

## M9.2 Manufacturing Manual

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for STM ATB

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## 1 Introduction

**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.

### 1.1 What is an STM ATB

**Text, STMA-65625** - An STM ATB is a train protection system providing ATB functionality in cooperation with an ETCS system. 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-EG equipped lines. The specific characteristics of the embodiment "STM" is explained below.

An STM (a "Specific Transmission Module") is an embodiment of a (national) automatic train protection (ATP) or automatic train control (ATC) system, with the feature of being manageable by an ETCS on-board system. I.e. the ETCS on-board system is master over the STM and can activate and deactivate it. This way transitions between different national ATP/ATC areas, and between national ATP/ATC areas and ETCS areas can be managed in a harmonized way. It allows ETCS equipped trains to operate on conventional (non ETCS) lines.

To optimize the overall configuration, a standard has been developed for the interface between ETCS and the STMs. This interface not only allows the ETCS system to switch on/off the specific ATP/ATC functionality, but also to share generic ATP/ATC facilities provided by the ETCS on-board system:


- Train specific parameters: Parameters entered during "Data Entry" and fixed parameters are sent by ETCS to the STMs
- Speed and distance measurement (odometry): Speed and distance information is sent by ETCS to the STMs
- Driver Machine Interface (DMI): information sent by an STM to ETCS will be presented at the ETCS DMI and inputs given by the driver will be passed by ETCS to the addressed STM.
- Control of traction and brakes (Traction Cut Off and Service/Emergency Brake Commands): Commands to cut of traction of to initiate braking sent by the STM will be passed to the traction and/or braking systems by the ETCS system.
- Cabin selection and driving direction: information concerning the currently selected cabin and the driving direction is sent by ETCS to the STMs.
- Juridical data and diagnostic data storage: The ETCS on-board will take care of storing juridical data and diagnostic data sent by the STM to the ETCS on-board.

The standardized interface specifications and the way ETCS and STMs should cooperate is defined in ERA ERTMS specifications, specifically in subsets-035/056/057/058/059.

Sharing facilities allows the design of lean STMs which only provide the specific national functionality, mostly analyzing trackside data sent by the national wayside systems and performing the specified protection/control functions.

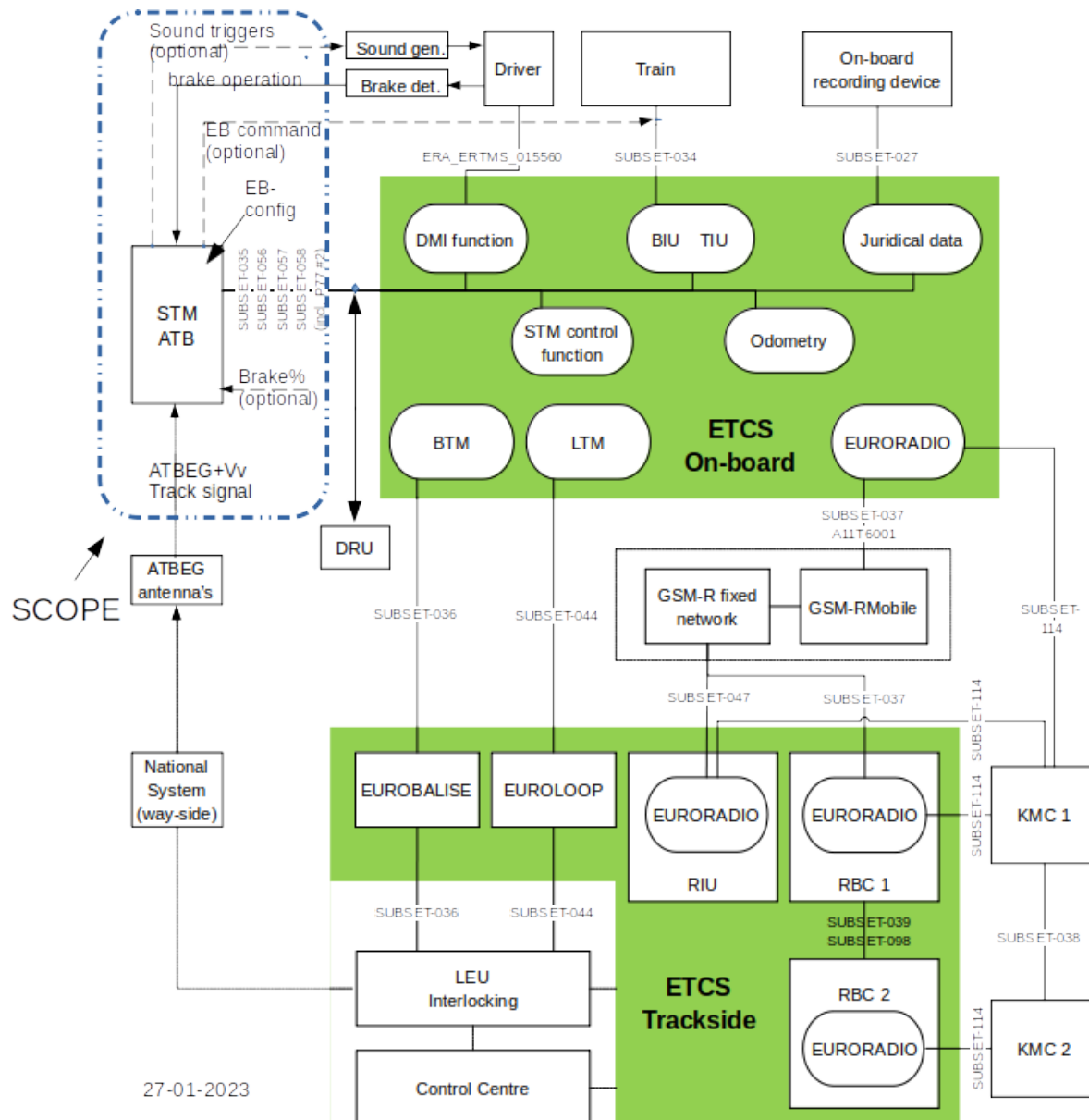
The use of the ETCS facilities is not mandatory for an STM (only the control of switching on/off is), therefore not all STMs are lean systems.

## 1.2 Scope

**Text, STMA-65620** - Figure  **STMA-4891** is taken from the ETCS specifications (subset-035 STM FFFIS Specific Transmission Module). It shows the ETCS reference architecture and the integration of STM ATB with the ETCS onboard system. The scope for this installation manual is marked.

**Definition, STMA-4891** - (figure)




STM ATB system scope



### 1.3 HQSE guidance note

#### Definition, STMA-67784 -

In this document the following graphical elements are used to emphasize HQSE relevance.

	<b>DANGER</b> Denotes a danger with a high <u>HQSE</u> content which must always be avoided.
	<b>WARNING</b> Denotes a risk with medium <u>HQSE</u> content which always requires attention as indicated.
	<b>REMARK</b> Denotes a situation with no or only minor <u>HQSE</u> 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.

### 1.4 References



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

All the documents references used in this document can be found in the document  [P6.1 Bibliography](#) available in the Polarion folder  [Processes](#)

#### Abbreviations, definitions and terminology

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

#### Requirement identification

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

### 1.5 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.

## 2 Manufacturing guidelines

### 2.1 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.

### 2.2 PCB production guidelines

 **Test Definition, STMA-71336** - All environmental requirements from  **STMA-8548 - D4.5 Environmental Requirement Specification (ERS)** have been taken into consideration in the development of the STM ATB.

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.


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

 **Test Definition, STMA-74090** - The PCB production shall as a minimum be compliant to IPC Class 2. 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."

 **Test Definition, STMA-68984** - The product development of the STM ATB is subject to the European Commission Decision on modules 2010/713/EU, module CB. The manufacturing of STM ATB is subject to 2010/713/EU module 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.

The manufacturer of the PCBs shall perform at least the tests contained in  M9.2\_A\_Annex\_System\_Test\_Plan

## 2.3 Issue and change management

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

## 3 Hardware production

**Text, 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

The TPD also includes the drawings and Bill of Materials for the enclosure.

### 3.1 Conformal Coating and Glue

### 3.1.1 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 influences of dirt, moisture and salt mist of the components and the PCB. The coating to be used is (or a coating with comparable specifications concerning relevant aspects. e.g. temperature):

Conformal Coating:

- EHFAC200H - Coating, Acrylic Conformal Coating, Halogenated Free, Aerosol, IPC-CC-83
- HumiSeal 1A33 Urethane Conformal Coating

The thickness of the coating shall be 40 um or more.




**Text, STMA-74575** - Working sequence:

- Masking the non coated area's, [3.1.2 - Coating preparation](#)
- Spraying the coat, [3.1.3 - Coating procedure](#)
- Gluing, [3.1.4 - Gluing instructions](#)

The description given in the remainder of this chapter is based manual coating and gluing. Other methods may be used as long as the indicated area's are treated.

### 3.1.2 Coating preparation

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

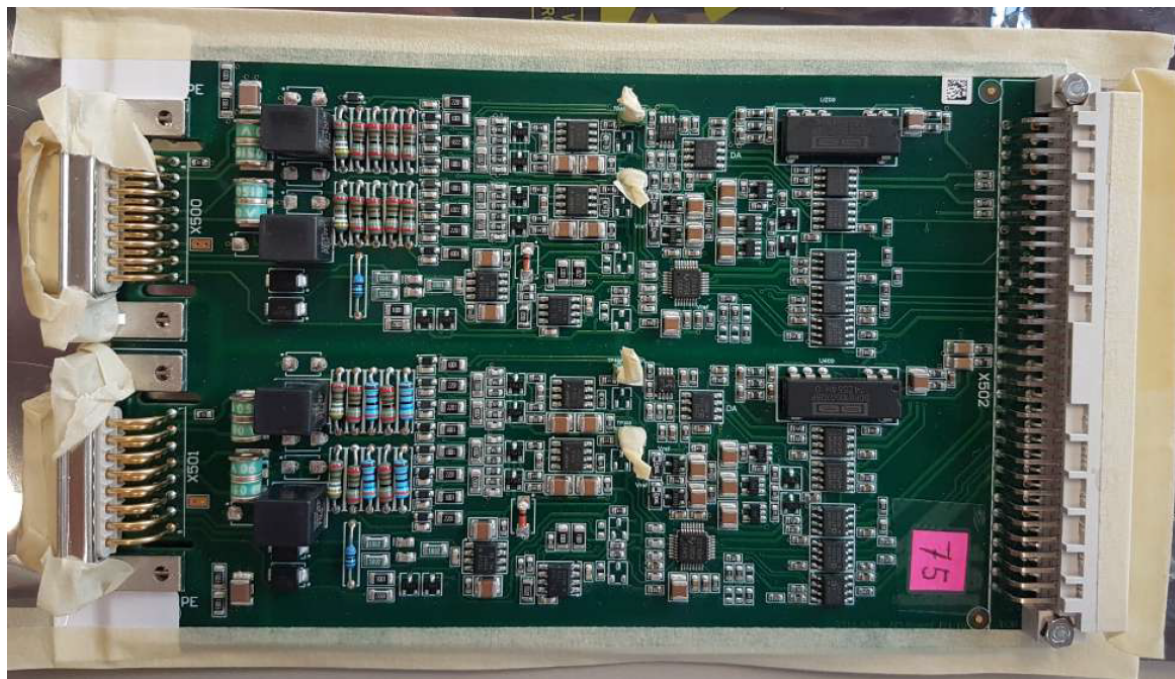
- The connector contacts shall be covered, the rest shall be coated,  [STMA-74584 - Figure: Backplane front, coating example](#)
- analog input board, see  [STMA-74579 - Figure: Analog Input Board front, coating example](#) and  [STMA-74580 - Figure: Analog Input Board back, coating example](#)

**Definition, STMA-74584** - Figure: Backplane front, coating example



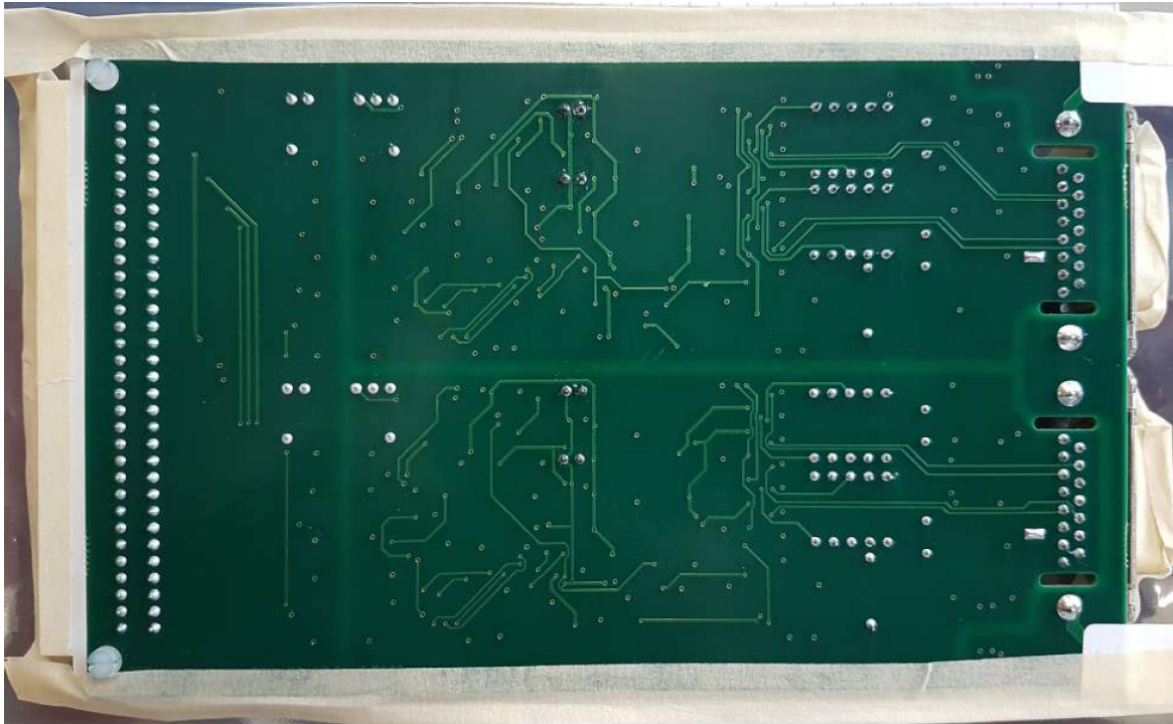


**Definition, STMA-74579** - Figure: Analog Input Board front, coating example



**Definition, STMA-74580** - Figure: Analog Input Board back, coating example





#### Text, STMA-80448 -

Items to be covered, see  [STMA-74580 - Figure: Analog Input Board back, coating example](#)

- 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.

**Definition, STMA-74577** - Figure: SAP Board front:



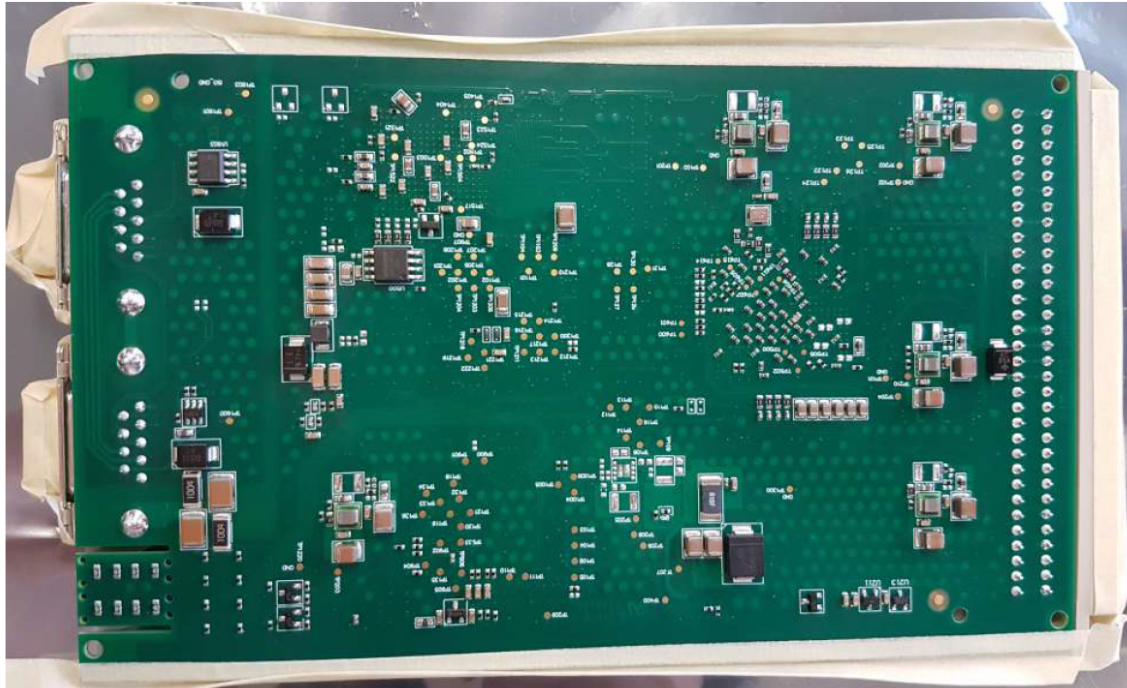
#### Text, STMA-80449 -

Items which shall not be coated, see  [STMA-74577 - Figure: 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 around the FPGA and NetX, since these are devices in BGA packages. The coating should cover the remaining airgap between the processor and the PCB surface.

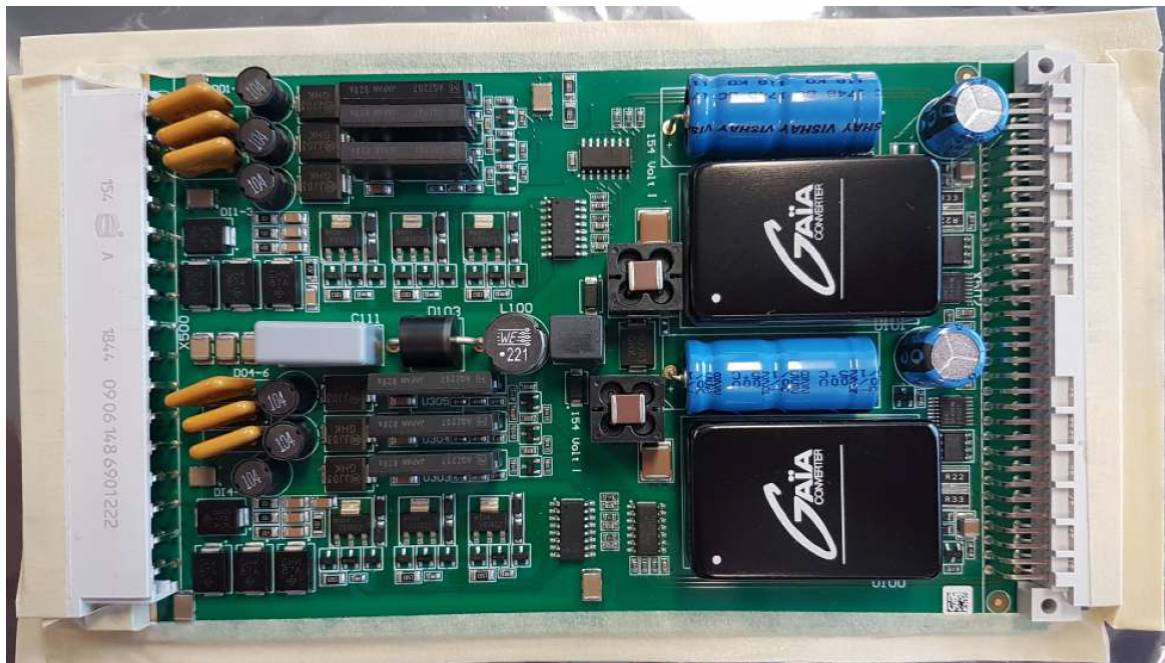
**Definition, STMA-74578** - Figure: SAP Board back:



**Text, STMA-80450** - Items which shall not be coated, see  **STMA-74578** - Figure: SAP Board back:

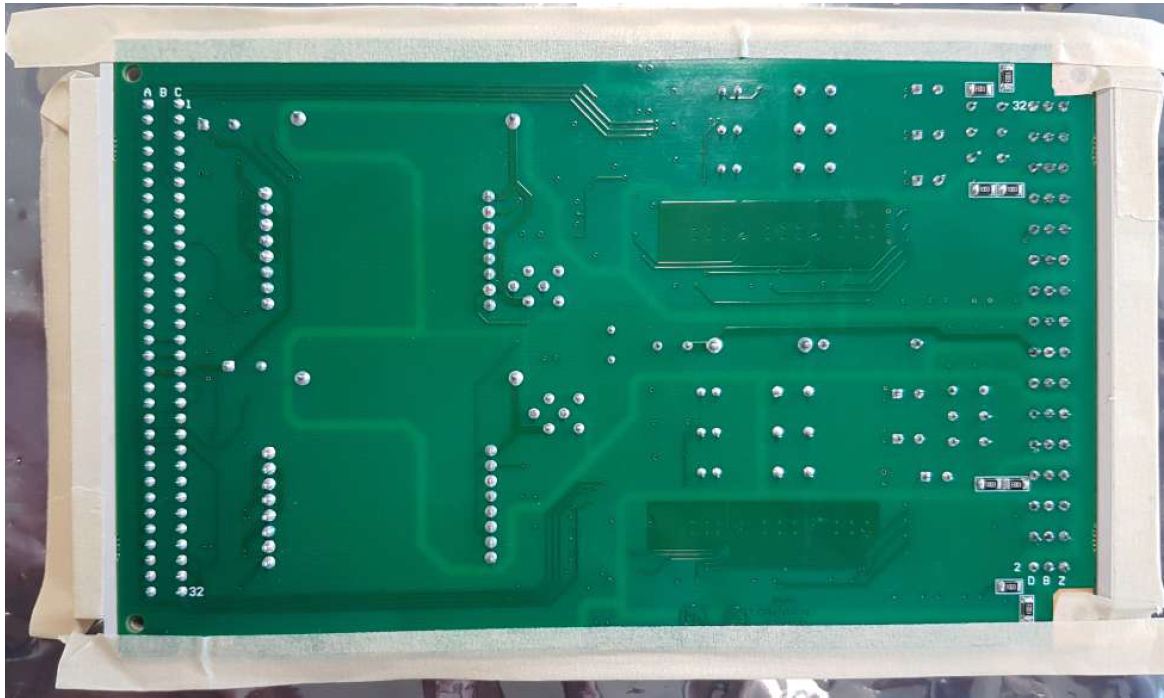
- The connector contacts shall be covered.
- The connector shielding and screw holes shall be covered.
- The grounding pads shall also be covered.
- The pin headers shall be covered
- The sides of the PCB shall be covered to prevent the boards from getting stuck when inserting the PCBA's into the enclosure.


**Definition, STMA-74581** - Figure: PS-DIO Board front:



**Definition, STMA-74582** - Figure: PS-DIO Board Back:





**Text, STMA-80451** - Items which shall not be coated, see  **STMA-74582** - [Figure: 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.

### 3.1.3 Coating procedure

**Text, STMA-74591** - The manufacturer shall refer to the coating procedure prescribed by the supplier of the coating.

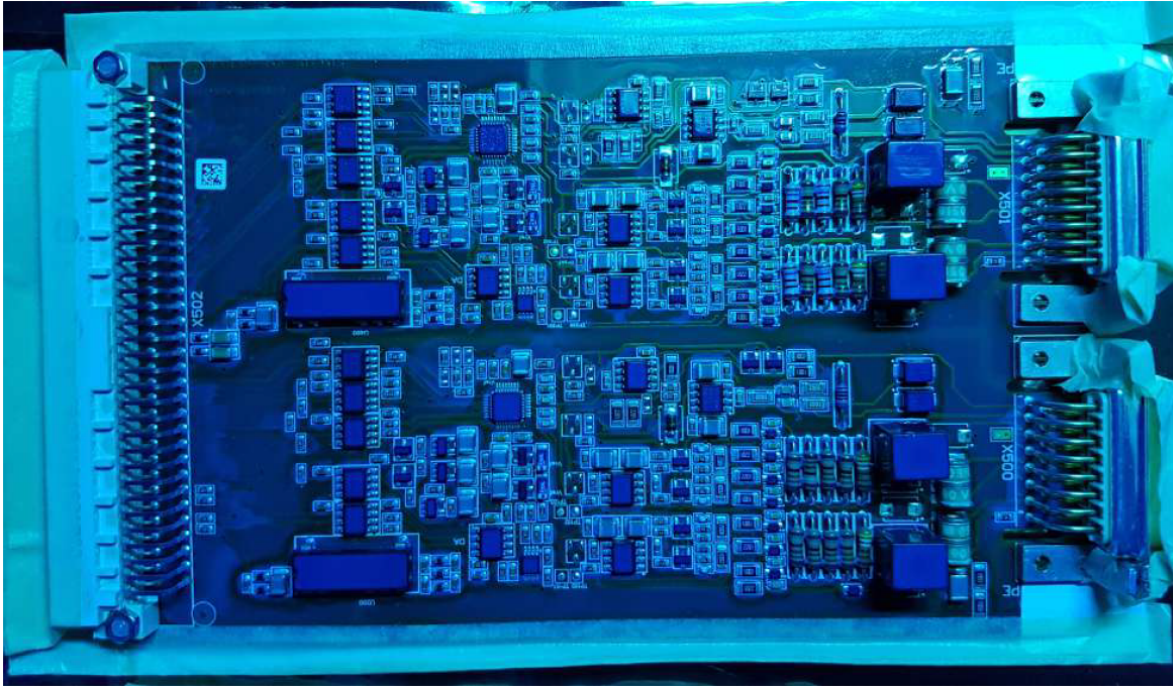
**Text, STMA-74592** -

Optical check:

The coating thickness can be seen with a UV-lamp with a wavelength around the 375 nm.

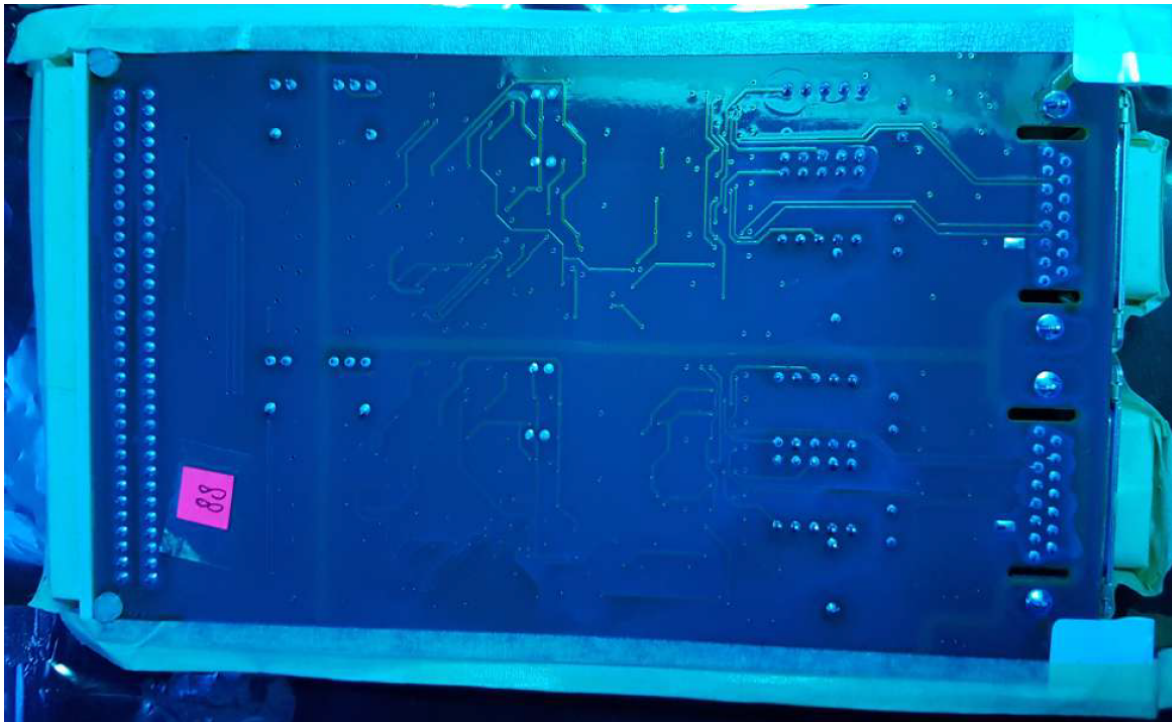
The thicker the coating the more deeper the blue color.

**Definition, STMA-80446** - [Figure: Analog Input Board front \(Example\):](#)



**Definition, STMA-74594 -**

Figure: Analog Input Board Back (Example):

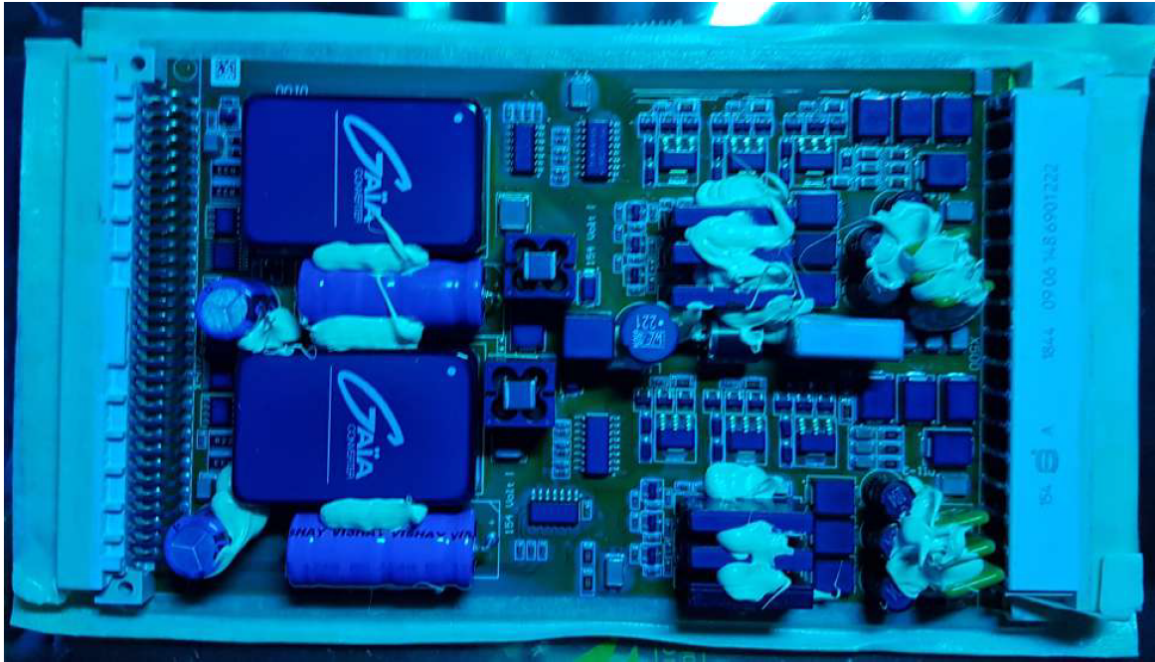


\* The sticker was removed before coating.

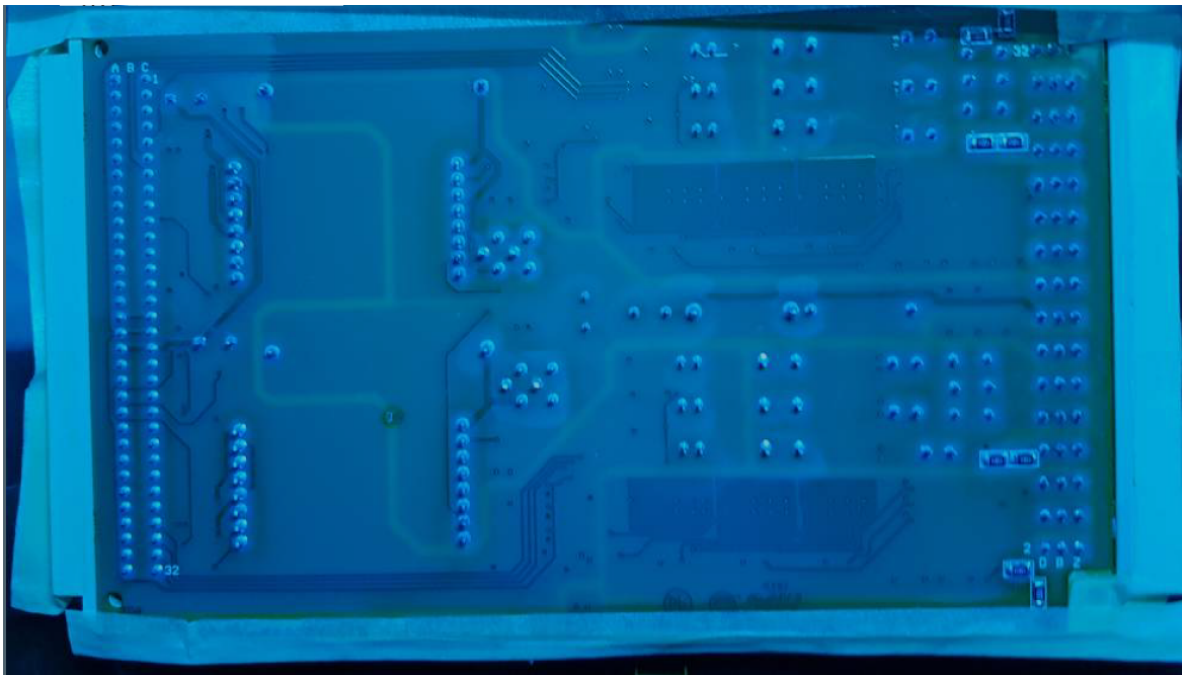
**Definition, STMA-74593 -** Figure: SAP Board front (Example):



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**Definition, STMA-74597** - Figure: PS-DIO Board back (Example):



### 3.1.4 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.

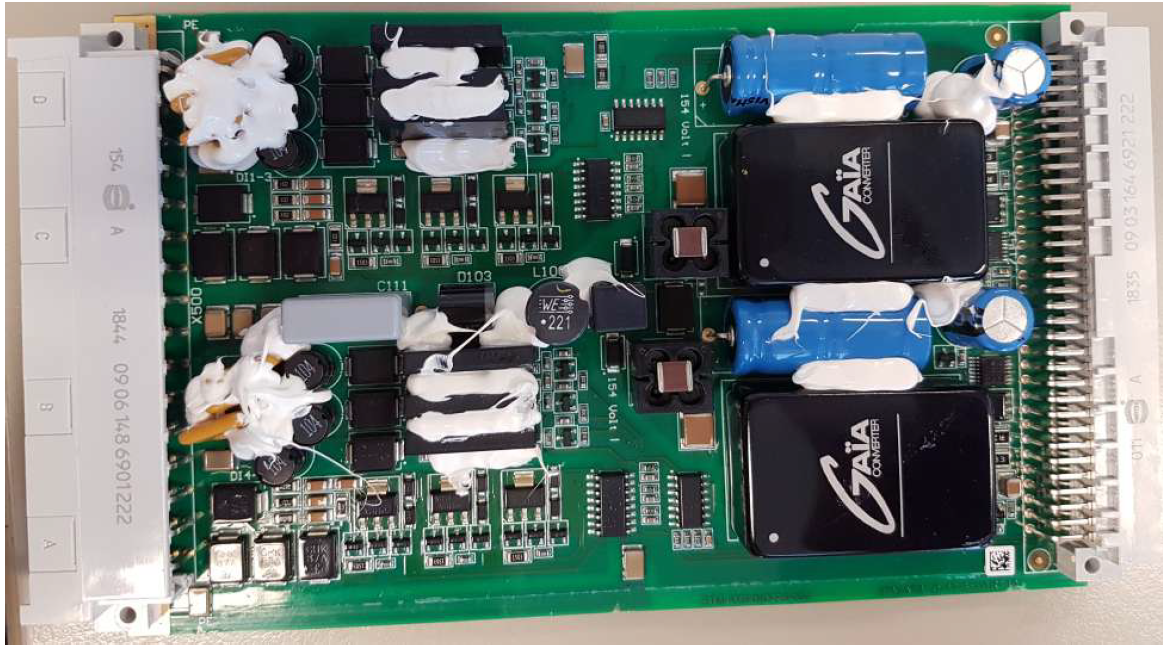
The components at risk are:

- The yellow fuses  
2x 3 PTC through hole R300/R310/R320 R301/R311/R321
- The black inductors  
2x 3 radial through hole L300/L302/L304 L301/L303/L305
- The six isolators in the middle.  
2x 3 optical isolators through hole U300/U301/U302 U303/U304/U305



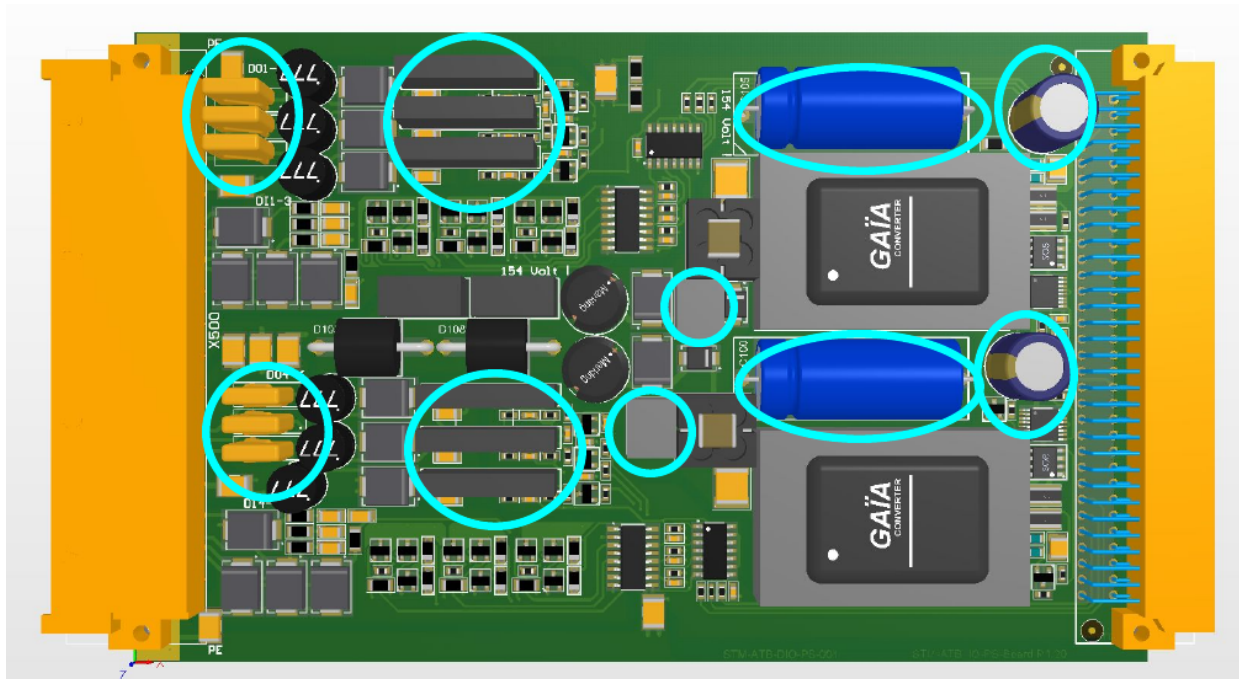
- The electrolytic capacitors
  - 1 capacitor through hole C112
  - 2x axial capacitor through hole C100 C105
  - 2x radial capacitor through hole C101 C110

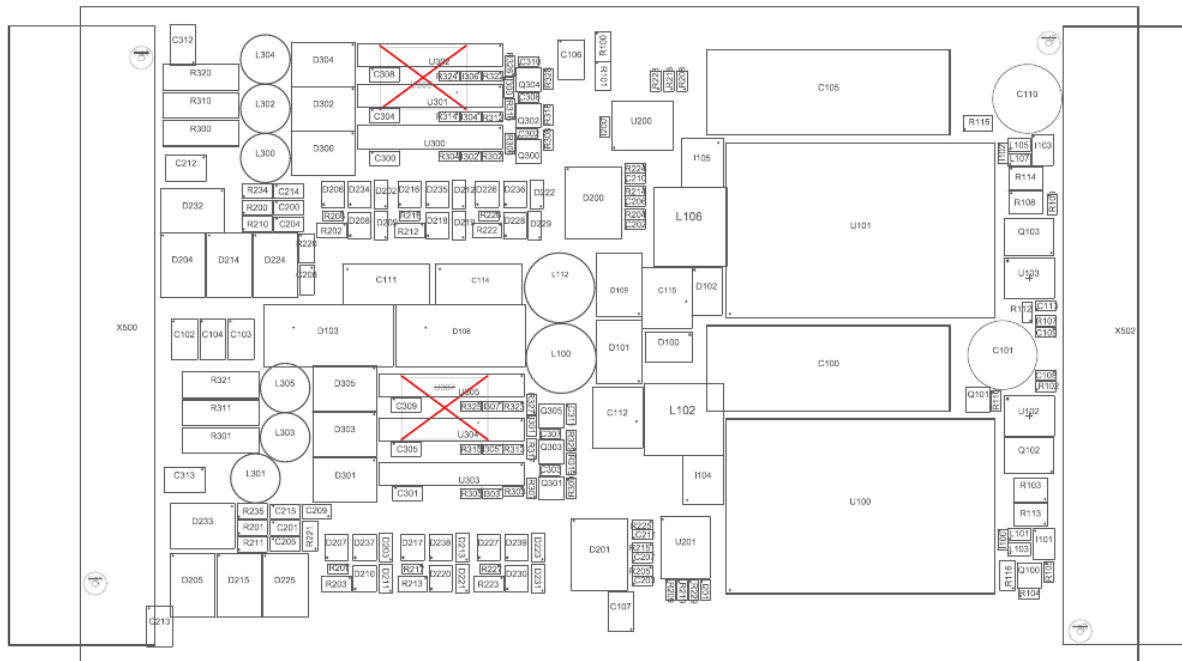
**Definition, STMA-80447** - Figure: gluing example based on V1.0 Hardware



**Definition, STMA-69637** - Figure: DIO+PS board 3D design

Items to be glued at the DIO+PS board are indicated with blue circles






From left to right:

- 2x 3 PTC through hole R300/R310/R320 R301/R311/R321 (to be glued to L300-L305)
- 2x 3 opto-isolatoren through hole U300/U301/U302 U303/U304/U305
- 2 condensator through hole C112 C115
- 2x axiale elco through hole C100 C105
- 2x radiale elco through hole C101 C110

#### 4 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.

 **Test Definition, STMA-69035** - The software of the STM ATB shall be loaded on the processors on the SAP Board. The manufacturer shall ascertain that the prescribed 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 other than in 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.

**4.1 Preparation**

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

- laptop with software (see web-links for updates):
  - J-Flash V6.30b. <https://www.segger.com/downloads/jlink/>
  - netX Bootwizard V1.4.0.1. <https://kb.hilscher.com/display/BOOTWIZ/Bootwizard+V1.4.0.1>
  - netHOST v1.0.0.0. <https://kb.hilscher.com/pages/viewpage.action?pageId=117984813>
  - Vivado Lab Edition v2022.2. <https://www.xilinx.com/support/download.html>

(or newer)

- power supply connector with ON/OFF switch (12 V DC Backplane connector (pins A18 and C18 (+) and A15 and C15 (-)));
- JTAG 20-pins to 10-pins adapter (modified(\*)) as shown below as nr 4;
- Jlink Segger Version 10.1 as shown below as nr 2
- Cable with two single pin connectors or a 2.54mm jumper, as shown below as nr 1;
- Digilent JTAG-HS3 programming cable (mUSB – Jtag) with custom adapter (\*\*) as shown  [STMA-80452 - figure: programming tools Olimex ARM-JTAG 20-10 adapter with modifications in br...](#) as nr 3.
- USB adapter cable (\*\*\*) for Hilscher netX51.
- System override adapter (\*\*\*\*)

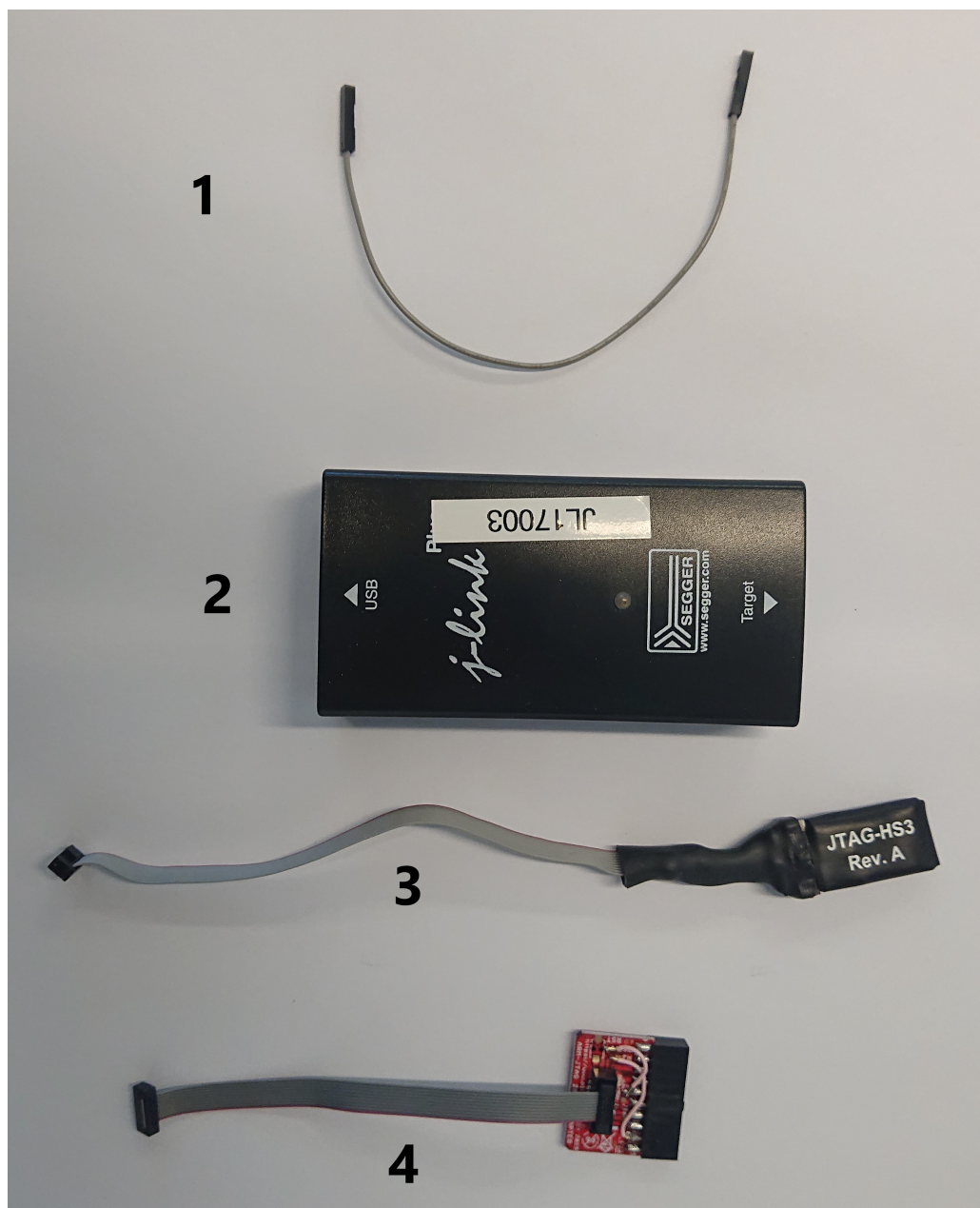
(\*) Note: The adapter has been modified to facilitate the Hercules processor, which does not fully adhere to the Cortex 9-pin standard. The schematic of the modification is given below. The adapter (without modification) is commercially available by Olimex (Olimex ARM-JTAG-20-10).

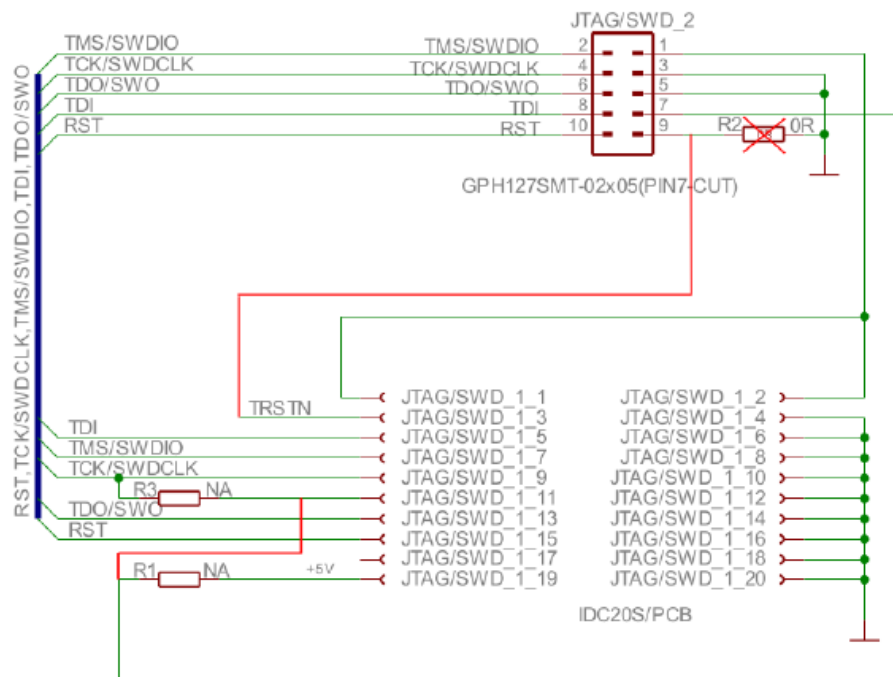
(\*\*) Note: The pinout of the Digilent programming cable is different than the target connector on the SAP board. Therefore, a custom adapter is required. The pins are given in the figure below.

(\*\*\*) Note: The Hilscher netX51 can be used in USB device mode for a.o. firmware download. The SAP board does not include the USB connector due to space constraints. The USB pins and GND are available on the SAP board on connector X101. A transient voltage suppressor is implemented on the SAP board. The connector is a 10-pins 2x5, 1.27mm pitch Samtec connector. A pin table is given below.

(\*\*\*\*) Note: A system override adapter is necessary to keep the SAP board from entering the safe state after programming the functional processor, which prevents programming the other programmable elements on the board. The system override adapter needs to be placed on the X103 connector on the SAP board. The adapter needs to connect X103:1 to GND, which is available on X103:5 and X103:6.

**Definition, STMA-80452** - figure: programming tools





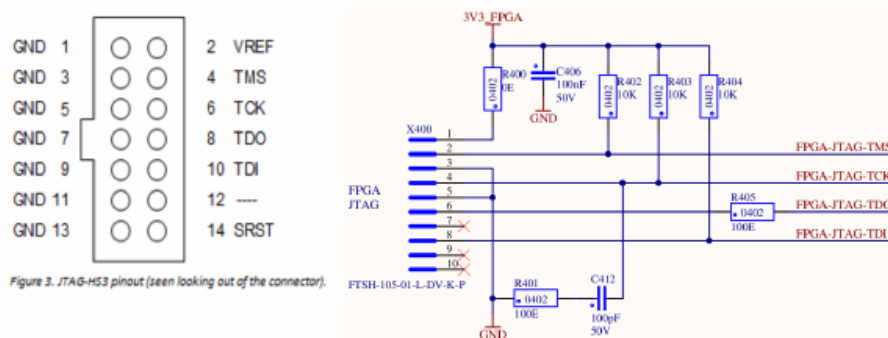
## ARM-JTAG 20-10 ADAPTER

Rev. A

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<http://www.olimex.com/dev>

Olimex ARM-JTAG 20-10 adapter with modifications in bright red.



### Definition, STMA-80453 - table

Digilent JTAG-HS3 programming cable pinout [left] and its counterpart, X400 on the SAP board [right].


pin	definition
X101:10	USB D+
X101:9	USB D-
X101:8	GND
X101:7	GND

X101 connector pin definition (partial) on SAP board for netX51 USB device mode.

## 4.2 Loading the software onto the Hercules processor

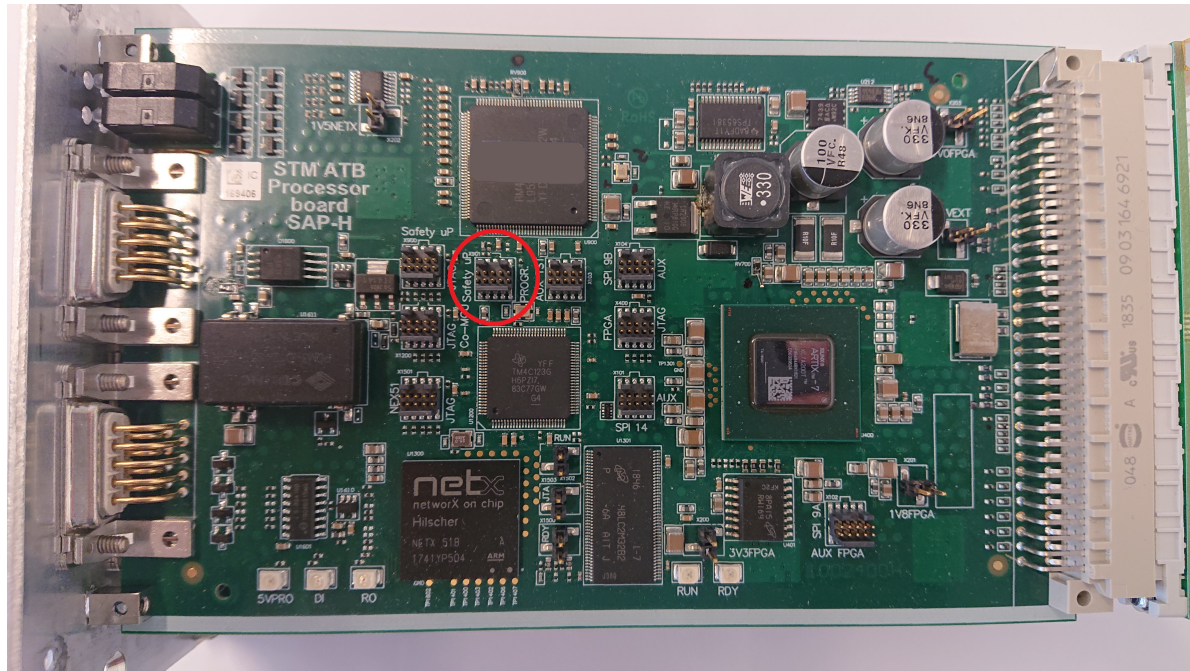
**Text, STMA-69039 -**

1. 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

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

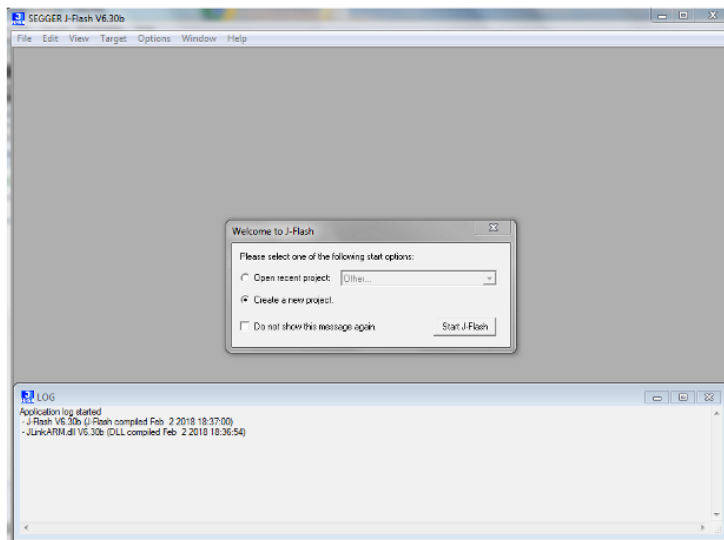
**Definition, STMA-69040 -** Figure: Hardware connections for loading the software on the Hercules processor



**Text, STMA-69057 -**

4. Open the software loading program "J-Flash V6.30b" on the laptop;
5. The pop-up "Welcome to J-Flash" appears. Select "Create a new project" and click "Start J-Flash" (Figure  **STMA-69052**);

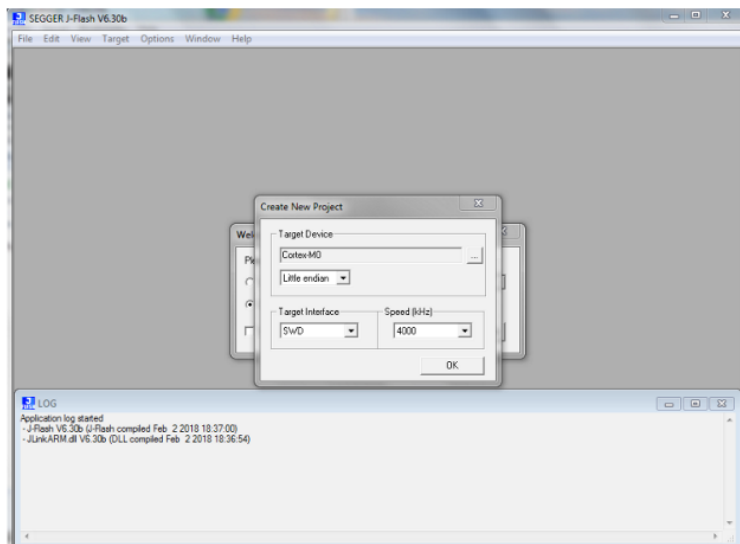
**Definition, STMA-69052 -** Figure: Welcome to J-Flash [Project]




**Text, STMA-69053 -**

6. 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]**



**Text, STMA-69051 -**

7. 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]**



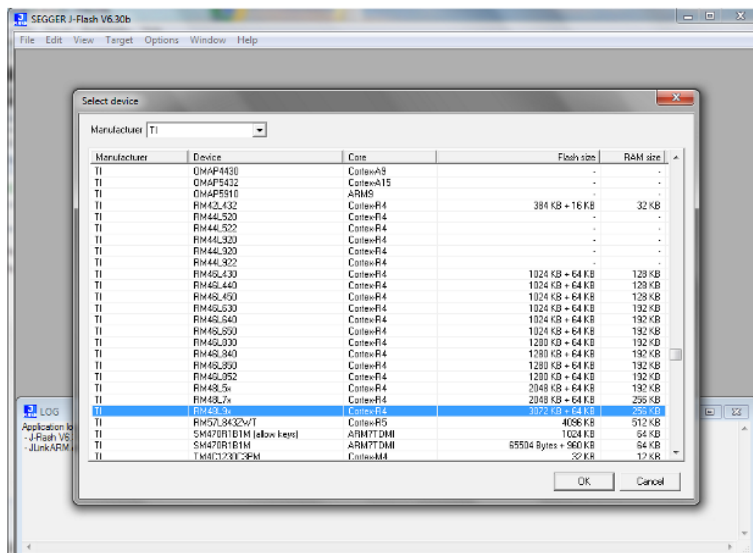



Figure: Select device [Project\_3]

**Text, STMA-69056 -**

- 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]

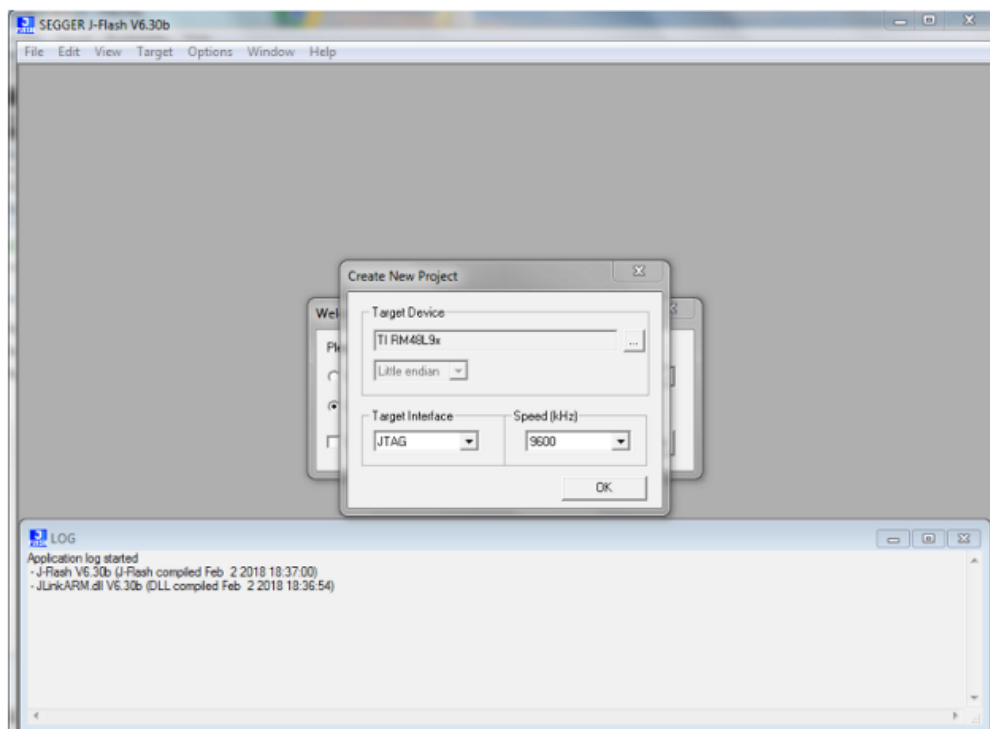
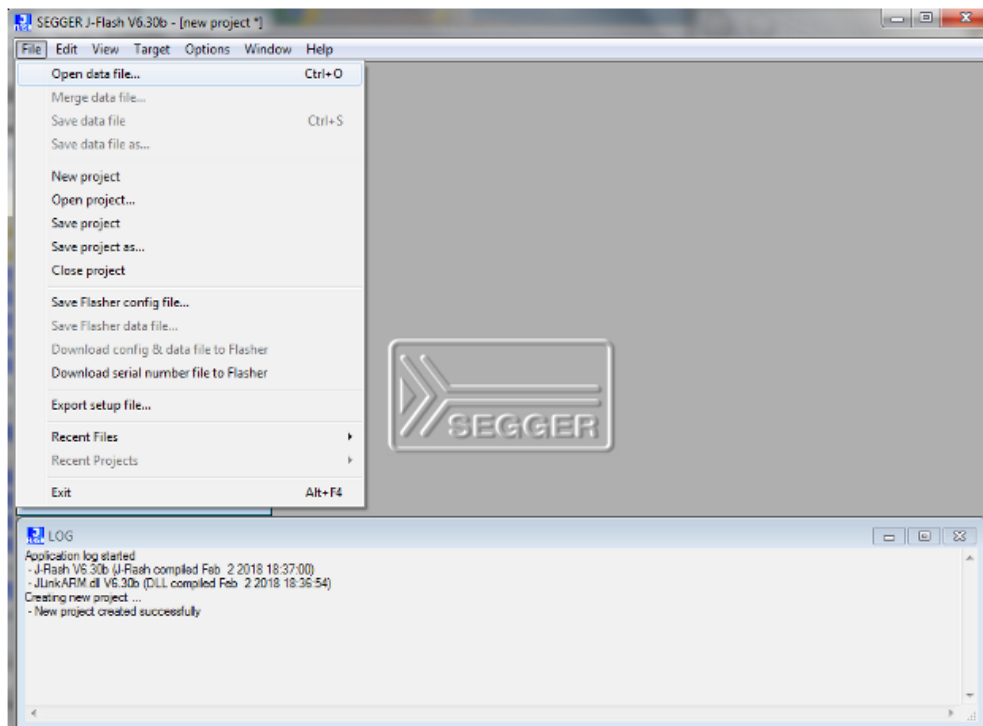


Figure: Create new project 2 [Project\_4]


**Text, STMA-69120 -**

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

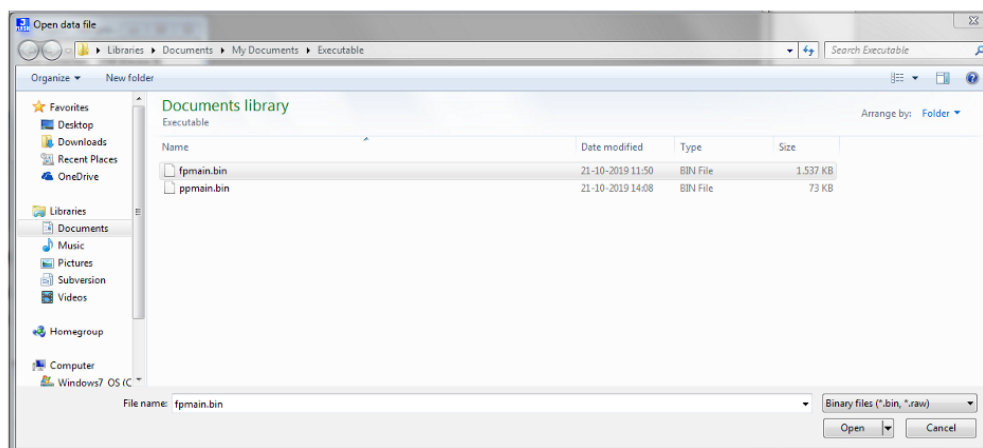
**Definition, STMA-69048 -** Figure: Open data file [LoadFile\_1]



**Text, STMA-69049 -**

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

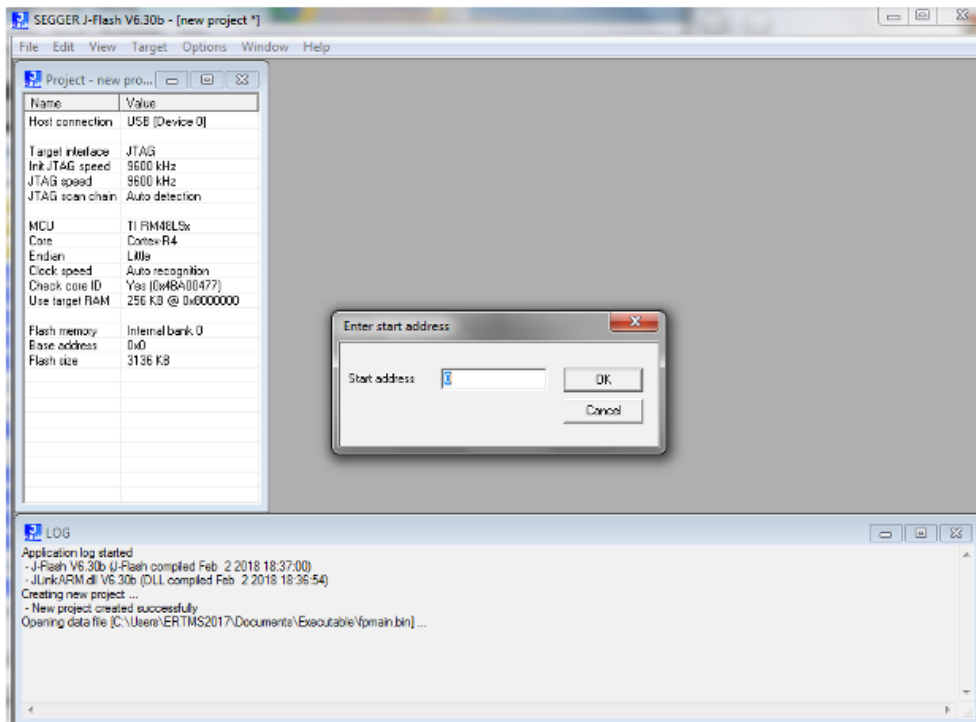
**Definition, STMA-69047 - Figure: Select data file [LoadFile\_select]**



**Text, STMA-69045 -**

11. The pop-up “Enter start address” appears. Enter “0” (zero) and click “OK” (Figure  STMA-69046)

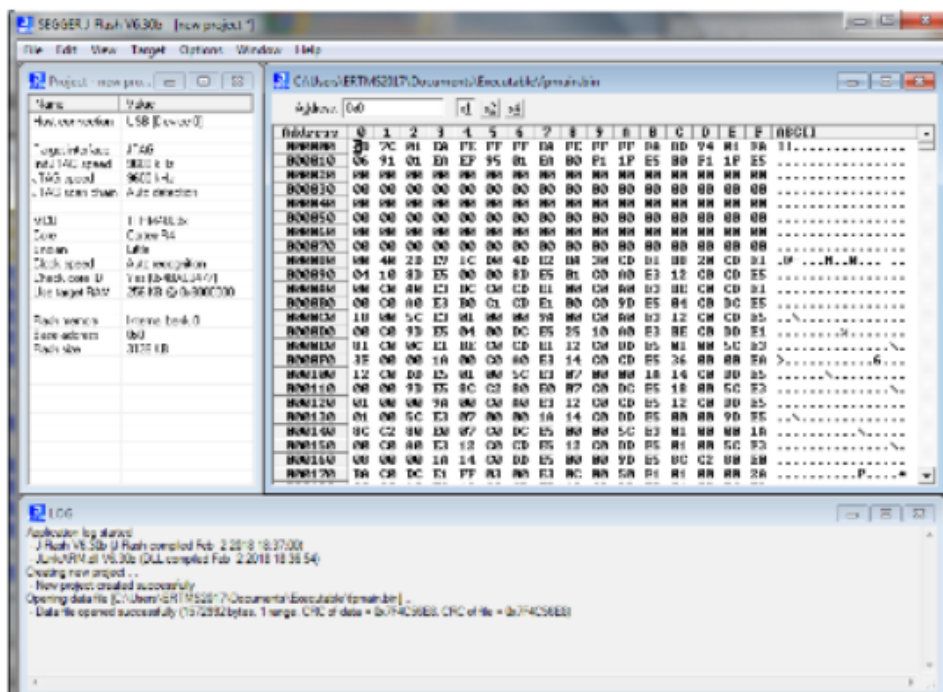
**Definition, STMA-69046 - Figure: Enter start address [LoadFile\_2]**



Text, STMA-69121 -

12. 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]

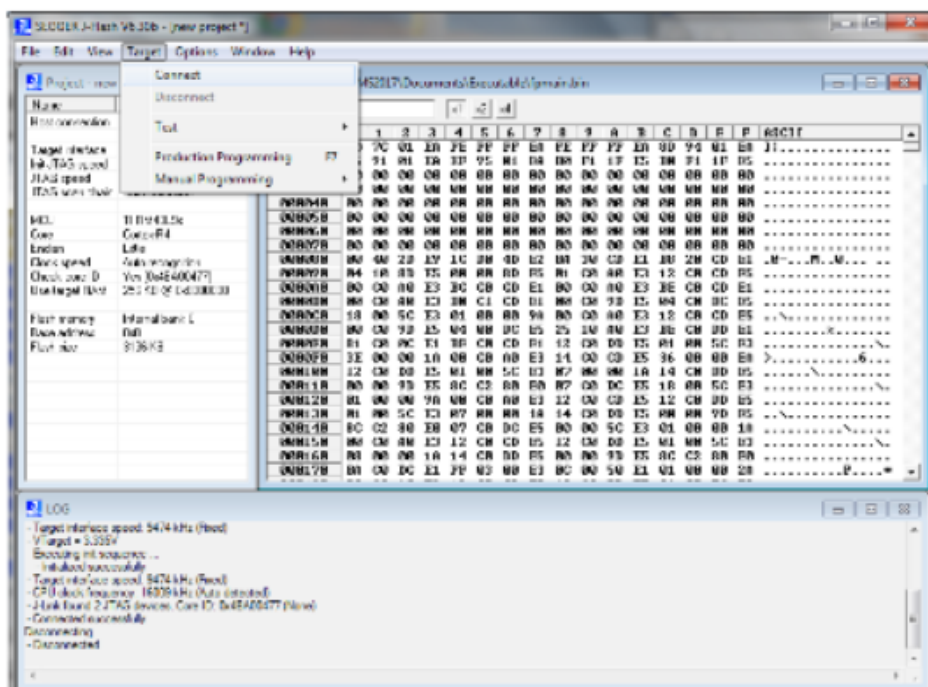


Text, STMA-69074 -

13. Click "Target" (on the top ribbon) and select "Connect" on the pop-up (Figure [STMA-69066](#));

Definition, STMA-69066 - Figure: Connect Target [Connect]

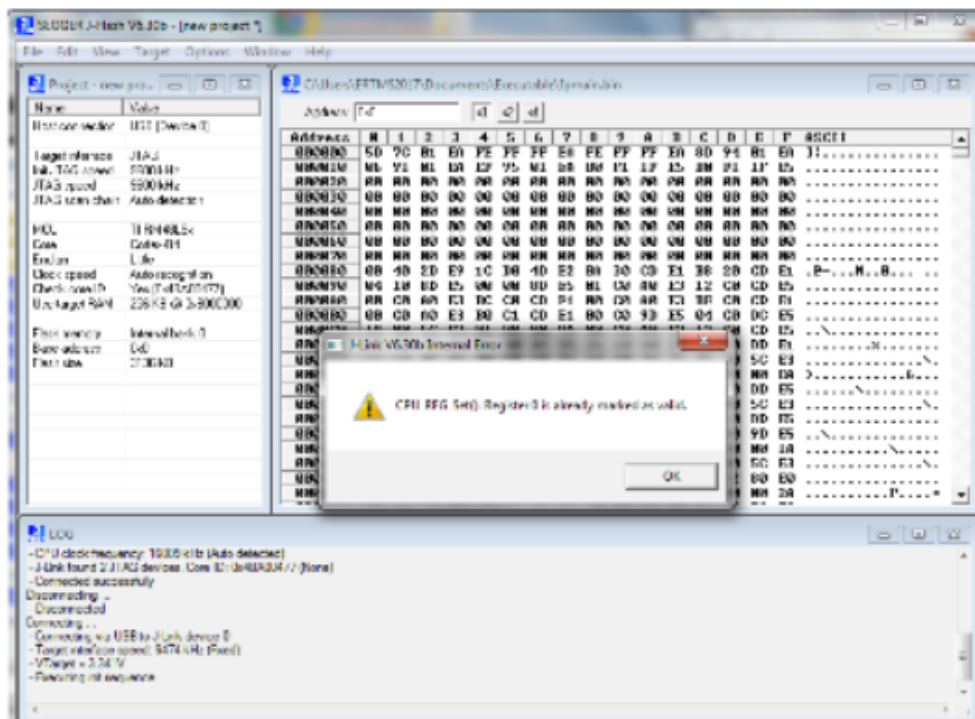




Text, STMA-69067 -

14. 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]




Text, STMA-69065 -

15. Again click “Target” (on the top ribbon) and select “Production Programming” on the pop-up (Figure STMA-69069);

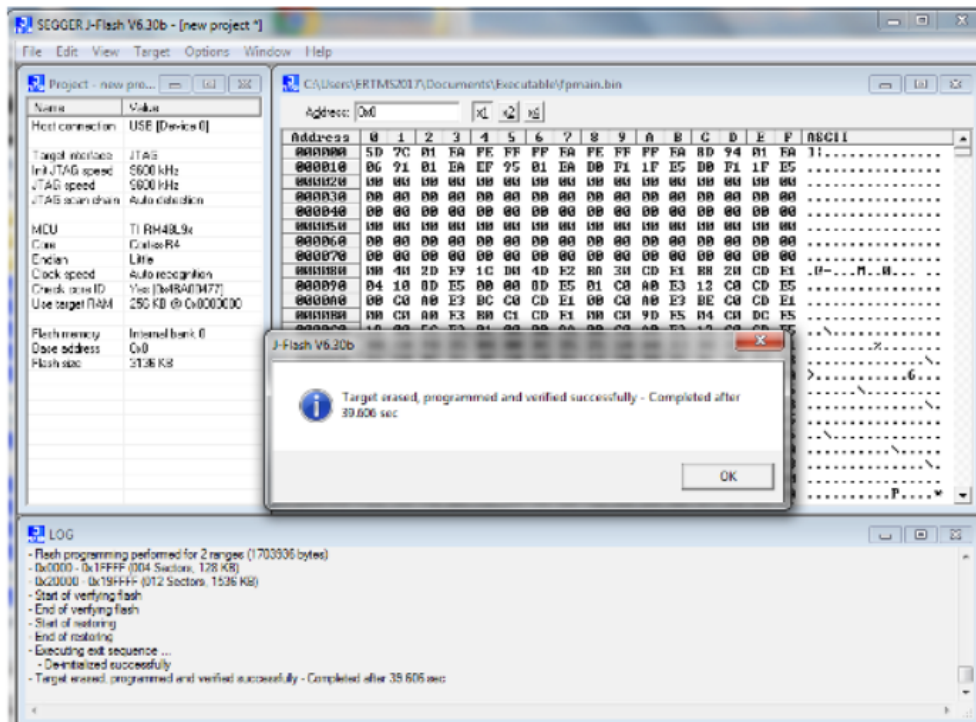
Definition, STMA-69069 - Figure: Production programming [Program]

16. The pop-up “J-Flash” appears with a progress bar. The software is loaded on the Hercules processor (Figure 10-6-9068);

[illegible]

17. 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** - Figure: Hercules programmed and verified successfully [Program\_done]



**Text, STMA-69060** -

18. 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;

**Text, STMA-69061** -

19. Power off the SAP board and continue with [4.3 - Debugging](#) ;
20. Disconnect the JLink cable connector from connector X901 on the SAP Board

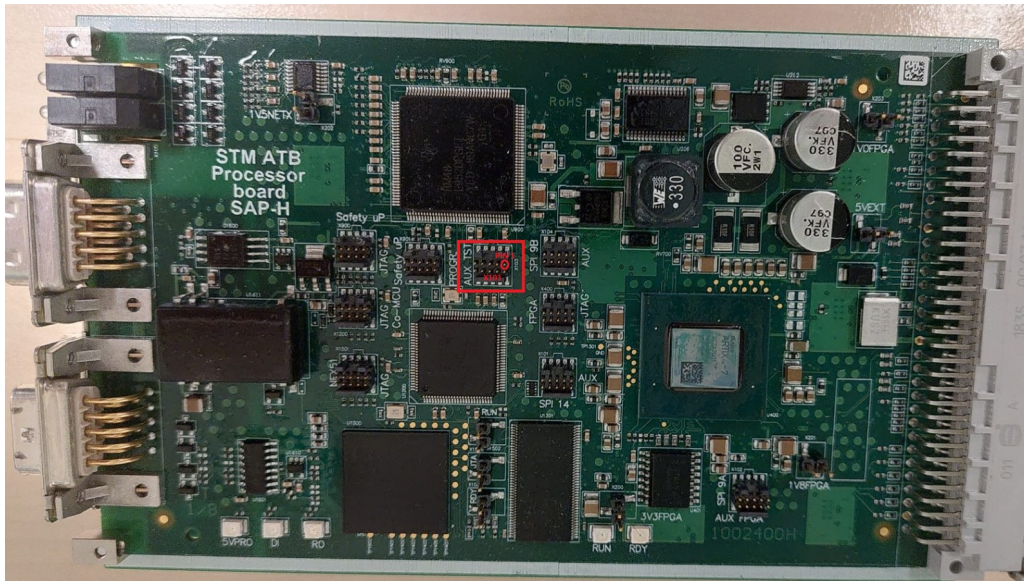
### 4.3 Debugging

**Text, STMA-69070** -

1. Connect pin 1 of the X103 connector with any GND pin, for instance pin C32 of the Backplane connector (Figure [ST MA-69072](#));
2. Establish power supply to the SAP Board
3. Apply 12 V DC to the pins A18 and C18 (+) and A15 and C15 (-) of the Backplane connector;
4. Switch the power supply OFF and, after waiting at least 2 seconds, ON again;
5. 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](#) .

**Definition, STMA-69072** - Figure: Hardware connection for debugging








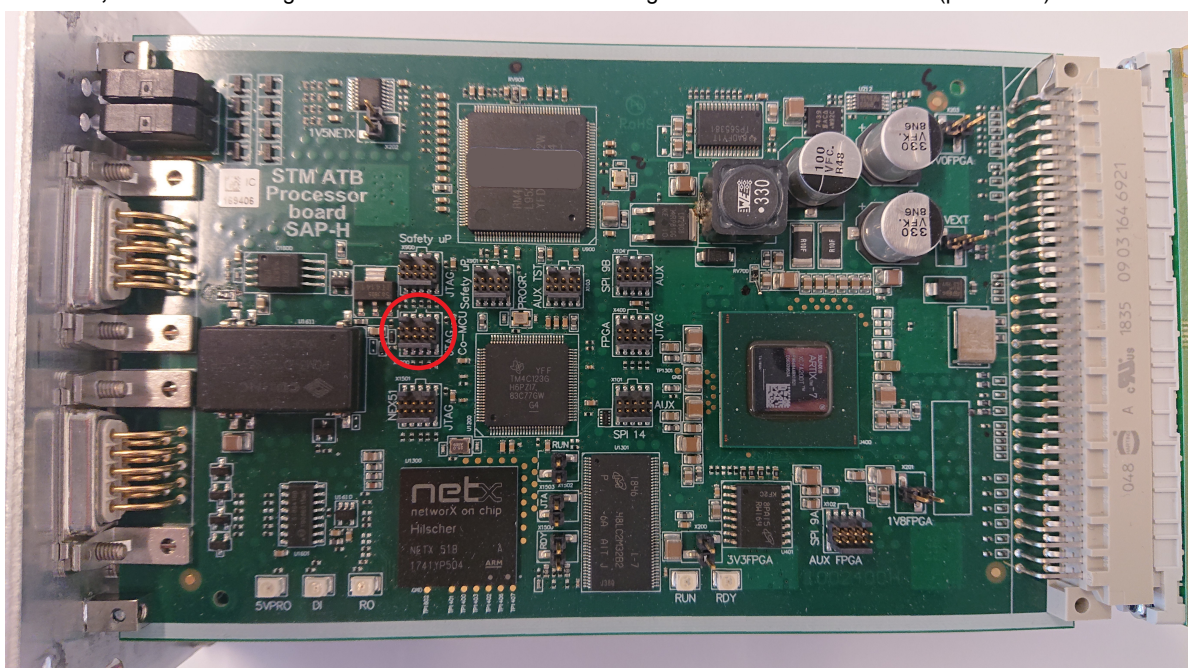
#### 4.4 Loading the software on the TIVA (co)processor

Text, STMA-69077 -


Initial state:

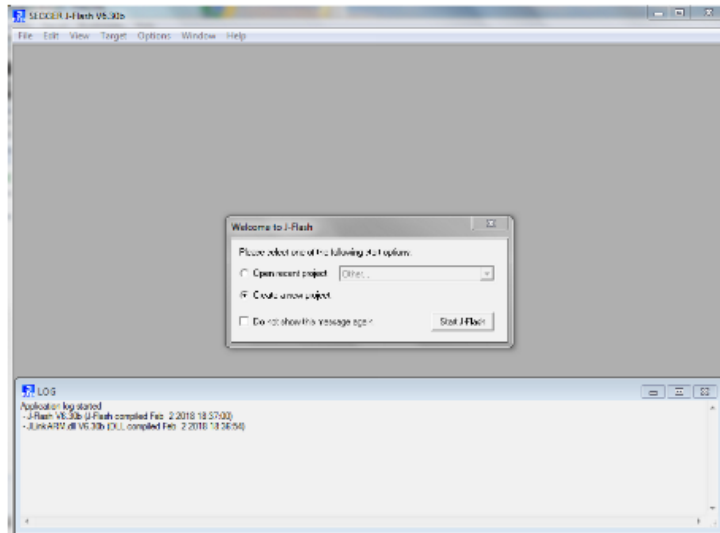
- Power off
  - pin 1 of the X103 connector with any GND pin, for instance pin C32 of the Backplane connector (Figure  STMA-69072 ) connected (see  STMA-69070 )
1. Connect a USB port of the laptop with the X1200 connector on the SAP Board, using a standard USB cable, a Jlink Segger (Nr 2) and the JLink cable connector (Nr 4) (Figure  STMA-69075);
  2. Establish power supply to the SAP Board.
  3. 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)

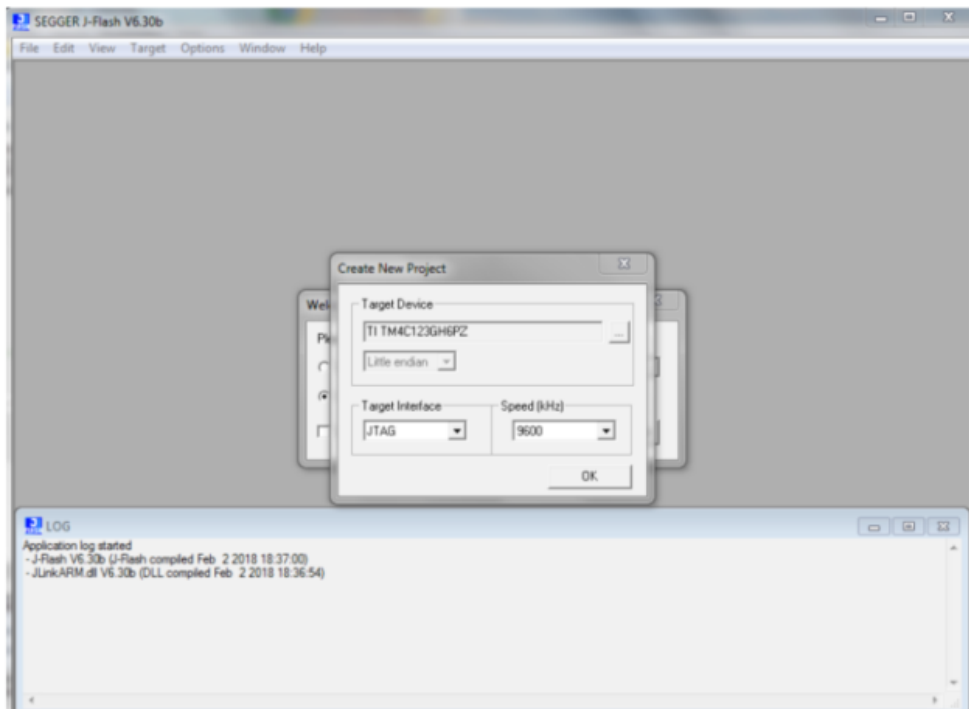



**Text, STMA-69124 -**

4. Open the software loading program “J-Flash V6.30b” on the laptop;
5. The pop-up “Welcome to J-Flash” appears. Select “Create a new project” (Figure  STMA-69313).

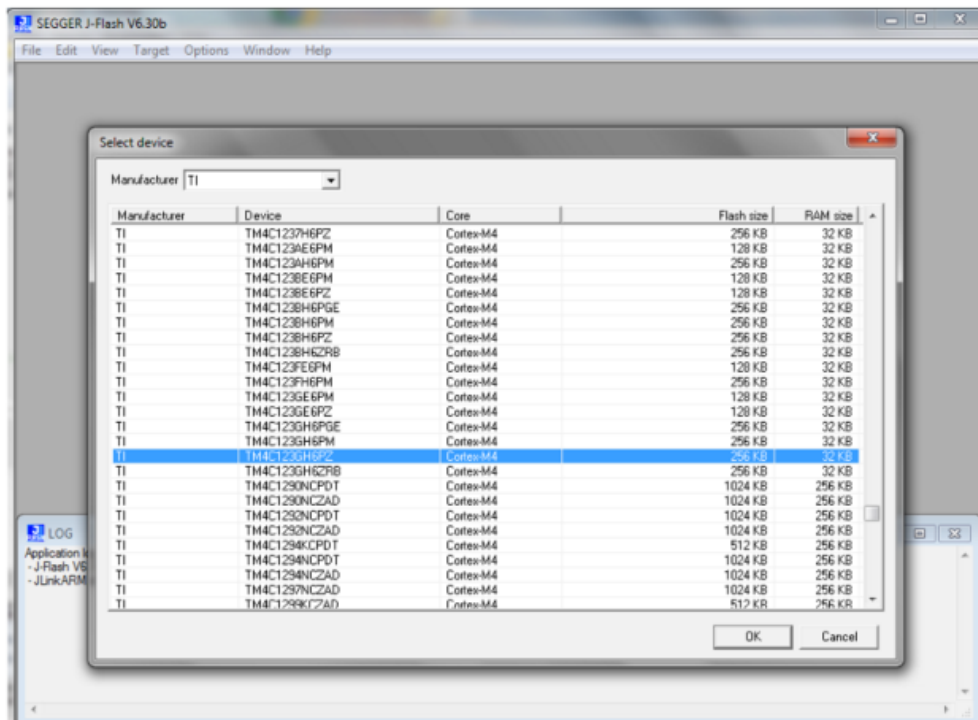
**Definition, STMA-69313 - Figure: Welcome to J-Flash [Project]****Text, STMA-69125 -**

6. 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]****Text, STMA-69148 -**

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

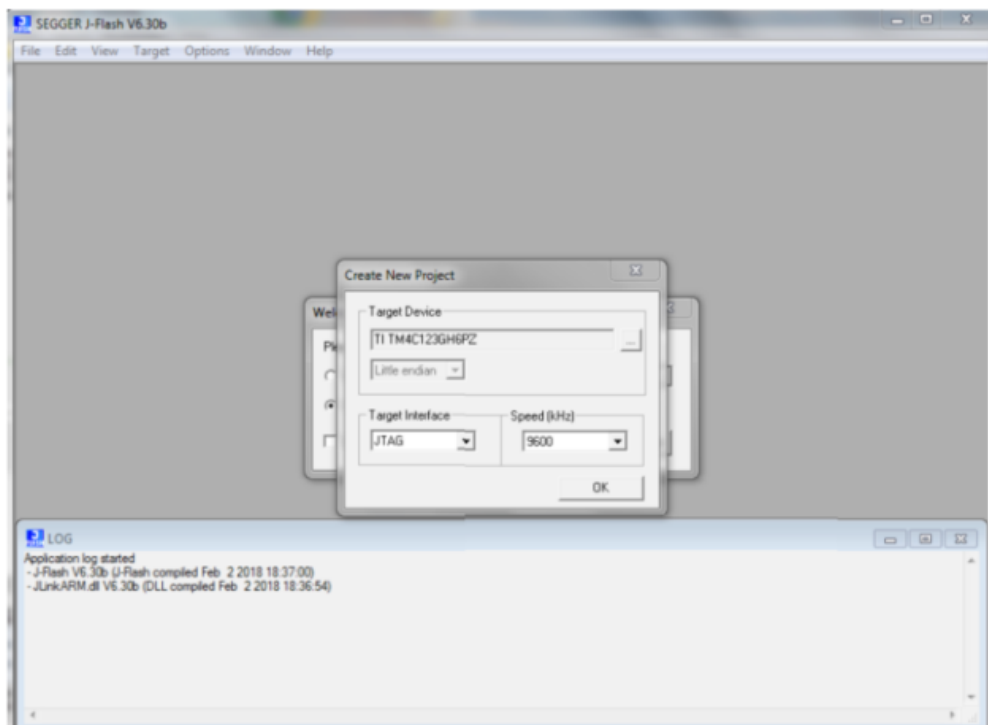
**Definition, STMA-69149** - Figure: Select device [Project\_device]



**Text, STMA-69139** -

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

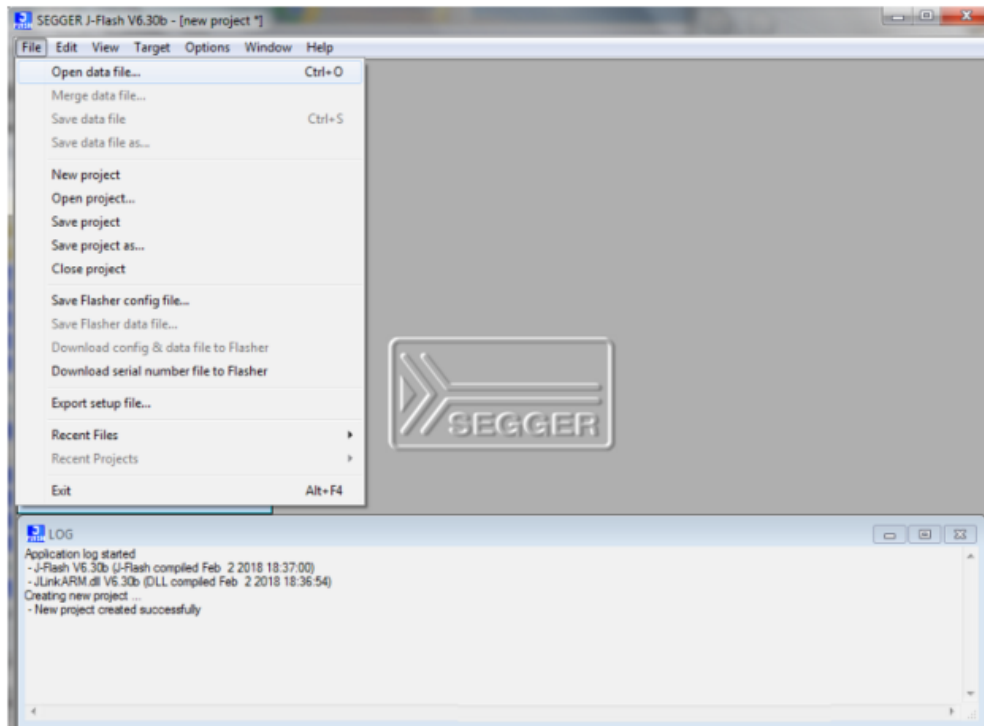
**Definition, STMA-69140** - Figure: Create new project 2 [Project\_settings]




**Text, STMA-69137** -

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

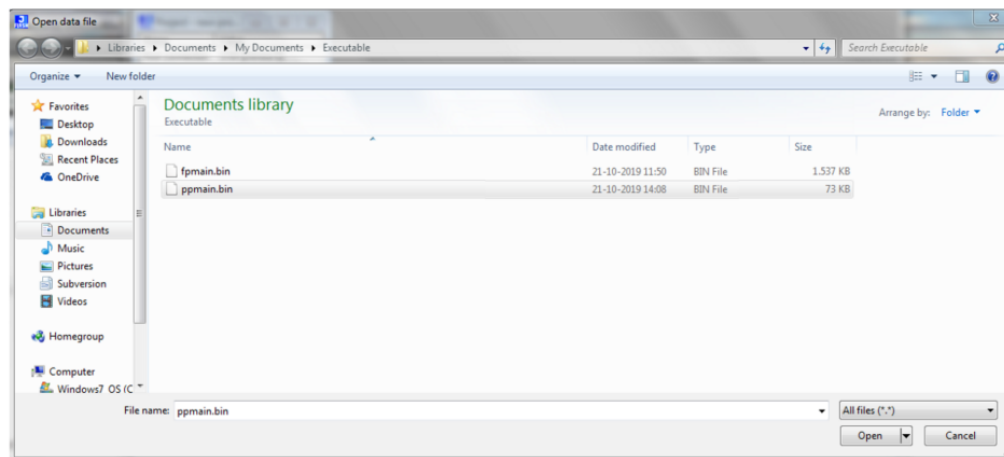
**Definition, STMA-69138** - Figure: Open data file [LoadFile\_1]




**Text, STMA-69144** -

10. 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]

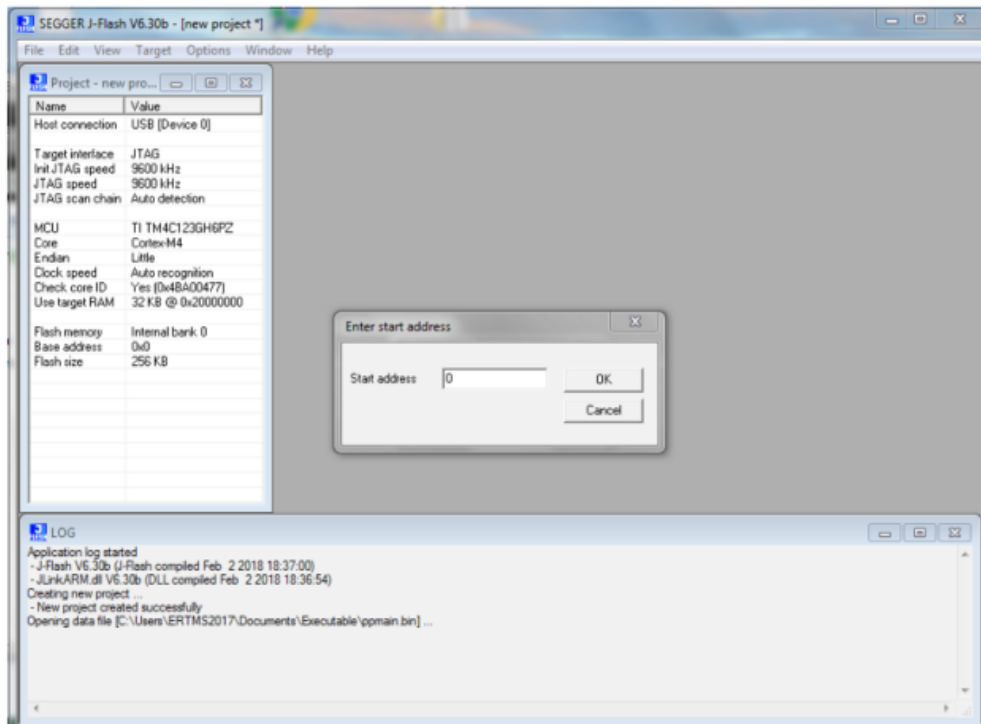


**Text, STMA-69141** -

11. The pop-up “Enter start address” appears. Enter “0” and click “OK” (Figure  STMA-69153);

**Definition, STMA-69153** - Figure: Enter start address [LoadFile\_3]

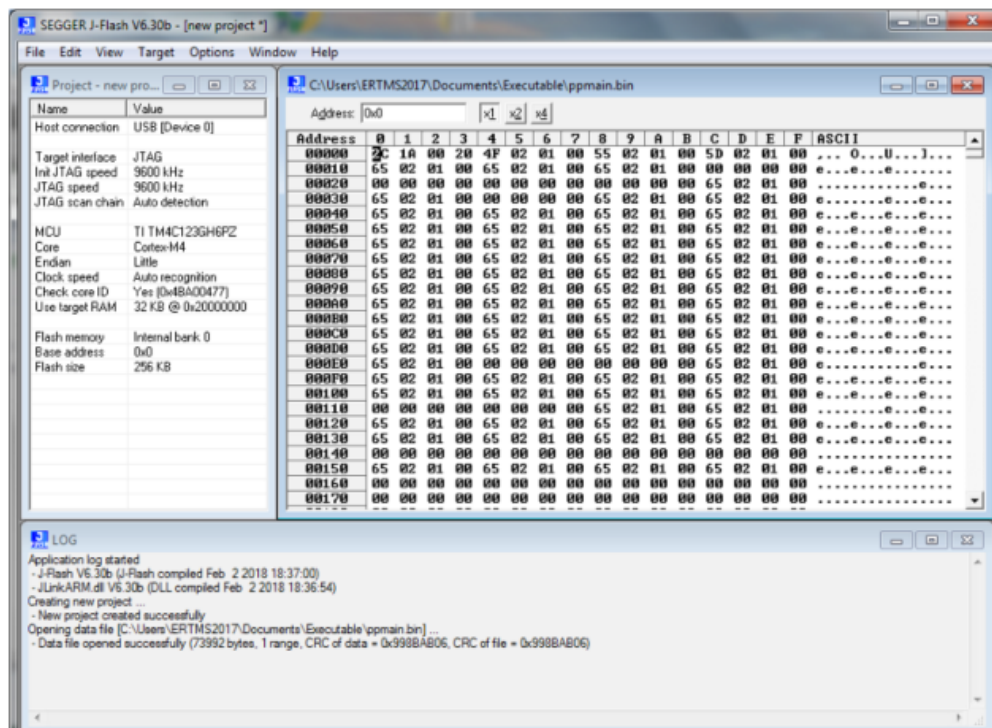




Text, STMA-69155 -

12. 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]

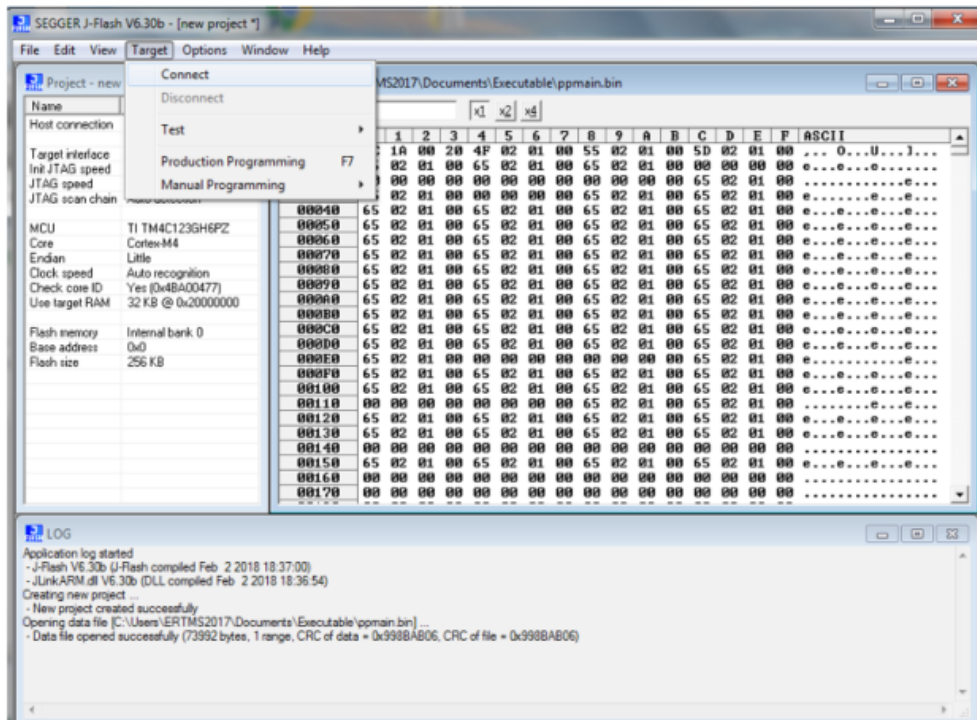


Text, STMA-69152 -

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



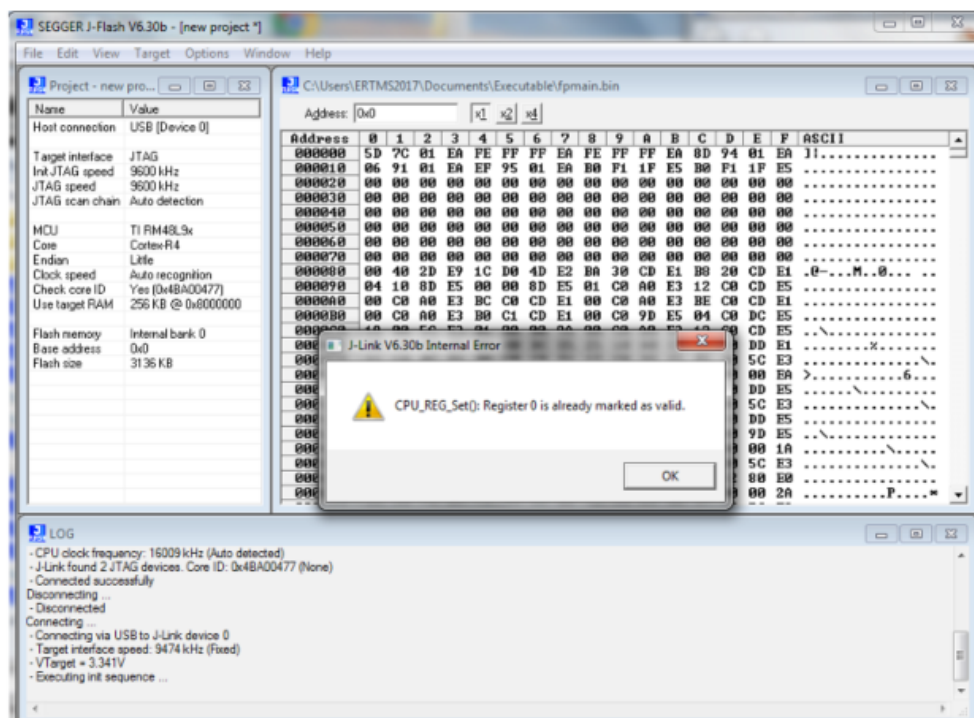
**Definition, STMA-69150** - Figure: Connect target [Connect]



**Text, STMA-69145** -

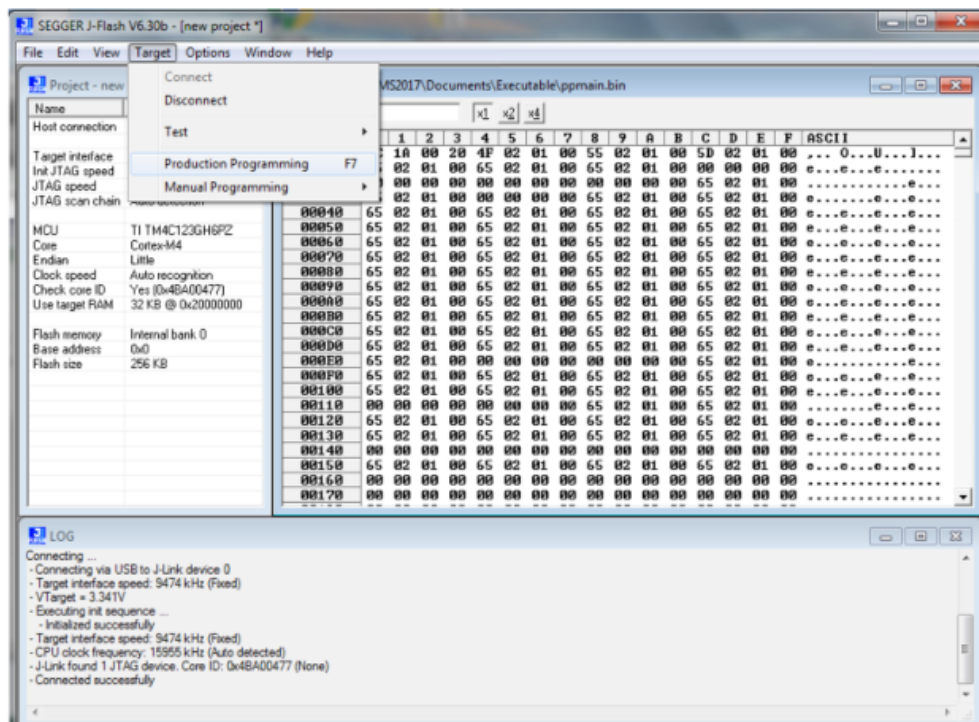
14. If the pop-up “J-Link V6.30b Internal Error” appears, ignore the error, click “OK” (Figure STMA-69147), and continue with step 14, immediately if this error message doesn’t appear;

**Definition, STMA-69147** - Figure: Internal error [Connect\_error]

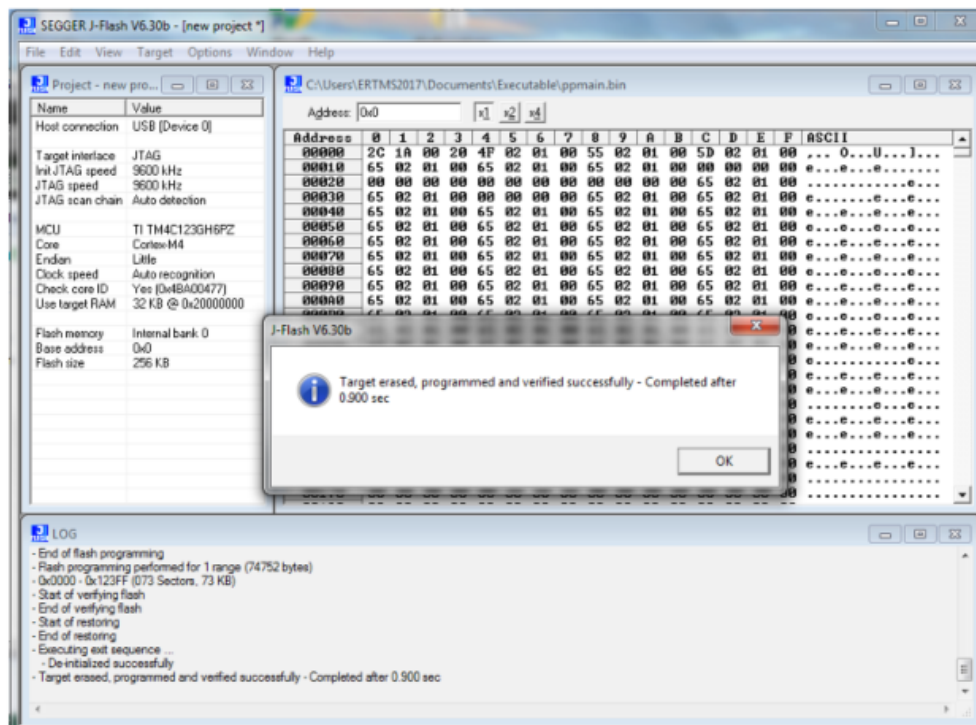


**Text, STMA-69142** -

15. 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]**Text, STMA-69136** -


16. 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]**Text, STMA-69135** -

17. 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;


**Text, STMA-69132 -**

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


#### 4.5 Loading the software on the netX processor

**Text, STMA-69130 -**

Initial state:

- Power off
1. 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.

**Text, STMA-69160 -**

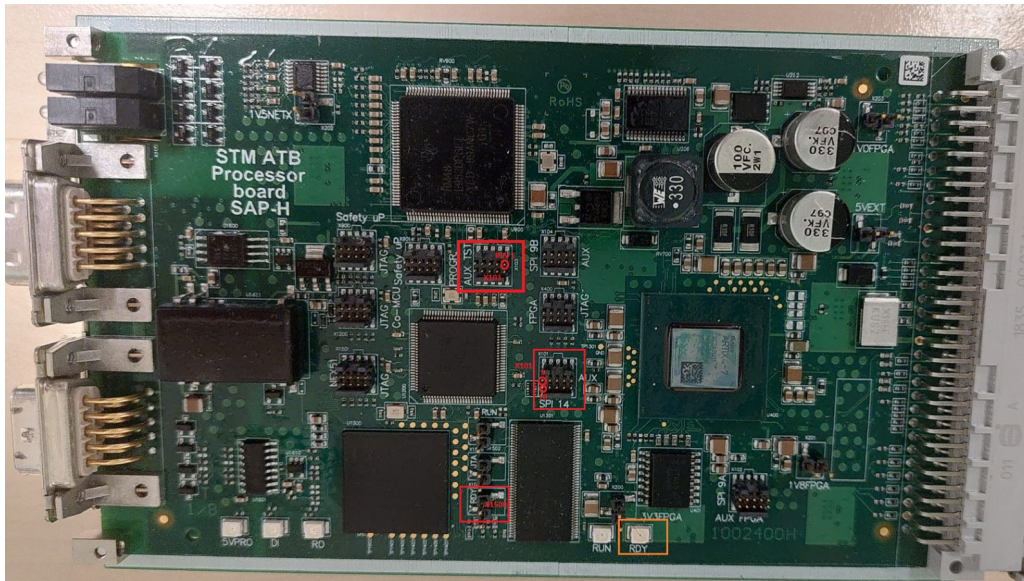
2. Connect a USB port of the laptop with the pins 9 (-) and 10 (+) of the X101 connector on the SAP Board, using two Nr 1 wires to connect to the bootloader jumper (Figure  **STMA-69131**);
3. Place a jumper on X1500;

The LED “RDY” flashes yellow (see figure  **STMA-69131** within the green square);


**Text, STMA-74723 -**

4. 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.

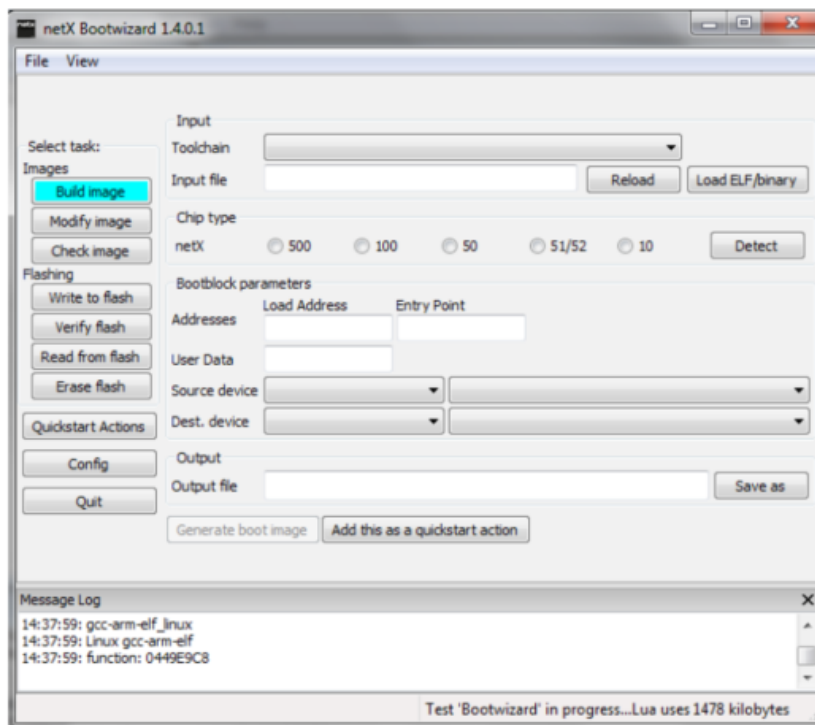
**Definition, STMA-69131 -** Figure: Hardware connections for loading the software on the netX processor




**Text, STMA-69161 -**

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

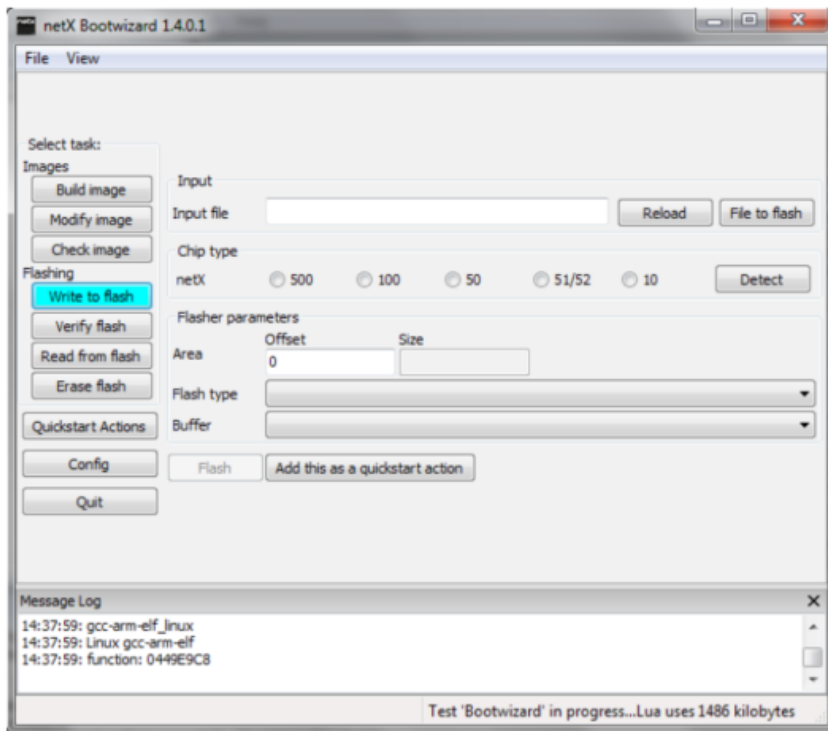
**Definition, STMA-69159 -** Figure: netX Bootwizard start [Start]



**Text, STMA-69157 -**

7. The screen “Write to flash” appears. Click “Detect” (Figure  STMA-69158);

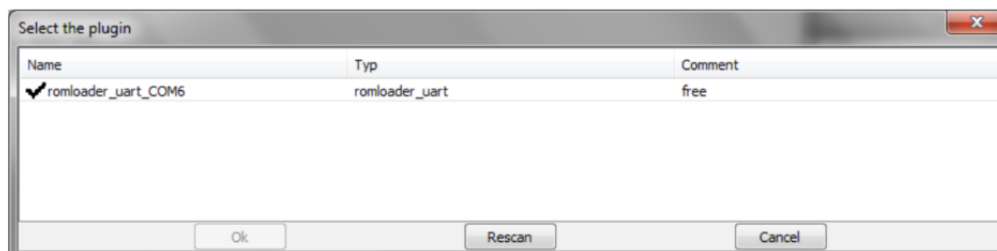
**Definition, STMA-69158 -** Figure: Write to flash 1 [write\_to\_flash]



**Text, STMA-69154 -**

8. 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]

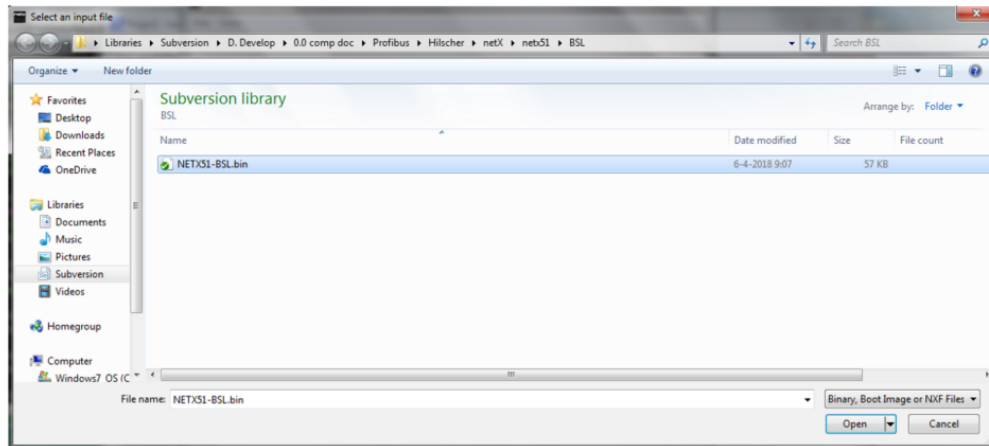


**Text, STMA-69179 -**

9. 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]

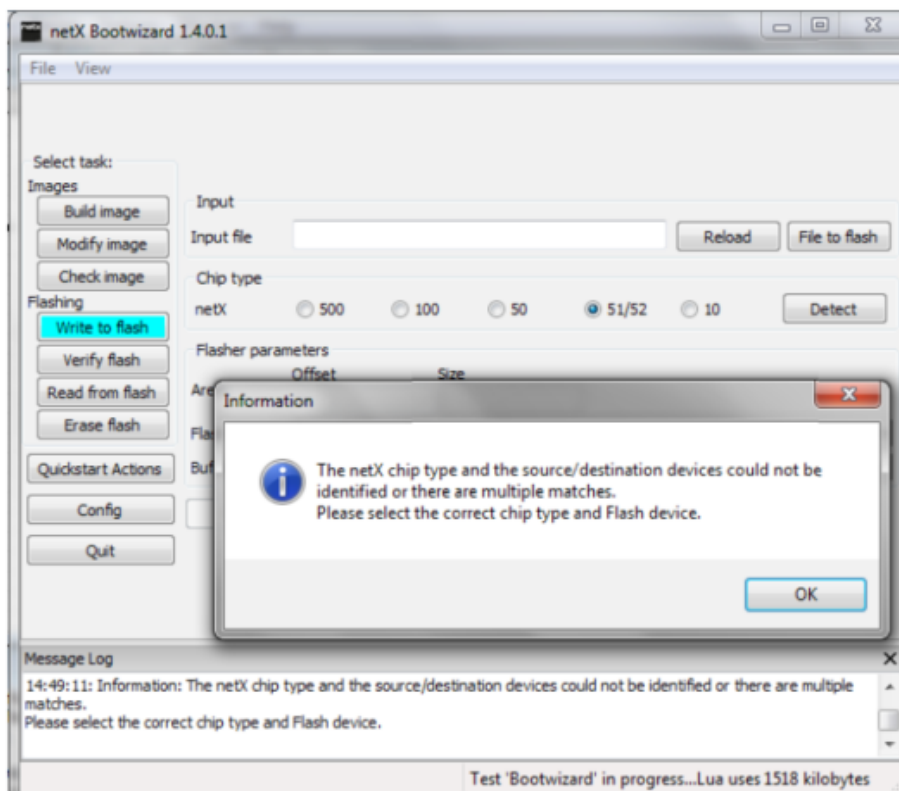




**Text, STMA-69173 -**

10. 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);

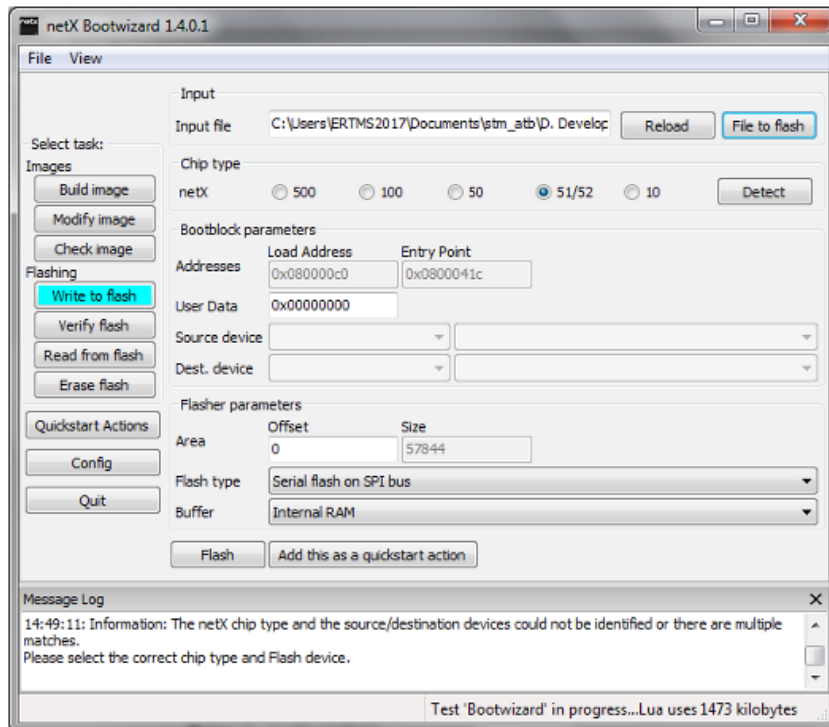
**Definition, STMA-69174 -** Figure: Information pop-up [write\_to\_flash\_info\_popup]



**Text, STMA-69171 -**

11. The screen “Write to flash” re-appears. Select “Flash” (Figure STMA-69243);

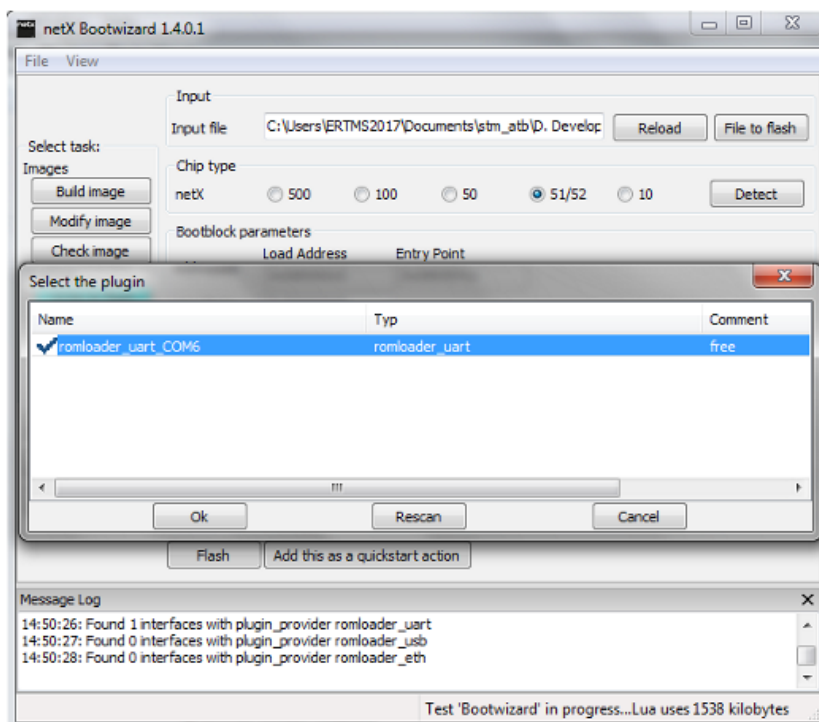
**Definition, STMA-69243 -** Figure Write to flash 2 [write\_to\_flash\_new\_screen]



**Text, STMA-69172 -**

12. The pop-up “Select the plugin” re-appears. Select “romloader\_uart\_COM6” once more and click “OK” (Figure [STMA-69244](#));

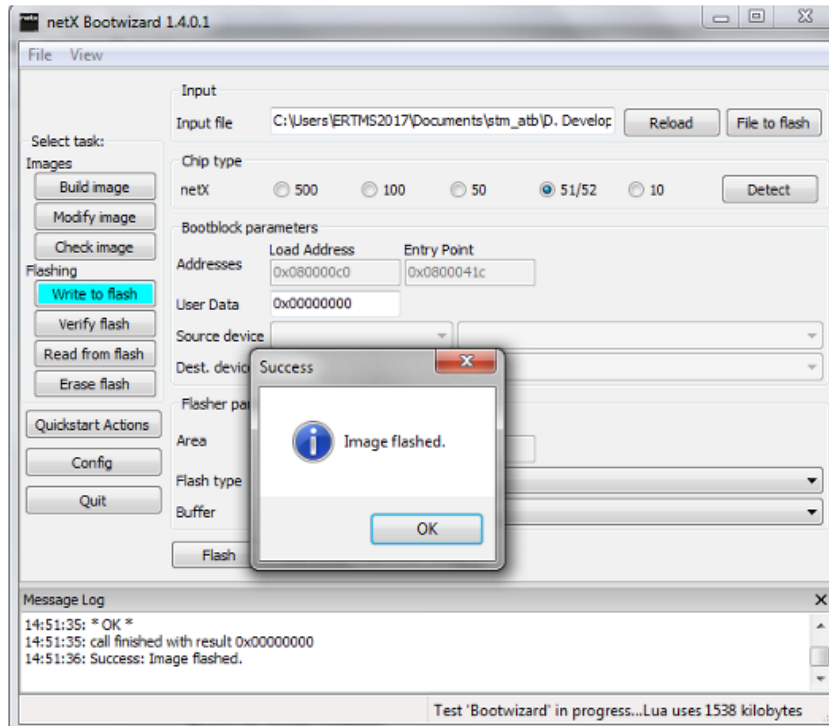
**Definition, STMA-69244 -** Figure: Select the plugin 2 [write\_to\_flash\_select]




**Text, STMA-69176 -**

13. 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]

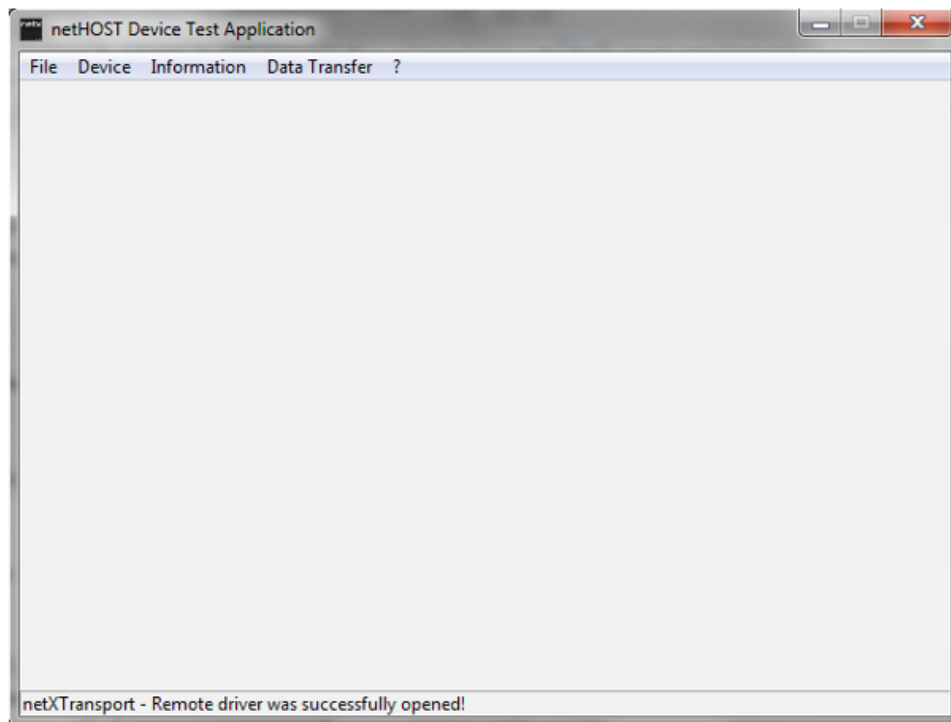


**Text, STMA-69178** -

14. Remove the jumper from the X1500 connector;
15. Switch the power supply to the SAP Board "OFF" and, after waiting at least 2 seconds, ON again;
16. 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]

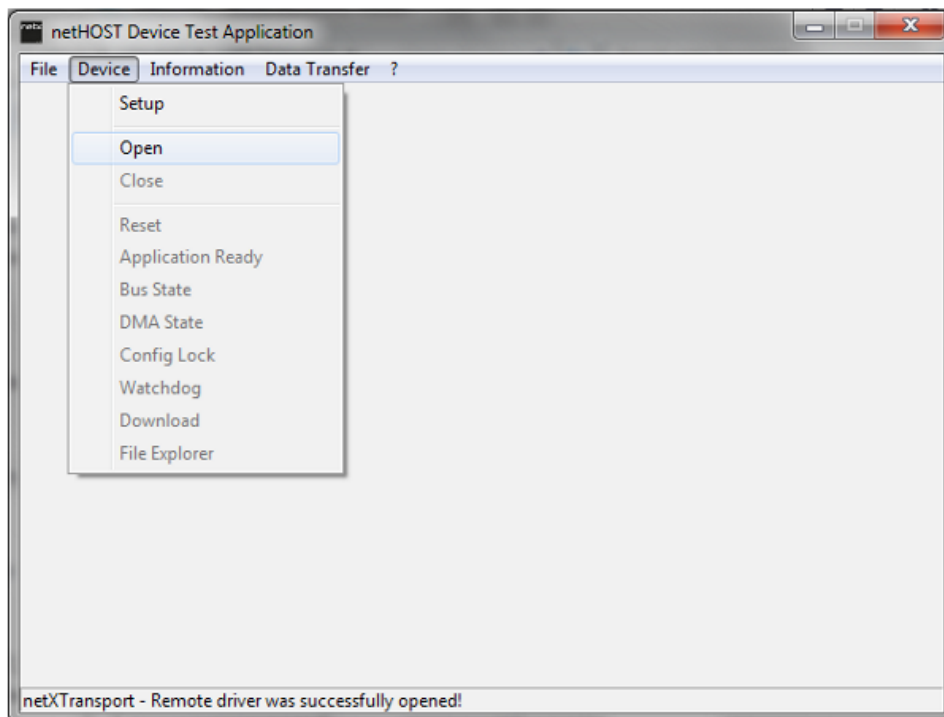




**Text, STMA-69175 -**

17. Click “Device” (on the top ribbon) and select “Open” on the pop-up (Figure  STMA-69234;

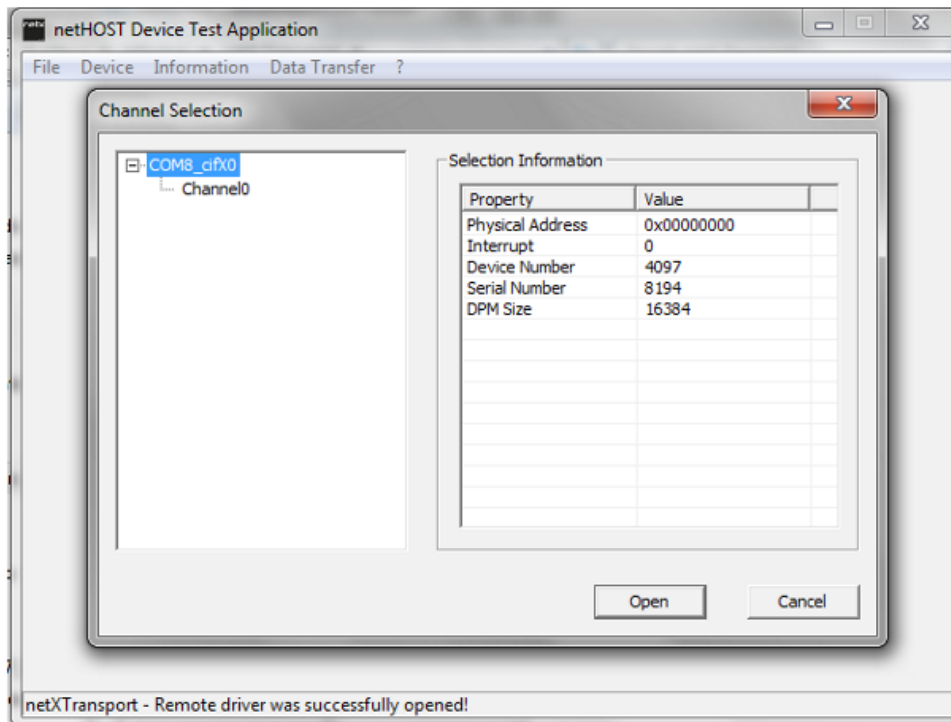
**Definition, STMA-69234 -** Figure: Open device [netHOST\_open\_1]



**Text, STMA-69169 -**

18. The pop-up “Channel selection” appears. Select “COM8\_cifX0” and click “Open” (Figure  STMA-69235);

**Definition, STMA-69235 -** Figure: Channel selection [netHOST\_open\_2]



Text, STMA-69170 -

19. 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]

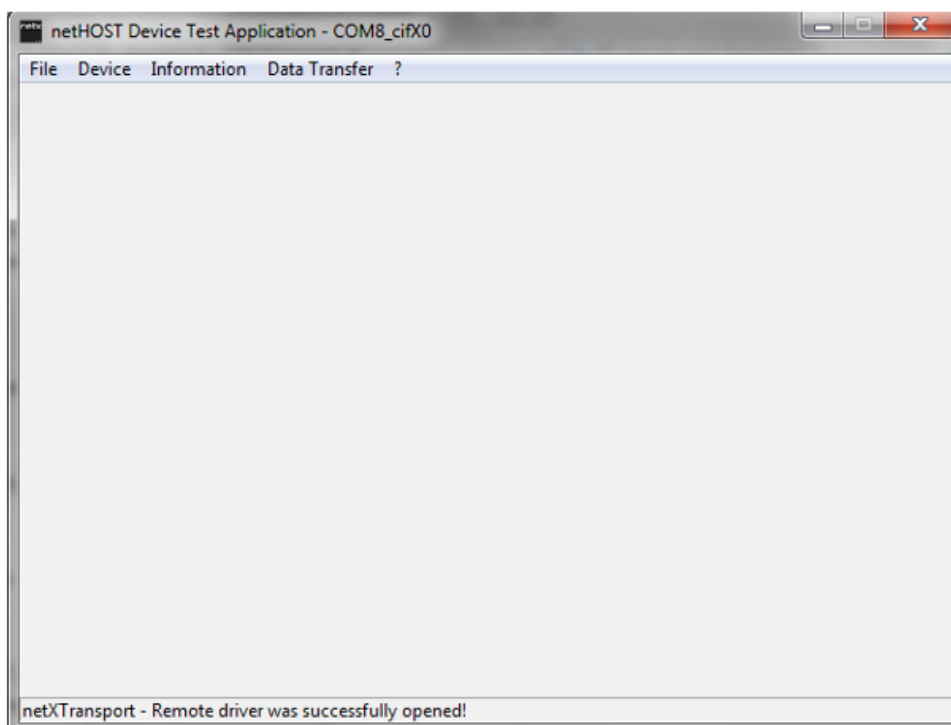


Figure: Remote driver was successfully opened [netHOST\_open\_succes]

Text, STMA-69167 -

20. 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]

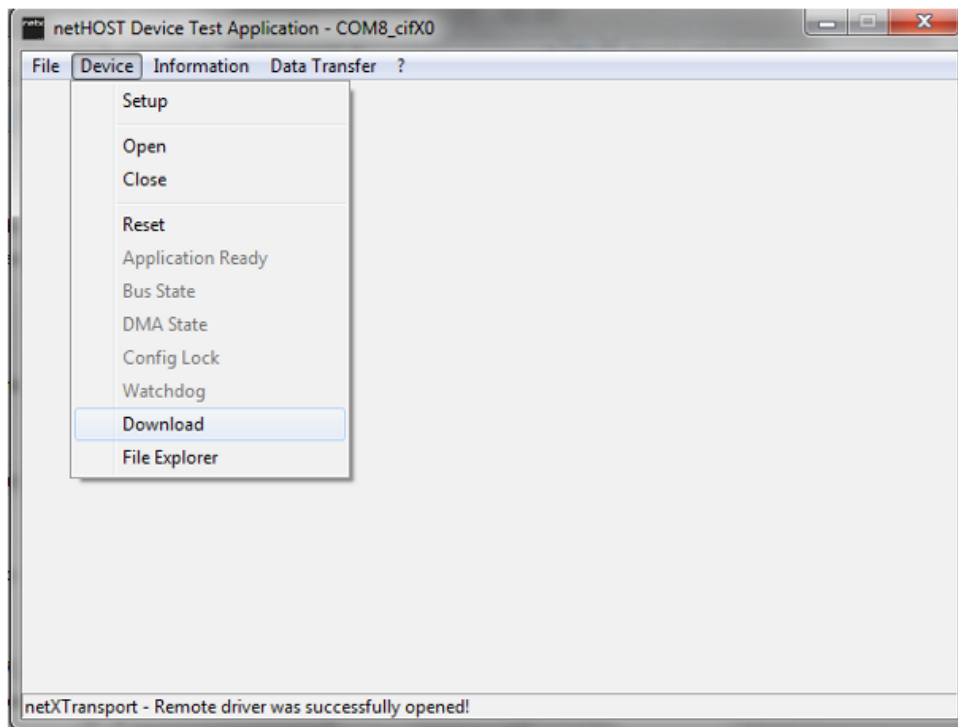
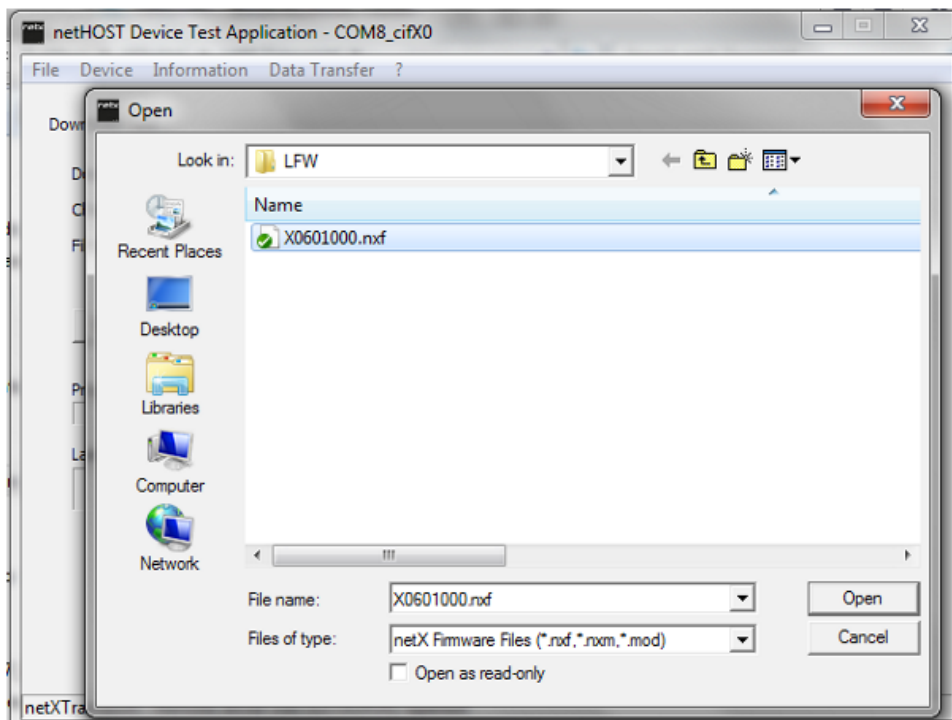


Figure: Download device [netHOST\_download\_1]


**Text, STMA-69168** -

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

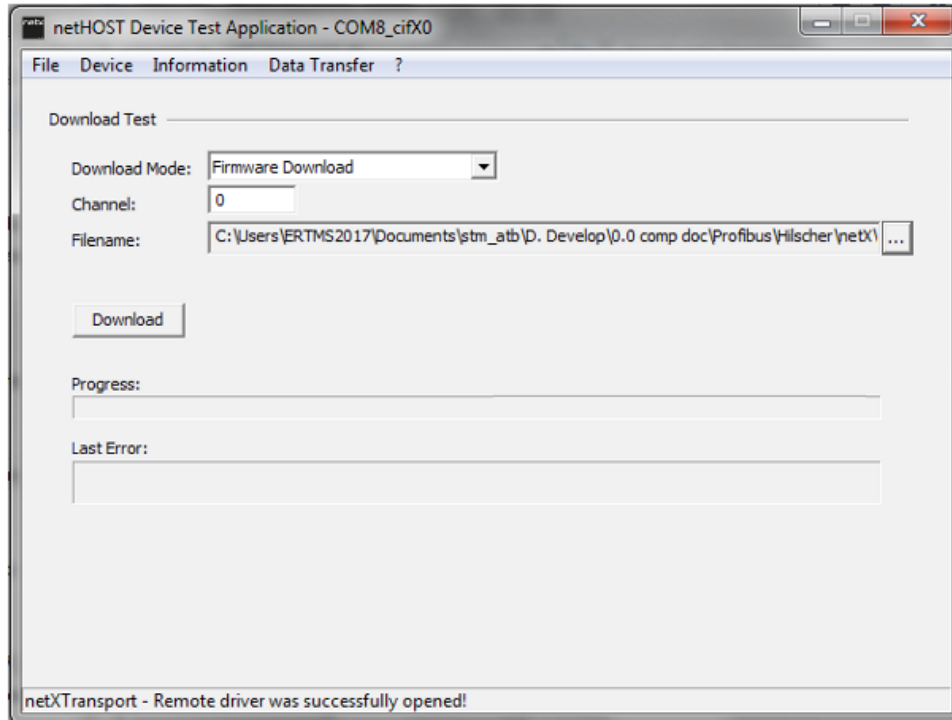
**Definition, STMA-69238** - Figure: Open file [netHOST\_download\_file]




**Text, STMA-69165 -**

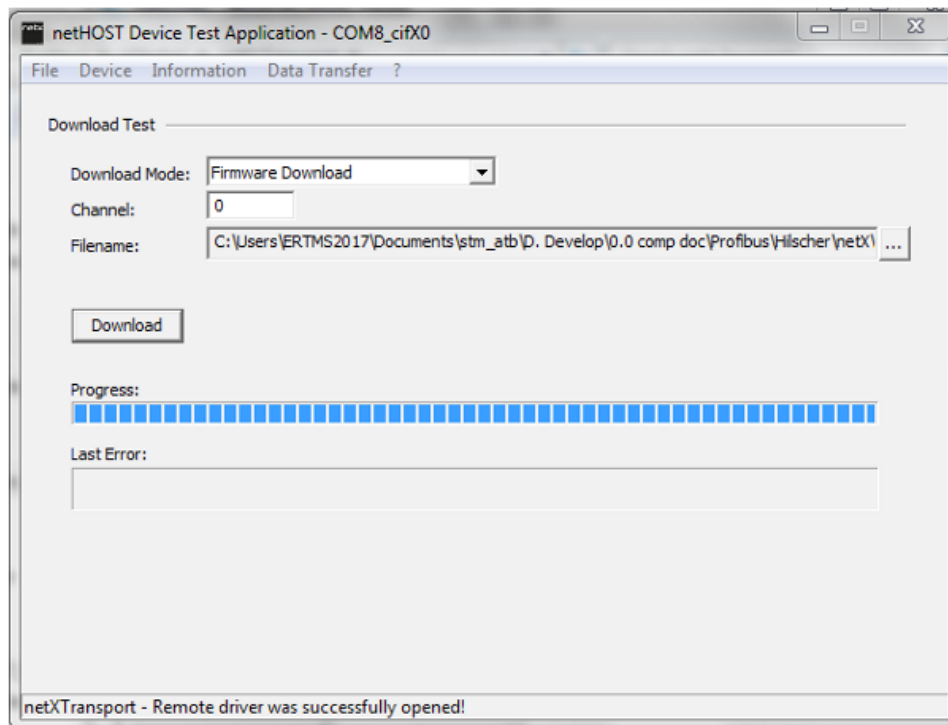
22. The pop-up “netHOST Device Test Application – COM8\_cifX0” appears. Select the “Download Mode” “Firmware Download” and click “Download” (Figure  STMA-69282);

**Definition, STMA-69282** - Figure: Download mode [netHOST\_download\_settings]

**Text, STMA-69166 -**

23. 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]



**Text, STMA-69177 -**

24. Disconnect the JLink cable connector from connector X901 on the SAP Board and continue with [STMA-69280 - Loading the software on the FPGA processor](#).

#### 4.6 Loading the software on the FPGA processor

**Text, STMA-69281 -**

Initial state:

- Power off
  - pin 1 of the X103 connector with any GND pin, for instance pin C32 of the Backplane connector (Figure [STMA-69072](#)) connected (see [STMA-69070](#))
1. Connect a USB port of the laptop using a Digilent JTAG-HS3 programming cable (mUSB – Jtag) (Nr 3) with the X400 connector on the SAP Board, ([STMA-69278 - Figure: Hardware connections for loading the software on the FPGA processor](#));
  2. 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;

**Text, STMA-69279 -**

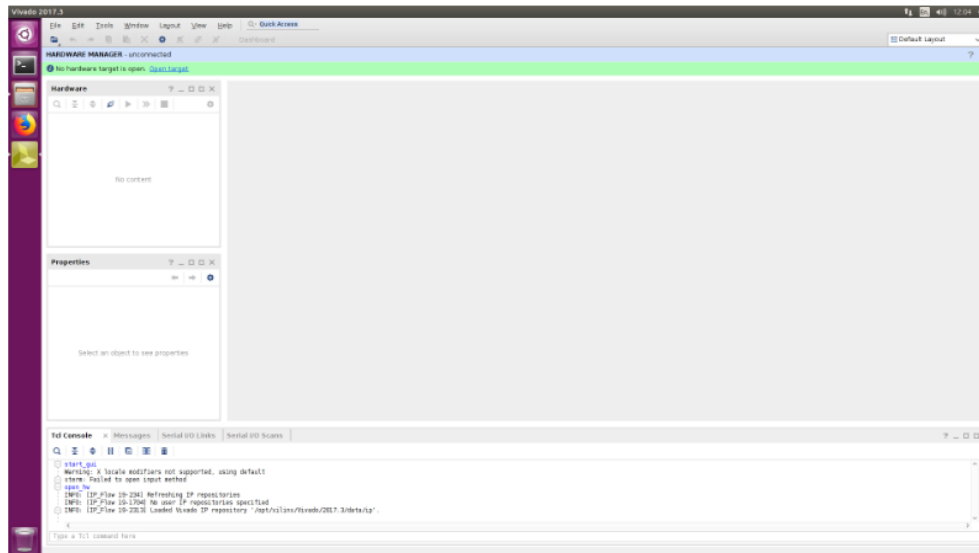
3. Open the software loading program “Vivado 2017.3” on the laptop;
4. The Vivado start screen appears. On the tile “Tasks”, select “Open hardware manager” (Figure [STMA-69271](#));

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


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](#));

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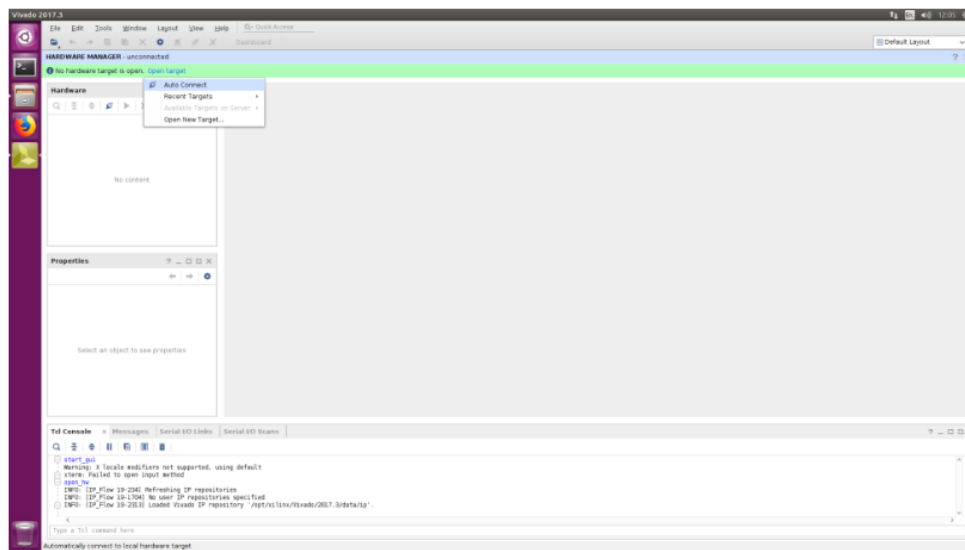





**Text, STMA-69269 -**

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

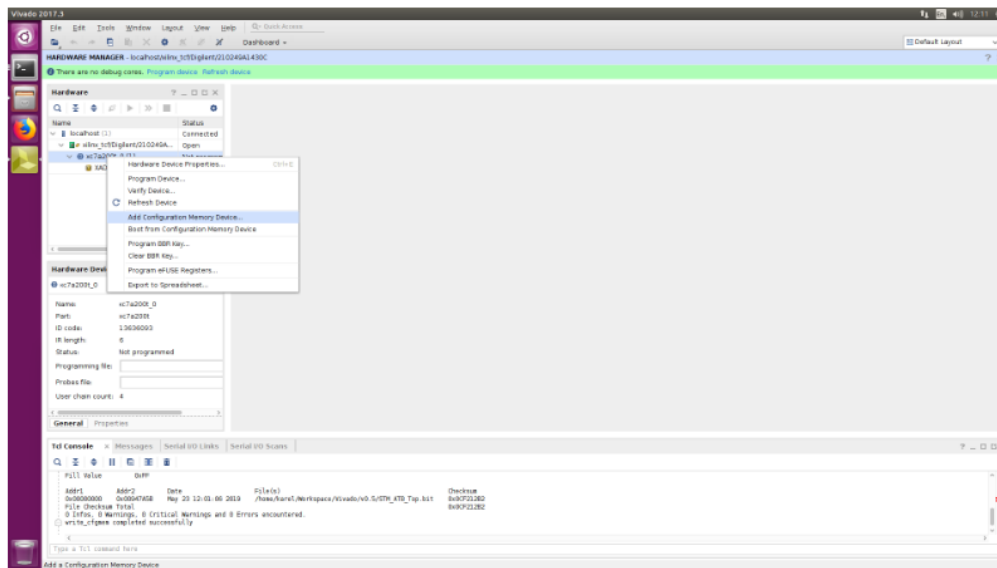
**Definition, STMA-69249 - Figure: Auto connect [sc04]**



**Text, 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);

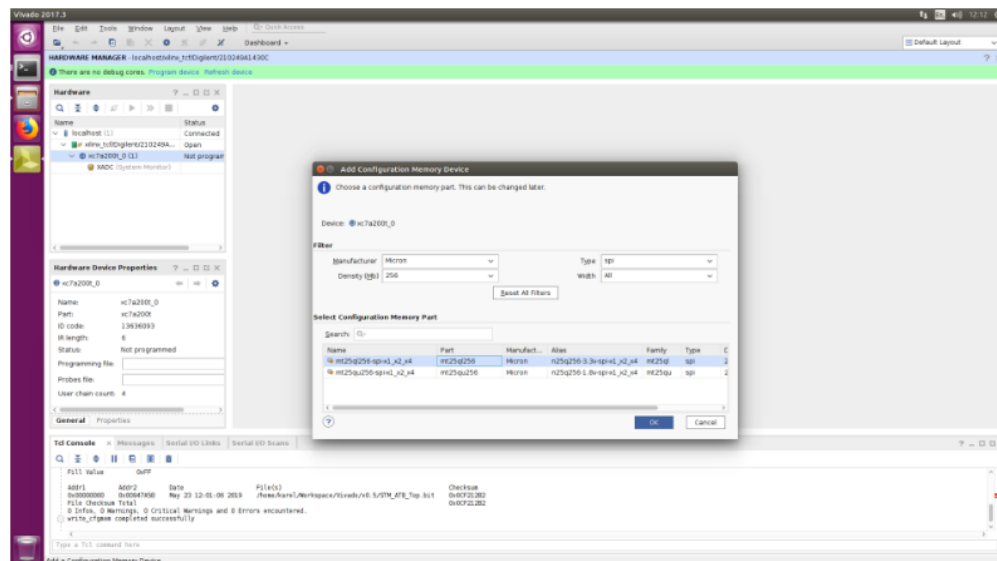
**Definition, STMA-69250 - Figure: Add configuration memory device 1 [sc16]**



### Text, STMA-69268 -

- 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 [STM A-69247](#));

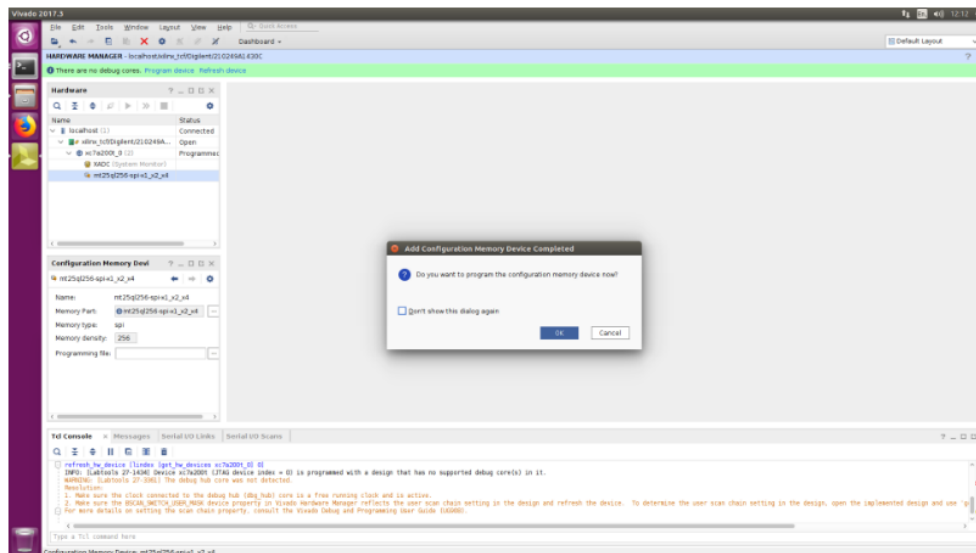
### Definition, STMA-69247 - Figure: Add configuration memory device 2 [sc17]



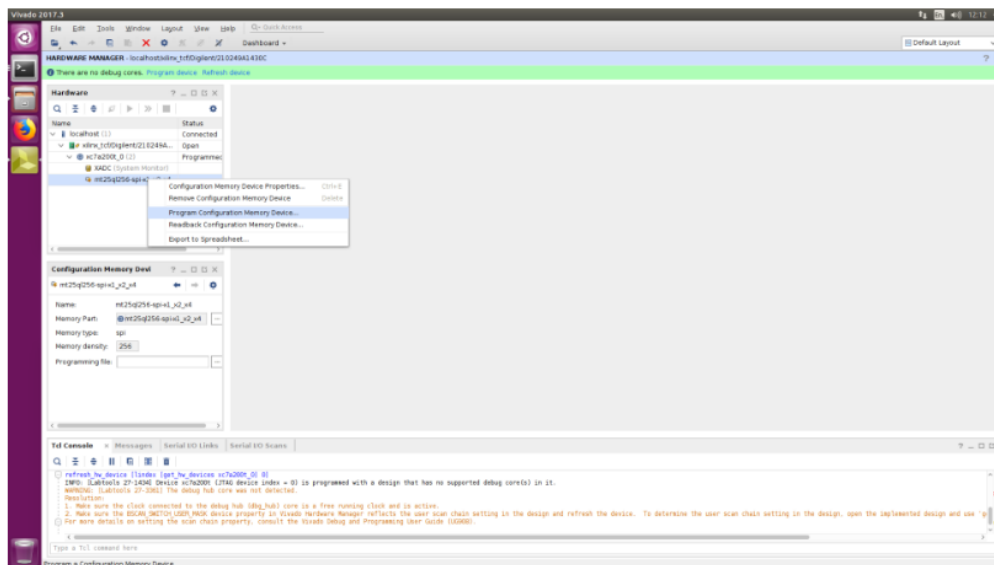
### Text, STMA-69266 -

- The pop-up “Add Configuration Memory Device completed” appears. Click “OK” to program the memory configuration device (Figure [STM A-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 [STM A-69245](#));

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



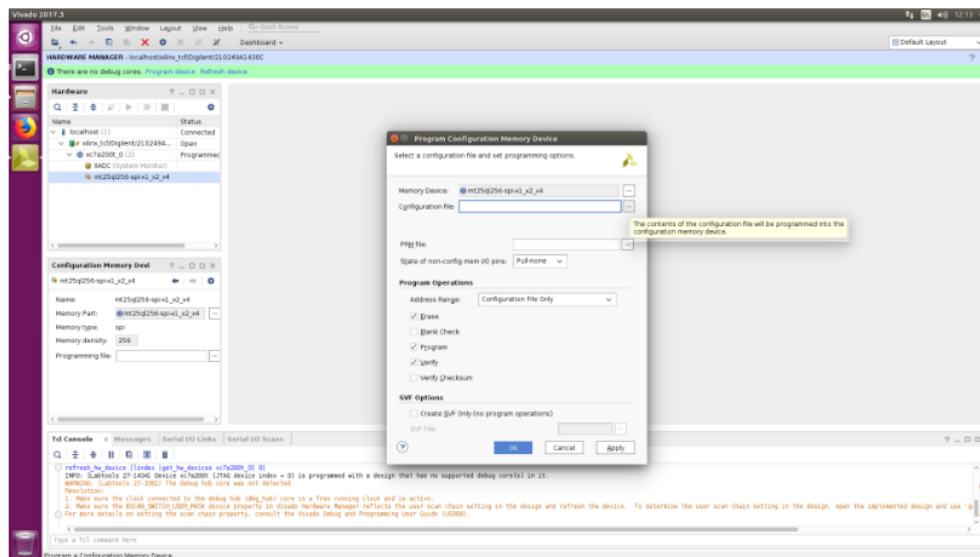
**Definition, STMA-69245** - Figure: Program configuration memory device 1 [sc19]



**Text, 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](#));

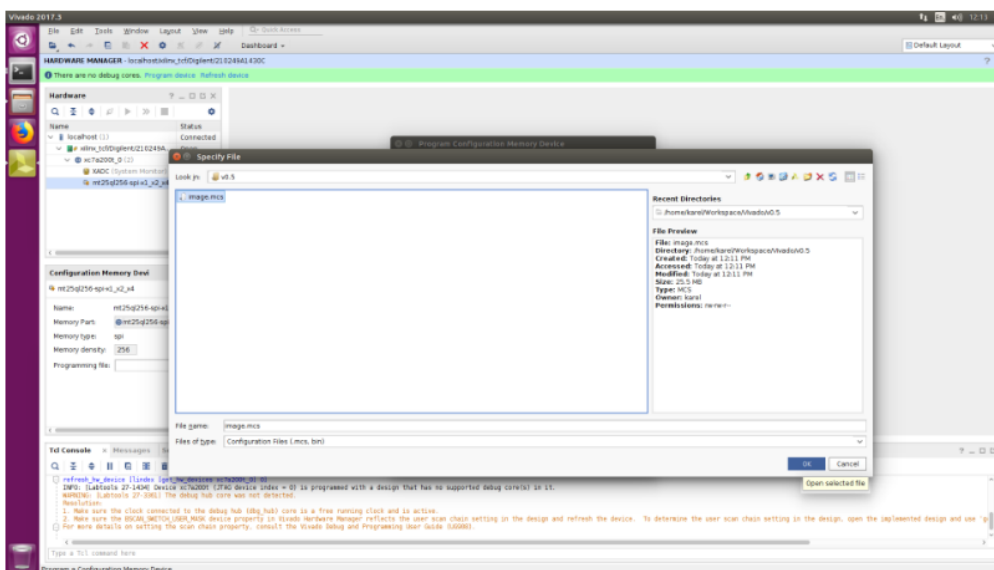
**Definition, STMA-69246** - Figure: Program configuration memory device 2 [sc20]



**Text, 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]**

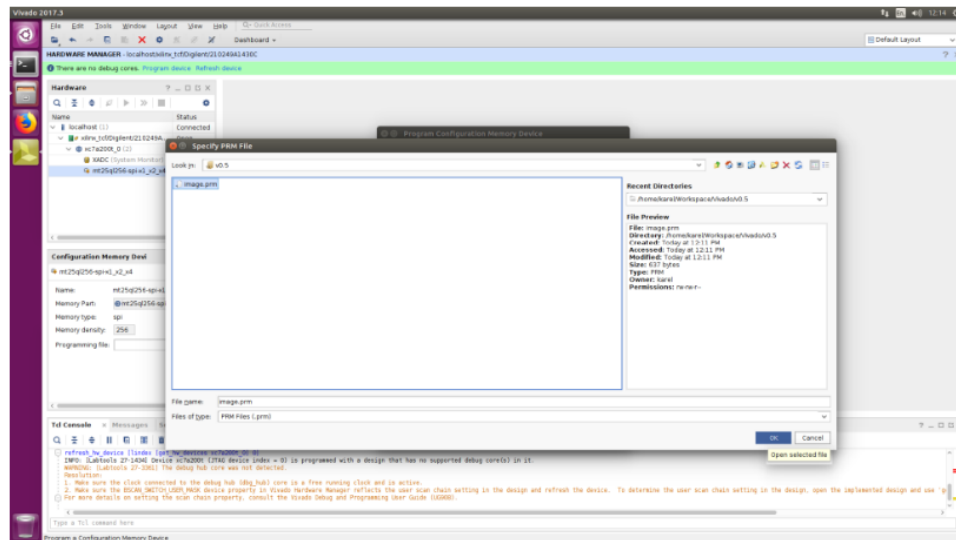


**Text, STMA-69265 -**

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]**

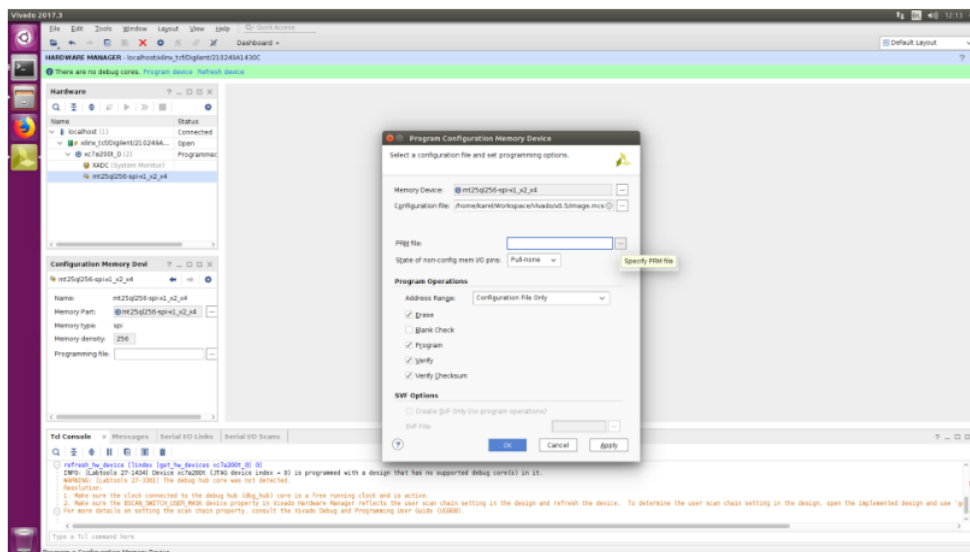




**Text, STMA-69262 -**

13. The pop-up “Program Configuration Memory Device” re-appears again. Select “Erase”, “Program”, “Verify” and “Verify checksum” and click “OK” (Figure [STMA-69225](#));

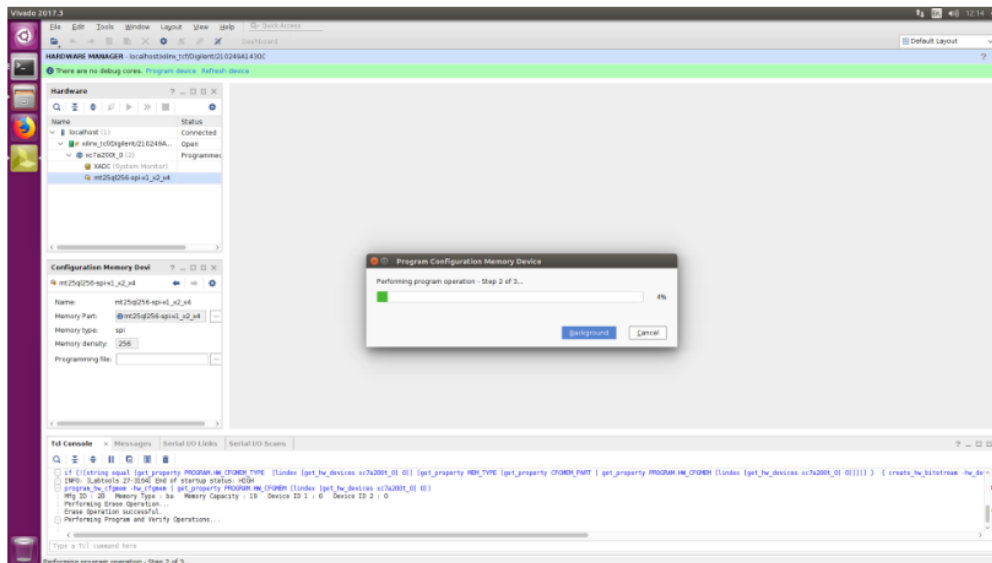
**Definition, STMA-69225 - Figure: Program configuration memory device 2 [sc22]**



**Text, 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](#));

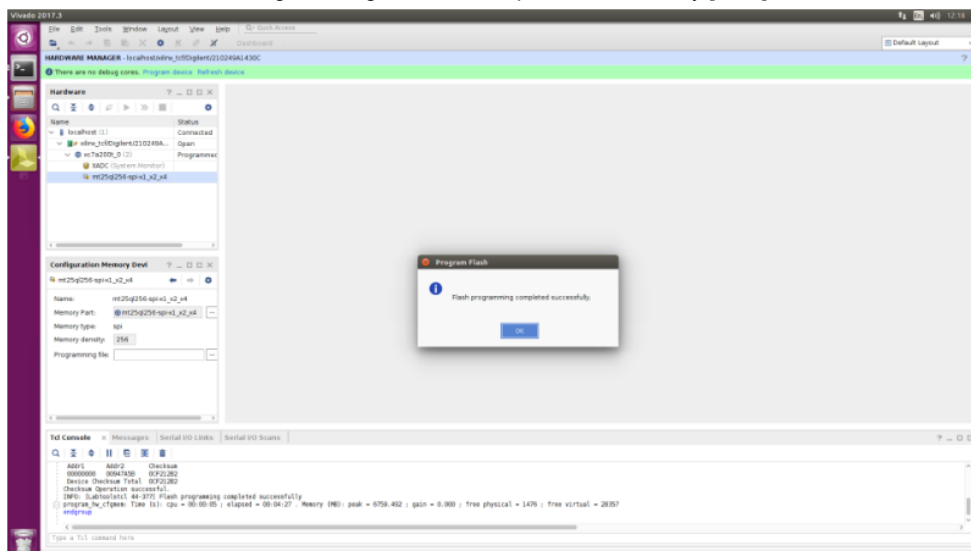
**Definition, STMA-69232 - Figure: Progress bar [sc26]**



**Text, STMA-69255 -**

15. The pop-up “Program Flash” now opens with the message “Flash programming completed successfully”. Click “OK” (Figure [STMA-69233](#));

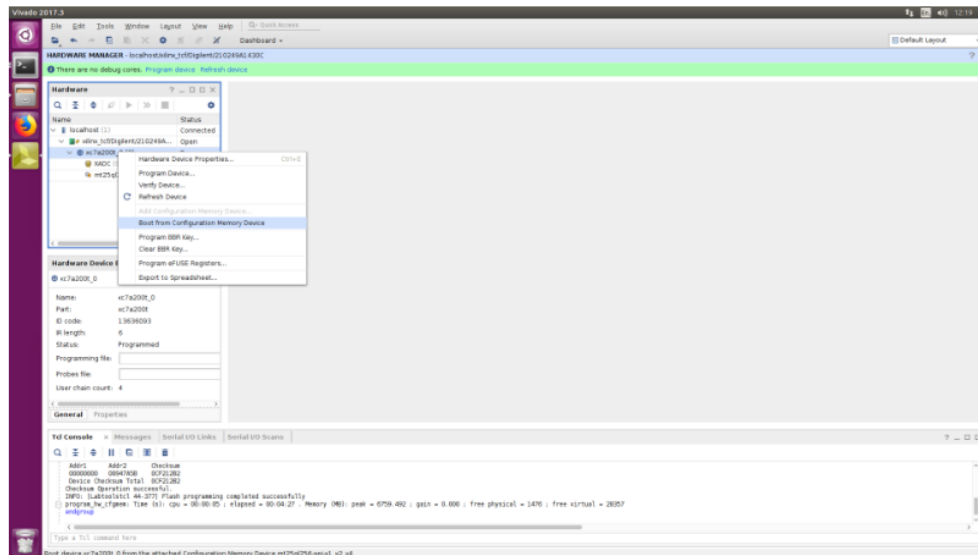
**Definition, STMA-69233 -** Figure: Program flash completed successfully [sc28]



**Text, 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 [STM A-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]



#### Text, 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.
19. Remove the system override adapter from connector X103 connector of the SAP board
20. Report the entire software loading procedure successfully finished and the software ready for testing

### 4.7 Testing the software

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

A final checks will be done after [STMA-71240 - Assembling](#) on the integrated system by a [STMA-72628 - Factory tests for assembled series product](#).

## 5 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.

## 5.1 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.

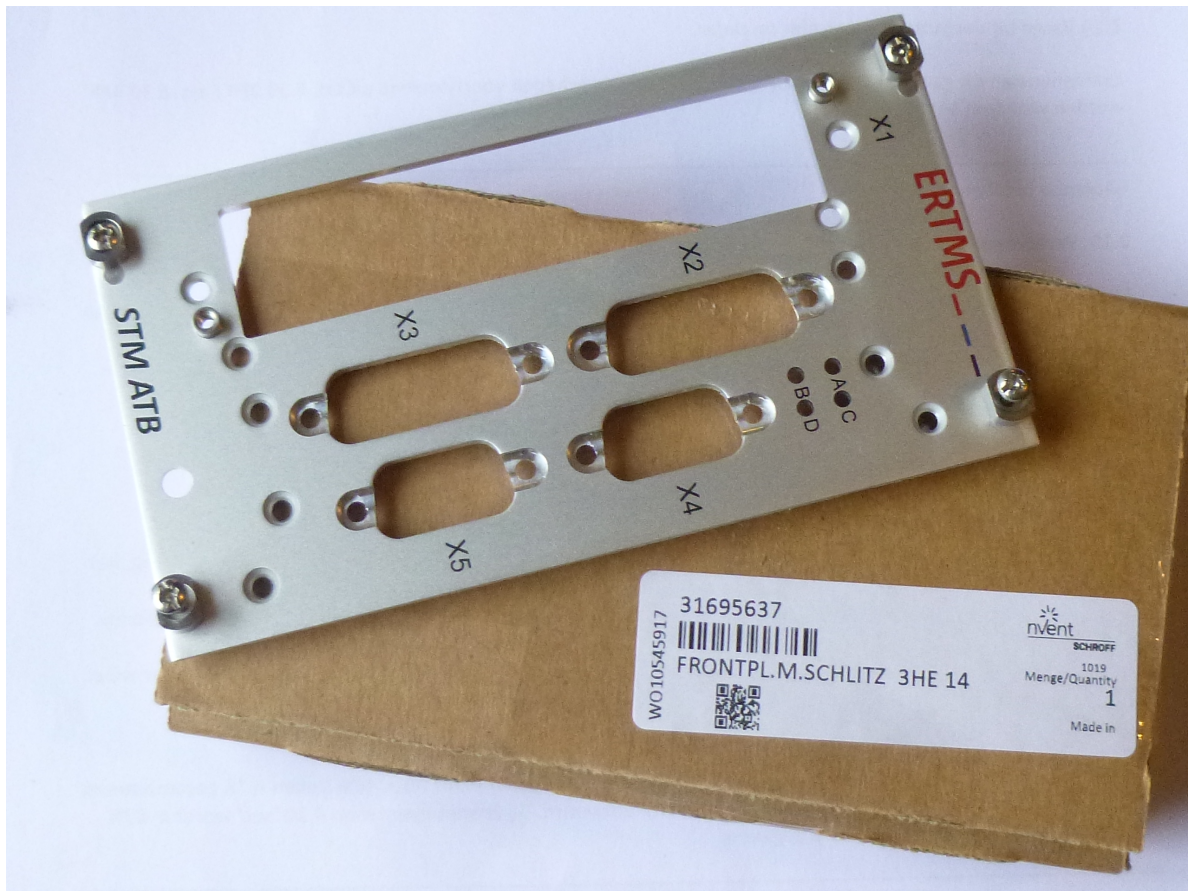
**Text, STMA-74734** - The STM ATB module consists of the following parts:

- DIO+PS board; 100 x 160mm
- AIN board; 100 x 160mm
- SAP board; 100 x 160mm
- BP board; 95 x 46 mm
- Enclosure:
  - 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; DV-B2 / 2M3

## 5.2 Assembly parts

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

**Definition, STMA-74742** - Front panel; 31695637:

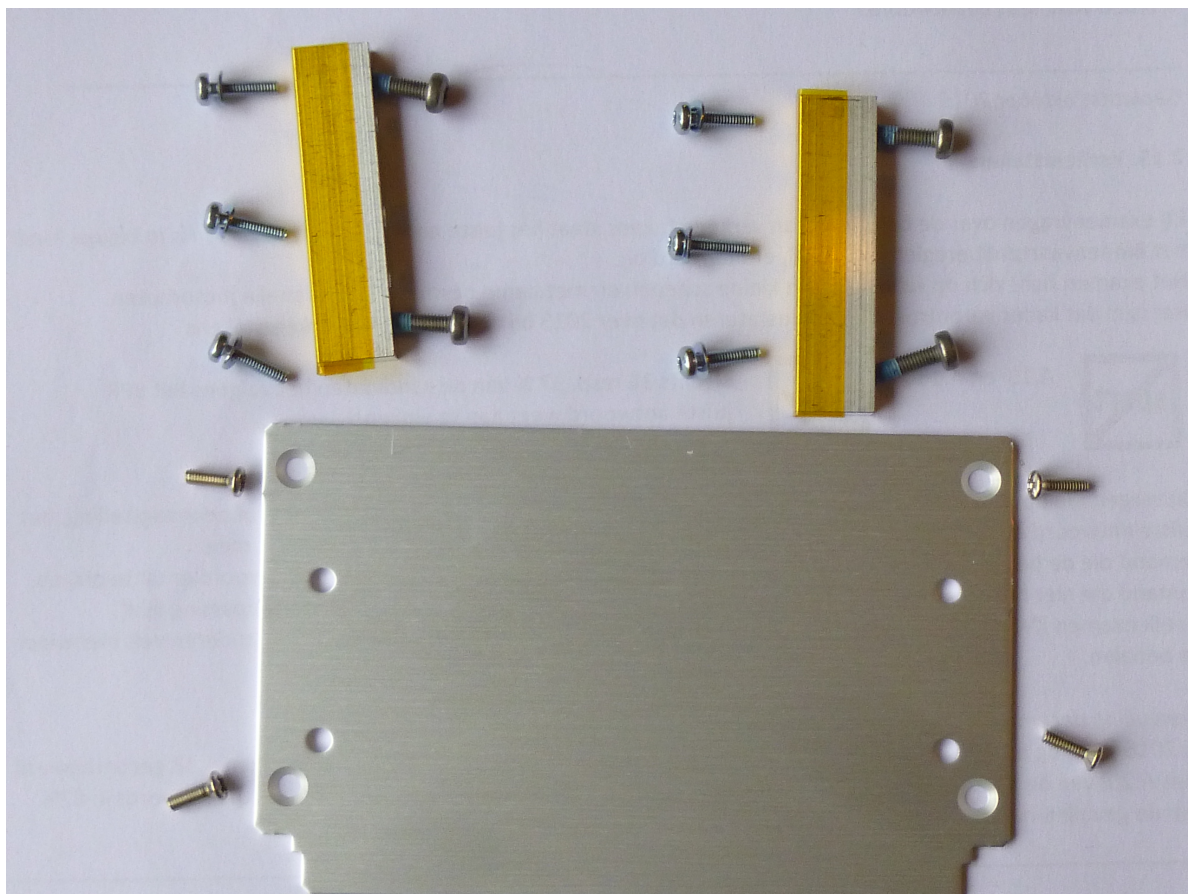


**Definition, STMA-74743** - Tube 188m; 31695640:





**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:



### 5.3 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.

**Text, 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

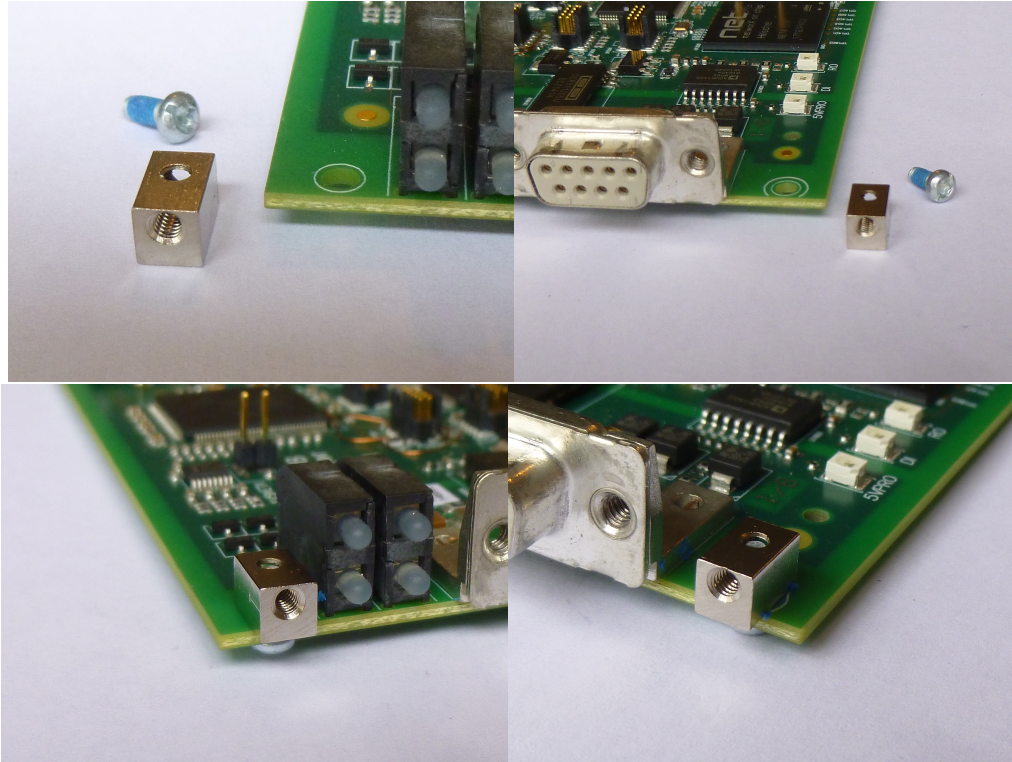


### 5.3.1 Mounting the SAP board

**Text, STMA-74746** - 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-80454** - Figure: Components for mounting the SAP board to the front panel, mounting the studs.

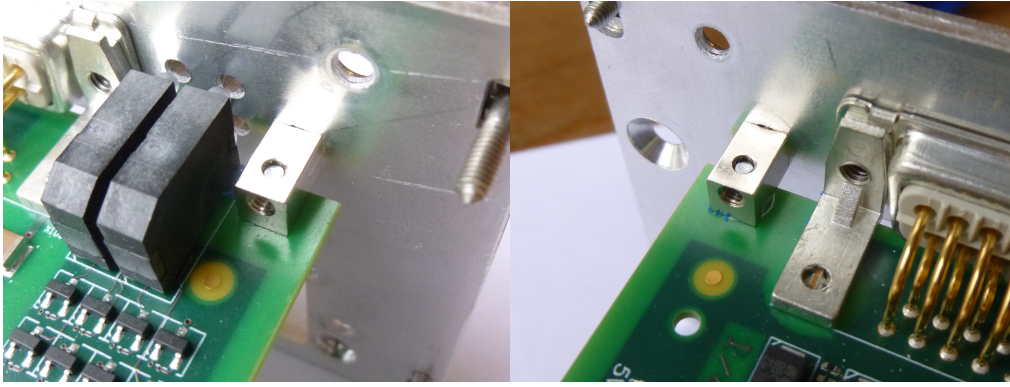


**Text, STMA-74755** - mount the SAP to the front panel

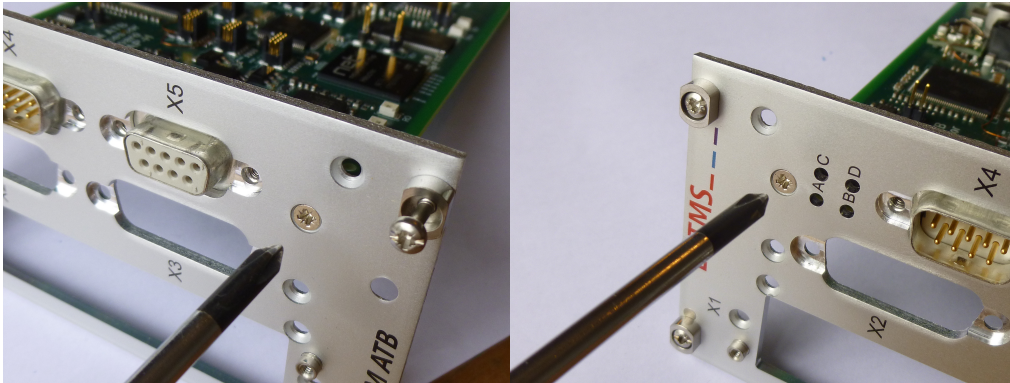
steps

- Push the SAP board against the rear side of the front panel,  [STMA-80455 - Figure: mounting the SAP to the front panel-1](#)
- At the front side the two countersunk screw's (M3x6) must now be screwed in. Do not fasten them yet, see  [STMA-74749 - Figure: mounting the SAP to the front panel-2](#)
- Screw the M3 SubD screws for later connection of the SubD connectors. Do not fasten them yet, see  [STMA-74750 - Figure: mounting the SAP to the front panel-3](#)

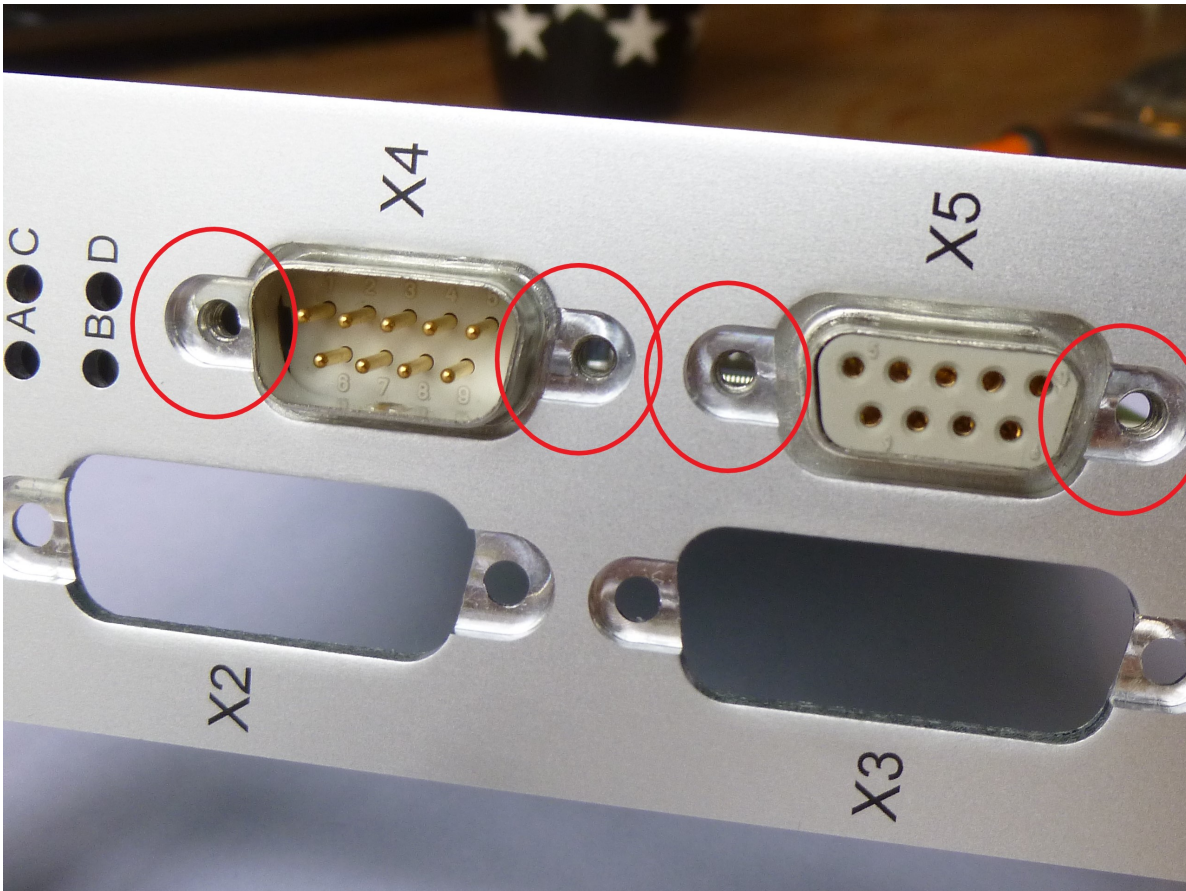
**Definition, STMA-80455** - Figure: mounting the SAP to the front panel-1



**Definition, STMA-74749** - Figure: mounting the SAP to the front panel-2



**Definition, STMA-74750** - Figure: mounting the SAP to the front panel-3



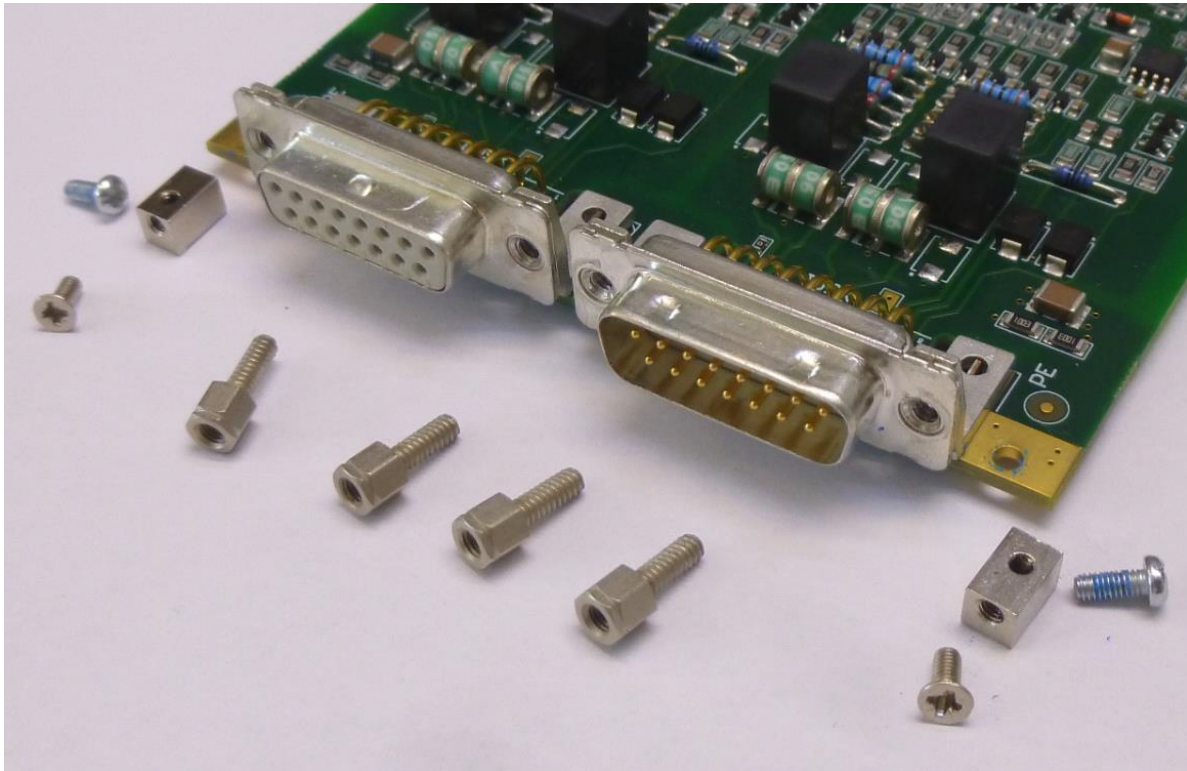
**Text, STMA-74747** - The studs must now align between the front panel and the pcb. This must be done before fastening the screws in the following steps:



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

### 5.3.2 Mounting the AIN board

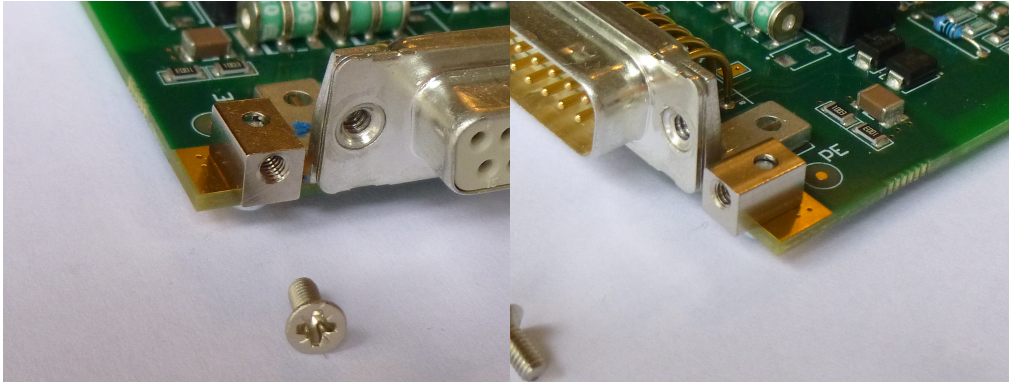
**Definition, STMA-74748** - Figure: Components for mounting the AIN board to the front panel



**Text, STMA-74752** - mounting the Ain-board to the front panel  
steps:

- 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, see [STMA-80456 - Figure: Mounting studs at the Ain-board](#) and [STMA-74753 - Figure: Mounting the AIN board to the front panel-1](#)
- At the front the two countersunk screw's (M3x6) must now be screwed in. Do not fasten them yet, see [STMA-80457 - Figure: Mounting the AIN board to the front panel-2](#)
- Screw the M3 SubD screws into the SubD connectors. Do not fasten them yet, [STMA-80458 - Figure: Mounting the AIN board to the front panel-3](#)

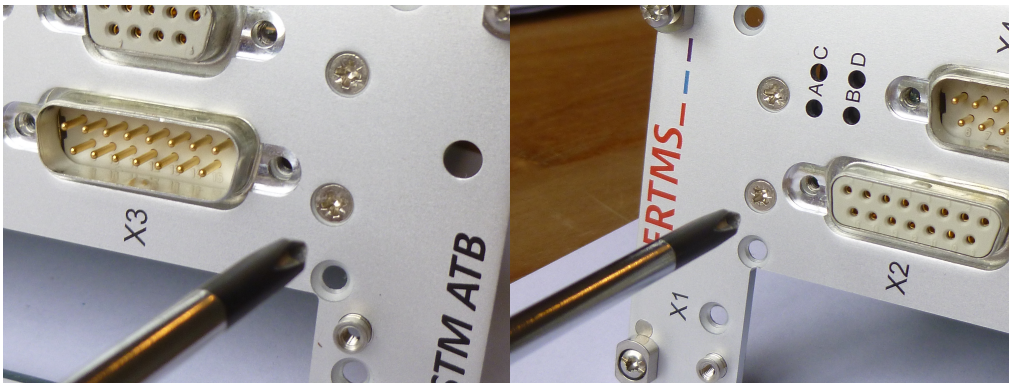
**Definition, STMA-80456** - Figure: Mounting studs at the Ain-board



**Definition, STMA-74753** - Figure: Mounting the AIN board to the front panel-1



**Definition, STMA-80457** - Figure: Mounting the AIN board to the front panel-2



**Definition, STMA-80458** - Figure: Mounting the AIN board to the front panel-3



**Text, STMA-74759** -

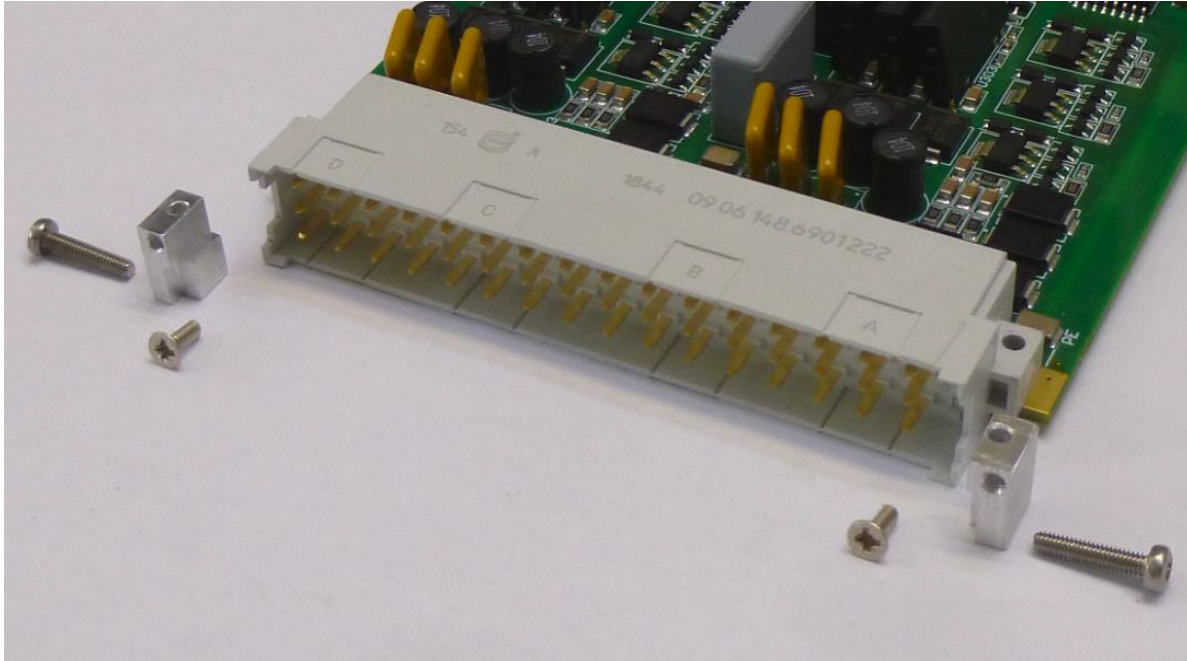
1. Fasten the two countersunk screws a little;
2. Fasten the four SubD screws a little;
3. Check the alignment of the studs and SubD connectors;
4. Fasten the pcb (torx) screws completely;

5. Fasten the two countersunk screws completely;
6. Fasten the four SubD screws completely;
7. Check every screw that is fastened

### 5.3.3 Mounting the DIO+PS board

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

The picture shows the DIO+PS board with the special mounting studs and screws.



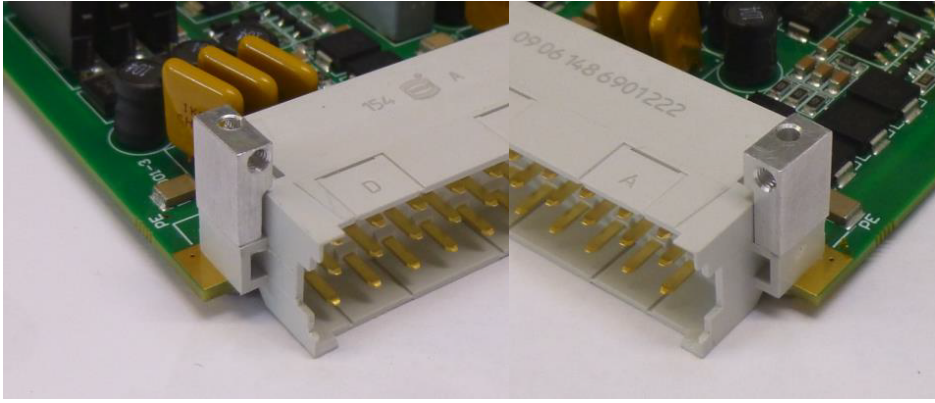
**Text, STMA-80459** - mounting the DIO board

steps:

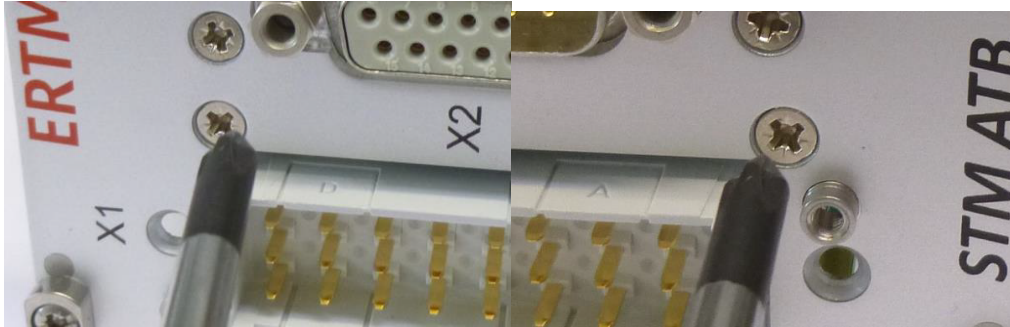
- The two special made studs must be screwed to the top off the DIO-PS board, at the left and right hand side of the DIN connector. Note: the two studs are different:
  - The left one is the: 3169031, the OB version.
  - The right one is the: 3169032, the UN version
- Position the studs in the direction 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, see [STMA-74764 - Figure mounting the DIO board-1](#)
- 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, see [STMA-74765 - Figure: mounting the DIO board-2](#)

**Definition, STMA-74764** - Figure mounting the DIO board-1





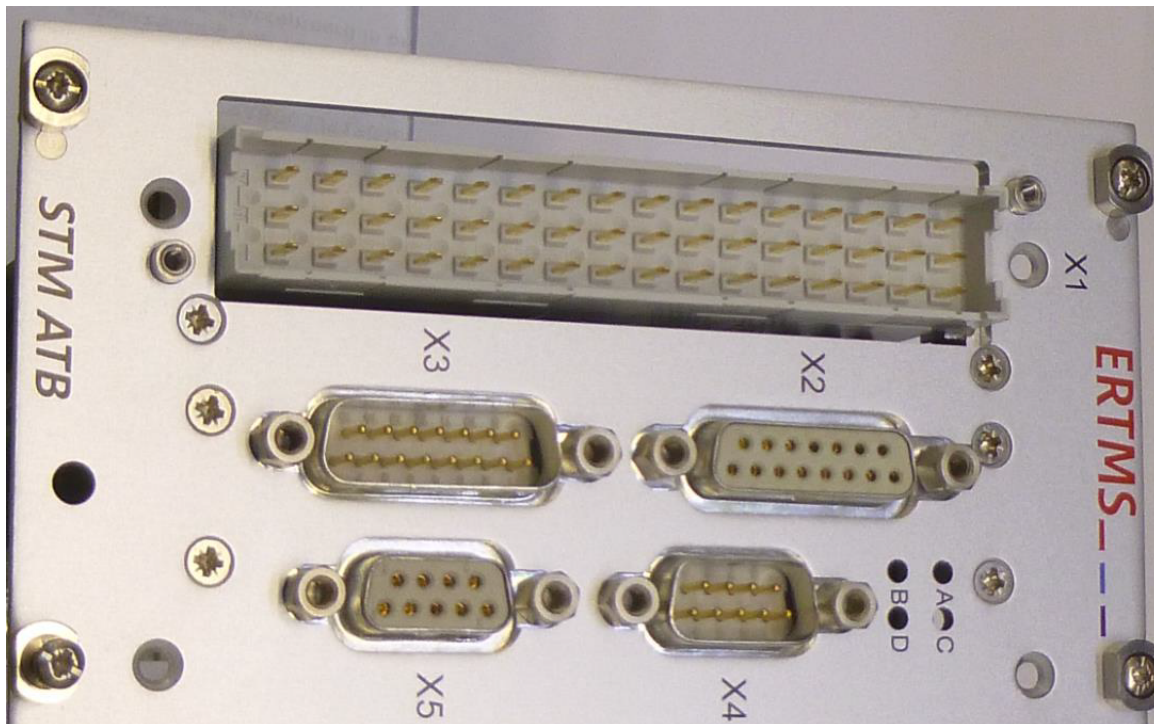
**Definition, STMA-74765** - Figure: mounting the DIO board-2



**Text, STMA-74968** - The studs must now align between the front panel and the pcb. This must be done before fastening the screws 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** - Figure: Front with mounted PCBAs

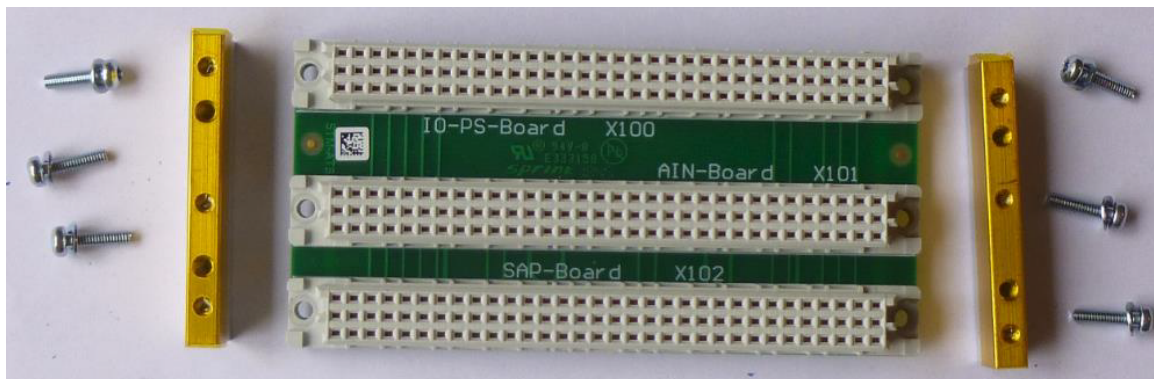


### 5.3.4 Mounting the BP board

**Text, STMA-80460** - Composing and place the back-plane steps:

- 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, see [STMA-74971 - Figure: components for mounting the backplane](#)
- 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, see [STMA-75089 - Figure: fit the screws to secure the back plane connectors at the distance blocks](#)
- 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, see

**Definition, STMA-74971** - Figure: components for mounting the backplane

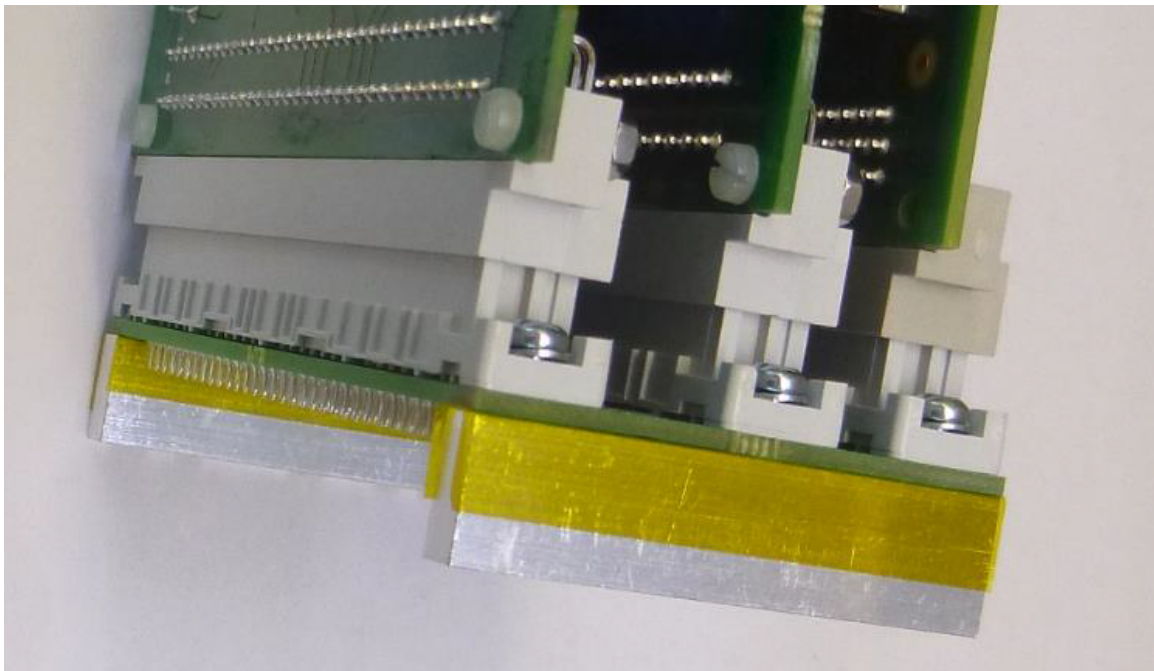


**Definition, STMA-75089** - Figure: fit the screws to secure the back plane connectors at the distance blocks








**Definition, STMA-75090** - Figure: placing the backplane  [STMA-75090 - Figure: placing the backplane](#)





### 5.3.5 Insert the assembly into the enclosure

**Text, 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 the housing from the front (flush) side of the housing.

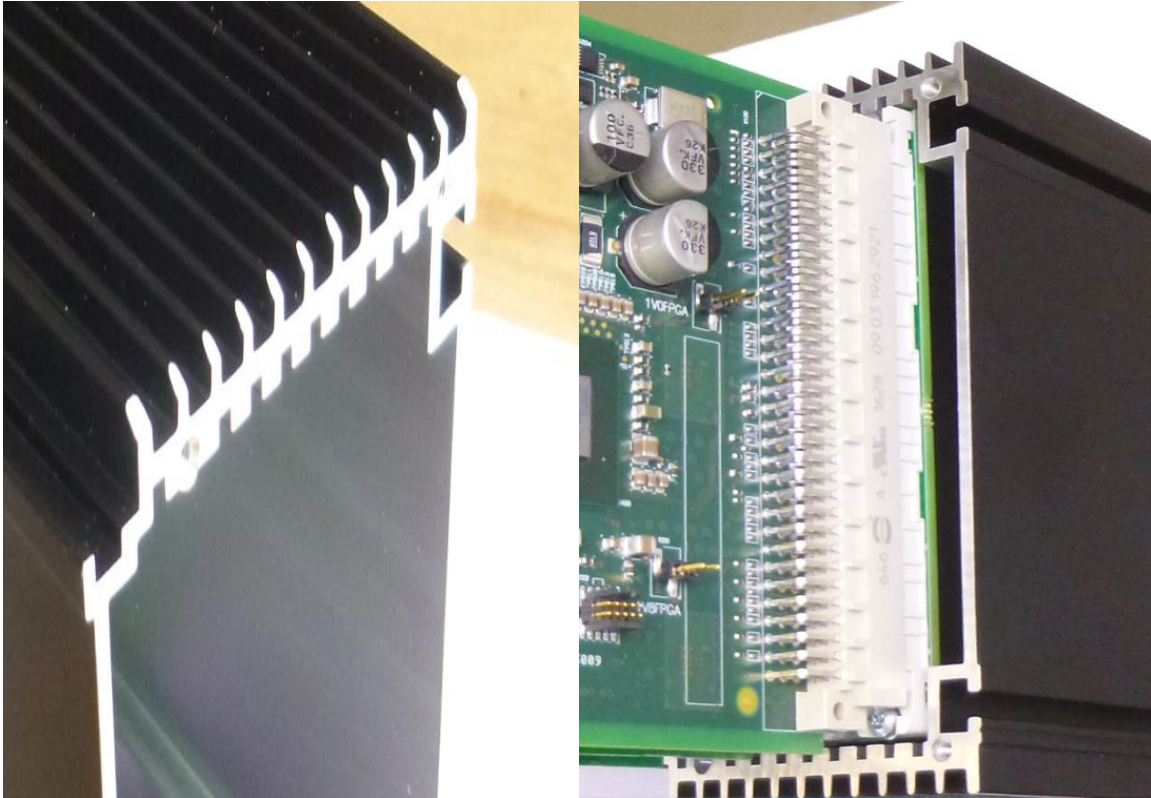
**Text, STMA-80462** - insert the assembly into the enclosure steps:

- Align the housing with the assembly as shown in  [STMA-80461 - Figure: position the assembly in front of the enclosure](#) . The PCBA's should fit exactly into the slots inside the housing.
- Slide the assembly completely into the housing until the front plate is in contact with the housing, see  [STMA-75095 - Figure: assembly in the enclosure, seen from the rear side](#).
- 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, see  [STMA-75092 - Figure: Components for mounting](#)

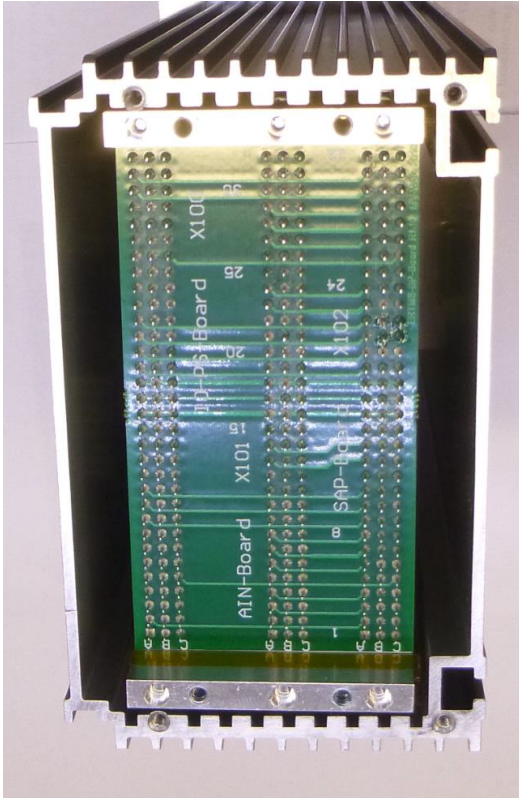
the rear panel

- Screw the four torx screw's (M3x10) into the inner rear panel holes into the distance blocks, see  STMA-80463 - [Figure: fix the rear panel to the enclosure and to the back plane studs.](#)
- Now insert the counter sunk M3 screws into the front plate and fasten them completely, see  STMA-75093 - [Figure: fix the front panel at the enclosure](#)
- Mount a brass bolt to the earthing hole to be able to attach an earthing braid bond when the system is installed in a cabinet. The bolt shall fit (flat at the back side of the front panel) into the concerning conical hole in the front panel.

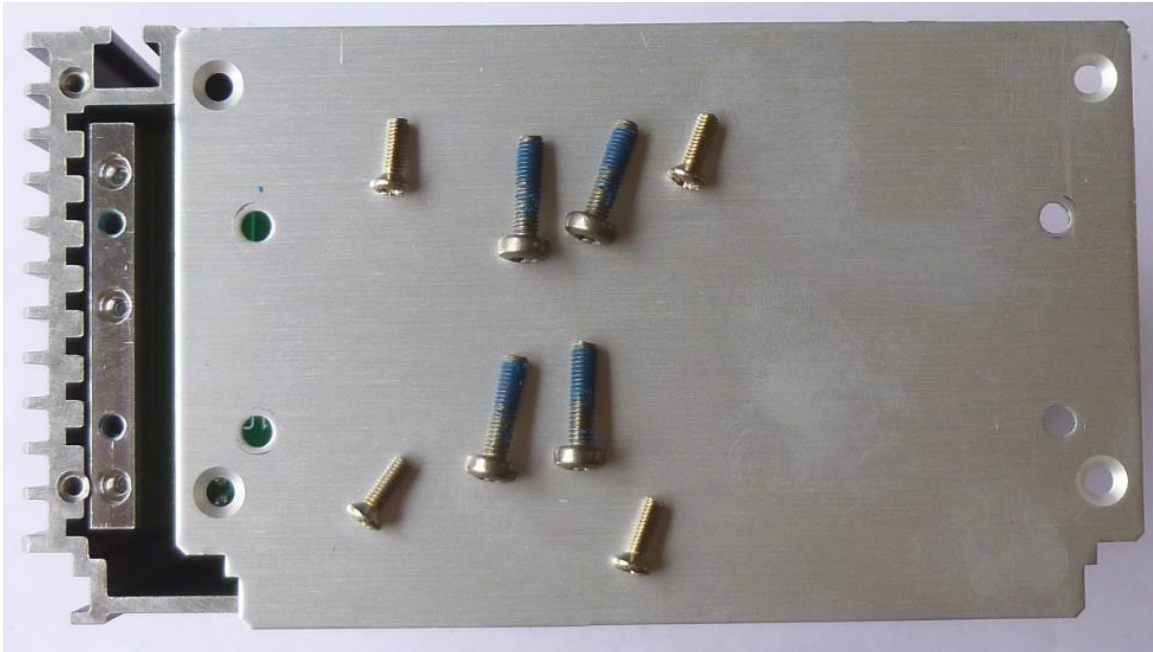
**Definition, STMA-80461** - Figure: position the assembly in front of the enclosure



**Definition, STMA-75095** - Figure: assembly in the enclosure, seen from the rear side.

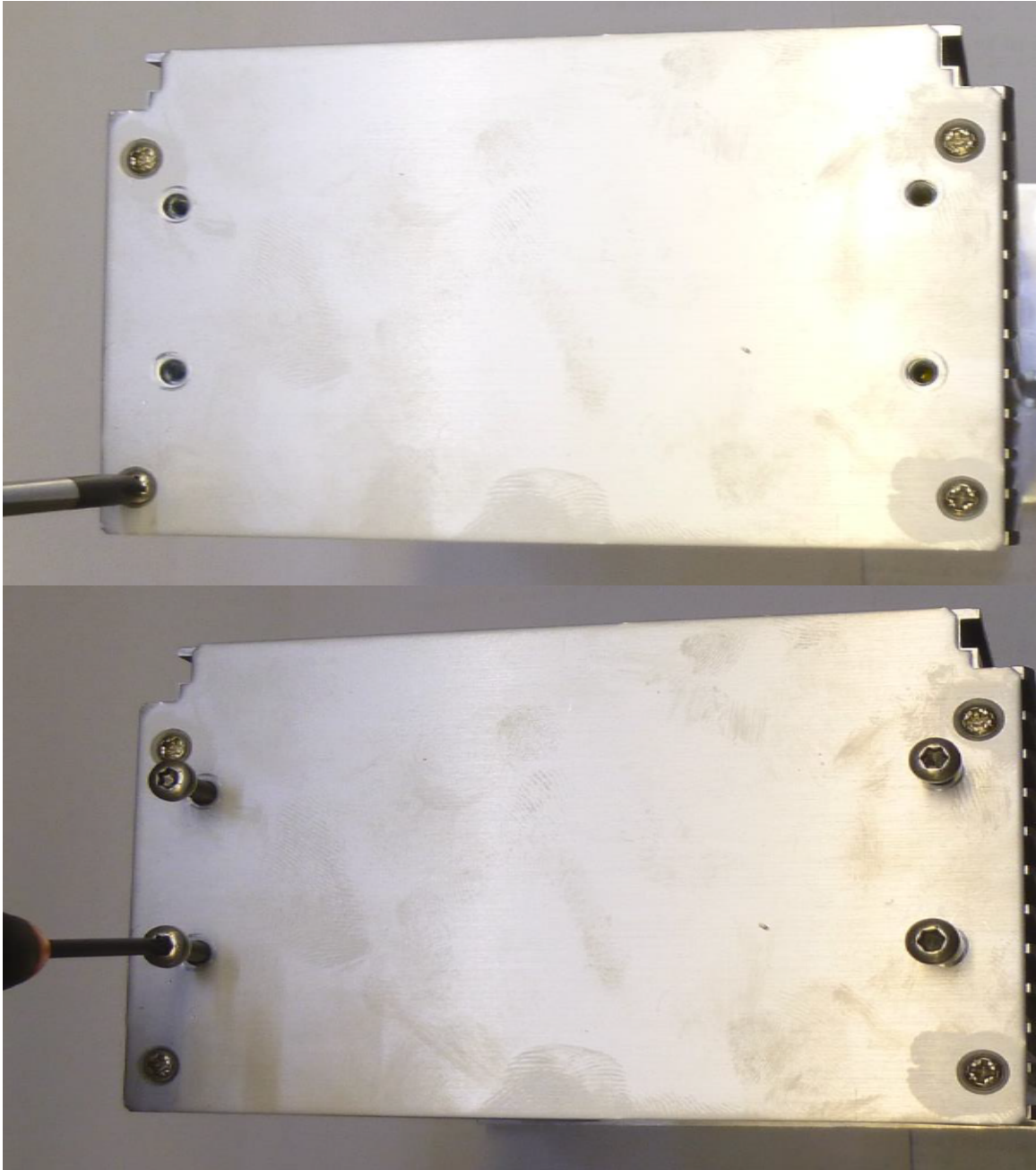


**Definition, STMA-75092** - Figure: Components for mounting the rear panel

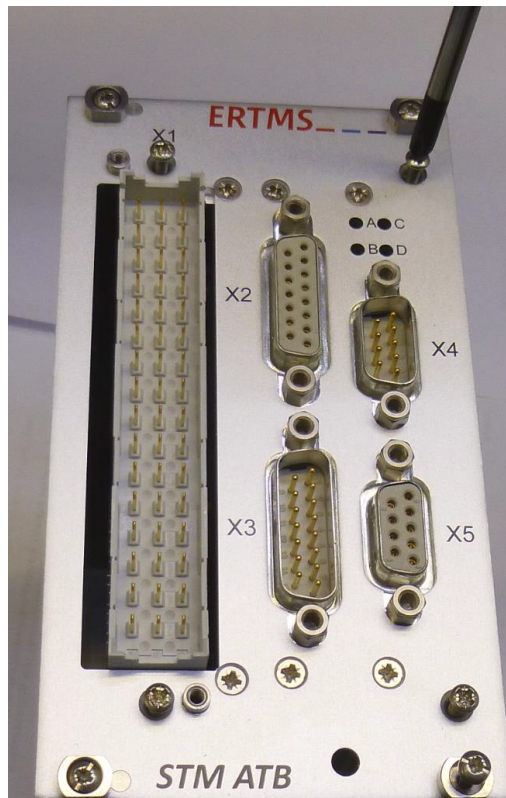


**Definition, STMA-80463** - Figure: fix the rear panel to the enclosure and to the back plane studs.





**Definition, STMA-75093** - Figure: fix the front panel at the enclosure



## 6 System testing

### 6.1 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

### 6.2 Manufacturing tests

#### 6.2.1 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.

#### 6.2.2 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.

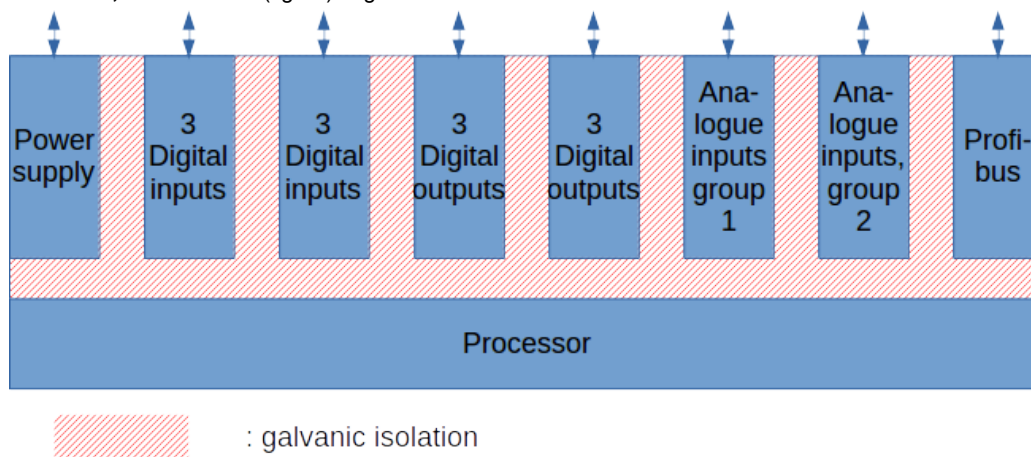
#### 6.2.2.1 Combinations to be tested

**Text, STMA-77922** - The insulation and voltage withstand tests shall be performed between areas which are galvanically separated from each other. 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



**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

#### 6.2.2.2 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.

#### 6.2.2.3 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.

## 7 Factory tests for assembled series product

**Text, STMA-76723** -

After production compliance with the design shall be shown. This concerns the HW as well as the software installation (correct version). Proving compliance is the responsibility of the manufacturer.

For this purpose an example for a factory acceptance test is given in [STMA-80656 - M9.2\\_A\\_Annex\\_System\\_Test\\_Plan](#).

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.