M9.2 Manufacturing Manual

for the development of an STM ATB

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Document ID	M9.2
Version	2.0
Revision	546137
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Reviewed	546137 ,STMA-79823
Approved	546137 ,STMA-79835
Archive	SID-ERTMS-1000810
Date:	2020/07/24 11:50

Authorization

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Contents

1 Introduction

1.1 What is an STM ATB

Text, STMA-68992 - An STM is a train protection system which prevents trains from over speeding and/or unauthorized movements. It allows ETCS equipped trains to operate on conventional (non ETCS) lines. An STM ATB is a "Specific Transmission Module" designed and built according to the ERA ERTMS specifications and national requirements for ATB-EG. When integrated with an onboard ETCS system, the combination of STM ATB and the ETCS onboard system ensures all ATB-EG and ATB-Vv functionalities on ATB equipped lines.

1.2 Purpose
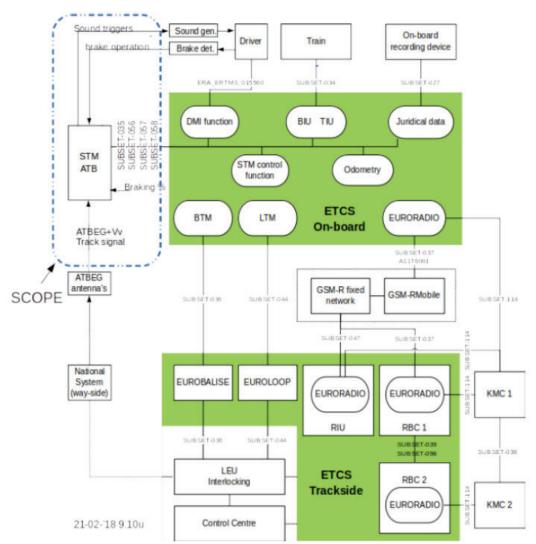
Text, STMA-68987 - This document is the manufacturing manual for STM ATB. It provides instructions and guidance for the production of the hardware, the installation of the firmware, the final assembly of the system and production of the cable sets.

1.3 Scope

Text, STMA-68989 - Figure 1 (▌ STMA-69011) is taken from the ETCS specifications (subset-035). It shows the ETCS reference architecture and the integration of the STM ATB with the ETCS onboard system. The scope for this manual is marked.

Definition, STMA-69011 - Figure 1: ETCS reference architecture and scope of this manual

2 HQSE guidance note

Definition, STMA-69012 - In this document the following graphical elements are used to emphasize HQSE relevance:

⚠️	**DANGER** Denotes a danger with a high HQSE content which must always be avoided.

☞	**WARNING** Denotes a risk with medium HQSE content which always requires attention as indicated.

💡	**REMARK** Denotes a situation with no or only minor HQSE content which is best served by attention as indicated.

Text, STMA-69322 - All parts of this STM ATB manufacturing procedure may only be executed if all prevailing health and

safety requirements are met. These health and safety requirements include, but are not limited to:

- proper staff training and qualification for the tasks to performed;
- appropriate HQSE measures, based on project specific risk inventory;
- proper use of personal protective equipment.

The manufacturer shall provide its staff with appropriate instructions and oversees the adherence thereof.

3 References

3.1 Reference documents

Text, STMA-69003 -

Ref.nr.	Document ID	Title	Revision
1	2012/19/EU	WEEE Directive	04.07.2012
2	2016/797/EU	Interoperability Directive	11.05.2016
3	2016/798/EU	Railway Safety Directive	11.05.2016
4	2016/919/EU	Technical Specification of Interoperability for Control Command and Signaling	17.05.2016
5	EN 45545	Fire Protection on Railway Vehicles	
6	EN 50121	Railway Applications. Electromagnetic Compatability	2015
7	EN 50125-1	Railway Applications – Environmental Conditions for Equipment – Part 1: Rolling Stock and On-board Equipment	2014
8	EN 50155	Railway Applications. Rolling Stock. Electronic Equipment	2007 (Incl 2010 addendum)
9	EN 50264	Railway Applications – Railway Rolling Stock Power and Control Cables having Special Fire Performance	2008
10	IEC 61158-2	Industrial Communication Networks – Fieldbus Specifications – Part 2: Physical Layer Specification and Service Definition	2014
11	IEC 61373	Railway Applications – Rolling Stock Equipment – Shock and Vibration Tests	2010
12	IPC-2581		

3.2 Abbreviations, definitions and terminology

Text, STMA-69004 - Table 1: abbreviations [P6.2]

abbreviation	legend
AC	Alternating Current
ADC	Analog to Digital Converter
AIN Board	Analog Input Board

ATB	Automatische Trein Beïnvloeding – Dutch national ATP system
ATB-EG	First generation ATB in the Netherlands, based on 75 Hz encoded track signal
ATB-Vv	Improved version of ATB-EG system, with add on balises and signal loops for protection of trains at 0-40 km/h
ATP	Automatic Train Protection
BIU	Brake Interface Unit
CCS	Control, Command and Signaling
CPU	Central Processing Unit
DC	Direct Current
DI	Digital Input
DIO+PS Board	Digital IO plus Power Supply Board
DMI	Driver Machine Interface
DO	Digital Output
ECM	Entity in Charge of Maintenance
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Norm
ERA	European Railway Agency
ERTMS	European Rail Traffic Management System
ESD	Electrostatic Discharge
ETCS	European Train Control System
EVC	European Vital Computer (part of the ETCS onboard system)
GND	Ground
GSM-R	Global System for Mobile Communications - Railways
IEC	International Electrotechnical Commission
IO	Input Output
JRU	Juridical Recorder Unit
LED	Light Emitting Diode
LRU	Line Replaceable Unit
N/A	Not Applicable
NC	Normally Closed
NO	Normally Open
NOBO	Notified Body
PCB	Printed Circuit Board
PE	Protective Earth
PROFIBUS	Process Field Bus

PSU	Power Supply Unit
SAP Board	Safe APplication Board
STM	Specific Transmission Module
STS	Signal at danger (stoptonend sein)
TBD	To Be Defined
TIU	Train Interface Unit
TSI	Technical Specifications for Interoperability
UIC	International Union of Railways
USB	Universal Serial Bus

3.3 Requirement identification

Text, STMA-68994 - The STM ATB product development project makes use of an automated requirement management system and references to the requirements have been made in this document. Each requirement has been assigned with a unique ID, with the format "STMA-<number>".

4 Audience

Text, STMA-68995 - This ATB STM manufacturing manual is intended to be used by manufacturing, production, testing and supervising staff qualified and responsible for the production of electronic systems and for the STM ATB system integrator.

Text, STMA-69127 - The qualification demands are to be determined by the management of the manufacturer concerned in accordance with the safety demands, statutory and customer requirements.

5 Manufacturing guidelines

5.1 Organizational guidelines

Definition, STMA-68986 - The STM ATB product development and production are subject to the European Commission Decision on modules 2010/713/EU. The conformity of the product development of the STM ATB has been assessed and certified by the Notified Body(NOBO) TÜV Süd according to 2010/713/EU module CB.

As such, the production of the STM ATB is subject to one of the following two 2010/713/EU modules:

- *Module CD. Conformity to type based on quality management system of the production process:*
  - requires the manufacturer to operate a quality management system approved by a NOBO for the production, final product inspection and testing of electronic systems and be subject to surveillance under the responsibility of that NOBO as well as to draw up a written EC declaration of conformity for the electronic system and keep it at the disposal of the national authorities for 10 years after the last STM ATB has been manufactured;

- *Module CF. Conformity to type based on product verification:*
  - Requires the manufacturer to operate an assessment procedure under examinations and tests by a NOBO based on individual (as opposed to statistical (according to TSI CCS ch. 6.2.2)) product verification which ensures conformity of the system with the approved type described in the EC-type examination certificate and with the requirements of the TSI that apply to them;

The manufacturer shall select one of these two 2010/713/EU modules (CD or CF) to comply with in the production of the STM ATB and all of its components as well as a NOBO to assess and certify the production according to the selected module.All parts of this manufacturing procedure shall be subject to that.

Proper waste management shall be implemented in accordance with the prevailing statutory requirements including, but not limited to WEEE Directive 2012/19/EU.

The manufacturer provides its staff with appropriate instructions and oversees the adherence thereof.

5.2 PCB production guidelines

All environmental requirements from ▯ STMA-8548 - D4.5 Environmental Requirement Specification (ERS) have been taken into consideration in the development of the STM ATB. However special consideration has to be given to the following EN50155 requirements during production:

Requirement, STMA-8596 - EN50155, subsection 9.2.3: Connections to components shall be made such that no mechanical or thermal stress exceeds the limits specified for the component.
Bending of component leads shall not cause damage or permanent stress to the component body/lead junction.

Requirement, STMA-16115 - EN50155, Section 9.6.2: Printed boards shall be procured and manufactured according to the provisions of the relevant Specification from the list below:
- EN 123000 (Generic Specification - Printed boards);
- EN 123200 (Sectional Specification - Single and double sided printed boards with plain holes);
- EN 123300 (Sectional Specification - Multilayer printed boards);

Requirement, STMA-16117 - EN50155, Section 9.6.4: The base material shall be an epoxide woven glass fabric laminated sheet of defined flammability (vertical burning test) for rigid printed boards and for use in the fabrication of multilayer printed boards, according to EN 61249-2-7, EN 61249-2-10 and EN 62326, as appropriate.
Other materials may be used providing they meet or exceed the performance of base material specified above.

Requirement, STMA-8606 - EN50155, Section 9.11: All materials shall be dimensionally stable, non-hygroscopic, resistant to fungal growth and either non ignitable or resistant to flame propagation (the latter is covered by EN45545)
and
no material shall be on the RoHS list, Directive 2002/95/EG and Directive 2011/65/EU
and
no material shall be on the REACH list, EC regulation 2006/1907/EU.

Requirement, STMA-76561 - Appropriate quality inspections/tests on the PCB shall be done to ensure the absence of whiskers in the solder.

The PCB production shall be compliant to IPC Class 3: "High Reliability or Harsh Operating Environment Electronic Products — [12] Includes the equipment and products where continued performance or performance on demand is critical. Equipment downtime cannot be tolerated and must function when required such as in life support items or flight control systems. Printed boards in this class are suitable for applications where high levels of assurance are required and service is essential."

Definition, STMA-68984 - The manufacturing of the STM ATB is subject to the European Commission Decision on modules 2010/713/EU, module CB and one of the three modules CD or CF. As such, the manufacturing of all parts is also subject to 2010/713/EU. As such, the STM ATB manufacturer shall check that all parts and the assembly have been produced and tested in accordance the applicable modules of 2010/713/EU (summarized in 5.1 Organizational requirements) and that type conformity is ensured.

Therefore, the manufacturer of the PCBs shall perform at least the tests contained in:

- Boundary scan tests and test environment are described in D7.1.5.0.1.

- D7.1.0 Hardware Test Plan
- D7.1.5.0 SAP Board Unit Test Plan

5.3 Issue and change management

Definition, STMA-76388 - The manufacturer shall have a quality system compliant to ISO9001 to ensure continued registration of components, modules and configurations of systems. This should also incorporate an obsolescence process for all components used in the STM ATBEG.

6 Hardware production

Definition, STMA-74093 - All required information for the production of the PCBA is contained in the Technical Production Dossier. For each of the four PCB's a separate TPD has been developed. Please refer to:

1. TPD Backplane
2. TPD AIN Board
3. TPD DIO+PS Board
4. TPD SAP Board

6.1 Conformal Coating and Glue

6.1.1 General description

Text, STMA-74573 - This paragraph explains how the coating and gluing of the boards shall be done.

Hardware Design, STMA-74574 - The gluing is a measure against vibration damages for the larger components. The glue to be used is (or similar):

- Bostik super fix 009

Hardware Design, STMA-74572 - The coating is a measure against the infuences of dirt, moisture and salt mist of the components and the PCB. The coating to be used is (or similar):

Conformal Coating:

- EHFAC200H - Coating, Acrylic Conformal Coating, Halogenated Free, Aerosol, IPC-CC-83
- The thickness of the coating shall be 40 um or more.

Text, STMA-74575 - Working sequence:

- Masking the non coated area's.
- Spraying the coat.
- Gluing

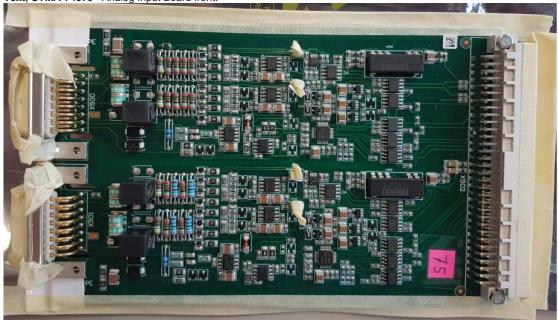**6.1.2 Coating preparation**

Text, STMA-74583 - The figures below show which parts shall be covered during coating to preserve a clean surface.

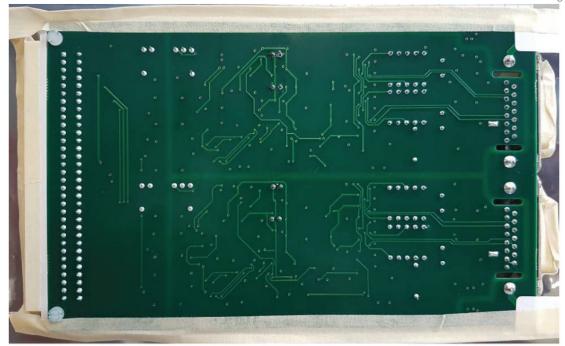**Text, STMA-74584 -** Backplane front:

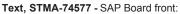- The connector contacts shall be covered, the rest shall be coated.

Text, STMA-74579 - Analog Input Board front:

Text, STMA-74580 - Analog Input Board back:

- The connector contacts shall be covered.
- The connector shielding and screw holes shall be covered to preserve a clean surface for good grounding.
- The grounding pads in the left corner shall also be covered to preserve a clean surface for good grounding.
- The pin headers shall be covered.
- The sides of the PCB shall be covered to prevent the boards from getting stuck when inserting the PCBA's into the enclosure.
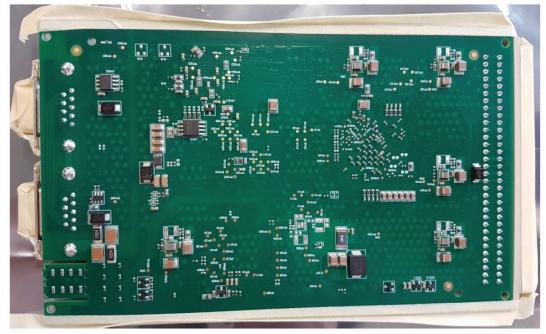
Text, STMA-74577 - SAP Board front:

- All connectors, contacts and shields shall be covered to prevent coating and to preserve a clean contact surface.
- Special care shall be taken arround the FPGA and NetX. The coating should cover the remaining airgap between the processor and the PCB surface.
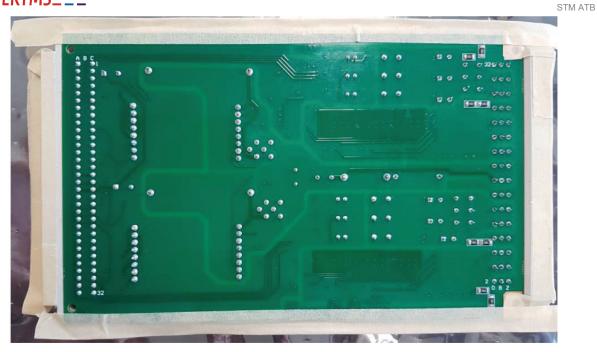
Text, STMA-74578 - SAP Board back:

- The connector contacts shall be covered.
- The connector shielding and screw holes shall be covered.
- The grounding pads shall also be covered.
- The pin headers shall be covered
- The sides of the PCB shall be covered to prevent the boards from getting stuck when inserting the PCBA's into the enclosure.

Text, STMA-74581 - PS-DIO Board front:

Text, STMA-74582 - PS-DIO Board Back:

- The connector contacts shall be covered.
- The sides of the PCB shall be covered to prevent the boards from getting stuck when inserting the PCBA's into the enclosure.

6.1.3 Coating procedure

Text, STMA-74591 - Refer to the coating procedure prescribed by the supplier of the coating.
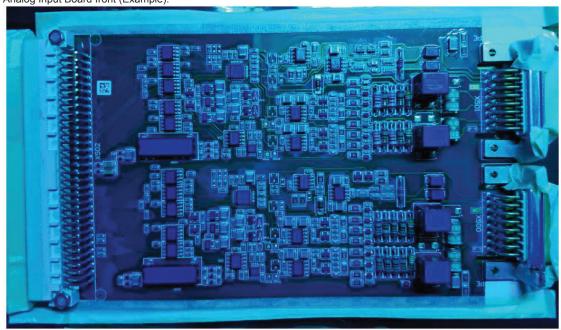The thickness of the spray shall be at a minimum of 40 um.

Text, STMA-74592 -
Optical check:
The coating thickness can be seen with a UV-lamp with a wavelength around the 375 nm.
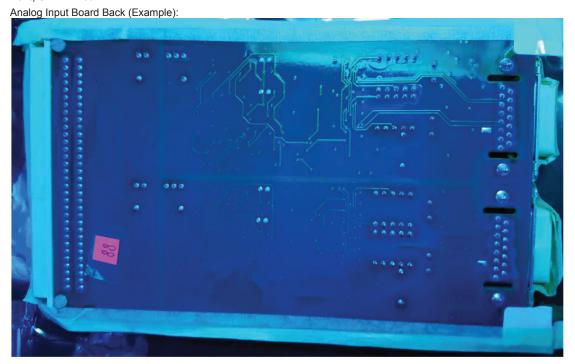The thicker the coating the more deeper the blue color.
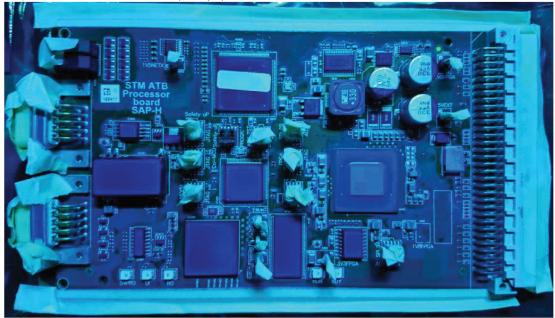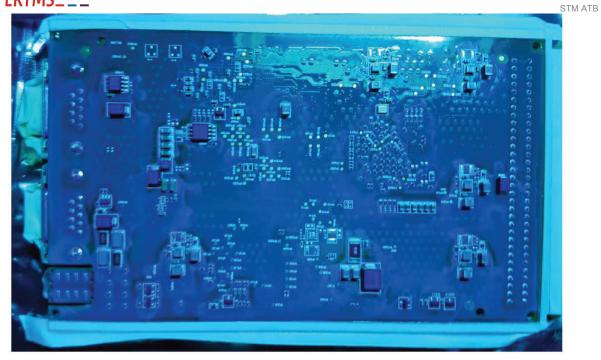
Analog Input Board front (Example):

Text, STMA-74594 -

Analog Input Board Back (Example):

* The sticker was removed before coating.

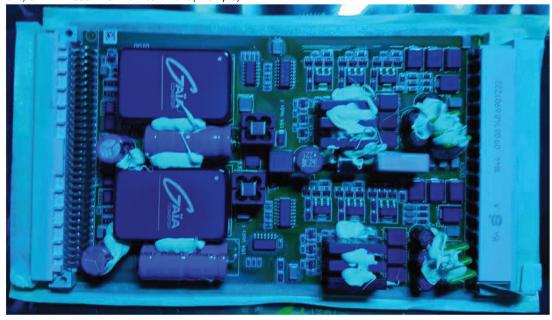**Text, STMA-74593 -** SAP Board front (Example):

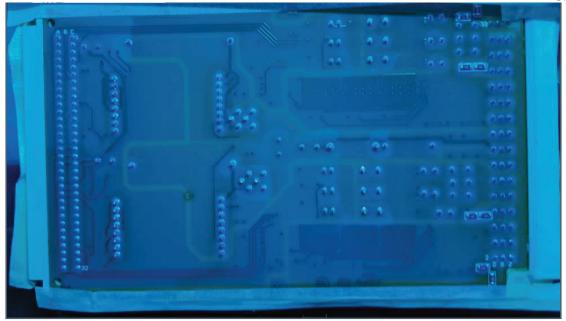**Text, STMA-74598 -** SAP Board back (Example):

Text, STMA-74596 - PS-DIO Board front (Example):

Text, STMA-74597 - PS-DIO Board back (Example):

6.1.4 Gluing instructions

Text, STMA-74600 - After the coating has hardened, the components at risk of vibration damages on the PS-DIO Board shall be glued together.
The components at risk are:

- The elco's
- The yellow fuses
- The black coils (by the yellow fuses)
- The six black rectangular components in the middle.

7 Software installation and testing

Text, STMA-77952 - The procedure for software installation and testing described in this chapter is used for a small series. Automated systems may be used by the manufacturer. Configuration and sequence of programming when using such tools can be derived from the description below.

The software of the STM ATB shall be loaded on the processors on the SAP Board.

⚠	**DANGER** Check that all HQSE procedures for working safely have been fulfilled.

The manufacturer shall always ascertain that the latest software version is installed. The current Product Safety Case describes the correct firmware versions that are allowed to be in operation in the STM ATB. Any other firmware version can lead to unsafe system responses and are NOT allowed to be used in anything othet than a test setup.

Text, STMA-69128 - The installation procedure consists of 7 parts:

1. Preparation;
2. Loading the software onto the Hercules processor;
3. Debugging;
4. Loading the software on the TIVA (co)processor;
5. Loading the software on the netX processor;
6. Loading the software on the FPGA processor;
7. Testing the software.

Definition, STMA-69122 -

☞	**WARNING** The software loading procedure always starts with loading the software on the Hercules processor, followed by debugging. Only thereafter loading the software on the TIVA (co)processor, the netX processor and the FPGA processor may be started.

7.1 Preparation

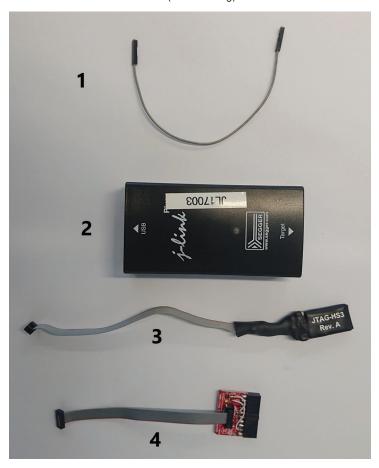**Definition, STMA-69123 -**

⚠	**DANGER** Check that all HQSE procedures for working safely have been fulfilled.

Definition, STMA-69041 - Check that all tools and materials required for the software loading procedures are available:

- laptop with software:
  - J-Flash V6.30b;
  - netX Bootwizard 1.4.0.1;
  - netHOST v1.0.0.0;
  - Vivado 2017.3;

- power supply connector with ON/OFF switch (230 V AC standard power supply – 12 V DC Backplane connector (pins A18 and C18 (+) and A15 and C15 (-)));
- JLink cable connector (modified) as shown below as nr 4;
- Jlink Segger Version 10.1 as shown below as nr 2

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- Cable with two single pin connectors, as shown below as nr 1;

- bootloader cable connector (mUSB – Jtag) as shown below as nr 3.

7.2 Loading the software onto the Hercules processor

Definition, STMA-69039 -

1. Establish power supply to the SAP Board.

- Apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector;

Definition, STMA-69040 -

Figure: Hardware connections for loading the software on the Hercules processor

2. Connect a USB port of the laptop with the X901 connector on the SAP Board. Using the JLink segger, standard USB cable and JLink cable connector (Nr 4)
In ⚡ STMA-69040 the jumper to be connected is encircled.

3. Open the software loading program "J-Flash V6.30b" on the laptop;

4. The pop-up "Welcome to J-Flash" appears. Select "Create a new project" and click "Start J-Flash" (Figure ⚡ STMA-69052);
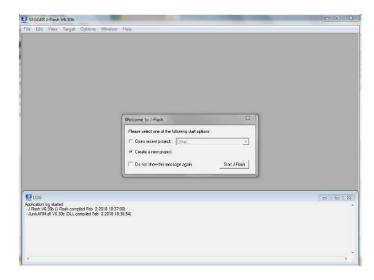
Definition, STMA-69052 -

Figure: Welcome to J-Flash [Project]

Definition, STMA-69053 -

5. The pop-up "Create New Project" appears. Click the "Target Device" browse button "…" (Figure ⚡ STMA-69050);
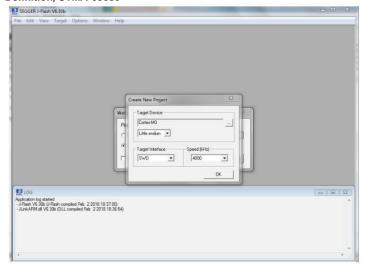
Definition, STMA-69050 -

Figure: Create new project 1 [Project_2]

Definition, STMA-69051 -

6. The "Select Device" browse window appears. First select Manufacturer "TI", then select Device "RM48L9x" and click "OK" (Figure ¡ STMA-69055);
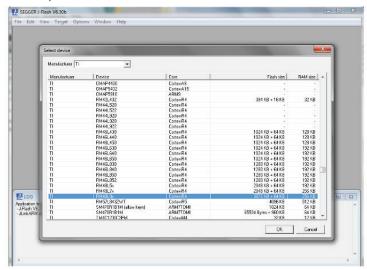
Definition, STMA-69055 -

Figure: Select device [Project_3]

Definition, STMA-69056 -

7. The pop-up "Create New Project" re-appears. Select "Target Interface" "JTAG", then "Speed [kHz]" "9600" and click "OK" (Figure ¡ STMA-69054);
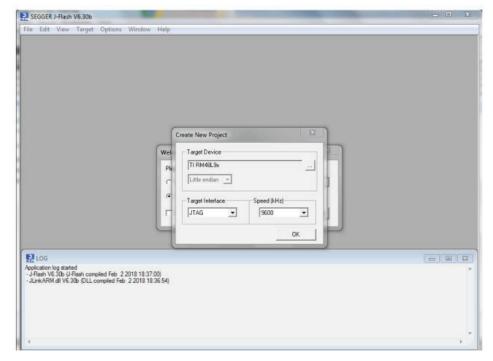
Definition, STMA-69054 -

Figure: Create new project 2 [Project_4]

Definition, STMA-69120 -

8. Click "File" (on the top ribbon) and select "Open data file" on the pop-up (Figure ⁞ STMA-69048);

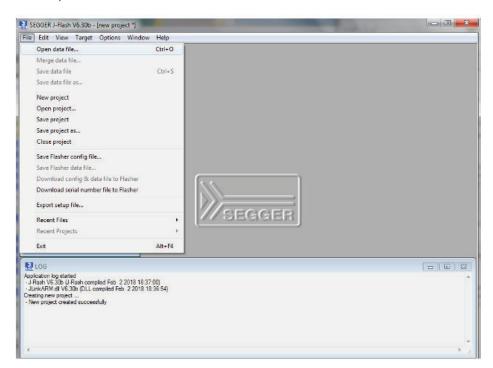**Definition, STMA-69048 -**

Figure: Open data file [LoadFile_1]

Definition, STMA-69049 -

9. The Explorer window "Open data file" opens. Select File type ".bin", then select file "fpmain.bin" and click "open" (Figure STMA-69047);

Definition, STMA-69047 -

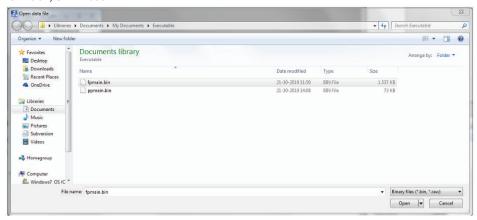Figure: Select data file [LoadFile_select]

Definition, STMA-69045 -

10. The pop-up "Enter start address" appears. Enter "0" (zero) and click "OK" (Figure STMA-69046)

Definition, STMA-69046 -
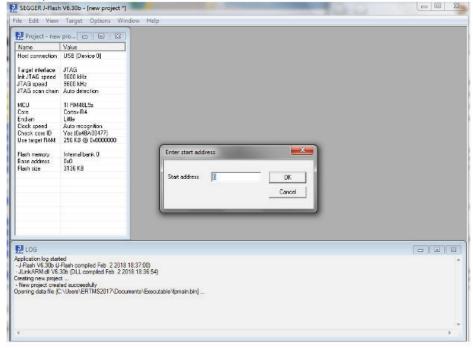
Figure: Enter start address [LoadFile_2]

Definition, STMA-69121 -

11. The file "fpmain.bin" now loads and the screen "….\Executable\fpmain.bin" appears (Figure STMA-69073);

Definition, STMA-69073 -
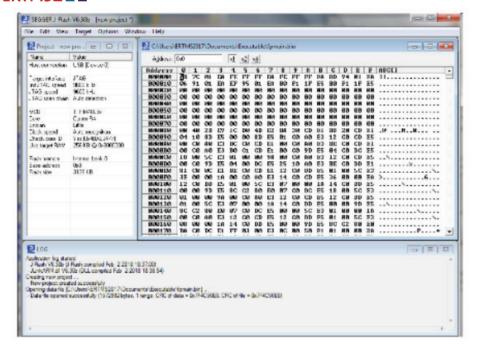
Figure: Screen fpmain.bin [LoadFile_3]

Definition, STMA-69074 -

12. Click "Target" (on the top ribbon) and select "Connect" on the pop-up (Figure ⸬ STMA-69066);

Definition, STMA-69066 -

Figure: Connect Target [Connect]
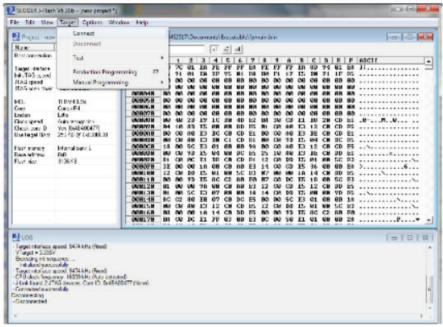
Definition, STMA-69067 -

13. If the pop-up "J-Link V6.30b Internal Error" appears, ignore the error, click "OK" (Figure ⸬ STMA-69064), and continue with step 14, immediately if this error message doesn't appear;

Definition, STMA-69064 -

Figure: Internal error [Connect_error]
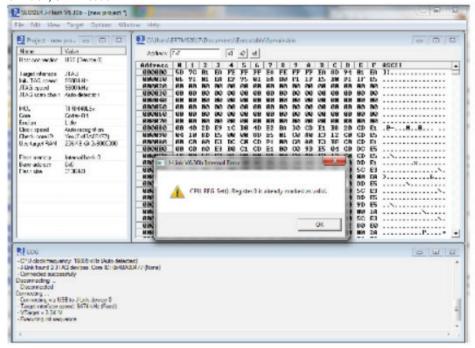
Definition, STMA-69065 -

14. Again click "Target" (on the top ribbon) and select "Production Programming" on the pop-up (Figure ⁞ STMA-69069);

Definition, STMA-69069 -

Figure: Production programming [Program]

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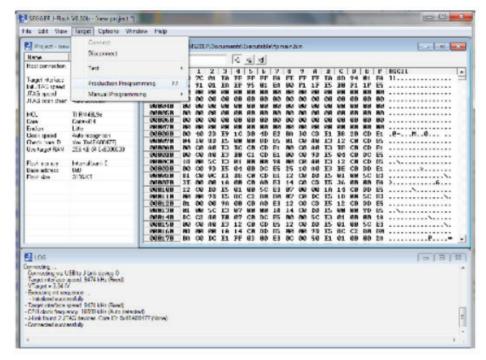
Definition, STMA-69071 -

15. The pop-up "J-Flash" appears with a progress bar. The software is loaded on the Hercules processor (Figure ⁞ STMA-69068);

Definition, STMA-69068 -
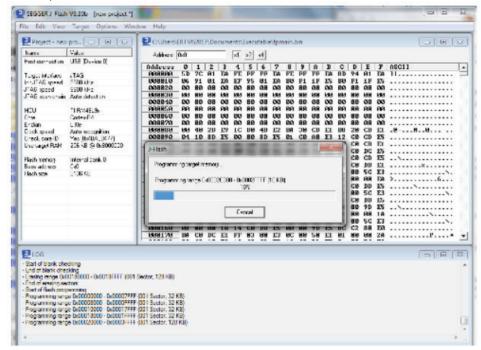
Figure: Progress bar [Program_load]

Definition, STMA-69062 -

16. When the software is loaded on the Hercules processor, the timeline on the pop-up is replaced by the message "Target erased, programmed and verified successfully – Completed after … sec". Click "OK" (Figure ⁞ STMA-69063);

Definition, STMA-69063 -

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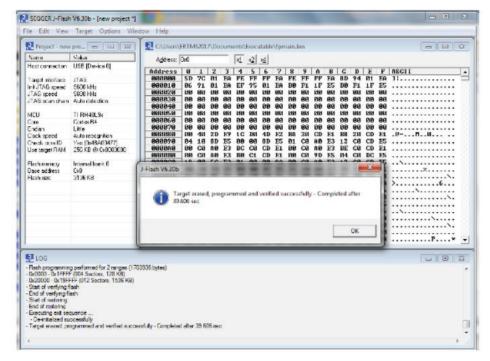
Figure: Hercules programmed and verified successfully [Program_done]

Definition, STMA-69060 -

17. The software is successfully loaded onto the Hercules processor. Close the program "J-Flash V6.30b" on the laptop by clicking "X" in the top right corner of the screen:

- If the message "Target erased, programmed and verified successfully – Completed after … sec" does not appear, the loading of the software on the Hercules processor is not confirmed or failed. In that case only, go back to step 3 and follow the procedure from there for a second time;

Definition, STMA-69061 -

18. Disconnect the JLink cable connector from connector X901 on the SAP Board and continue with ⬚ STMA-69058 - Debugging ;

7.3 Debugging

Definition, STMA-69059 -

1. Establish power supply to the SAP Board
   - Apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector;

Definition, STMA-69070 -

2. Connect pin 1 of the X103 connector with any GND pin, for instance pin C32 of the Backplane connector (Figure ⬚ STMA-69072);

Definition, STMA-69072 -

Figure: Hardware connection for debugging

Definition, STMA-69078 -

3. Switch the power supply OFF and, after waiting at least 2 seconds, ON again;

Definition, STMA-69079 -

4. The LEDs A and C on the front of the SAP Board flash orange. Continue with ▯ STMA-69076 - Loading the software on the TIVA (co)processor .

7.4 Loading the software on the TIVA (co)processor

Definition, STMA-69077 -

1. Establish power supply to the SAP Board.

- Apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector;

Definition, STMA-69075 -

Figure: Hardware connection for loading the software on the TIVA co(processor)

Definition, STMA-69124 -

2. Connect a USB port of the laptop with the X1200 connector on the SAP Board, using a standard USB cable, a Jlink Segger (Nr 2) and the JLink cable connector (Nr 4) (Figure STMA-69075);

3. Open the software loading program "J-Flash V6.30b" on the laptop;

4. The pop-up "Welcome to J-Flash" appears. Select "Create a new project" (Figure STMA-69313).

Definition, STMA-69313 -

Figure: Welcome to J-Flash [Project]
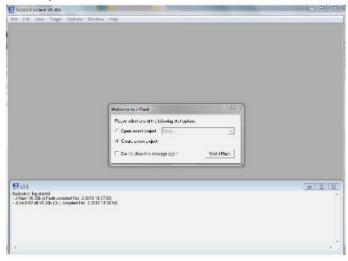
Definition, STMA-69125 -

5. The pop-up "Create New Project" appears. Click the "Target Device" browse button "…" (Figure STMA-69126)

Definition, STMA-69126 -
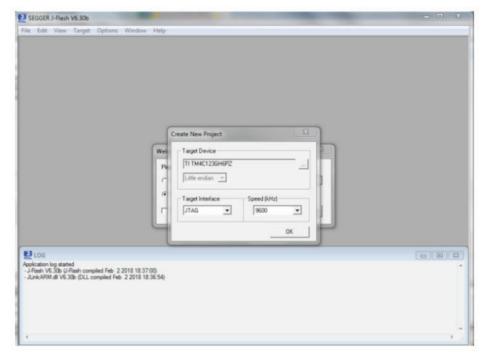
Figure: Create new project 1 [Project_settings]

Definition, STMA-69148 -

6. The "Select Device" browse window appears. First select Manufacturer "TI", then select Device "TM4C123GH6PZ" and click "OK" (Figure ┇ STMA-69149);

Definition, STMA-69149 -
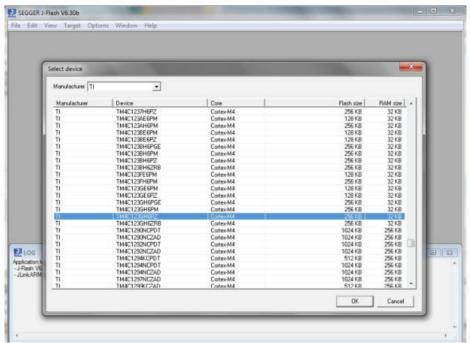
Figure: Select device [Project_device]

Definition, STMA-69139 -

7. The pop-up "Create New Project" re-appears. Select "Target Interface" "JTAG", then "Speed [kHz]" "9600" and click "OK" (Figure ⏐ STMA-69140);

Definition, STMA-69140 -
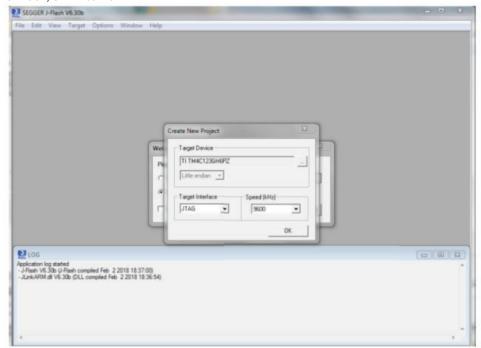
Figure: Create new project 2 [Project_settings]

Definition, STMA-69137 -

8. Click "File" (on the top ribbon) and select "Open data file" on the pop-up (Figure ⏐ STMA-69138).

Definition, STMA-69138 -

Figure: Open data file [LoadFile_1]
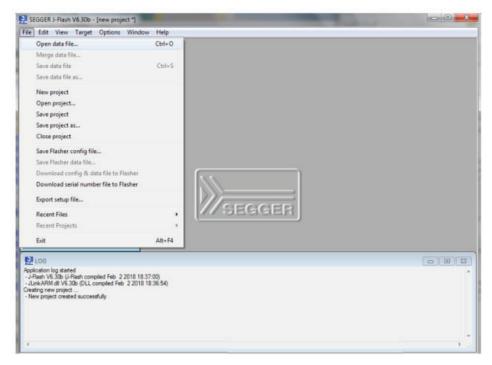
Definition, STMA-69144 -

9. The Explorer window "Open data file" opens. Select File type ".bin", then select file "ppmain.bin" and click "open" (Figure STMA-69146);

Definition, STMA-69146 -
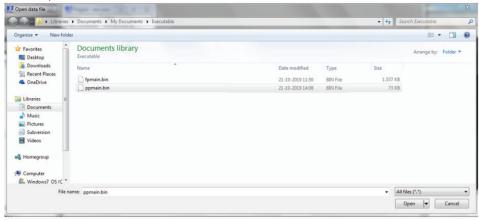
Figure: Select data file [LoadFile_2]

Definition, STMA-69141 -

10. The pop-up "Enter start address" appears. Enter "0" and click "OK" (Figure STMA-69153);

Definition, STMA-69153 -
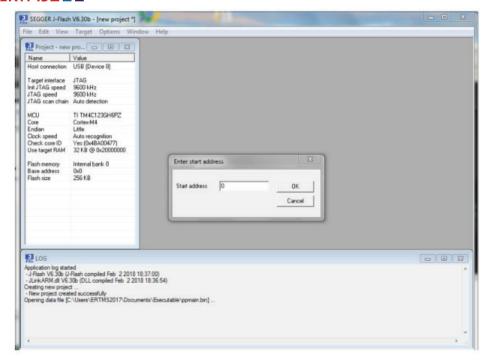
Figure: Enter start address [LoadFile_3]

Definition, STMA-69155 -

11. The file "ppmain.bin" now loads and the screen "….\Executable\ppmain.bin" appears (Figure ⸬ STMA-69151);

Definition, STMA-69151 -
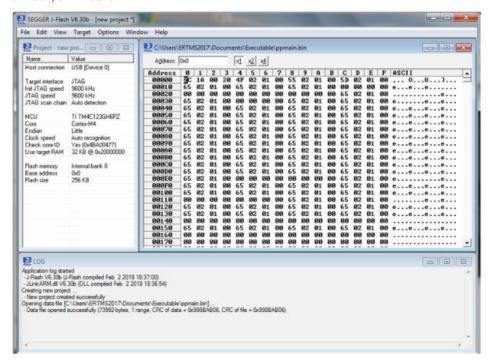
Figure: Screen ppmain.bin [LoadFile_done]

Definition, STMA-69152 -

12. Click "Target" (on the top ribbon) and select "Connect" on the pop-up (Figure ⁞ STMA-69150);

Definition, STMA-69150 -

Figure: Connect target [Connect]
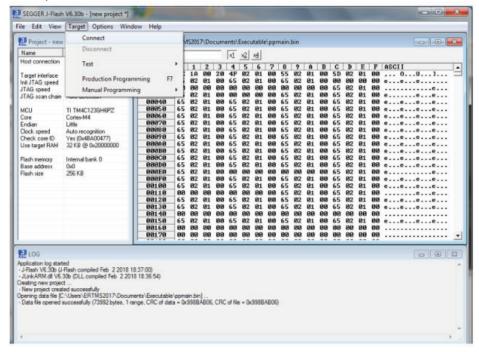
Definition, STMA-69145 -

13. If the pop-up "J-Link V6.30b Internal Error" appears, ignore the error, click "OK" (Figure ⁞ STMA-69147), and continue with step 14, immediately if this error message doesn't appear;

Definition, STMA-69147 -

Figure: Internal error [Connect_error]
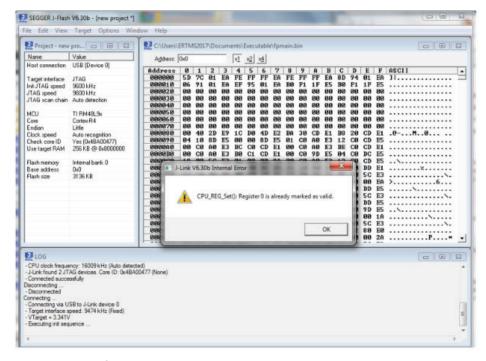
Definition, STMA-69142 -

14. Again click "Target" (on the top ribbon) and select "Production Programming" on the pop-up (Figure ⁞ STMA-69143);

Definition, STMA-69143 -
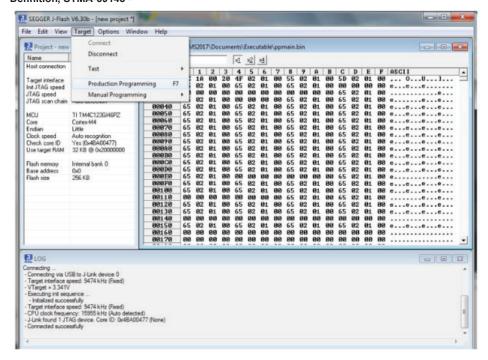
Figure: Production programming [Program]

Definition, STMA-69136 -

15. The software is immediately loaded on the TIVA (co)processor and the message "Target erased, programmed and verified successfully – Completed after … sec" appears. Click "OK" (Figure STMA-69134);

Definition, STMA-69134 -
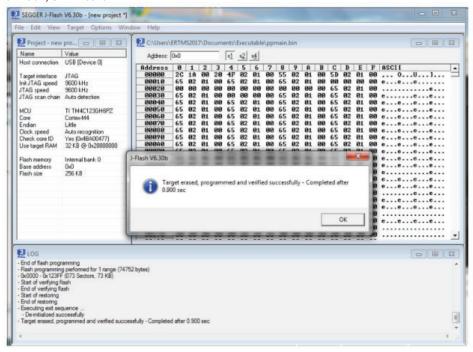
Figure: TIVA programmed and verified successfully [Program_done]

Definition, STMA-69135 -

16. The software is successfully loaded on the TIVA (co)processor. Close the program "J-Flash V6.30b" on the laptop by clicking "X" in the top right corner of the screen;

- If the message "Target erased, programmed and verified successfully – Completed after … sec" does not appear, the loading of the software on the TIVA (co)processor is not confirmed or failed. In that case only, go back to step 3 and follow the procedure from there for a second time;

Definition, STMA-69132 -

17. Disconnect the JLink cable connector from connector X1200 on the SAP Board and continue with STMA-69133 - Loading the software on the netX processor .

7.5 Loading the software on the netX processor

Definition, STMA-69130 -

1. Establish power supply to the SAP Board; Apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector.

Definition, STMA-74723 -

2. Connect pin 1 of the X103 connector with any GND pin, for instance pin C32 of the Backplane connector (Figure STMA-69072); This is done to enter the debug mode, which will allow the processor to be flashed.

Definition, STMA-69131 -
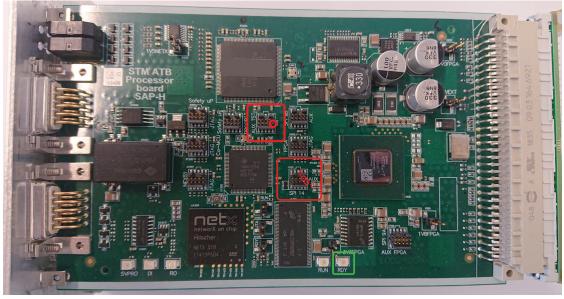
Figure: Hardware connections for loading the software on the netX processor

Definition, STMA-69160 -

3. Connect a USB port of the laptop with the pins 9 (-) and 10 (+) of the X101 connector on the SAP Board, using two Nr 1 wires to connect to the bootloader jumper (Figure ⁞ STMA-69131);

The LED "RDY" flashes yellow (see figure ⁞ STMA-69131 within the green square);

Definition, STMA-69161 -

4. Open the software loading program "netX Bootwizard 1.4.0.1" on the laptop;
5. The "netX Bootwizard 1.4.0.1" start screen appears with "Build image" selected (Figure ⁞ STMA-69159). Change the selection to "Write to flash";

Definition, STMA-69159 -
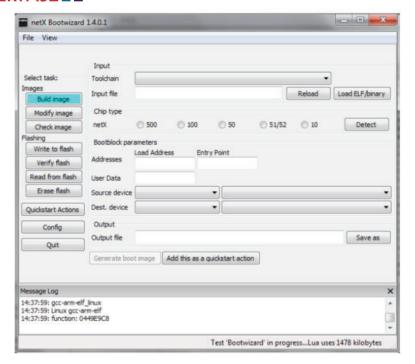
Figure: netX Bootwizard start [Start]

Definition, STMA-69157 -

6. The screen "Write to flash" appears. Click "Detect" (Figure ⁞ STMA-69158);

Definition, STMA-69158 -
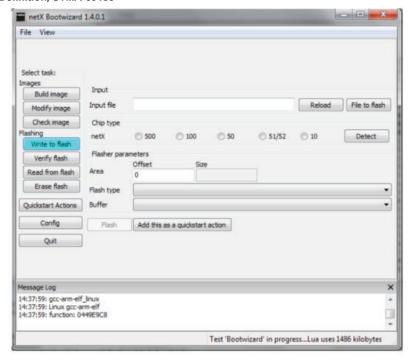
Figure: Write to flash 1 [write_to_flash]

Definition, STMA-69154 -

7. The "netX Bootwizard 1.4.0.1" detects the chiptype and the pop-up "Select the plugin" appears. Select the "romloader_uart" file (laptop dependent, in this example: "romloader_uart_COM6") and click "OK" (Figure ⁞ STMA-69156);

Definition, STMA-69156 -

Figure: Select the plugin 1 [write_to_flash_detect]

Definition, STMA-69179 -

8. The screen "Write to flash" (Figure ⁞ STMA-69158) re-appears. Select "File to flash". The pop-up "Select an input file" appears. Select File type "Binary, Boot Image or NXF Files" (".bin"), then select file "NETX51-BSL.bin" and click "Open" (Figure ⁞ STMA-69180);

Definition, STMA-69180 -
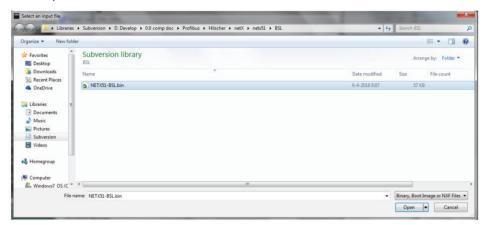
Figure: Select an input file [write_to_flash_file]

Definition, STMA-69173 -

9. The pop-up "Information" appears with the message "the netX chip type and the source/destination devices could not be identified or there are multiple matches. Please select the correct chip type and Flash device". Click "OK" (Figure ⁞ STMA-69174);

Definition, STMA-69174 -
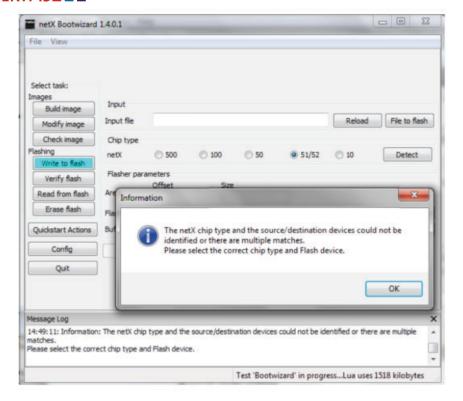
Figure: Information pop-up [write_to_flash_info_popup]

Definition, STMA-69171 -

10. The screen "Write to flash" re-appears. Select "Flash" (Figure ⁞ STMA-69243);

Definition, STMA-69243 -
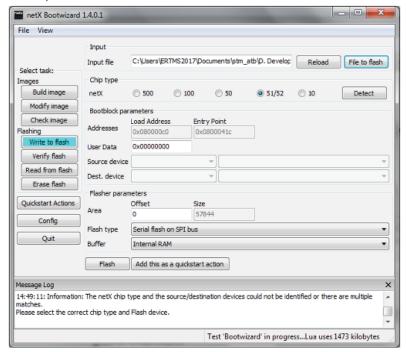
Figure Write to flash 2 [write_to_flash_new_screen]

Definition, STMA-69172 -

11. The pop-up "Select the plugin" re-appears. Select "romloader_uart_COM6" once more and click "OK" (Figure ‼ STMA-69244);

Definition, STMA-69244 -
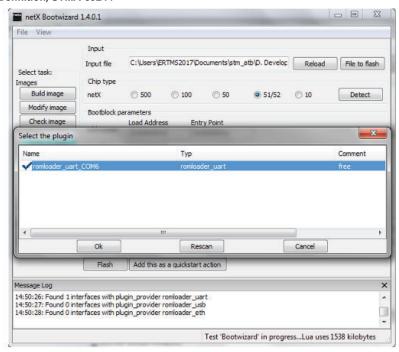
Figure: Select the plugin 2 [write_to_flash_select]

Definition, STMA-69176 -

12. The file "NETX51-BSL.bin" which was selected in step 7 is now loaded and the pop-up "Success" appears with the message "Image flashed" (Figure 38, ‼ STMA-69236);

Definition, STMA-69236 -
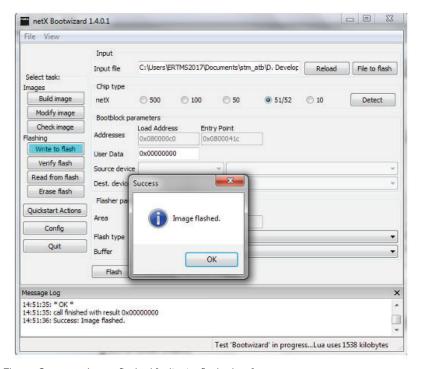
Figure: Success - Image flashed [write_to_flash_done]

Definition, STMA-69178 -

13. Remove the jumper from the pins 9 (-) and 10 (+) of the X101 connector;
14. Switch the power supply to the SAP Board "OFF" and, after waiting at least 2 seconds, ON again;
15. Open the software loading program "netHOST v1.0.0.0" on the laptop. The "netHOST Device Test Application" start screen appears. (Figure STMA-69237);

Definition, STMA-69237 -
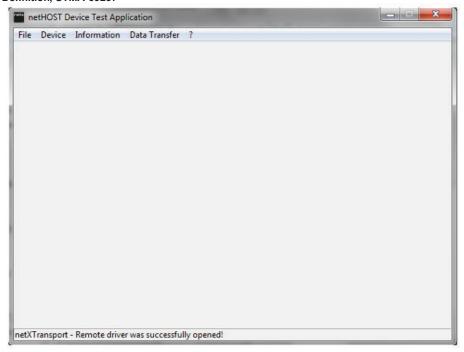
Figure: netHOST start [netHOST_start]

Definition, STMA-69175 -

16. Click "Device" (on the top ribbon) and select "Open" on the pop-up (Figure ┇ STMA-69234);

Definition, STMA-69234 -
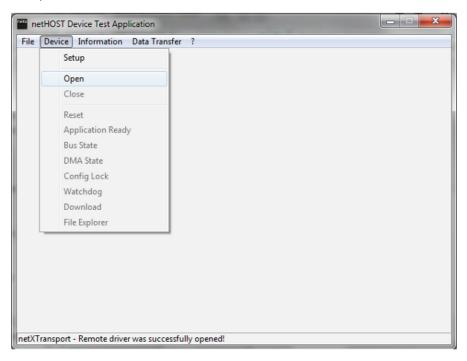
Figure: Open device [netHOST_open_1]

Definition, STMA-69169 -

17. The pop-up "Channel selection" appears. Select "COM8_cifX0" and click "Open" (Figure ┇ STMA-69235);

Definition, STMA-69235 -
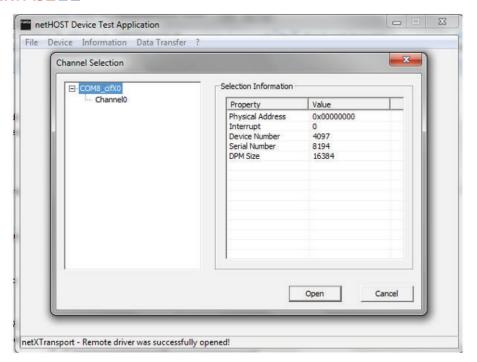
Figure: Channel selection [netHOST_open_2]

Definition, STMA-69170 -

18. The pop-up "netHOST Device Test Application – COM8_cifX0" opens with (on the bottom line) the message "netXTransport – Remote driver was successfully opened!". (Figure ⸬ STMA-69239);

Definition, STMA-69239 -
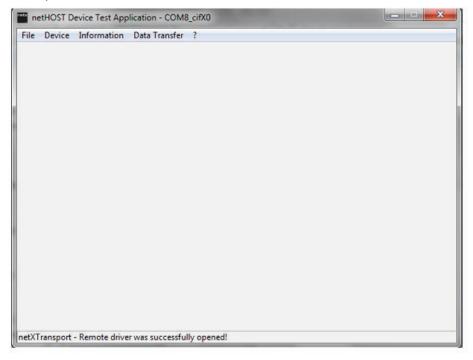
Figure: Remote driver was successfully opened [netHOST_open_succes]

Definition, STMA-69167 -

19. Click "Device" (on the top ribbon) and select "Download" on the pop-up (Figure ⫶ STMA-69241);

Definition, STMA-69241 -
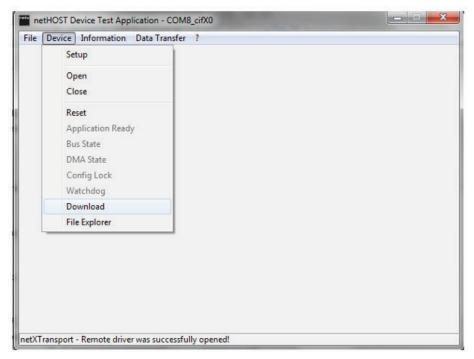
Figure: Download device [netHOST_download_1]

Definition, STMA-69168 -

20. The Explorer window "Open"opens. Select the file type "netX Firmware Files", the file "X0601000.nxf" and click "Open" (Figure ⫶ STMA-69238);

Definition, STMA-69238 -
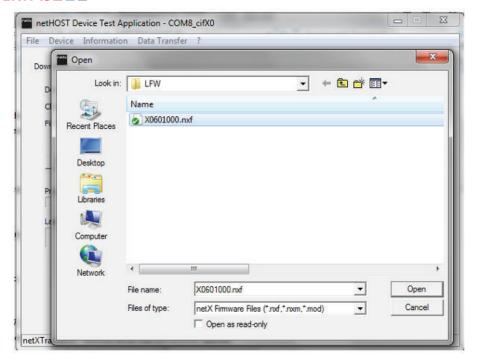
Figure: Open file [netHOST_download_file]

Definition, STMA-69165 -

21. The pop-up "netHOST Device Test Application – COM8_cifX0" appears. Select the "Download Mode" "Firmware Download" and click "Download" (Figure ⋮ STMA-69282);

Definition, STMA-69282 -
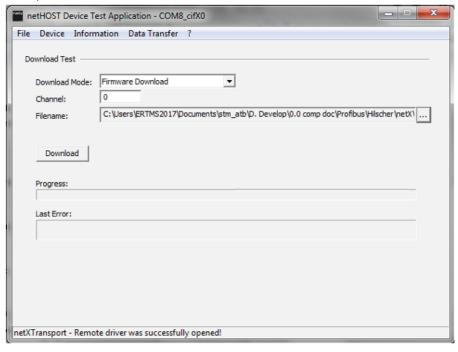
Figure: Download mode [netHOST_download_settings]

Definition, STMA-69166 -

22. The Progress bar on the pop-up "netHOST Device Test Application – COM8_cifX fills. Once the Progress bar is filled to completion, the software is successfully loaded on the netX processor. Close the program "netHOST" on the laptop by clicking "X" in the top right corner of the screen (Figure ⧉ STMA-69284);

Definition, STMA-69284 -
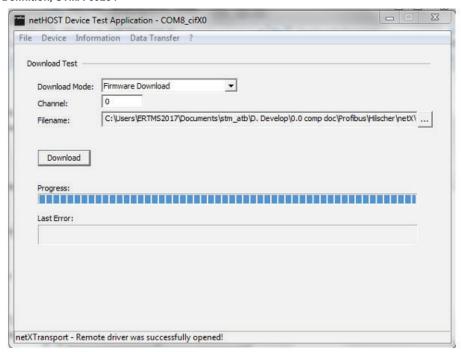
Figure: Progress bar [netHOST_download_done]

Definition, STMA-69177 -

23. Disconnect the JLink cable connector from connector X901 on the SAP Board and continue with ⧉ STMA-69280 - Loading the software on the FPGA processor .

7.6 Loading the software on the FPGA processor

Definition, STMA-69281 -

1. Establish power supply to the SAP Board, apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector;

Definition, STMA-69278 -
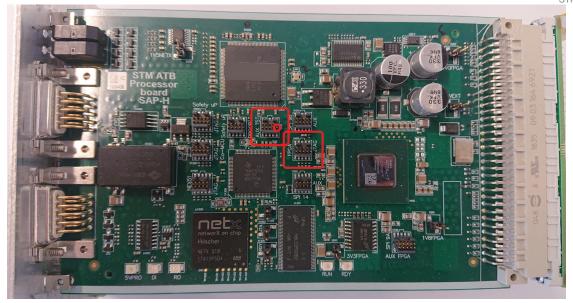
Figure: Hardware connections for loading the software on the FPGA processor

Definition, STMA-69279 -

2. Connect a USB port of the laptop using a standard USB cable, the JLink Segger with the X400 connector on the SAP Board, using the JLink cable connector (Nr 3) (Figure ┇ STMA-69278);

3. Open the software loading program "Vivado 2017.3" on the laptop;

4. The Vivado start screen appears appears. On the tile "Tasks", select "Open hardware manager" (Figure ┇ STMA-69271);

Definition, STMA-69271 -
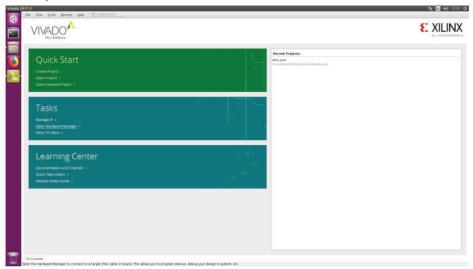
Figure: Vivado start [sc02]

Definition, STMA-69272 -

5. The hardware manager opens and just below the top of the screen a green information bar shows the message "No hardware target is open". Click "Open target" just behind this message (Figure ┇ STMA-69252);

Definition, STMA-69252 -
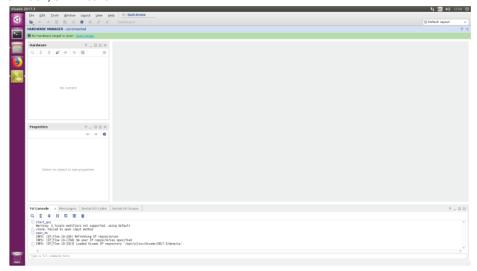
Figure: Open target [sc03]

Definition, STMA-69269 -

6. A pop-up opens. Select "Auto Connect" to connect to the target (Figure ⬛ STMA-69249);

Definition, STMA-69249 -
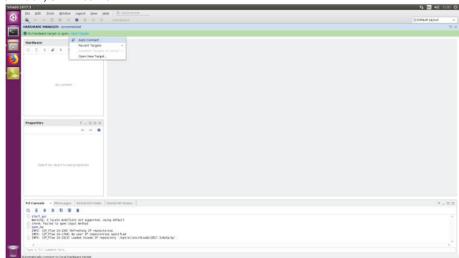
Figure: Auto connect [sc04]

Definition, STMA-69270 -

7. The "Hardware" pane on the upper left-hand side of the screen fills. Right-click the file "xc7a200t" in the "Hardware" pane. A pop-up appears; left-click "Add Configuration Memory Device" (Figure ⬛ STMA-69250);

Definition, STMA-69250 -
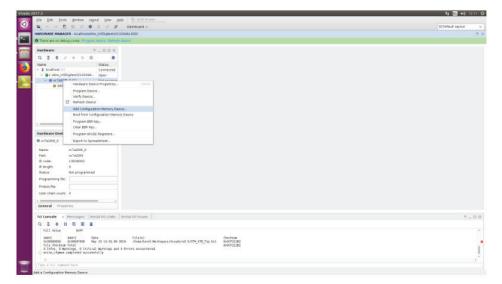
Figure: Add configuration memory device 1 [sc16]

Definition, STMA-69268 -

8. The Explorer window "Add Configuration Memory Device" appears. Select "Manufacturer" "Micron", then "Density (Mb)" "256", "Type" "spi". and "mt25ql-256-spi-x1_x2_x4" Alias "n25q256-3.3v- spi-x1_x2_x4". Then click "OK" (Figure ⁝ STMA-69247);

Definition, STMA-69247 -
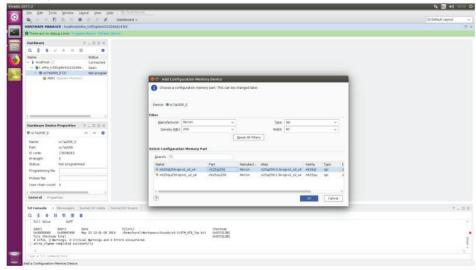
Figure: Add configuration memory device 2 [sc17]

Definition, STMA-69266 -

9. The pop-up "Add Configuration Memory Device completed" appears. Click "OK" to program the memory configuration device (Figure ⁝ STMA-69248):

- Alternatively, if the pop-up "Add Configuration Memory Device completed" doesn't appear, right-click the memory configuration device "mt25ql-256-spi-x1_x2_x4" in the "Hardware" pane on the upper left-hand side of the screen. A pop-up appears; left-click "Program Configuration Memory Device" (Figure ⁝ STMA-69245);

Definition, STMA-69248 -
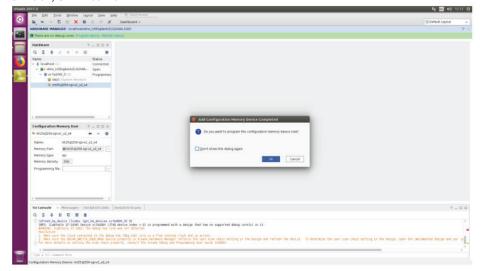
Figure: Add configuration memory device completed [sc18]

Definition, STMA-69245 -
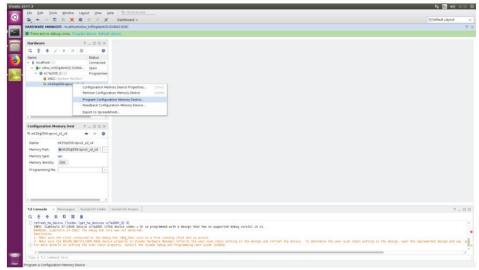
Figure: Program configuration memory device 1 [sc19]

Definition, STMA-69267 -

10. The pop-up "Program Configuration Memory Device" opens. Click the "…" button on the right-hand side of the "Configuration file" line on the pop-up to open the explorer window (Figure ⸸ STMA-69246);

Definition, STMA-69246 -
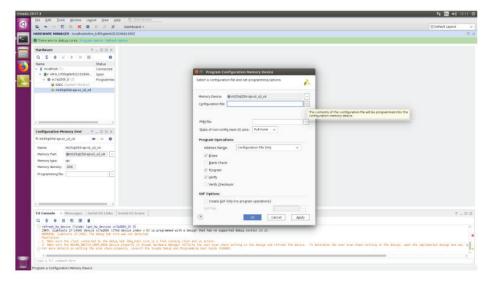
Figure: Program configuration memory device 2 [sc20]

Definition, STMA-69264 -

11. The explorer window "Specify File" opens. Select the memory configuration file (in this example "home/karel/Workspace/Vivado/v0.5/image.mcs") and click "OK" (Figure ┋ STMA-69240);

Definition, STMA-69240 -
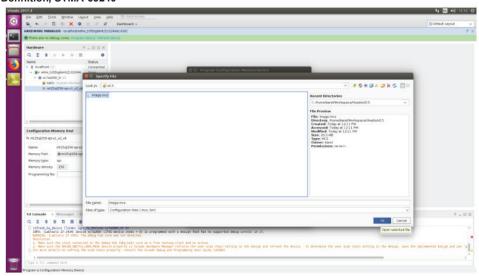
Figure: Specify file [sc21]

Definition, STMA-69265 -

12. The pop-up "Program Configuration Memory Device" re-appears, Click the "…" button on the right-hand side of the "PRM file" line on the pop-up (Figure ┋ STMA-69246) to open the explorer window (Figure ┋ STMA-69242) where you can save the .prm file on the path chosen in step 11
(in this example "home/karel/Workspace/Vivado/v0.5/image.prm");

Definition, STMA-69242 -
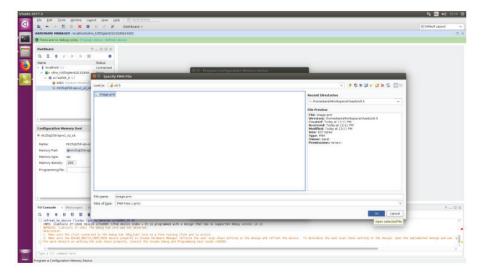
Figure: Specify PRM file [sc23]

Definition, STMA-69262 -

13. The pop-up "Program Configuration Memory Device" re-appears again. Select "Erase", "Program", "Verify" and "Verify checksum" and click "OK" (Figure ⫶ STMA-69225);

Definition, STMA-69225 -
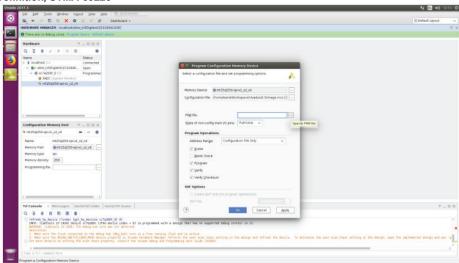
Figure: Program configuration memory device 2 [sc22]

Definition, STMA-69263 -

14. The selected software is now loaded on the FPGA. Depending on the selection one or more consecutive progress bars in the pop-up "Program Configuration Memory Device" appear (Figure ⫶ STMA-69232);

Definition, STMA-69232 -
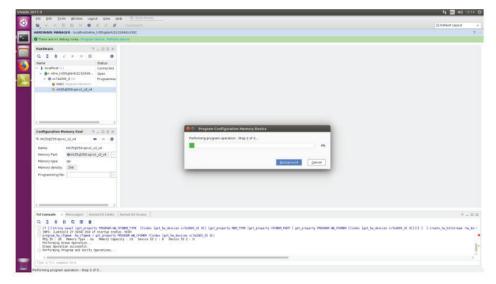
Figure: Progress bar [sc26]

Definition, STMA-69255 -

15. The pop-up "Program Flash" now opens with the message "Flash programming completed successfully". Click "OK" (Figure ▌ STMA-69233);

Definition, STMA-69233 -
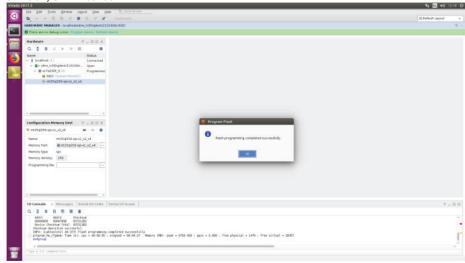
Figure: Program flash completed successfully [sc28]

Definition, STMA-69256 -

16. With the programming completed, the FPGA is not yet loaded with the bitstream from the memory configuration device. To load the software on the FPGA processor, right-click the artix file "xc7a200t" in the "Hardware" pane on the upper left-hand side of the screen. A pop-up appears; left-click "Boot from Configuration Memory Device" (see Figure ▌ STMA-69230) or switch the power supply OFF and, after waiting at least 2 seconds, ON again;

Definition, STMA-69230 -
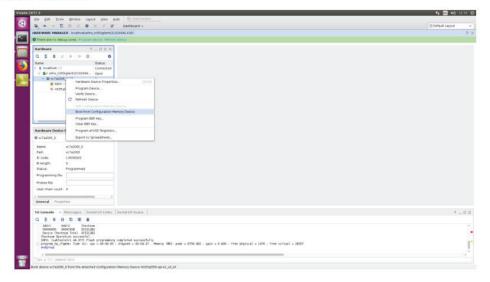
Figure: Boot from Configuration Memory Device [sc29]

Definition, STMA-69254 -

17. The software is loaded on the FPGA processor. Close the program "Vivado 2017.3" on the laptop by clicking "X" in the top right corner of the screen.

18. Disconnect the JLink cable connector from connector X400 on the SAP Board and report the entire software loading procedure successfully finished and the software ready for testing.

7.7 Testing the software

Text, STMA-77917 - If all software loading was succesfull, to be recognized from the indications described above, the software is loaded correctly. The correct behaviour is tested during development. The integrated CRC protects against data corruption.

A final check will be done after 🔖 STMA-71240 - Assembling on the integrated system by a 🔖 STMA-72628 - Factory tests for assembled series product.

8 Assembling

Hardware Design, STMA-74094 - Each STM ATB produced shall be identifiable with:

- The name or trademark of the manufacturer;
- A serial number of the unit produced;
- The year of production;
- Full system configuration (hardware and software items).

located on the front face of the STM ATB. These markings shall be permanent and not removable.

8.1 Introduction

Text, STMA-74736 - This part of the manual describes the assembly of the STM-ATB housing. The housing is based on a HF-tube housing from manufacturer Schroff. The STM ATB consists of 4 PCBA's, which will be mounted in the tube.

Definition, STMA-74734 - The STM ATB module consists of the following parts:

- DIO+PS board; 100x 160mm
- AIN board; 100x 160mm
- SAP board; 100x 160mm
- BP board; 95x 46 mm
- Front panel; 31695637
- Tube 188m; 31695640
- Rear panel; 31695665
- Front panel mounting set; 21191548
- Rear panel mounting set; 21191549
- Distance blocks for the BP board; 31695902
- SubD bolts; [part number]

8.2 Assembly parts

Text, STMA-74738 - This paragraph shows the delivered mounting sets of the housing

Definition, STMA-74742 - Front panel; 31695637:
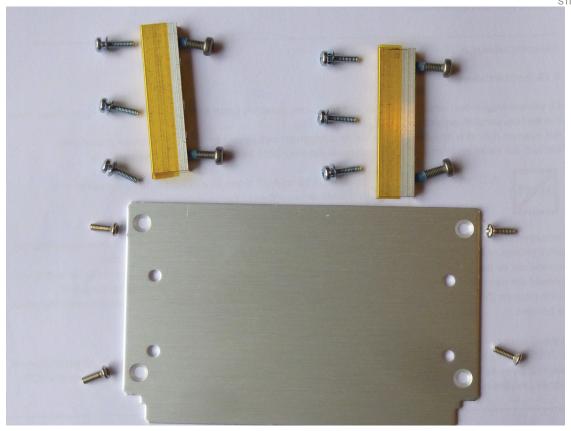
Definition, STMA-74743 - Tube 188m; 31695640:

Definition, STMA-74740 - Rear panel; 31695665, Rear panel mounting set; 21191549 and Distanceblocks for the BP board; 31695902:

Definition, STMA-74741 - Front panel mounting set; 21191548, 31696031 and 31696032:

8.3 Assembly description

Text, STMA-74744 - Mounting all the pcba's into the housing has to be done in correct steps. All parts are connected using screws, with a restriction that some screws are not reachable any more after mounting the next part.

Definition, STMA-74745 - The main mounting steps are:

1. mounting the SAP board to the front panel
2. mounting the AIN board to the front panel
3. mounting the DIO+PS board to the front panel
4. mounting the distance blocks to the BP board
5. Press the BP board against the boards
6. Push the boards in to the tube
7. Mount the rear panel, than mount the front panel to the tube
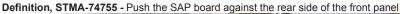
8.3.1 Mounting the SAP board
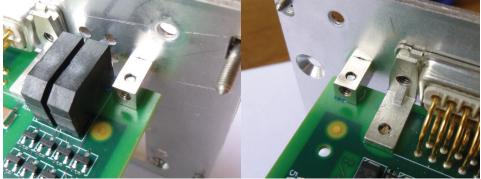
Definition, STMA-74746 - Mounting the SAP board to the front panel

Two studs must be screwed on top off the SAP board, at the left hand side next to the Led-holder and at the right hand side next to the SubD connector.

The studs are identical and have all two M3 screw holes. Position the stud in the direction as shown in the picture. The front screw hole should be oriented at the top. The stud is connected to the pcb with a screw from the underside of the PCB. Don't fasten the screws at this moment! This will allow some adjustment later on.

Definition, STMA-74755 - Push the SAP board against the rear side of the front panel
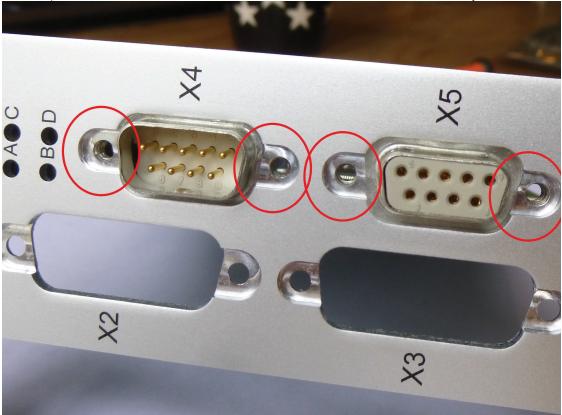
Definition, STMA-74749 - At the front side the two countersunk screw's (M3x6) must now be screwed in. Do not fasten them yet.

Definition, STMA-74750 - Screw the M3 SubD screws into the SubD connectors. Do not fasten them yet.

Definition, STMA-74747 - The studs must now align between the front panel and the pcb. This must be done before fastening the srews in the following steps:

1. Fasten the two countersunk screws a little;
2. Fasten the four SubD screws a little;
3. Check the alignment of the studs and SubD connectors;
4. Fasten the pcb (torx) screws completely;
5. Fasten the two countersunk screws completely;
6. Fasten the four SubD screws completely;
7. Check every screw that is fastened

8.3.2 Mounting the AIN board

Definition, STMA-74748 - Mounting the AIN board to the front panel
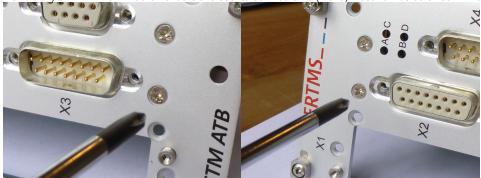
Definition, STMA-74752 - Two studs must be screwed on top off the AIN board. At the left hand side next to the female SubD, at the right hand side next to the male SubD connector. The studs are identical and have two M3 screw holes. Position the stud in the direction as shown in the picture.The front screw hole should be oriented at the top. The stud is connected to the pcb with a screw from the underside of the PCB. Don't fasten the screw at this moment.

Definition, STMA-74753 - Push the AIN- board against the rear side of the front panel.

Definition, STMA-74751 - At the front the two countersunk screw's (M3x6) must now be screwed in. Do not fasten them yet.

Definition, STMA-74754 - Screw the M3 SubD screws into the SubD connectors. Do not fasten them yet.

Definition, STMA-74759 -
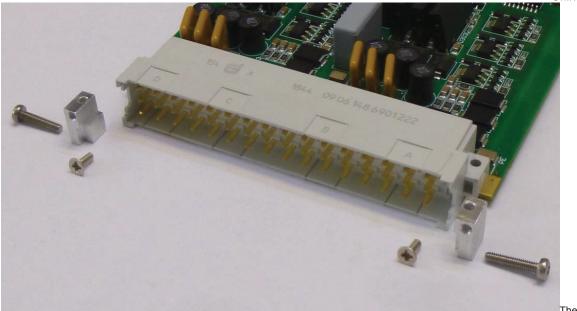
1. Fasten the two countersunk screws a little;
2. Fasten the four SubD screws a little;
3. Check the alignment of the studs and SubD connectors;
4. Fasten the pcb (torx) screws completely;
5. Fasten the two countersunk screws completely;
6. Fasten the four SubD screws completely;
7. Check every screw that is fastened

8.3.3 Mounting the DIO+PS board

Definition, STMA-74763 - Mounting the DIO+PS board to the front panel

The picture shows the DIO+PS board with the special mounting studs and screws.
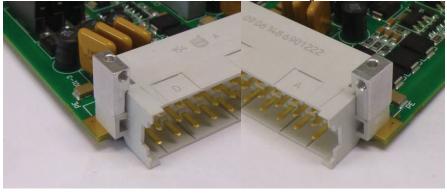
The two special made studs must be screwed to the top off the DIO-PS board, at the left and right hand side of the DIN connecor.

Note: the two studs are different:

- The left one is the: 3169031, the OB version.
- The right one is the: 3169032, the UN version

Definition, STMA-74764 -

Position the studs in the direction as shown in the picture, screw the M3x12 screw into the stud from the underside of the PCBA. Don't fasten the screw at this moment, to allow for some alignment.

Definition, STMA-74765 - Push the DIO-PS board against the rear side of the front panel

At the front the two countersunk screw's (M3x6) must now be screwed in. Do not fasten them yet to allow for alignment.
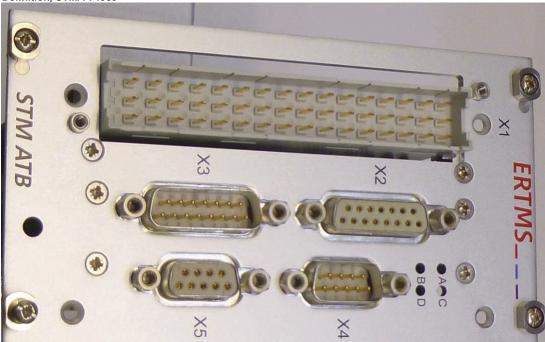
Definition, STMA-74968 - The studs must now align between the front panel and the pcb. This must be done before fastening

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the srews in the following steps:
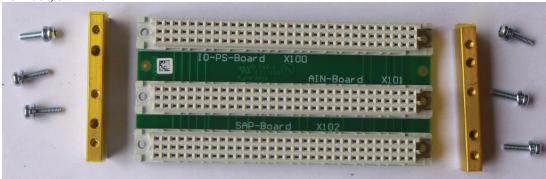
1. Fasten the two countersunk screws a little;
2. Check the alignment of the studs;
3. Fasten the pcb (torx) screws completely;
4. Fasten the two countersunk screws completely;
5. Check every screw that is fastened

Definition, STMA-74969 -

8.3.4 Mounting the distance blocks to the BP board

Definition, STMA-74971 -
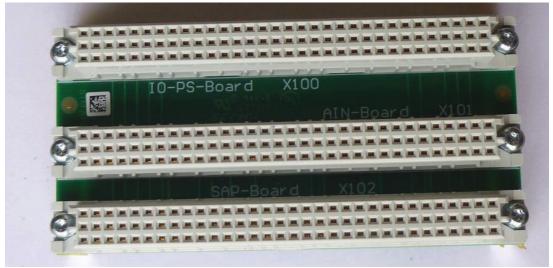
Two identical distance blocks must be mounted against the rear side of the BP-board. The blocks are partly covered in insulation tape, this side must be place against the pcb as shown above.

Definition, STMA-75089 -
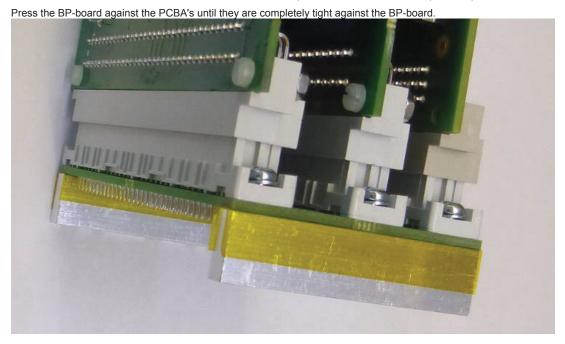
 Align each block with the pcb edge and fasten all M3x10 screw. Make sure the rings are as far to the plastic connectors as possible, otherwise these rings will catch the side of the housing when sliding the PCBA's into the housing.

Definition, STMA-75090 - Position the BP-board behind the system boards. This fits in only one way.
Press the BP-board against the PCBA's until they are completely tight against the BP-board.

8.3.5 Insert the assembly into the housing
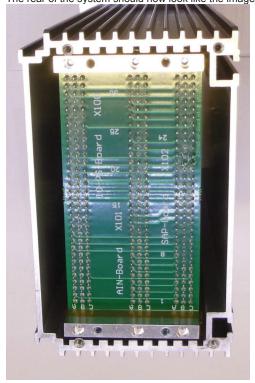
Definition, STMA-75094 - The housing has rounded edges on one side and is flush on the other side. The rounded edges represent the rear of the housing. The PCBA assembly shall be inserted into te housing from the front (flush) side of the housing.
Align the housing with the assembly as shown below. The PCBA's should fit exactly into the slots inside the housing.
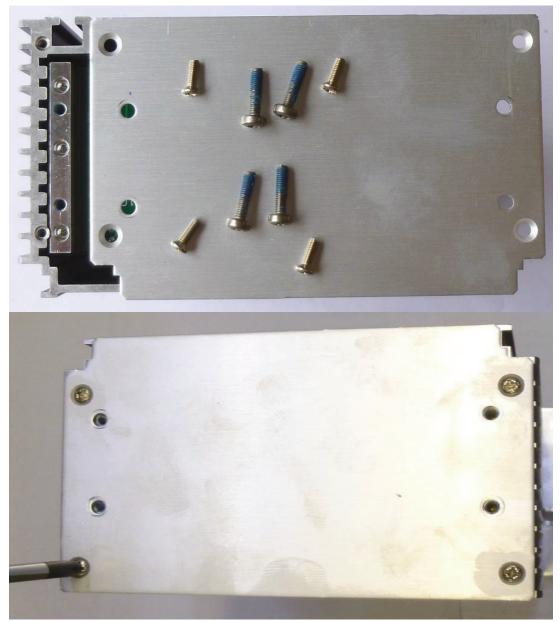
Definition, STMA-75095 - Slide the assembly completely into the housing until the front plate is in contact with the housing. The rear of the system should now look like the image below.

Definition, STMA-75092 - Mount the rear panel with the rear end plate as shown below. Then connect the rear end blocks of the assembly to the rear end plate using the screws covered with lock-tight paste.
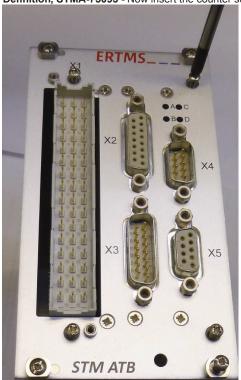
Screw the four torx screw's (M3x10) into the inner rear panel holes into the distance blocks.

Definition, STMA-75093 - Now insert the counter sunk M3 screws into the front plate and fasten them completely.

Definition, STMA-75091 - Mount a copper M6 bolt to the earthing hole to be able to attach an earthing braid bond when the system is installed in a cabinet.

9 System testing

9.1 Configuration management and record keeping

Requirement, STMA-75527 - The system hardware configuration shall be recorded

Requirement, STMA-75528 - The system software configuration shall be recorded

Requirement, STMA-75529 - The manufacturing tests/test results shall be recorded, traceable to system level

9.2 Manufacturing tests

9.2.1 Visual inspection

Requirement, STMA-76412 - A visual inspection shall be done on all produced PCBA's. The visual inspection shall be carried out to ensure that the equipment is of sound construction and, so far as can be ascertained, meets the requirements given in the TPD files for the PCBA's.

9.2.2 Insulation test

Text, STMA-77919 - The aim of this test is to ensure that the mounting of components, their metal connections and casings, and the routing of wiring and printed board tracks, are not located too close to surrounding metal parts or fixings. In addition the test will verify the design clearances of circuits with requirements for galvanic isolation. The test shall be carried out on each fully assembled PCBA.

The test comprises two parts, an insulation measurement test (carried out before and after the voltage withstand test), and the voltage withstand test.
Insulation measurement and voltage withstand tests shall be carried out on one of these two alternatives:

1. individual subracks and/or printed board assemblies, and racks and cubicles without subracks or printed board assemblies;
2. complete racks and cubicles fitted with all subracks and printed board assemblies.

Steps:

- STMA-76405 - Insulation measurement test: Where galvanic isolation is required, the insulation measurement values shall be taken
- STMA-76406 - Voltage withstand test: test voltages shall be applied between the two sides of the isolation barrier.
- STMA-76405 - Insulation measurement test: The insulation measurement tests shall be repeated.

Considerations:

- The voltage withstand test procedure shall be arranged such that individual circuits are subjected to the minimum number of applications of the dielectric test voltage.
- For subracks and printed board assemblies with exposed metal parts, frames or front panels, or metal fixings, which can either be touched or require galvanic isolation, then the test shall be carried out between all the connections shorted together and these metal parts.

If the insulation test has been carried out as part of the routine test, then it shall not be repeated during the type test.
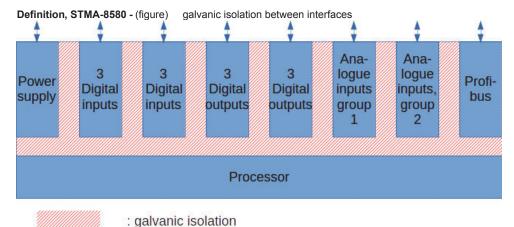
9.2.2.1 Combinations to be tested

Text, STMA-77922 - The insulation and voltage withstand tests shall be performed between areas which are galvanically separated from eachother. The SAP is not reachable from outside, therefore the test shall be done in two stages:

- Tests per PCB
- Tests on the integrated system

The tests shall prove the isolation as indicated in ⬚ STMA-8580 - (figure) galvanic isolation between interfaces, except between digital in and digital out.

Definition, STMA-8580 - (figure) galvanic isolation between interfaces

: galvanic isolation

Text, STMA-77923 - Tests per PCB:

- SAP: All backplane connector pins at the SAP against all pins in one of the profibus connectors, except PE
- Ain: All backplane connector pins at the Ain-board against all pins in connector AD-A (⬚ STMA-8241), except PE
- Ain: All backplane connector pins at the Ain-board against all pins in connector AD-B (⬚ STMA-8276), except PE
- DIO: All backplane connector pins at the DIO-board against pins 1x-16x in the DIO front connector (except PE)
- DIO: All backplane connector pins at the DIO-board against pins 18x-32x in the DIO front connector (except PE)

Text, STMA-77924 - Tests at the integrated system:

- DIO connector pins 6x against DIO connector pins 24x
- DIO connector pins 12x against DIO connector pins 30x
- Ain: AD-A, all pins except PE against Ain: AD-B all pins except PE
- DIO connector, all pins except PE against PE
- Ain: AD-A and AD-B, all pins except PE against PE
- Profibus, all pins, except PE against PE

9.2.2.2 Insulation measurement test

Text, STMA-77920 - The insulation resistance test shall be carried out at 100 VDC (500VDC for tests concerning the DIO connector) and the values shall be recorded.
The test shall then be repeated after the voltage withstand test
Test acceptance requirements:
There shall be no fundamental deterioration from the initial measurement.

9.2.2.3 Voltage withstand test

Text, STMA-77918 - Whenever possible, a.c. voltage of 50 or 60 Hz shall be used. If not applicable, a d.c. voltage of a value corresponding to the a.c. voltage peak shall be used. The test voltage shall be applied by gradually increasing the voltage amplitude to the test voltage, and maintained at the specified level for 1 min.

A sinusoidal rms value of the test voltage shall be:

- 100V: for all tests concerning a profibus or analogue signal connector (all subD9 and subD15 connectors)
- 1 000 V for tests (also) concerning the DIO connector

Test acceptance requirements:

Neither disruptive discharge nor flashover shall occur.

9.2.3 Performance test

Requirement, STMA-76413 - A performance test shall be done on all produced PCBA's. These Measurements shall be carried out at the ambient temperature. The tests to be performed are captured in ⊕D7.1.0 Hardware Unit Test Plan Performance tests concerning the integrated STM ATB system are described in chapter ▯ STMA-72628 - Factory tests for assembled series product.

10 Cabling manufacturing and testing

10.1 Cabling requirements

Hardware Design, STMA-69229 - The STM ATB shall be installed in a variety of trains/locomotives and in a variety of locations in the vehicle.

The cable connector types are specified for the STM ATB interface:

- X1: DIN 41612 Type F female:
    - with 3 cables: A (DIO), B (PS) and C (DIO)

- X2: SubD-15 crimp pin:
    - with 2 cables: D (AIN) and E (AIN);

- X3: SubD-15 crimp socket;
    - with 2 cables: F (AIN) and G (AIN);

- X4: SubD-09 crimp pin;
    - with 1 cable: H (Profibus) or terminator;

- X5: SubD-09 crimp socket
    - with 1 cable: J (Profibus) or terminator

Definition, STMA-69226 - The manufacturer shall choose the appropriate cables in accordance with:

- Profibus cables in accordance with EN50170 and EN50264
- DIO, PS and AIN cables in accordance with EN 50264
- For analogue input signals (subD-15 connectors) shielded twisted pair cabling shall be used;
    (one twisted pair per analogue signal)

- For the battery referenced signals (DIO + power supply connector) a shielded cable shall be used.
- Voltage and current rated for the application;

- temperature -25 ° C to +70 ° C ambient and up to 85 ° C during 10 minutes maximum.

The cabling shall be RoHS and REACH compliant.

Definition, STMA-77961 - Vehicle specific issues:

- number of Profibus connections to the STM ATB
- type of ATB antennas used in the vehicle;
- brake system used in the vehicle;
- number of cabins controlled from the unit, e.g. if two or four antennas are connected;
- cable length and curvature.

Definition, STMA-69227 -

Cable connector types, see ⌷ STMA-69308 - Appendix C: Cable connector parts.
The recommandations of the connector supplier shall be taken into account.

10.2 Preparations

Definition, STMA-69214 -

1. Check that the required length of each cable (A-J) has been determined, see Table ⌷ STMA-69215;

Definition, STMA-69215 - Table: cutting length of the STM ATB cables
The length of the cables is to be determined vehicle dependent, i.e. tbd.

code	tag	maximum number active wires	cutting length [m]
A	STM-ATB DIO4-6	12	tbd
B	STM-ATB Supply	6	tbd
C	STM-ATB DIO1-3	12	tbd
D	STM-ATB AIN 1	6	tbd
E	STM-ATB AIN 2, 3	9	tbd
F	STM-ATB AIN 5	6	tbd
G	STM-ATB AIN 6, 7	9	tbd
H	STM-ATB PROFIBUS 1	2 (if connected to Profibus)	tbd
J	STM-ATB PROFIBUS 2		tbd

Requirement, STMA-40594 - The length of the Profibus shall not exceed 200 m per segment.

Requirement, STMA-40593 - The antennas shall be installed according to the installation requirements provided by the antenna supplier.

Definition, STMA-69222 -

2. Check that the vehicle specific resistors to be built into the counter connectors X2, X3 and (if applicable) X4 or X5 have been determined and supplied:
   - antenna resistors (4) depending on the type of ATB coil installed in the vehicle for which the STM ATB cabling is

ordered, see Table ⫶ STMA-69223:

Definition, STMA-69223 -

Table: ATB antenna specific resistors to be built into counter connectors X2 and X3

ATB antenna	antenna resistor [Ω]
Alstom Bar	1740
Alstom V	14000
PW-170	5620
PW-225	11300
Fase 3	1740
No antenna	220

Definition, STMA-69220 -

- gain resistors (4):
    - 4 ATB antennas installed (general, dual-directional vehicle): 4 x 560 Ω;
    - only 2 ATB antennas installed (single directional rail vehicle or in case both cabins will be equipped with an ETCS onboard installation): 2 x 560 Ω for the installed ATB antennas and 2 x open circuit for ATB antennas that are not installed;
- Antenna specific resistors, see table ⫶ STMA-69223
- configuration resistors (2) depending on the brake system installed in the vehicle for which the STM ATB cabling is ordered, see Table **T** STMA-77964 - Configuration resistor: ;

Text, STMA-77964 - Configuration resistor:

Resistor [kOhm] E96 series	Minimum voltage [V]	Maximum voltage [V]	Braking percentage
4,53	1,25	1,37	36
3,01	0,97	1,09	46
2	0,62	0,74	54
1,5	0,35	0,47	55
1,13	0,06	0,18	65
0,845	-0,23	-0,11	72
0,634	-0,52	-0,40	91
0,464	-0,81	-0,69	113
0,332	-1,09	-0,97	119
0,221	-1,37	-1,25	160

84% and 100% are not supported.
These values are only relevant for trains > 500m which always drive
above 100km/h. These locomotive shall either be allowed to drive 130km/h,
When driving alone (113%) or reduce speed when hauling long trains.

Definition, STMA-69218 -

- terminator resistors (3) to build into the terminator for connector X4 or X5 if only one Profibus connection to the STM ATB is to be established and the other STM ATB Profibus connector (X5 or X4) is spare: 2 x 390 Ω + 1 x 220 Ω.

Definition, STMA-69219 - 3. Check that all components to be assembled and tools are present:

- see Table in Appendix C: Parts list

10.3 Assemble DIN 41612 counter connector X1 with the cables A, B and C

Definition, STMA-69217 -

1. Cut and strip the cables A, B and C according the specification of the connector supplier:

    - If (a) cable(s) is/are provided with more cores than active (A and C: 12, B: 6):
        - Cut any unused cores and isolate each of them with a protective cover;
    - Label the cables;

2. Connect the active cable cores to the non-PE pins on the STM ATB counter connector X1 according to Table ❗ STMA-69210:

    - Using the crimp contacts;
    - perform a visual inspection and a mild pulling test on each contact assembled;

3. Connect the cable jacket to the PE pins on the on the STM ATB counter connector X1 according to Table ❗ STMA-69210:

    - perform a visual inspection and a mild pulling test on each contact assembled;

4. Assemble the counter connector in the housing and hand fasten all connector housing screws:

    - ensure that the counter connector is placed correctly in the housing;

5. Secure all cable entries into the counter connector housing with the crimp flanges and ferrules;
6. Close the unused cable entries of the connector housing with the blanking pieces and hand fasten all blanking piece housing screws;
7. Perform a visual inspection and a mild pulling test on each cable assembled;
8. Counter connector X1 with cables A, B and C is ready for testing;

Definition, STMA-69210 - Table: cable cores and pinning counter connector X1
If the individual wires are labeled, the labels shall be according to the pin name llisted in table ❗ STMA-8323 (M9.3 Installation Manual). Only labeling the cables is also sufficient.
The colours are to be decided by the manufacturer
The train interface is determined by the system integrator

cable	core		counter connector X1	train interface
	colour	label	pinning	
C	jacket	PE	32z	tbd
	jacket	PE	32b	tbd
	jacket	PE	32d	tbd
	tbd	tbd	30z	tbd
	tbd	tbd	30b	tbd
	tbd	tbd	30d	tbd
	tbd	tbd	28z	tbd
	tbd	tbd	28b	tbd
	tbd	tbd	28d	tbd
	jacket	PE	26z	tbd
	jacket	PE	26b	tbd
	jacket	PE	26d	tbd
	tbd	tbd	24z	tbd
	tbd	tbd	24b	tbd
	tbd	tbd	24d	tbd
	tbd	tbd	22z	tbd
	tbd	tbd	22b	tbd
	tbd	tbd	22d	tbd
B	jacket	PE	20z	tbd
	jacket	PE	20b	tbd
	jacket	PE	20d	tbd
	tbd	tbd	18z	tbd
	tbd	tbd	18b	tbd
	tbd	tbd	18d	tbd
	tbd	tbd	16z	tbd
	tbd	tbd	16b	tbd
	tbd	tbd	16d	tbd
	jacket	PE	14z	tbd
	jacket	PE	14b	tbd
	jacket	PE	14d	tbd
A	tbd	tbd	12z	tbd
	tbd	tbd	12b	tbd
	tbd	tbd	12d	tbd
	tbd	tbd	10z	tbd
	tbd	tbd	10b	tbd
	tbd	tbd	10d	tbd
	jacket	PE	8z	tbd
	jacket	PE	8b	tbd
	jacket	PE	8d	tbd
	tbd	tbd	6z	tbd
	tbd	tbd	6b	tbd
	tbd	tbd	6d	tbd
	tbd	tbd	4z	tbd
	tbd	tbd	4b	tbd
	tbd	tbd	4d	tbd
	jacket	PE	2z	tbd
	jacket	PE	2b	tbd
	jacket	PE	2d	tbd

Pinning diagram (counter connector X1), columns z b d, rows 32, 30, 28, 26, 24, 22, 20, 18, 16, 14, 12, 10, 8, 6, 4, 2.

10.4 Assemble sub-D15 counter connector X2 with the cables D and E

Hardware Design, STMA-69212 -

1. Cut and strip the cables D and E and their wires according to the specification of the connector supplier :

   - If (a) cable(s) is/are provided with more cores than active (D: 6, E: 9):
     - Cut any unused cores and isolate each of them with a protective cover;
   - Label the cables;

2. Connect the active cable cores to the pins on the STM ATB counter connector X2 according to Table ⁞ STMA-69198:

   - using the crimp contacts;
   - perform a visual inspection and a mild pulling test on each contact assembled;

3. Insert the specified resistors according to Table ⁞ STMA-69213:
   (alternatives, e.g. placing the resistors on a PCB inside the connector housing, is also acceptable as long as the resistors are inside the shielded area).

   - cut the resistor wires to the length required to fit into the counter connector X2 housing;
   - strip the resistor wires, turn them around the resistor pins and solder them to the pins;
   - guide the resistor wires along the resistor in the same direction;
   - shrink a shrink sleeve with inner melt around the resistor assembly for protection;
   - perform a visual inspection and a mild pulling test on each contact assembled;

Definition, STMA-69213 - Table 7: resistors to be installed in counter connector X2

resistor type	resistance	wire length	resistor wiring	between pins
antenna resistors	refer to step 2, Table 4	tbd		7-15
				5-12
gain resistors	refer to step 2	tbd		6-14
				4-11
configuration resistor	refer to step 2, Table 5	tbd		1-8

Definition, STMA-69211 -

4. Connect the cable jacket to the PE shield on the on the STM ATB counter connector X2
5. perform a visual inspection and a mild pulling test on the contact assembled;

Definition, STMA-69200 -

6. Assemble the counter connector in the housing and hand fasten all connector housing screws;

REMARK
There is very little room between cable D and the upper connector housing screw of cable E. Take care not to damage the cable.

Definition, STMA-69201 -

7. Secure all cable entries into the counter connector housing with the cable clamps and ferrules;

8. perform a visual inspection and a mild pulling test on each cable assembled;

9. Counter connector X2 with cables D and E is ready for testing.

Definition, STMA-69198 - Table: cable cores and pinning counter connector X2

The labels (if used) shall be according to the pin name llisted in table ⚠ STMA-8241 plus the specific coils mentioned in ⚠

STMA-76728 (📄 M9.3 Installation Manual); coil names: AR, AL, BR and BL (for CabA Right,..etc.)

The colours are to be decided by the manufacturer

The train interface is determined by the system integrator

cable	core			counter connector X2		train interface
	colour	label	resistor		pinning	
D	tbd	tbd	config to 1	8		tbd
	tbd	tbd	antenna to 7	15		tbd
	tbd	tbd	antenna to 15	7		tbd
	tbd	tbd	gain to 6	14		tbd
	tbd	tbd	gain to 14	6		tbd
	tbd	tbd		13		tbd
E	tbd	tbd	antenna to 12	5		tbd
	tbd	tbd	antenna to 5	12		tbd
	tbd	tbd	gain to 11	4		tbd
	tbd	tbd	gain to 4	11		tbd
	tbd	tbd		3		tbd
	tbd	tbd		10		tbd
	tbd	tbd		2		tbd
	tbd	tbd		9		tbd
	tbd	tbd	config to 8	1		tbd
	jacket	PE		Sh		tbd

10.5 Assemble sub-D15 counter connector X3 with the cables F and G:

Definition, STMA-69206 -

1. Cut and strip the cables F and G and their wires according to the specification of the connector supplier:

   - If (a) cable(s) is/are provided with more cores than active (F: 6, G: 9):
     - Cut any unused cores and isolate each of them with a protective cover;

   - Label the cables;

2. Connect the active cable cores to the pins on the STM ATB counter connector according to Table ⚠ STMA-69205:

   - using the crimp contacts;
   - perform a visual inspection and a mild pulling test on each contact assembled;

3. Insert the specified resistors according to Table ⚠ STMA-69207:

   (alternatives, e.g. placing the resistors on a PCB inside the connector housing, is also acceptable as long as the resistors are inside the shielded area).

   - cut the resistor wires to the length required to fit into the counter connector X3 housing;
   - strip the resistor wires, turn them around the resistor pins and solder them to the pins;
   - guide the resistor wires along the resistor in the same direction;
   - shrink a shrink sleeve with inner melt around the resistor assembly for protection;
   - perform a visual inspection and a mild pulling test on each contact assembled;

Definition, STMA-69207 - Table 9: resistors to be installed in counter connector X3

resistor type	resistance	wire length	resistor wiring	between pins
antenna resistors	refer to step 2, Table 4	tbd		2-9
				4-12
gain resistors	refer to step 2	tbd		3-10
				5-13
configuration resistor	refer to step 2, Table 5	tbd		1-8

Definition, STMA-69204 -

4. Connect the cable jacket to the PE shield on the on the STM ATB counter connector:

5. perform a visual inspection and a mild pulling test on the contact assembled;

6. Assemble the counter connector in the housing and hand fasten all connector housing screws:

> **REMARK**
> There is very little room between cable F and the upper connector housing screw of cable G. Take care not to damage the cable.

7. Secure all cable entries into the counter connector housing with the cable clamps and ferrules;

8. Perform a visual inspection and a mild pulling test on each cable assembled;

9. Counter connector X3 with cables F and G is ready for testing.

Definition, STMA-69205 - Table 10: cable cores and pinning counter connector X3

The labels (if used) shall be according to the pin name llisted in table ⚠ STMA-8276 plus the specific coils mentioned in ⚠
STMA-76727 (📄 M9.3 Installation Manual): coil names: AR, AL, BR and BL (for CabA Right,..etc.)
The colours are to be decided by the manufacturer
The train interface is determined by the system integrator

cable	core		counter connector X3			train interface
	colour	label	resistor		pinning	
F	tbd	tbd	config to 8	1		tbd
	tbd	tbd	antenna to 2	9		tbd
	tbd	tbd	antenna to 9	2		tbd
	tbd	tbd	gain to 3	10		tbd
	tbd	tbd	gain to 10	3		tbd
	tbd	tbd		11		tbd
G	tbd	tbd	antenna to 12	4		tbd
	tbd	tbd	antenna to 4	12		tbd
	tbd	tbd	gain to 13	5		tbd
	tbd	tbd	gain to 5	13		tbd
	tbd	tbd		6		tbd
	tbd	tbd		14		tbd
	tbd	tbd		7		tbd
	tbd	tbd		15		tbd
	tbd	tbd	config to 1	8		tbd
	jacket	PE		Sh		tbd

10.6 Assemble Profibus connectors and cabling

Definition, STMA-68348 - The STM ATB is equipped with a male and a female Sub-D09 Profibus connector. Each of these connectors can be used to connect the STM ATB to the ETCS onboard system, in which case the other Sub-D09 connector is spare. The STM ATB profibus connections have internal surge protection. Termination is external.
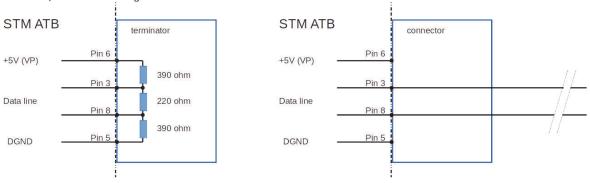
The profibus can be configured as a linear/daisy chain network.

One connector is used for each of the neighboring systems.

If the STM ATB is the last system in the chain, a termination (▯ STMA-77911 - Figure: Profibus terminator and connector) shall be placed on the second connector.

If the STM ATB is removed for whatever reason, the two cables or the one cable and the terminator can be connected to restore the network. The latter is the reason to use a male and female connector.

Definition, STMA-77911 - Figure: Profibus terminator and connector

Text, STMA-77925 - The STM ATB is equipped with two Profibus connectors, one male (X4) and one female (X5).

One or both of the SubD-09 connectors X4 and X5 shall be used as a cable connector, connecting to the two wire profibus. However in case the Profibus topology is a star network, or if the STM ATB is the last system in the daisy chain/linear network then at one of the connectors a terminator has to be placed. Below both options are described.

10.6.1 Profibus connector plus cable to connect to the Profibus

Definition, STMA-69190 -

1. Cut and strip the cable H and its wires according Table ▯ STMA-69215 :

    - If the cable is provided with more cores than active (2):
        - Cut any unused cores and isolate each of them with a protective cover;

    - Label the cable and the cores according to Table ▯ STMA-69191;

2. Connect the active cable cores to the pins on the subD-09 STM ATB counter connector X4 according to Table ▯ STMA-69191 and do the same with the subD-09 connector (m/f as specified by the customer) on the train interface side:

    - using the crimp contacts;
    - perform a visual inspection and a mild pulling test on each contact assembled;

3. Assemble the counter connector in the housing and hand fasten all connector housing screws;
4. Secure the cable entry into the counter connector housing with the cable clamp and ferrules;
5. Perform a visual inspection and a mild pulling test on both sides of the cable;

6. The Profibus connector (either Counter connector X4 with cable H or Counter connector X5 with cable J) is ready for testing.

7. Repeat steps 1 to 6 if two Profibus cables shall be connected.

Definition, STMA-69191 - Table: cable cores and pinning counter connector X4 if connected to Profibus

cable	core		counter connector X4/X5 when used to connect to the Profibus
	colour	label	pinning
J	-	spare	1
	-	spare	2
	red	data line (B)	3
	-	spare	4
	-	spare	5
	-	spare	6
	-	spare	7
	green	data line (A)	8
	-	spare	9

10.6.2 Profibus connector as terminator

Definition, STMA-69530 -

1. Insert the specified resistors according to ⁝ STMA-77911 - Figure: Profibus terminator and connector and ⁝ STMA-69526 - Table: cable cores and pinning counter connector X5 if terminator terminator X4/...

   - cut the resistor wires to the length required to fit into the counter connector X4 housing;
   - strip the resistor wires, turn them around the resistor pins and solder them to the pins;
   - guide the resistor wires along the resistor in the same direction;
   - shrink a shrink sleeve with inner melt around the resistor assembly for protection;
   - perform a visual inspection and a mild pulling test on each contact assembled

2. Assemble the counter connector in the housing and hand fasten all connector housing screws;
3. Close the unused cable entry of the connector housing with the blanking pieces and hand fasten all blanking piece housing screws;
4. Perform a visual inspection;
5. The terminator, (either Counter connector X4 or Counter connector X5) is ready for testing as terminator.

Definition, STMA-69526 - Table: cable cores and pinning counter connector X5 if terminator

function	terminator X4/X5	
	resistor	pinning
	-	1
	-	2
data line (B)	220 Ω to 8 390 Ω to 6	3
	-	4
GND	390 Ω to 8	5
5 V DC (Vp)	390 Ω to 3	6
	-	7
data line (A)	220 Ω to 3 390 Ω to 5	8
	-	9

10.7 Cabling testing

Definition, STMA-69274 -

Each cable shall be tested concerning the correct connections and isolation.

11 Factory tests for assembled series product

Text, STMA-76723 - The factory test for the assembled series product is performed on the complete assembly, with the production firmware installed on all processors. These test will require a test environment that simulates the functional environment of a vehicle. This can be done by using a test environment or by using an on-board system. This test shall be performed on all assembled systems before leaving the factory.

11.1 Test environment

Text, STMA-76722 - In order to perform the testing activities described in the following sections, a set of tools is required. A possible toolset for this purpose is described in detail in the work instructions [Q2.10.4 Testing work instructions], however another test enviroment may be used as long as the defined tests are correctly executed and assessed.
The test enviroment shall include:

- An ETCS onboard (simulator), connected with the STM ATB via the Profibus Connection. At the remaining Profibus connector a terminator may be placed.
- ATBEG coils of one of the 5 possible types, connected for all 4 inputs (must be 4 times the same type).
  The test environment shall support all 5 antenna types.
- The inputs for detection of brake operation are connected according to one of the options described in M9.3 Installation Manual , item STMA-73212 - Inputs used for detection of brake operation. Information concerning brake opera...
  The test environment shall support all options described.
- The outputs used to control the "Gong" and the "Bel" are monitored and logged by the test system.

- All application messages in the Profibus communication shall be logged by the test system.
- A configuration resistor indicating a braking percentage of 100%, according to **T** STMA-77964 - Configuration resistor: has been placed in the counter connectors X2 and X3.
- An ATBEG code simulator (e.g. a "lusplank") is installed to inject the requested ATBEG codes
- A simulator of an ATBVv signal is available.

11.2 Functional tests

Text, STMA-77926 - The goal of the factory acceptance test is to show that the STM ATB is correctly composed. This can be tested with the following steps:

1. Install the STM ATB in the test environment equipped with the ATBEG antennas of the type for which the unit is delivered (and the correct resistors in counter connectors X2 and X3).
2. Power on the unit and perform a start of mission, i.e. sent all necessary configuration data with brake type "Passenger in P" and the braking percentage unknown (further configuration data is arbitrary as long as the conditions listed in M9.3 Installation Manual are fulfilled).
   Check if the 4 LEDs at the front panel of the STM ATB are green (In case the system doesn't reach its stable operational condition, the LED status and the JRU messages used for trouble shooting can be found in: STMA-63492 - M9.4 Maintenance Manual)
   Check if the configuration data (e.g. software versions and coil type) reported in JRU packet STM-161 type 2 (see M9.4 Maintenance Manual) is correct.
   note: proves the correct implementation of the input circuits and profibus.
3. If the STM ATB reaches CS mode, select level STM ATB, i.e. command the STM ATB into DA, the STM ATB shall provide the DMI information according to STMA-8277 - DMI configuration table according to . Description Values NID_STM of the STM 1 (... necessary to show the cab signals and other indicators.
4. The STM ATB shall now correctly respond to operation of the brakes and releasing the brakes (recognized from the white lamp indicator which shall be on if the brakes are operated).
   note: proves the correct implementation of one brake detection interface
5. If this state has been reached the tests specified in the table below shall be executed

number	action	criteria
1	Inject code96, high level 10Arms, low level 0A, Duty cycle is 50% *note: to test the gong digital output signal*	The green indicator shall be shown without any text. The digital output "Gong" shall close. A packet STM-46 with information gong is sent
2	Increase the speed to 126km/h, and reduce the speed as soon as the criteria are met. *note: to check the configuration resistor and the rembel digital output signal*	At 125km/h the digital output "rembel" shall close and a packet STM-46 with command "rembel" on shall be sent.
3	Reduce the speed to standstill	The digital output "rembel" shall open at 125km/h and a packet STM-46 with command "rembel" off and trigger bel-damping shall be sent.
4	Sent additional configuration data with braking percentage = 120% *note: to test that the configuration resistor is overruled*	A cab signal Yellow13 shall be added and "14" shall be shown at the green cab signal
5	Increase the low level of the ATBEG code in	At low level = 6A or 8A, a packet STM-35

	steps of 2A, with an interval of 10s. *note: to test the correct implementation of the decoding and input circuits*	changing the cab signal from Green to Yellow shall be sent.
6	Simulate an ATBVv signal beacon 3 stop *to test high frequency behaviour of the inputs*	An EB command (packet STM-128) shall be sent by the STM ATB.

6. Repeat step 2 to 4 for all options for brake detection as described in 📘 M9.3 Installation Manual , item 📄 STMA-73212 - Inputs used for detection of brake operation. Information concerning brake opera...

   note: proves the correct implementation of all brake detection interfaces

7. Repeat step 2 for all other coil types excluding the ATB phase 3 antenna.

   note: proves the correct implementation of the antenna circuits.There are phase3 antennas with slightly different characteristics, therefore those might lead to false fails (i.e. not recognizing the antenna).

12 Appendices

12.1 Appendix A: STM ATB pin occupation

Definition, STMA-8323 - (table)

For the power supply and digital I/O signals a front connector type DIN41612-F-48P is defined.

DIO Front connector

Pin	I/O	Pin name	Description
2d		*PE*	Shield
4d	I	*DIn_1B*	Digital input
6d		*DIn_B-PWR*	External power supply for input circuit
8d		*PE*	
10d	O	*DOut_1B*	Digital output
12d		*DOut_B-GND*	Digital out ground
14d		*PE*	
16d	I	*Supply +*	Power input
18d	I	*Supply -*	Power input
20d		*PE*	
22d	I	*DIn_1A*	Digital input
24d		*DIn_A-PWR*	External power supply for input circuit
26d		*PE*	
28d	O	*DOut_1A*	Digital output
30d		*DOut_A-GND*	Digital out ground
32d		*PE*	
2b		*PE*	

4b	I	*DIn_2B*	Digital input
6b		*DIn_B-GND*	Digital in ground
8b		*PE*	
10b	O	*DOut_2B*	Digital output
12b		*DOut_B-GND*	Digital out ground
14b		*PE*	
16b	I	*Supply +*	Power positive input
18b	I	*Supply -*	Power negative/return input
20b		*PE*	
22b	I	*DIn_2A*	Digital input
24b		*DIn_A-GND*	Digital in ground
26b		*PE*	
28b	O	*DOut_2A*	Digital output
30b		*DOut_A-GND*	Digital out ground
32b		*PE*	
2z		*PE*	
4z	I	*DIn_3B*	Digital input
6z		*Di4-6 GND*	Digital in ground
8z		*PE*	
10z	O	*DOut_3B*	Digital output
12z		*DOut_B GND*	Digital out ground
14z		*PE*	
16z	I	*Supply +*	Power input
18z	I	*Supply -*	Power input
20z		*PE*	
22z	I	*DIn_3A*	Digital input
24z		*DIn_A-GND*	Digital in ground
26z		*PE*	
28z	O	*DOut_3A*	Digital output
30z		*DOut_A-GND*	Digital out ground
32z		*PE*	

Definition, STMA-19190 - The digital inputs are defined as specified in the table below (if the inputs are not connected the input value shall be defined in the same way for all inputs, i.e. all inputs which are not connected shall be either all "high" or all

"low")

input	signal	description
DIn_1A	BHA	Brake Handle Applied
DIn_2A	BSO	Brake Sufficiently Operated
DIn_3A	SIA	Spare Input Asserted
DIn_1B	BHN	Brake Handle Not applied
DIn_2B	BSN	Brake Not Sufficiently operated
DIn_3B	SIN	Spare Input Not Asserted

Definition, STMA-28699 - The digital outputs are defined as specified in the table below

output	signal	description
DOut_1A	rembel	Acoustic signal, overspeed
DOut_2A	gong	Acoustic signal, cab signal change
DOut_3A	Spare Out	Spare Output
DOut_1B	WhiteLamp	White indicator, brake operated
DOut_2B	RedLamp	Red indicator, brake commanded by ATB
DOut_3B	BlueLamp	Blue indicator, monitoring active

Definition, STMA-8241 - (table)
AD-A Front connector, SubD-15-F

Pin	I/O	Pin name	Description
1	I	Rconfig_A	Configuration resistor input
15	I	AIn_1A+	Coil input
7	I	AIn_1A-	Coil input
14	I	Rg_1A+	Coil gain resistor
6	I	Rg_1A-	Coil gain resistor
13		AIn_A_GND	
5	I	AIn_2A+	Coil input
12	I	AIn_2A-	Coil input
4	I	Rg_2A+	Coil gain resistor
11	I	Rg_2A-	Coil gain resistor
3		AIn_A_GND	
10	I	AIn_3A+	brake pipe pressure input
2	I	AIn_3A-	brake pipe pressure input
9	I	AIn_A_GND	
8	I	Rconfig_A_ret	Configuration resistor return
Sh		PE	Shield

Definition, STMA-76728 - AD-A front connector further specification of the coil inputs

Inputs 15-7: coil cabin A right hand side in driving direction A; Inputs 14-6: Coil gain resistor Cabin A right hand side

Inputs 5-12: coil cabin B left hand side in driving direction B; inputs 4-11: Coil gain resistor Cabin B left hand side

Definition, STMA-8276 - (table)

AD-B Front connector, SubD-15-M

Pin	I/O	Pin name	Description
8	I	*Rconfig_B*	Configuration resistor input
9	I	*AIn_1B+*	Coil input
2	I	*AIn_1B-*	Coil input
10	I	*Rg_1B+*	Coil gain resistor
3	I	*Rg_1B-*	Coil gain resistor
11		*AIn_B_GND*	
4	I	*AIn_2B+*	Coil input
12	I	*AIn_2B-*	Coil input
5	I	*Rg_2B+*	Coil gain resistor
13	I	*Rg_2B-*	Coil gain resistor
6		*AIn_B_GND*	
14	I	*AIn_3B+*	brake pipe pressure input
7	I	*AIn_3B-*	brake pipe pressure input
15	I	*AIn_B_GND*	
1	I	*Rconfig_B_ret*	Configuration resistor return
Sh		*PE*	Shield

Definition, STMA-76727 - AD-B front connector further specification of the coil inputs

Inputs 15-7: coil cabin B right hand side in driving direction B; Inputs 14-6: Coil gain resistor Cabin B right hand side

Inputs 5-12: coil cabin A left hand side in driving direction A; inputs 4-11: Coil gain resistor Cabin A left hand side

Definition, STMA-8172 - table

Profibus connector pinning (Sub-D9)

Pin	Name	Description
1	not used	
2	not used	
3	RxD/TxD?P	Data line plus (B)
4	not used	
5	DGND	Data ground
6	VP	+5V supply for bus termination
7	not used	
8	RxD/TxD-N	Data line minus (A)
9	not used	

12.2 Appendix B: LED status indications

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 **T** 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 severitye 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

12.3 Appendix C: Cable connector parts

Definition, STMA-69310 -

Connector parts					
code	type	number	description	Manufacturer (example)	Order code (example)
X1	Connector	1	DIN 41612 Type F female	Harting	09 06 248 3201 222
	Hood	1	DIN-Power shell housing D 20 metall emv	Harting	09 06 848 0551
	Cable entries (cable type dependant)	2	Crimp flange, 9 mm	Harting	61 03 000 0072
		2	Crimp ferrule, 14 mm	Harting	61 03 000 0061
		1	Crimp flange, 5 mm	Harting	61 03 000 0066
		1	Crimp ferrule, 8 mm	Harting	61 03 000 0051
		4	Crimp flange insert	Harting	09 06 800 9952
		5	Blanking piece	Harting	61 03 000 0042
	Connector female crimp FC contacts	34	Copper alloy, conductor: 0.5…1.5 for FC 3	Harting	09 06 000 7482
	Alternative screw cable entries	?	DIN-Power cable clamp D20 zinc die cast	Harting	09 06 800 9955
		?	Blinding piece D20 zinc die cast	Harting	09 06 800 9951
X2	Pin connector	1	SubD-15 crimp pin	Inotec	DC15P-G
	hood	1	D-Sub full metal hood with screw locking, M3 screw	Inotec	DG15 MSB-91
	Cable entries	?	Cable clamp	Inotec	DKS100
		?	ferrule	Inotec	CH-x/x (*)
	Crimp contacts	?	Crimp contacts, pin, AWG 24-20	Inotec	DCC2P4
X3	Socket connector	1	SubD-15 crimp socket	Inotec	DC15S-G
	hood	1	D-Sub full metal hood with screw locking, M3 screw	Inotec	DG15 MSB-91
	Cable entries	?	Cable clamp	Inotec	DKS100
		?	ferrule	tbd	tbd
	Crimp contacts	?	Crimp contacts, socket, AWG 24-21	Inotec	DCC2S4
X4	Pin connector	1	SubD-09 crimp pin	Inotec	DC09P-G
	hood	1	D-Sub full metal hood with screw locking, M3 screw	Inotec	DG09 MSX-91
	Cable entries	?	Cable clamp	Inotec	DKS100
		?	ferrule	tbd	tbd

	Crimp contacts	?	Crimp contacts, pin, AWG 24-20	Inotec	DCC2P4
X5	Socket connector	1	SubD-09 crimp socket	Inotec	DC09S-G
	hood	1	D-Sub full metal hood with screw locking, M3 screw	Inotec	DG09 MSX-91
	Cable entries	?	Cable clamp	Inotec	DKS100
		?	ferrule	tbd	tbd
	Crimp contacts	?	Crimp contacts, socket, AWG 24-21	Inotec	DCC2S4