		
Name	RamTstStopApi {RAMTST_STOP_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_Stop"		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst156_Conf :**		
Name	RamTstSuspendApi {RAMTST_SUSPEND_API}		
Description	Preprocessor switch to disable / enable the function "RamTst_Suspend".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
RamTstAlgorithms	1	This container holds all of the available test algorithms for the specific microcontroller. Each test algorithm is selected ON or OFF before compiling so that only the desired test algorithms are in the compiled code.
RamTstConfigPar-ams	1	This container specifies configuration parameters which are set at pre-compile or link time.


RamTst :EcucModuleDef
upperMultiplicity = 1
lowerMultiplicity = 0
+container
RamTstCommon : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+parameter
RamTstDevErrorDetect : EcucBooleanParamDef
RamTstGetVersionInfoApi : EcucBooleanParamDef
RamTstStopApi :EcucBooleanParamDef
RamTstAllowApi :EcucBooleanParamDef
RamTstGetExecutionStatusApi : EcucBooleanParamDef
RamTstGetTestResultApi : EcucBooleanParamDef
RamTstGetTestResultPerBlockApi : EcucBooleanParamDef
RamTstSelectAlgParamsApi : EcucBooleanParamDef
RamTstGetAlgParamsApi : EcucBooleanParamDef
RamTstGetTestAlgorithmApi : EcucBooleanParamDef
RamTstGetNumberOfTestedCellsApi : EcucBooleanParamDef
RamTstChangeNumOfTestedCellsApi : EcucBooleanParamDef
RamTstSuspendApi :EcucBooleanParamDef
RamTstResumeApi :EcucBooleanParamDef
RamTstRunFullTestApi : EcucBooleanParamDef
RamTstRunPartialTestApi : EcucBooleanParamDef

10.1.8 RamTstAlgorithms

SWS Item	**RamTst065_Conf :**
Container Name	RamTstAlgorithms{RamTst_Algorithms}
Description	This container holds all of the available test algorithms for the specific micro-controller. Each test algorithm is selected ON or OFF before compiling so that

	only the desired test algorithms are in the compiled code.
Configuration Parameters	

SWS Item	**RamTst129_Conf :**		
Name	RamTstAbrahamTestSelected {RAMTST_ABRAHAM_TEST_SELECTED}		
Description	Preprocessor switch to select the Abraham Test ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst130_Conf :**		
Name	RamTstCheckerboardTestSelected {RAMTST_CHECKERBOARD_TEST_SELECTED}		
Description	Preprocessor switch to select the Checkerboard Test ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst132_Conf :**		
Name	RamTstGalpatTestSelected {RAMTST_GALPAT_TEST_SELECTED}		
Description	Preprocessor switch to select the Galpat Test ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

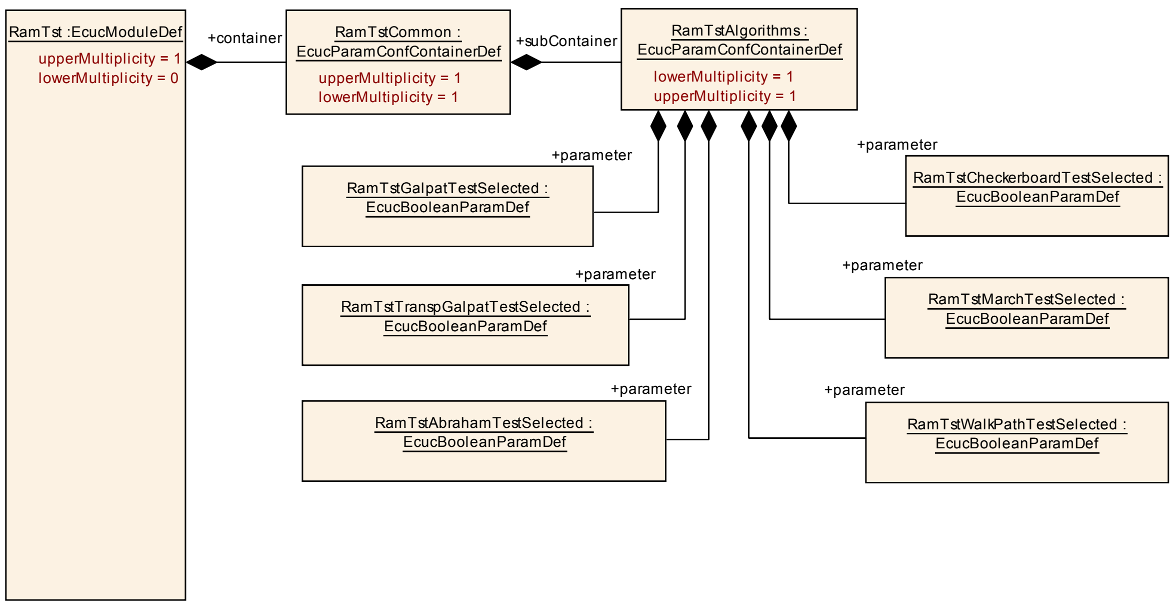
SWS Item	**RamTst133_Conf :**		
Name	RamTstMarchTestSelected {RAMTST_MARCH_TEST_SELECTED}		
Description	Preprocessor switch to select the March Test ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst134_Conf :**
Name	RamTstTranspGalpatTestSelected {RAMTST_TRANSP_GALPAT_TEST_SELECTED}
Description	Preprocessor switch to select the Transparent Galpat Test ON or OFF
Multiplicity	1

Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst135_Conf :**		
Name	RamTstWalkPathTestSelected {RAMTST_WALK_PATH_TEST_SELECTED}		
Description	Preprocessor switch to select the Walking Path Test ON or OFF		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: Module		

No Included Containers


RamTst :EcucModuleDef
upperMultiplicity = 1
lowerMultiplicity = 0
+container
RamTstCommon : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+subContainer
RamTstAlgorithms : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = 1
+parameter
RamTstGalpatTestSelected : EcucBooleanParamDef
+parameter
RamTstCheckerboardTestSelected : EcucBooleanParamDef
+parameter
RamTstTranspGalpatTestSelected : EcucBooleanParamDef
+parameter
RamTstMarchTestSelected : EcucBooleanParamDef
+parameter
RamTstAbrahamTestSelected : EcucBooleanParamDef
+parameter
RamTstWalkPathTestSelected : EcucBooleanParamDef

10.1.9 RamTstConfigParams

SWS Item	**RamTst066_Conf :**
Container Name	RamTstConfigParams{RamTst_ConfigParams}
Description	This container specifies configuration parameters which are set at pre-compile or link time.
Configuration Parameters	

SWS Item	**RamTst181_Conf :**
Name	RamTstDefaultAlgParamsId {RAMTST_DEFAULT_ALG_PARAMS_ID}

Description	This is the identifier for the default "RamTstAlgParams" valid after the "RamTst_Init(..)" function. It is the initial value for a RAM variable which could be changed by the function "RamTst_SelectAlgParams".		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst154_Conf :**		
Name	RamTstMinNumberOfTestedCells {RAMTST_MIN_NUMBER_OF_TESTED_CELLS}		
Description	Minimum number of tested cells for one cyle of a background test, as defined by implementer.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

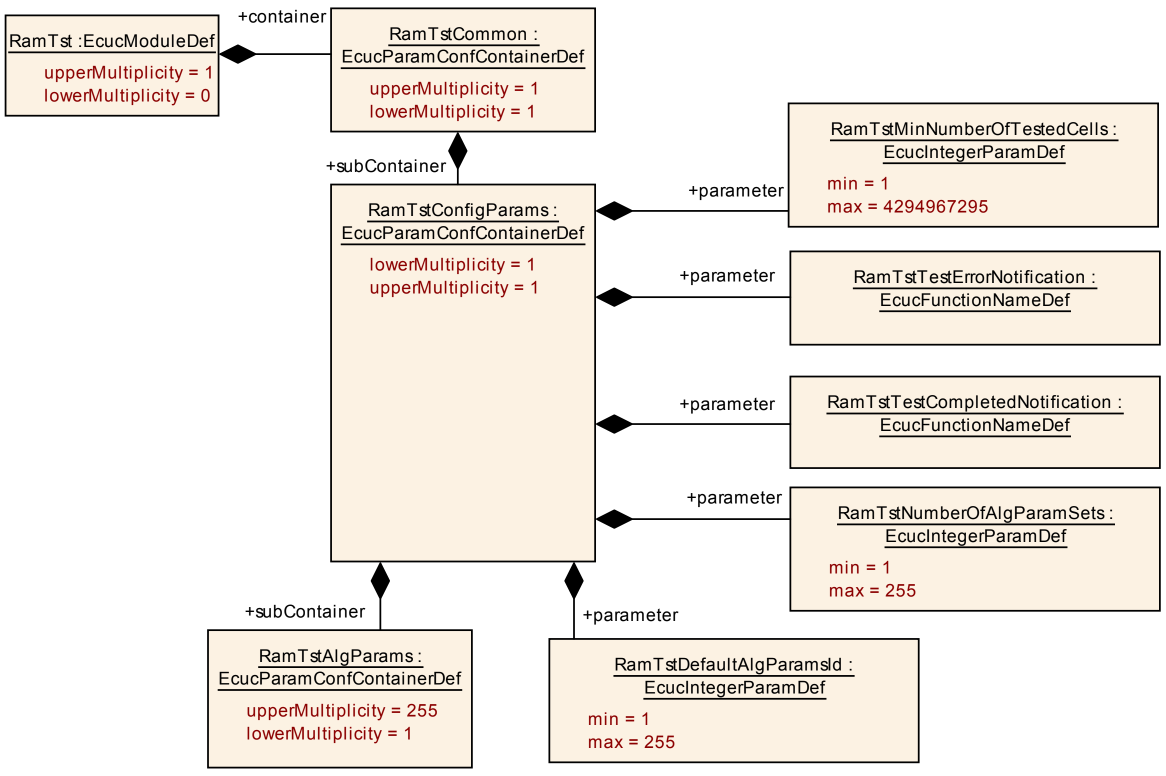
SWS Item	**RamTst180_Conf :**		
Name	RamTstNumberOfAlgParamSets {RAMTST_NUMBER_OF_ALG_PARAM_SETS}		
Description	Number of configured parameter sets for the available test algorithms. calculationFormula = count of the container RamTst_AlgParams		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module dependency: "RamTstNumberOfAlgParamSets" is derived by the count of "RamTstAlgParams" which is part of the same subContainer and has a multiplicity of 1 to 255.		

SWS Item	**RamTst138_Conf :**		
Name	RamTstTestCompletedNotification {RAMTST_TEST_COMPLETED_NOTIFICATION}		
Description	This function will be called from abackground test after finishing the RAM test without an error.		
Multiplicity	1		
Type	EcucFunctionNameDef		
Default value	--		
maxLength	--		
minLength	--		
regularExpression	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME

	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst139_Conf :**		
Name	RamTstTestErrorNotification {RAMTST_TEST_ERROR_NOTIFICATION}		
Description	This function will be called from a background test if an error occurs during the RAM test.		
Multiplicity	1		
Type	EcucFunctionNameDef		
Default value	--		
maxLength	--		
minLength	--		
regularExpression	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
RamTstAlgPar-ams	1..255	This container holds parameters for configuring an algorithm. For each algorithm selected in the RamTst_Algorithms container there can be one or more RamTstAlgParams containers. The multiplicity of the included container RamTstBlockParams depends on the number of separate blocks of RAM which are defined for the particular test configuration.


RamTst :EcucModuleDef
upperMultiplicity = 1
lowerMultiplicity = 0
+container
RamTstCommon : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+subContainer
RamTstConfigParams : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = 1
+parameter
RamTstMinNumberOfTestedCells : EcucIntegerParamDef
min = 1
max = 4294967295
+parameter
RamTstTestErrorNotification : EcucFunctionNameDef
+parameter
RamTstTestCompletedNotification : EcucFunctionNameDef
+parameter
RamTstNumberOfAlgParamSets : EcucIntegerParamDef
min = 1
max = 255
+subContainer
RamTstAlgParams : EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
+parameter
RamTstDefaultAlgParamsId : EcucIntegerParamDef
min = 1
max = 255

10.1.10 RamTstAlgParams

SWS Item	**RamTst090_Conf :**
Container Name	RamTstAlgParams{RamTst_AlgParams}
Description	This container holds parameters for configuring an algorithm. For each algorithm selected in the RamTst_Algorithms container there can be one or more RamTstAlgParams containers. The multiplicity of the included container RamTstBlockParams depends on the number of separate blocks of RAM which are defined for the particular test configuration.
Configuration Parameters	

SWS Item	**RamTst179_Conf :**		
Name	RamTstAlgParamsId {RAMTST_ALG_PARAMS_ID}		
Description	This is the identifier by which this RamTstAlgParams set can be selected.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 255		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst178_Conf :**		
Name	RamTstAlgorithm {RAMTST_ALGORITHM}		
Description	This is the algorithm for which this RamTstAlgParams set is defined. Note that the same algorithm can be used in more than one RamTstAlgParams. Constraint: Only the algorithms selected by RamTstCommon/ RamTstAlgorithms can be used.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	RAMTST_ABRAHAM_TEST	--	
	RAMTST_CHECKERBOARD_TEST	--	
	RAMTST_GALPAT_TEST	--	
	RAMTST_MARCH_TEST	--	
	RAMTST_TRANSP_GALPAT_TEST	--	
	RAMTST_WALK_PATH_TEST	--	
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst152_Conf :**		
Name	RamTstExtNumberOfTestedCells {RAMTST_EXT_NUMBER_OF_TESTED_CELLS}		
Description	This is the absolute maximum value for the number of cells that NUMBER_OF_TESTED_CELLS and MAX_NUMBER_OF_TESTED_CELLS can be.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE

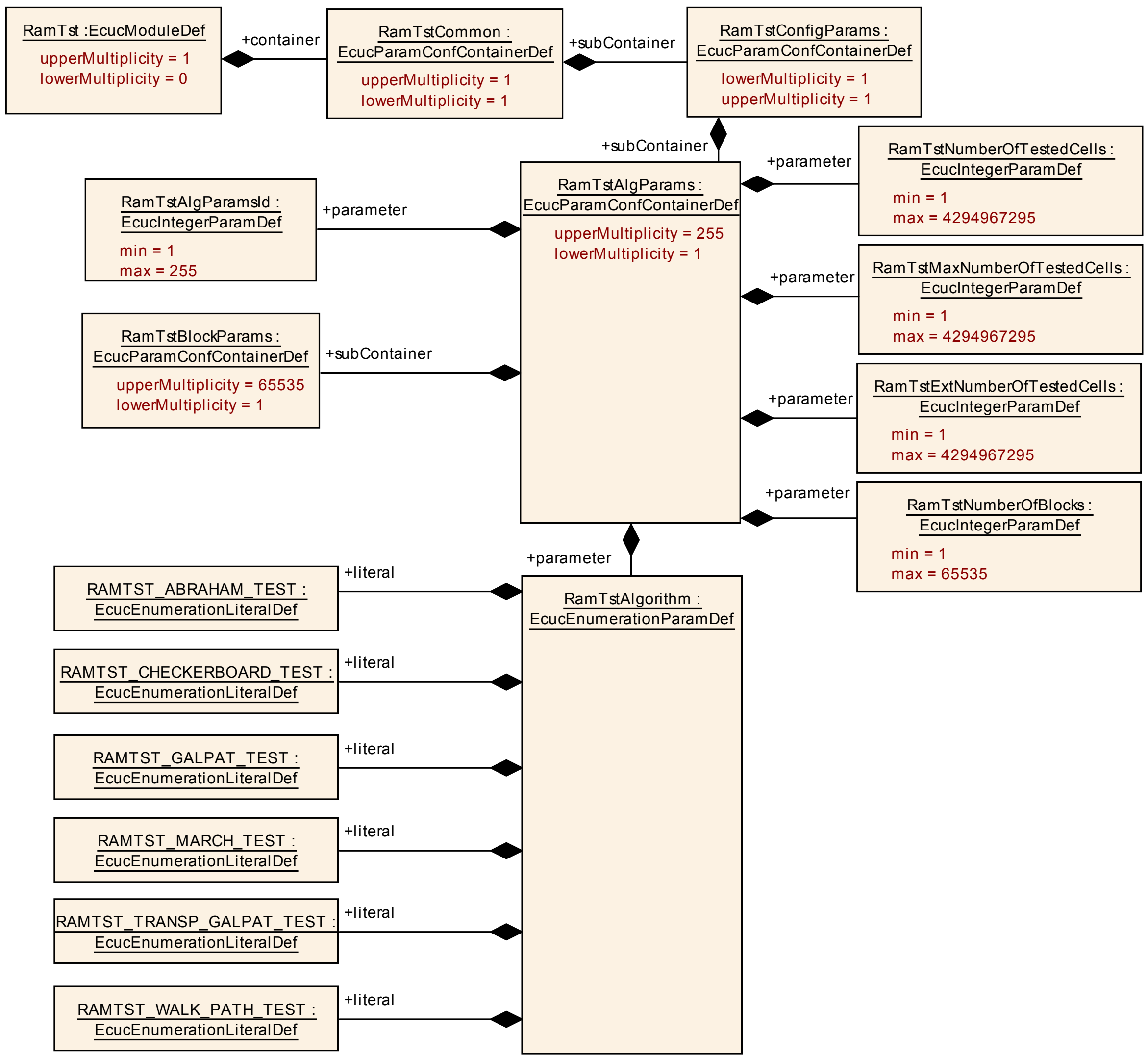
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst153_Conf :**		
Name	RamTstMaxNumberOfTestedCells {RAMTST_MAX_NUMBER_OF_TESTED_CELLS}		
Description	This is the maximum value for the number of cells that can be tested in one cycle of a background test.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst141_Conf :**		
Name	RamTstNumberOfBlocks {RAMTST_NUMBER_OF_BLOCKS}		
Description	Number of RAM blocks configured using the container "RamTst_BlockParams" calculationFormula = Count of RamTstBlockParams contained in this RamTstAlgParams.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 65535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module dependency: "RamTstNumberOfBlocks" is derived by the count of the number of "RamTstBlockParams" containers which are part of the same subcontainer and have a multiplicity of 0..65535.		

SWS Item	**RamTst142_Conf :**		
Name	RamTstNumberOfTestedCells {RAMTST_NUMBER_OF_TESTED_CELLS}		
Description	This is the initial value for a RAM variable, which can be changed by the function "RamTst_ChangeNumberOfTestedCells"		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
RamTstBlockPar-ams	1..65535	This container holds the description for one block of RAM. For each RAM block to be tested by a given algorithm, there is one container which describes the block. Multiple instances of this container are in-cluded in each container RamTst_AlgParams.


RamTst :EcucModuleDef
upperMultiplicity = 1
lowerMultiplicity = 0
+container
RamTstCommon : EcucParamConfContainerDef
upperMultiplicity = 1
lowerMultiplicity = 1
+subContainer
RamTstConfigParams : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = 1
+subContainer
RamTstAlgParams : EcucParamConfContainerDef
upperMultiplicity = 255
lowerMultiplicity = 1
RamTstAlgParamsId : EcucIntegerParamDef
min = 1
max = 255
+parameter
RamTstBlockParams : EcucParamConfContainerDef
upperMultiplicity = 65535
lowerMultiplicity = 1
+subContainer
RamTstNumberOfTestedCells : EcucIntegerParamDef
min = 1
max = 4294967295
RamTstMaxNumberOfTestedCells : EcucIntegerParamDef
min = 1
max = 4294967295
RamTstExtNumberOfTestedCells : EcucIntegerParamDef
min = 1
max = 4294967295
RamTstNumberOfBlocks : EcucIntegerParamDef
min = 1
max = 65535
+parameter
RamTstAlgorithm : EcucEnumerationParamDef
+literal
RAMTST_ABRAHAM_TEST : EcucEnumerationLiteralDef
RAMTST_CHECKERBOARD_TEST : EcucEnumerationLiteralDef
RAMTST_GALPAT_TEST : EcucEnumerationLiteralDef
RAMTST_MARCH_TEST : EcucEnumerationLiteralDef
RAMTST_TRANSP_GALPAT_TEST : EcucEnumerationLiteralDef
RAMTST_WALK_PATH_TEST : EcucEnumerationLiteralDef

10.1.11 RamTstBlockParams

SWS Item	**RamTst091_Conf :**
Container Name	RamTstBlockParams{RamTst_BlockParams}
Description	This container holds the description for one block of RAM. For each RAM block to be tested by a given algorithm, there is one container which describes the block. Multiple instances of this container are included in each container RamTst_AlgParams.
Configuration Parameters	

SWS Item	**RamTst143_Conf :**		
Name	RamTstBlockId {RAMTST_BLOCK_ID}		
Description	ID of the RAM block		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 65535		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	

Scope / Dependency	scope: Module

SWS Item	**RamTst144_Conf :**		
Name	RamTstEndAddress {RAMTST_END_ADDRESS}		
Description	End Address of the RAM block. Constraint: It must be larger than the RamTstStartAddress.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

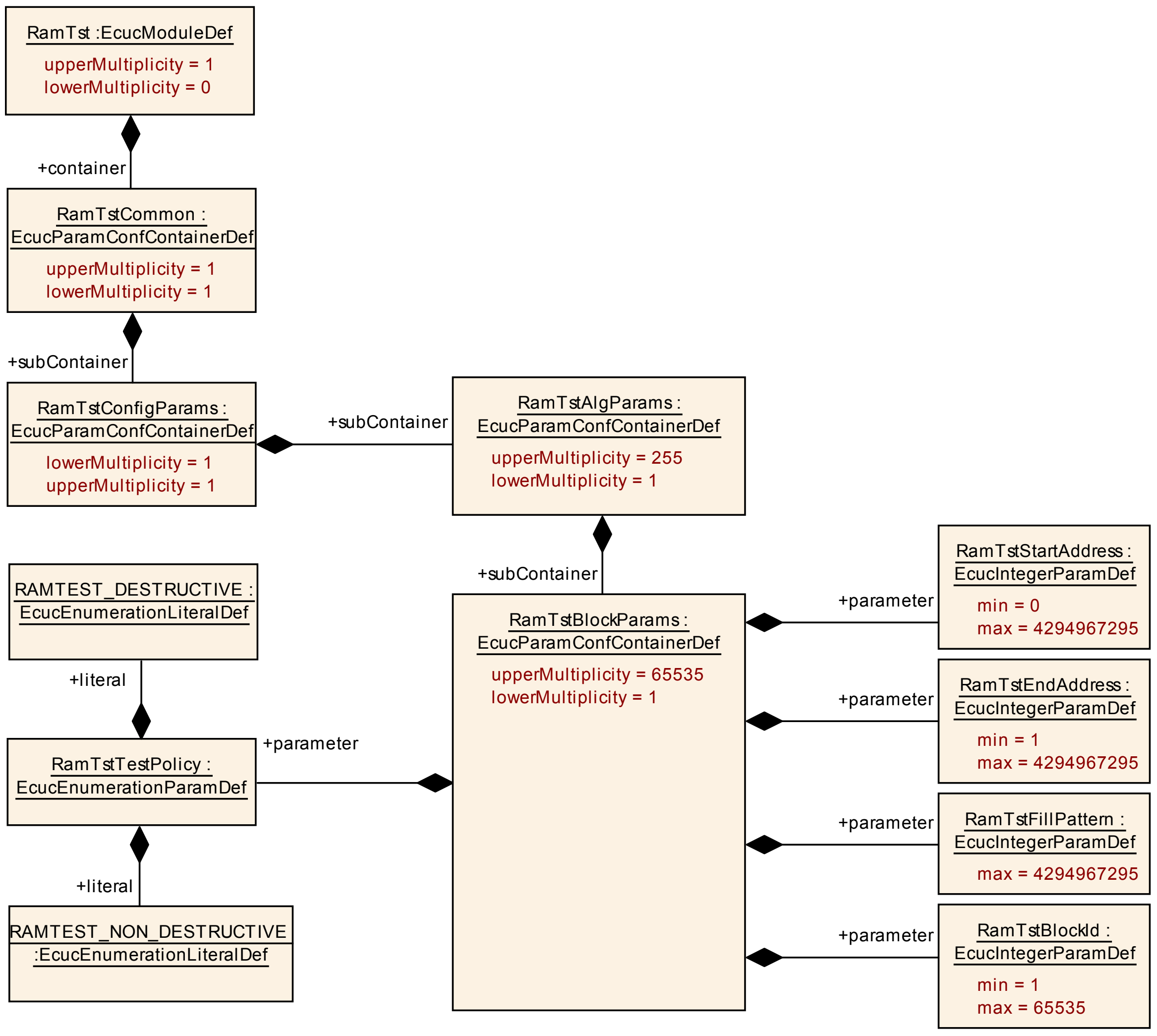
SWS Item	**RamTst176_Conf :**		
Name	RamTstFillPattern {RAMTST_FILL_PATTERN}		
Description	Pattern to be filled into each memory cell after destructive test of this block.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst145_Conf :**		
Name	RamTstStartAddress {RAMTST_START_ADDRESS}		
Description	Start Address of the RAM block. Constraint: It must be smaller than the RamTstEndAddress.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	0 .. 4294967295		
Default value	--		
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

SWS Item	**RamTst177_Conf :**		
Name	RamTstTestPolicy {RAMTST_TEST_POLICY}		
Description	Policy regading destruction or non-destruction of memory content.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	RAMTEST_DESTRUCTIVE	RAM test does not restore memory content.	
	RAMTEST_NON_DESTRUCTIVE	RAM test restores memory content.	
ConfigurationClass	***Pre-compile time***	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-

			TIME
	Post-build time	--	
Scope / Dependency	scope: Module		

No Included Containers



Published Parameters

[RamTst166] ⌈ The standardized common published parameters as required by BSW00402 in the SRS General on Basic Software Modules [3] shall be published within the header file of this module and need to be provided in the BSW Module Description (see [6]). ⌋()

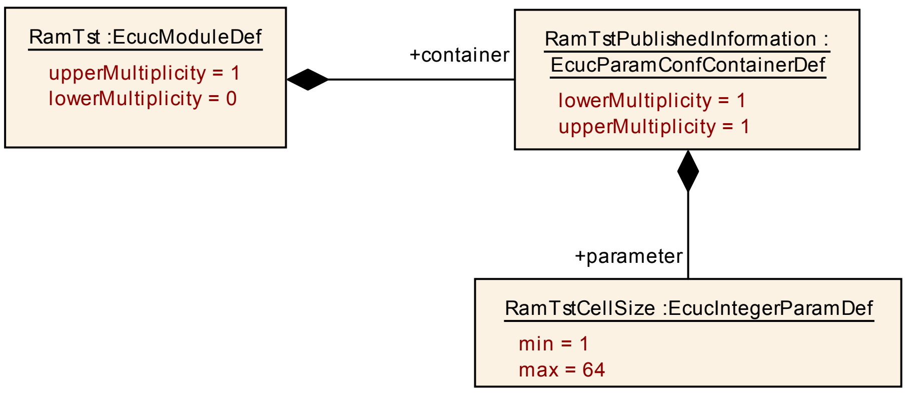
Additional module-specific published parameters are listed below if applicable.

10.1.12 RamTstPublishedInformation

SWS Item	**RamTst186_Conf :**
Container Name	RamTstPublishedInformation{RamTst_PublishedInformation}
Description	Container holding all RamTst specific published information parameter.
Configuration Parameters	

SWS Item	**RamTst187_Conf :**		
Name	RamTstCellSize {RAMTST_CELL_SIZE}		
Description	Size of RAM cells (in bits) which can be tested individually by the given implementation.		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 64		
Default value	--		
ConfigurationClass	***Published Information***	X	All Variants
Scope / Dependency	scope: Module		

No Included Containers



Implementation Specific Information and Parameters

[RamTst081] ⌈ The implementer shall provide measured or calculated runtime information in the documentation of the module for each algorithm implementation. The information is to be presented as shown in the following table, specifying whether the parameters are measured or calculated. ⌋(BSW00402)

Microcontroller	Frequency	RamCellSize [bit]:	No of cells/cycle	Average Runtime	Interrupt lock time	Internal used RAM
--	--	--	--	--	--	--

[RamTst205] ⌈ If an implementation of the RAM Test module supports vendor specific test algorithms or other additional configuration parameters, the implementer shall provide a formal vendor-specific definition of these parameters including their documentation (as part of the BSW Module Description). ⌋()

11 Changes from Release 3.1 to Release 4.0

Deleted SWS Items

SWS Item	***Rationale***
RamTst025	Removed
RamTst151_Conf, RamTst151	Removed
RamTst042	Removed

Replaced SWS Items

SWS Item of Release 1	***replaced by SWS Item***	***Rationale***
RamTst136_Conf	RamTst181_Conf	Allow more than one parameter set per algorithm,
RamTst119_Conf	RamTst182_Conf	Allow more than one parameter set per algorithm

Changed SWS Items

SWS Item	***Rationale***
Ramtst217	correction of the statement of the requirement Ramtst217.
Ramtst142_conf Ramtst144_conf Ramtst145_conf Ramtst152_conf Ramtst153_conf Ramtst154_conf Ramtst176_conf	max value of configuration parameters set to 4294967295.
RamTst080	Updated names of AR…version info; changed ; Removed internal version checks
RamTst037	Corrected
RamTst014	Clarification: Use “test result” instead of “test status”
RamTst018	Extended description
RamTst078	Added Instance Id ; Removed again
RamTst008	Corrected
RamTst009	Corrected
RamTst144_Conf	Added constraint
RamTst145_Conf	Added constraint
RamTst006	Removed superfluous state
RamTst021	used test algorithm instead of test algorithm ID
RamTst105	Allow more than one parameter set per algorithm
RamTst002	New formulation w.r.t. foreground tests
RamTst083	Allow more than one parameter set per algorithm
RamTst099	New wording
RamTst147	Improved wording w.r.t. execution state
RamTst045	Restricted to background test
RamTst046	Restricted to background test
RamTst033	Small correction (..stop can be called also if …EXECUTION_ALLOWED)
RamTst010	New formulation w.r.t. foreground tests
RamTst011	New formulation w.r.t. foreground tests
RamTst086	Addition to file structure

RamTst026	Allow more than one parameter set per algorithm
RamTst027	Allow more than one parameter set per algorithm
RamTst014	Do not set default algorithm on RamTstStop, as this would destroy the context of the test result, and is not in sync with other parts of the Spec, and not in sync
RamTst094	Changed: delete reference to non existing 'Ramtst_ConfigType'
RamTst095	Changed: delete reference to non existing 'Ramtst_ConfigType'
RamTst141_Conf, RamTst142_Conf, RamTst143_Conf, RamTst144_Conf, RamTst152_Conf, RamTst153_Conf, RamTst180_Conf	Refined min/max
RamTst191	Change range from 1..255 to 0..255

Added SWS Items

SWS Item	***Rationale***
RamTst153	Debugging concept
RamTst155	Debugging concept
RamTst157	Debugging concept
RamTst158	Debugging concept
RamTst159	Debugging concept
RamTst161	Debugging concept
RamTst162	Debugging concept
RamTst163	Debugging concept
RamTst164	Debugging concept
RamTst166	Added
RamTst167	Added
RamTst168	Added
RamTst169	Added
RamTst170	Added
RamTst171	Added
RamTst172	Added
RamTst173	This ID was obviously missing
RamTst174	Added
RamTst175	Added
RamTst176_Conf	Added
RamTst177_Conf	Added
RamTst178_Conf	Allow more than one parameter set per algorithm
RamTst179_Conf	Allow more than one parameter set per algorithm
RamTst180_Conf	Allow more than one parameter set per algorithm
RamTst183_Conf	Allow more than one parameter set per algorithm
RamTst184_Conf	Added
RamTst185_Conf	Added
RamTst186_Conf	Added
RamTst187_Conf	Added
RamTst188	Allow more than one parameter set per algorithm
RamTst189	Was type definition without ID
RamTst190	Was type definition without ID
RamTst191	Allow more than one parameter set per algorithm
RamTst192	Was type definition without ID
RamTst193	Allow more than one parameter set per algorithm
RamTst194	Allow more than one parameter set per algorithm

RamTst195	Foreground test APIs added
RamTst196	Foreground test APIs added
RamTst197	Foreground test APIs added
RamTst198	Foreground test APIs added
RamTst200	Added subchapter
RamTst201	Added subchapter
RamTst202	Added subchapter
RamTst203	Preconfigure configuration values
RamTst204	Allow vendor specific algorithms
RamTst205	Allow vendor specific algorithms
RamTst206	Foreground test APIs added
RamTst207	Added subchapter
RamTst208	File structure
RamTst210	Foreground test APIs added
RamTst211	Foreground test APIs added
RamTst212	Foreground test APIs added
RamTst213	Foreground test APIs added
RamTst214	Foreground test APIs added
RamTst215	Foreground test APIs added
RamTst216	Foreground test APIs added
RamTst217	Foreground test APIs added
RamTst221	Added
RamTst188_Conf, RamTst189_Conf	Added
Ramtst222	Added
Ramtst223	Added

12 Not applicable requirements

[RamTst999]「These requirements are not applicable to this specification.」
(BSW168, BSW170, BSW00336, BSW00375, BSW00383, BSW00386, BSW00399, BSW00400, BSW00404, BSW00405, BSW00416, BSW00417, BSW00422, BSW00423, BSW00424, BSW00425, BSW00426, BSW00428, BSW00429, BSW00432, BSW00434, BSW00437, BSW00438, BSW005, BSW006, BSW009, BSW010, BSW161, BSW162, BSW164, BSW172, BSW00301, BSW00302, BSW00306, BSW00308, BSW00309, BSW00312, BSW00321, BSW00328, BSW00333, BSW00341, BSW00347, BSW00353, BSW00361, BSW00370, BSW00374, BSW00378, BSW00379, BSW00413, BSW00438, BSW00440, BSW00441, BSW00443, BSW00444, BSW00449, BSW12063, BSW12064, BSW12067, BSW12068, BSW12069, BSW12075, BSW12125, BSW12267, BSW12461, BSW12462, BSW12463, BSW12078, BSW12092, BSW12265)