

## M9.4 Maintenance Manual

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for the development of an STM ATB

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## 1 Preface

**Text, STMA-76732** - This document contains the generic requirements concerning maintenance concerning systems which are installed in vehicles. The STM ATB doesn't require preventive maintenance. Therefore this includes only generic requirements for mechanical (de)installation work and diagnostics in case of fault finding. The diagnostics are to be used to determine in case of a fault whether the problem is concerning the peripherals (and which one) or the STM ATB. In the latter case the STM ATB shall be exchanged as it is considered to be a "Line Replaceable Unit".

Based on the content of this document, and the vehicle specific installation (see also [M9.3 Installation Manual](#)) the system integrator shall compose a vehicle specific maintenance manual to be used in the workshops, taking into account customer requirements.

This document doesn't provide information to repair STM ATB units, although the diagnostics might in case of a defective system also give information about the part of the STM ATB which causes the defect. It is however not foreseen to repair defective units.

### 1.1 References

#### **Text, STMA-14296 - Reference documents**

All the documents references used in this document can be found in the document [P6.1](#)

[Bibliography](#) available in the Polarion folder [Processes](#)

#### **Abbreviations, definitions and terminology**

An overview of the abbreviations, definitions and terminology used in this document can be found in document [P6.2 List of abbreviations, definitions and terms](#) available in the Polarion folder [Processes](#)

#### **Requirement identification**

The STM ATB project makes use of an automated requirement management system. In this system each requirement has been identified as a work item. Each work item has been automatically assigned with a unique ID, with the format "STMA-<number>". As a result requirement ID's are not in logical order. An overview of all the used STMA-numbers is given in document [P6.3 Requirement Overview](#) available in the Polarion folder [Processes](#)

## 2 Introduction

#### **Text, STMA-76730 -**

The STM ATB has been designed in a way no preventive maintenance is required. This includes the superfluity of calibration of the coil signal inputs after changing coils, changing the height of the coils after re-profiling the wheels etc.

Therefore maintenance is limited to checking the LED status at the front of the unit and analyzing the diagnostic data in the JRU messages.

In case a fault is detected which cannot be solved by restarting the system, the STM ATB unit shall be exchanged. The latter doesn't require any configuration, i.e. the unit can be exchanged by any STM ATB

of the same vendor and version (no rolling stock type dependencies).

**Text, STMA-76733 -**

The STM ATB has been designed as "line replaceable unit", i.e. the complete system can be exchanged at the line (e.g. at a station). The unit itself shall only be repaired in a workshop or by the supplier.

**Text, STMA-76734 -**

In case of replacing an STM ATB the replacement shall be a valid version for the concerning vehicle, i.e. a version compliant to the STM ATB specification version with which the vehicle has been homologated.

***note: As the STM ATB "blueprint" may be changed and produced by multiple companies, it cannot be guaranteed that different versions behave equally.***

## 2.1 Health and safety requirements for maintenance

**STMA-76731 -** Before removing connectors from the STM ATB the power supply shall be switched off. A description how this shall be done shall be provided per rolling stock type by the system integrator, as this is vehicle specific.

## 2.2 Electrical environment

**Text, STMA-75519 -**

For a specific vehicle the system integrator has to determine which STM ATB versions from which vendors can be used in the concerning vehicle.

The system integrator shall document the vendor-versions compatible with the vehicle.

**Text, STMA-76735 -**


The system integrator shall provide all vehicle specific documentation to the maintenance organization. This documentation shall at least include:

- onboard system design documentation
- hard- and software configuration of STM ATB
- cable assembly of STM ATB

## 2.3 Mechanical environment

**Text, STMA-76746 -** The STM ATB shall be mounted/unmounted only with all cabling removed. The connection and disconnection of the cabling is for a large part depending on the system integration in the vehicle. The system integrator shall describe the way the different connectors shall be (dis)connected. The description shall at least include one picture per connector showing the way the connectors are fixed on the unit.

**Text, STMA-76747 -** Generic requirements concerning mounting the connectors are equal to the mounting during installation as described in [M9.3 Installation Manual](#)

(for description of the cabling, see  [STMA-68361 - Figure: STM ATB connectivity \(schematic / front view\)](#))

**Definition, STMA-74439** - Connecting the STM ATBEG

8. The sequence and way of securing the cabling is vehicle specific and shall therefore be described in the vehicle specific design, choose a convenient sequence for connecting all cables based on the spatial limitations in the CCS cubicle.

Check which sequence for connecting the 8 (or 9) cables STM ATB cables (A/B/C/D/E/F/G/H/J) has been specified in the design.

**Definition, STMA-74437** - Secure cabling

9. Connect all STM ATB cables (8 or 9, according to the design) in the sequence established in step 8:

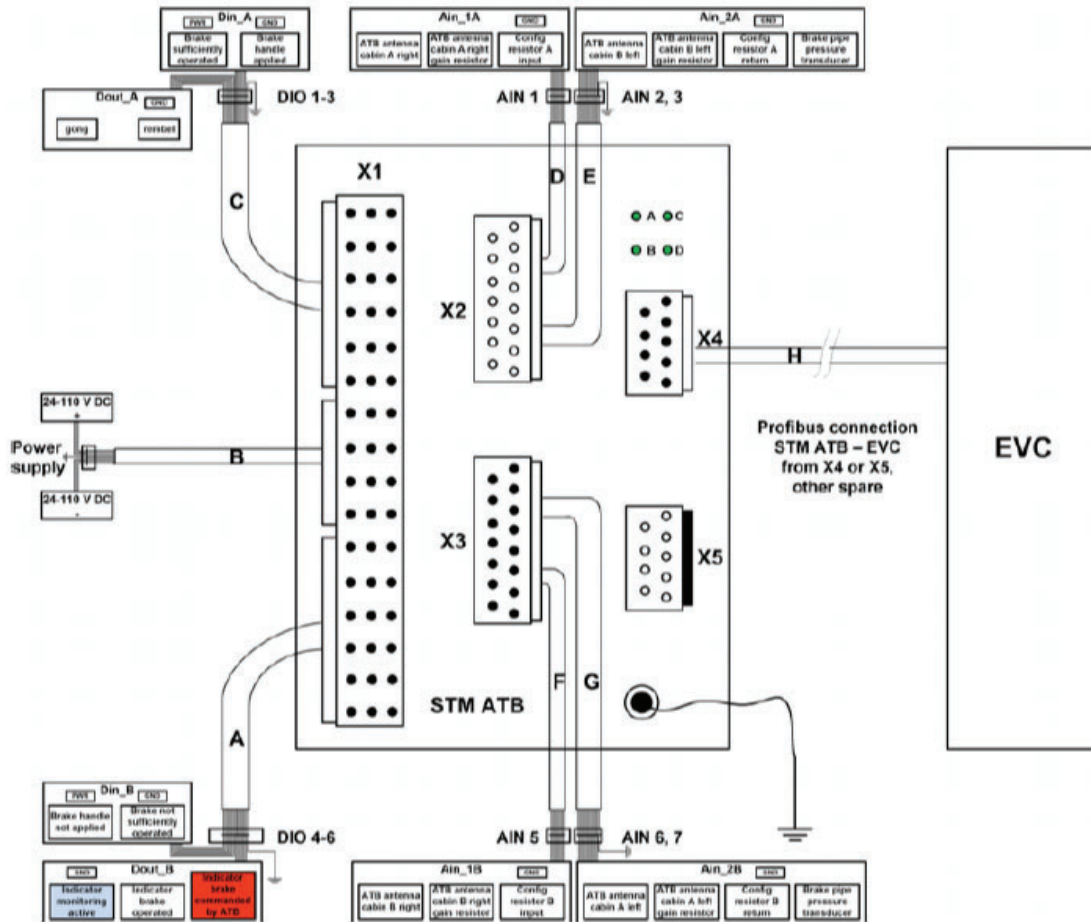
- 9 cables if both Profibus connectors are used and 8 if only one Profibus connector is used;
- If only one Profibus connector (X4 or X5) is used, cover the spare connector (X5 or X4) with a terminator;
- Fasten each cable where appropriate with cable fasteners so that the connectors fit onto the STM ATB and that the connections with the interfaces on the opposite side can be made without straining the cables, allowing for easy (de)installation of STM ATB;
- Connect each cable on the opposite side of STM ATB according to the vehicle specific design.
- Connect each cable connector to the corresponding connector on the STM ATB and fasten the connector hand-tight as the design requires with the screws/bolts provided by the supplier;

**Definition, STMA-74440** - Safety check on cabling

10. Check that all STM ATB connections are physically sound and safe:

- perform both a visual check and mechanical locking of all interfaces;
- check that the CCS cabinet door closes without putting strain on any cable;

**Definition, STMA-68361** - Figure: STM ATB connectivity (schematic / front view)



### 3 Diagnostics

**Text, STMA-77731** - Diagnostic information is provided via LED indications at the unit ([STMA-75452 - Indications at the unit](#)) and via the JRU interface. The latter consists of three different blocks of information sent using packet STM-161 to the JRU. In this chapter the meaning of the LEDs and each of the three JRU packets is described.

**Text, STMA-77984** - The relation between the status of LEDs 1 and 3, with the events triggered by the application is given in the document below:



A preview of the document is given in [STMA-77985 - Preview of the event-Measure/LED matrix](#).

Vertically the events are listed with a reference to the item (STMA-xx) where the event is described. An

event can lead to a triggered measure ("E" in the table), a continuous measure and/or LED indication up to switching of the system ("C" in the table) or a continuous measure and/or for a dedicated time ("C: xxx", xxx in ms).

In the row above the measures and LED indications the references to the items (STMA-xx) where the measure or LED severity is defined, is given.

The relations can be used for fault finding. In the following paragraphs it is described how the LEDs severities are shown and how the events and measures are communicated (JRU packet type 1: [STMA-75458 - Reported events and measures](#) ).

**Definition, STMA-77985 - Preview of the event-Measure/LED matrix**

**3.1 Indications at the unit**

**Text, STMA-77735** - At the front of the unit 4 three color LEDs are visible. Two of those LEDs (A and C, see [STMA-36942](#) ) are controlled by the safety processor in the unit, the other LEDs (B and D, see [STMA-44279](#) ) refer to the status AD converters.

The LEDs status can be used for fault finding.

**Definition, STMA-36942 - LED status:**

*The nine IDs defined below shall be used as separate states.*

*Each module which wants to control the LEDs can set a state. Which one prevails depends on the priority given in the table below.*

Severity Level	LED A	LED C	meaning
9	Green	Green	no fault



8	Green	Orange	non-specific fault
7	Green	Red	single power supply defect; exchange unit
6	Orange	Green	coils not detected or missing
5	Orange	Orange	no brake detection possible
4	Orange	Red	EB unavailable
3	Red	Green	ETCS related fault
2	Red	Orange	over / under temperature
1	Red	Red	exchange unit

**Text, STMA-76745** - The difference between "Severity level" 7 and 1 (both "exchange unit") is that with "Severity level" 7 normal operation is allowed and possible, however with higher risk on a failure leading to unavailability. So with "Severity level 7" the unit shall be replaced at a convenient moment, with severity level 1 the unit shall immediately be replaced.

Another status different from OK (severity level 9: "green", "green") indicates a fault which can be either inside or outside the STM ATB. Diagnostic information included in the JRU packets (especially JRU packet type 1: "events and measures") can be used, to trace the fault. If no external fault can be found and the status doesn't become OK (9) after a restart, then the STM ATB shall be replaced.

**Text, STMA-77732** - The meaning of LED B and D is defined in table **T** STMA-44279. LED B is used for channel A (coils cabin A-right and cabin B-left) and LED D is used for channel B (coils cabin B-right and cabin A-left).

**Text, STMA-44279** - During start-up of the STM ATB, status LEDs B and D blink shortly to indicate the status of the input channels.

LED B, D	Meaning
Red	Not active
Orange	Initialisation
Green	Operational

### 3.2 Legal information

**Text, STMA-77733** - JRU packet type 0 is used for information which shall be logged according to legal requirements. The definition of this packet is included in [STMA-75470 - Table: JRU Packet type 0 identifier Start byte type/units year 1 0 - 99 month 2...](#) .

**Definition, STMA-75470** - Table: JRU Packet type 0

identifier	Start byte	type/units
year	1	0 - 99
month	2	1 - 12
day	3	1 - 31
hour	4	0 - 23
minutes	5	0 - 59
seconds	6	0 - 59
not used	7	padding/not used
t_date_and_time	8	ms (32bit)
local_reference_time	12	ms (32bit)
d_sts	16	m
driver_operates_brakes	20	0 / 1
digital_inputs	21	<a href="#">STMA-75479</a>
guarded_speeds	22	km/h see <a href="#">STMA-75473</a>
selected_cabin	28	<a href="#">STMA-75474</a>
selected_direction	29	<a href="#">STMA-75471</a>
stm_state	30	<a href="#">STMA-75472</a>
stmatb_state	31	<a href="#">STMA-75476</a>
atbeg_state	32	<a href="#">STMA-75477</a>
atbv_state	33	<a href="#">STMA-75475</a>
atbeg_code	34	<a href="#">STMA-75478</a>
atbv_signal	35	<a href="#">STMA-75480</a>
eb_command	36	0 / 1
not used	37	padding/not used

not used	38	padding/not used
not used	39	padding/not used

**Definition, STMA-75479 - digital\_inputs**

0	digital input 1a
1	digital input 1b
2	digital input 2a
3	digital input 2b
4	digital input 3a
5	digital input 3b

**Definition, STMA-75473 - Guarded speeds**

Stores in 6 bytes with one byte per code for noCode, code96, code120, code147, code180, code220 with the speed in km/h.

**Definition, STMA-75474 - selected\_cabin**

0x00	cab_A
0x15	cab_B
0x2a	no_cab_active
0x3f	unknown

**Definition, STMA-75471 - selected\_direction**

0x00	neutral
0x15	forward
0x2a	backward
0x3f	unknown

**Definition, STMA-75472 - stm\_state**

0x00	State_CO
0x11	State_CO_Requested
0x22	State_CS
0x33	State_CS_FromCO_Requested

0x44	State_DA
0x55	State_DA_Trip
0x66	State_DA_Trip_CS
0x77	State_Failure
0x88	State_FailureEnd
0x99	State_FailurePost
0xaa	State_HS
0xbb	State_PO
0xcc	State_PO_Connected
0xdd	State_unknown

**Definition, STMA-75476 - stmatb\_state**

<b>0x00</b>	<b>State_Inactive</b>
0x15	State_Preparing
0x2a	State_Responsible
0x3f	State_unknown

**Definition, STMA-75477 - atbeg\_state**

<b>0x00</b>	<b>State_Attention</b>
0x24	State_Intervention
0x49	State_Braking
0x6d	State_No_ATBEG_area
0x92	State_Constant
0xb6	State_Off
0xdb	State_Entering_ATBEG_area
0xff	State_unknown

**Definition, STMA-75475 - atbv\_v\_state**

<b>0x00</b>	<b>State_BCM</b>
0x24	State_Overridden
0x49	State_Intervention

0x6d	State_STS
0x92	State_Monitoring
0xb6	State_Wait_for_monitoring
0xdb	State_Off
0xff	State_unknown

**Definition, STMA-75478 - atbeg\_code**

0x00	NoCode
0x11	Code257
0x22	Code220
0x33	Code180
0x44	Code147
0x55	Code120
0x66	Code96
0x77	Code75
0x88	Code50
0x99	Unknown

**Definition, STMA-75480 - atbv\_v\_signal**

0	Unknown
1	Release
2	3m
3	30m
4	120m

### 3.3 Reported events and measures

**Text, STMA-77734** - JRU packet type 1 is used to report event and measures. Events are mostly irregularities indicating a fault in or extern to the STM ATB. Events are also used to report specific operational conditions. Measures give an indication for the response of the system on the events. Some measures are stopped as soon as the event stopped, however other measures may continue, even if the event is not reported anymore. Table [STMA-77725](#) gives the structure of the packet, and refers to the detailed meaning of each of the events and measures.

The reported events and measures can be used to trace faults in case of a fault indicated by the LEDs at the front of the STM ATB. There is no need for regular checking of the JRU data, although regular analysis might be used to enhance the availability of the system.

**Definition, STMA-77725** - table: JRU Packet type 1

Variable	Start byte	Type/units
identifier	0	1
data	1	20 bytes (each 8 bits), defining events and measures For events see table <a href="#">STMA-77713</a> For measures, see table <a href="#">STMA-77714</a>

**Definition, STMA-77713** - Table: Event identification in JRU packet type 1

Description	Byte number	Bit number
Brake Pipe Pressure clipped	0	0
Configuration signal clipped	0	1
Coil signal clipped	0	2
75 Hz filtering fault.	0	3
fault concerning ATBEG coil signals, 2133.3 Hz fault detected	0	4
fault concerning ATBEG coil signals, 145 Hz fault detected	6	6
fault concerning ATBVv in the input circuits and/or in the IO Channels	0	5
a coil is missing.	0	6
Cabin with no coils selected.	0	7
Input channels out of sync	1	0
2133.3 Hz Test signal fault	1	1
145 Hz Test signal fault	1	2

spare input inconsistency fault	1	3
BHA inconsistency fault	1	4
BSO inconsistency fault	1	5
Brake Pipe Pressure consistency fault	1	6
Configuration consistency fault	1	7
EB unavailable	2	0
EB delay exceeds 300ms	2	1
Failure state of the STM state machine	2	2
NoSpeedInfo	2	3
BIU connection not available while STM state is DA (including sub states)	2	4
Illegal value or packet	2	5
Data format fault concerning input message	2	6
The driver tries to pass a signal not at danger using the ATBVv overrule procedure	2	7
Companion Chip Communication fault.	3	0
Profibus Cut-off circuit fault.	3	1
Profibus Cut-off detected.	3	2
Companion Chip reset not tested	3	3
Companion Chip MCU ESM fault	6	5
Telegram out queue reached maximum	6	4
single power supply failure	3	4
external disturbance containing code	3	5
multiple ATBVv frequencies detected	3	6
Coil Selection changed	3	7
Over Temperature error	4	0
Under Temperature error	4	1
Temperature Measurement Fault	4	2
Under_Overvoltage_Detected	4	3
Under_Overvoltage detection not available	4	4

IO Channel Timeout	4	5
Override Button Pushed	4	6
Override Button Released	4	7
BD Button Pushed	5	0
BD Button Released	5	1
Release Button Pushed	5	2
Release Button Released	5	3
Attention Button Pushed	5	4
Attention Button Released	5	5
FPGA_Powerdown Detected	5	6
No brake detection available	5	7
Three input channel resets within 60s	6	0
Input Handler Diagnostics skipped	6	1
Analogue input fault	6	2
75 Hz in configuration signal	6	3

**Definition, STMA-77714** - Table: Measure identification in JRU packet type 1

Description	Byte number	Bit number
Reset Input Block	10	0
Reset Decoder Only	10	1
Hold Safe State	10	3
Ignore BHA	10	4
Ignore BSO	10	5
Ignore Pressure	10	6
Ignore Config	10	7
Ignore Spare	11	0
Hide White Lamp	11	1
Hide Cab signals	11	2
Reduced low speed level	11	3




Reduce Train Speed


















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### 3.4 Analogue configuration, status and performance data

**Text, STMA-77737** - For configuration management and fault finding, status information is sent to the JRU in packet type 2 at least once per 10s. This packet is described in  STMA-75493.

**Definition, STMA-75493** - Table: JRU Packet type 2

identifier	0	2
coil_type_a	1	 STMA-75488
coil_type_b	2	 STMA-75488
cbp_used	3	0-1
cbp	4	0 - 65535
not used	6	--
fp_version	8	 STMA-75490
pp_version	12	 STMA-75490
fpga_version	16	 STMA-75490
netx_error_count	20	0 - 255,  STMA-75485
ptp_error_count	21	0 - 255,  STMA-75487
sl_error_count	22	0 - 255,  STMA-75483
sl_error	23	 STMA-75484
sl_telegram_in_count	24	0 - 65535,  STMA-75495
sl_telegram_out_count	26	0 - 65535,  STMA-75496
short_loop_time	28	0 - 65535,  STMA-75482
short_loop_counter	30	0 - 65535,  STMA-75492
long_loop_time	32	0 - 65535,  STMA-75494
long_loop_counter	34	0 - 65535,  STMA-75489
magn_75hz_left	36	float,  STMA-75491
magn_75hz_right	40	float,  STMA-75486
magn_1145hz	44	float
magn_1445hz	48	float

magn_1744_5hz	52	float
magn_2353hz	56	float
magn_2670_5hz	60	float
magn_traction_left	64	see below
magn_traction_right	88	see below

**Definition, STMA-75488 - Coil Type**

0x00	Alstom Bar
0x24	Fase 3
0x49	Alstom V
0x6d	No Coil
0x92	PW170_0
0xb6	Unknown
0xdb	PW225_30

**Definition, STMA-75490 - Version (fp, pp, fpga)**

Versions are stored as 32 bits. Currently this is further divided into major, minor and manufacturer.

major version	0	0 - 255
minor version	1	0 - 65535
manufacturer	3	0 - 255

**Definition, STMA-75485 - netx\_error\_count**

Number of errors reported by the NetX driver in the profibus processor.

**Definition, STMA-75487 - ptp\_error\_count**

Number of PTP reported by the profibus processor.

**Definition, STMA-75483 - sl\_error\_count**

Number of errors detected so far by the safety layer.

**Definition, STMA-75484 - sl\_error**

The most recently by the safety layer detected error. Note that the safety layer can detect several errors at a single invocation. Only one is reported.

00	crc_error
04	auth_acknowledge_takes_too_long

08	sequence_number_error
0c	protocol_error_during_setup
10	authentication_error
14	unexpected_run
18	stt_max_problem
1c	time_order_problem_sent
20	stl_version_error
41	all_is_ok
45	auth_request_takes_too_long
49	safety_level_mismatch
4d	sll_version_mismatch
51	got_disconnect_for_idle_or_defect
55	telegram_has_no_timestamp
59	long_term_drift_problem
5d	lack_of_time_telegrams
61	syncreftime_telegram_too_short
82	set_up_takes_too_long
86	idle_receive_timeout
8a	unknown_safety_level
8e	got_idle_while_in_connect_setup
92	got_data_while_not_in_state_data
96	unknown_stl_telegram
9a	short_term_drift_problem
9e	telegram_too_short
a2	startup_telegram_too_short
c3	connect_confirm_takes_too_long
c7	unknown_command
cb	setup_for_an_existing_connection
cf	got_auth_for_sl0_connection

d3	unexpected_ready_to_run
d7	stt_min_problem
db	time_order_problem_reception
df	telegram_too_long
e3	data_telegram_too_short

**Definition, STMA-75495** - sl\_telegram\_in\_count

Number of telegrams received according to the Safety Layer.

If the system is running properly this should match telegram\_in\_count

**Definition, STMA-75496** - sl\_telegram\_out\_count

Number of telegrams sent according to the Safety Layer.

**Definition, STMA-75482** - short\_loop\_time

Time in ms spend on the short loop since the previous JRU packet.

**Definition, STMA-75492** - short\_loop\_counter

Number of short loops performed since the previous JRU packet.

**Definition, STMA-75494** - long\_loop\_time

Time in ms spend on the long loop since the previous JRU packet.

**Definition, STMA-75489** - long\_loop\_counter

Number of long loops performed since the previous JRU packet.

**Definition, STMA-75491** - magn\_traction\_left

The magnitudes of the traction currents from the left coil per frequency.

Variable	Start byte	Type/units
300 Hz	64	float
400 Hz	68	float
450 Hz	72	float
600 Hz	76	float
900 Hz	80	float
1200 Hz	84	float

**Definition, STMA-75486** - magn\_traction\_right

The Magnitudes of the traction currents from the right coil per frequency.

Variable	Start byte	Type/units
300 Hz	88	float

400 Hz	92	float
450 Hz	96	float
600 Hz	100	float
900 Hz	104	float
1200 Hz	108	float

## 4 Maintenance activities

### 4.1 Preventive maintenance

**Text, STMA-77738** - The STM ATB doesn't require preventive maintenance, nor configuration when (re)installing.

### 4.2 Corrective maintenance

**Text, STMA-77740** - The STM ATB is a line replaceable unit. If based on the available diagnostics is concluded that the STM ATB is defective then the unit shall be exchanged.

### 4.3 System storage conditions

**Text, STMA-77741** - The following storage conditions for STM ATB shall be taken into account:

Storage temperature:

- Nominal storage temperature is between 0°C and 40°C.
- The ambient temperature shall not change more than 3°C / hour.

Humidity:

- STM ATB shall be stored in dry storage conditions
- The humidity may vary between 5 % and 95% (non condensing).

### 4.4 System disposal

**Text, STMA-77742** - System disposal shall comply with regulatory requirements:

- 2012/19/EU WEEE Directive