

M9.3 Installation Manual

for the development of an STM ATB

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1 Introduction

Text, STMA-77867 - In most cases the installation of an STM ATB will be a part of the installation of CCS systems including ETCS on-board. This manual gives a guideline for the installation design parts concerning the STM ATB. The actual installation shall comply with the design made according to this manual.


1.1 What is an STM ATB

Text, STMA-65625 - 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.

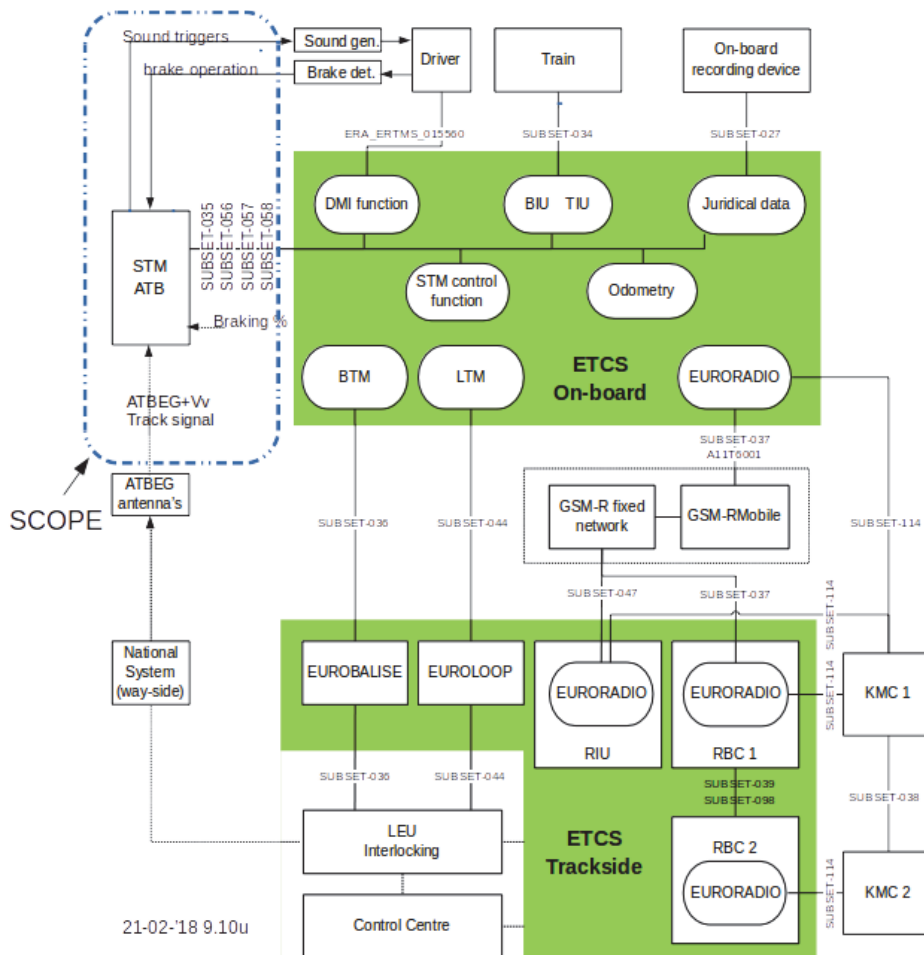
1.2 Purpose

Text, STMA-65624 - This document is the installation manual for STM ATB. It provides instructions and guidance for the installation design and safe construction and installation work.

1.3 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



Text, STMA-73301 - In scope:

- STM ATB unit.
- Analogue input connector cables (per STM ATB unit, 2 SubD-15 pin connector cables are required ¹).
- DIO/PSU connector cable (per STM unit, 1 DIN41612-F-48P connector cable is required).

¹) The type of Ain connector cable assembly is dependent on the type of ATBEG antenna used in the specific application.

An application shall use ATBEG antennas of the same type and make. Mixed use of ATBEG antenna types within a single application is not allowed. When replacing a defective ATBEG antenna with another type ATBEG antenna, all antennas must be of the same type and the corresponding type of Ain connector cable assembly shall be used.

Text, STMA-73302 - Out of scope ²):




- ATBEG antennas.
- Earthing cables.
- 19" mounting rack.

²) The items listed are presumed to be made available through other sources.

2 HQSE guidance note

Definition, STMA-67784 -

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.

3 References

Text, STMA-67778 -

Ref.Nr.	Document ID	Title	Revision
1	2006/1907/EU	Regulation concerning REACH	18.12.2006
2	2008/57/EC	Directive on the Interoperability of the Rail System within the Community	17.06.2008
3	2010/713/EU	Commission Decision on Modules for the Procedures for Assessment of Conformity, Suitability for Use and EC Verification to be used in the Technical Specifications for Interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council	09.11.2010
4	2011/65/EU	Directive on the Restriction of Hazardous Substances	08.06.2011
5	2012/19/EU	WEEE Directive	04.07.2012
6	2016/797/EU	Interoperability Directive	11.05.2016
7	2016/798/EU	Railway Safety Directive	11.05.2016
8	2016/919/EU	Technical Specification of Interoperability for Control Command and Signalling	17.05.2016
9	EN-ISO 4589-2	Plastics – Determination of Burning Behaviour by Oxygen Index – Part 2: Ambient temperature test	2017
10	EN 45545	Fire Protection on Railway Vehicles	
11	EN 50121	Railway Applications. Electromagnetic Compatibility	2015
12	EN 50125-1	Railway Applications – Environmental Conditions for Equipment – Part 1: Rolling Stock and On-board Equipment	2014
13	EN 50155	Railway Applications. Rolling Stock. Electronic Equipment	2007; 2010
14	EN 50170	General Purpose Field Communication System	1997
15	EN 50264	Railway Applications – Railway Rolling Stock Power and Control	2008

Cables having Special Fire Performance			
16	EN-IEC 60695-2	Fire Hazard Testing – Part 2: Glowing/hot-wire based Test Methods	2010-2014
17	EN-IEC 61249-2-7	Materials for Printed Boards and other Interconnecting Structures – Part 2-7: Reinforced Base Materials Clad and Unclad – Epoxide woven E-glass Laminated Sheets of Defined Flammability (Vertical Burning Test), Copper-clad	03.05.2002
18	EN-IEC 61249-2-10	Materials for Printed Boards and other Interconnecting Structures – Part 2-10: Reinforced Base Materials Clad and Unclad – Cyanate Ester, Brominated Epoxide, Modified or Unmodified, woven E-glass Reinforced Laminated Sheets of Defined Flammability (Vertical Burning Test), Copper-clad	27.02.2003
19	EN-IEC 61373	Railway Applications – Rolling Stock Equipment – Shock and Vibration Tests	31.05.2010
20	EN-IEC 62326-1	Printed Boards – Part 1: Generic Specification	05.03.2002
21	EN 123000	Generic Specification: Printed Boards	01.04.1991
22	EN 123200	Sectional Specification: Single and Double Sided Printed Boards with Plated-Through Holes	01.05.1992
23	EN 123300	Sectional Specification: Multilayer Printed Boards	01.05.1992
24	D6.1.*	Hardware design documentation STM ATB	
25	D6.2.*	Software design documentation STM ATB	

3.1 Abbreviations, definitions and terminology

Text, STMA-67779 - Table: 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
BHA	Brake Handle Applied
BIU	Brake Interface Unit
BSO	Brake Sufficiently Operated
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
NA	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
PTC	Positive Temperature Coefficient
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RoHS	Restriction of Hazardous Substances
SAP Board	Safe APplication Board
STM	Specific Transmission Module
STS	Signal at danger (stoptoend sein)
TBD	To Be Defined
TIU	Train Interface Unit
TSI	Technical Specifications for Interoperability

UIC	International Union of Railways
USB	Universal Serial Bus
WEEE	Waste of Electrical and Electronic Equipment

3.2 Requirement identification

Text, STMA-67776 - The STM ATB product development project makes use of an automated requirement management database 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-67777 - This STM ATB installation manual is intended to be used by technical staff qualified and responsible for the engineering and installation of onboard train protection systems.

The staff qualification demands are to be determined by the system integrator, in accordance with the regulatory and statutory requirements.

5 General requirements

5.1 Organizational requirements

STMA-68350 - The installation design based on the requirements in this manual shall be made by the system integrator in compliance with EU Directives 2016/797/EU and 2016/798/EU.

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

The ECM or workshop management provides its staff with appropriate workshop instructions and tools, and oversees the adherence and proper use thereof.

5.2 Health and Safety requirements

Definition, STMA-67774 - All parts of this STM ATB installation 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 be performed;
- appropriate HQSE measures, based on a project specific risk inventory;
- proper use of personal protective equipment.

The ECM or workshop management provides its staff with appropriate instructions and oversees the adherence thereof.

5.3 Material handling

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

Storage temperature:

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

Humidity:

- STM ATB shall be stored in dry storage conditions

- The humidity may vary between 5 % and 95% (non condensing).

5.4 Application conditions

Text, STMA-74441 - The following application conditions shall specifically be verified as those are relevant for the safe behaviour of the STM ATB in combination with the ETCS onboard during ATBEG operation. More (detailed) exported constraints are discussed in further paragraphs in this chapter.

STMA-74443 - Safety responsibility

When the STM ATBEG is fully operational, the ETCS onboard is in state SN and the STM ATBEG is in state DA, the STM ATBEG is responsible for guarding the train speed and informing the driver through the DMI. In all other cases, the STM ATBEG is not responsible for guarding the train speed and informing the driver. In that latter case, no ATB information shall be visible on the DMI.

STMA-75021 - The following Profibus communication considerations shall especially be checked by the system integrator:

STMA-74442 - Reconnecting after connection loss

After reconnection with the STM ATBEG, the STM manager (STM controller) shall resend the maximum train speed and braking percentage.

STMA-74447 - Timing of the EB command

The timing of the EB command is safety critical in the integrated ATP system of the STM ATBEG combined with the ETCS on-board. To provide the driver with enough time to react to a brake command, the ETCS on-board system shall command the emergency brakes within 300 ms of receiving the brake command on the Profibus from the STM ATBEG. If this can't be guaranteed, additional precautions shall be taken by the system integrator.

STMA-77912 - Check the safety levels communicated by the different ETCS functions to the STM ATB for setting the safety level of the concerning connection.

STMA-74448 - Timing of ATB EG sounds

The sum of the following delays:

- The time between the moment the driver operates the brakes and the moment the train provides information to the STM ATB indicating that the brake handle is applied (§ STMA-10889) shall not exceed 200 ms.
- The time between the moment the STM ATB provides the information that the "bel" shall sound (via profibus and parallel wiring), and the moment the "bel" sounds in the cabin shall not exceed 200 ms.
- The difference in communication time between any order to sound the "gong" and any order to sound the "bel" shall not exceed 100ms.

A shorter delay time shall be aspired, because it will automatically lead to an increased reaction time for the driver.

If these timing conditions can't be guaranteed, a separate sound generator may be used for this purpose. The STM ATBEG provides the required digital outputs for sound generators.

5.4.1 Odometer requirements

Text, STMA-74468 - The STM ATBEG requires information from the ETCS onboard system. This paragraph lists the required information and related constraints or timing.

Requirement, STMA-2763 -

The ETCS on-board shall provide a speed value to the STM ATB which is less than 0.8 s older than the real speed value, i.e. The delay in speed measurement plus the maximum delay in the communication including the time between two speed values being sent via the profibus shall be less than 0.8 s

Requirement, STMA-5113 -

The difference between the "upper bound of the measured speed" and the "estimated speed" reported by the ETCS on-board

shall not exceed 3 km/h + 2 % of the "upper bound of the measured speed".

note: exceeding with more than 2% will lead to a difference between the speed displayed to the driver and the train speed assumed for the speed monitoring function.

5.4.2 DMI requirements

Text, STMA-76725 - This chapter has been added to list the functional and safety related requirements to be fulfilled by the system integrator when designing the total configuration of STM - ETCS onboard. When these requirements have been fulfilled the combination of the STM ATB - ETCS onboard is an ATP system that complies with the ERA and Dutch legislation.

STMA-75022 - The ETCS on-board shall be fitted with a DMI that adheres to the following requirements:

Requirement, STMA-2694 -

The ETCS on-board shall display ATB icons according to the information in the packets STM-32 and STM-35 in combination with a DMI configuration table according to [STMA-10814 - D4.7.4 Specific Transmission Module \(SS035 v3.2.0\)](#) (provided by the principle: [STMA-8277 - DMI configuration table according to . Description Values NID_STM 1 \(...\)](#)).

Requirement, STMA-2813 -

The resulting layout as specified using the DMI configuration table shall comply with the requirements in CENELEC: CLC/prTR 505497 as far as this doesn't conflict with ETCS indicators used in level STM ATB.

Text, STMA-77898 - The ordering of the cab signals (indicatorID = positionID from 1 to 6) shall be such that the ordering of the indicators is from left to right or bottom up (IndicatorID=1 at the lowest position) for increasing indicatorIDs.

If the cab signals are placed bottom up from low speed to high speed an exemption from RIS requirement 4.7.5 shall be requested.

Requirement, STMA-10025 -

If the STM sends new Cab signals via the profibus then the ETCS on-board shall display the cab signals within 280ms.

Requirement, STMA-2704 -

If the STM sends an EB command via the Profibus, the ETCS on-board shall initiate switching off traction (this requirement can be further exported to the train).

Requirement, STMA-2795 - If a packet STM-46 containing the order to trigger the "gong" (one stroke signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "gong" as specified in the ATB DMI configuration table (gong.wav).

Requirement, STMA-2796 - If a packet STM-46 containing the order to trigger the "BD-signal" (stroked signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "BD-signal" as specified in the ATB DMI configuration table (BD signal.wav).

Requirement, STMA-2797 - If a packet STM-46 containing the order to trigger the "losbel" (stroked signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "losbel" as specified in the ATB DMI configuration table (losbel.wav).

Requirement, STMA-2798 - If a packet STM-46 containing the order to start the "bel" (continuous signal) is received from the STM ATB then

The ETCS on-board shall start the sound "bel" as specified in the ATB DMI configuration table (bel.wav).

Requirement, STMA-2799 - If a packet STM-46 containing the order to stop the "bel" (continuous signal) is received from the STM ATB then

The ETCS on-board shall stop the sound "bel" as specified in the ATB DMI configuration table (bel.wav)

Requirement, STMA-15230 - If a packet STM-46 containing the order to trigger the "bel damping" (one stroke signal) is received from the STM ATB then

The ETCS on-board shall trigger the sound "bel-damping" as specified in the ATB DMI configuration table (bel-damping.wav).

Requirement, STMA-2794 -

One pixel as defined in the DMI configuration table shall be displayed with a size of at least 0.32x0.32mm.

note: using a 10" screen with a resolution of 480x640 pixels leads to a size of 0.32x0.32mm per pixel.

Requirement, STMA-2806 -

The minimum size of an icon to be used for cab signals shall be 40x50 pixels (W x H)

Requirement, STMA-2812 -

The minimum font size to be used on the indicators for the cab signals shall be 30

Text, STMA-77899 - *note: The height (font size) for the text on the cab signals is specified in pixels.*

Requirement, STMA-76556 -

The maximum idle time guarded by the DMI function shall be 2s.

note: this is necessary to guarantee that a DMI fault due to a lost packet will be negated within 2s.

5.4.3 Requirements concerning ETCS

Text, STMA-77901 - The requirements listed in this paragraph are assumed to be imposed on an ETCS onboard by the ERA specifications. However as those are important for safe operation of the STM ATB, the concerning requirements are explicitly repeated. In general the ETCS on-board is assumed to be compliant with the ERA set of specification #2.

Requirement, STMA-2702 -

If the STM sends an EB command via the Profibus then the ETCS on-board shall command the EB within 300ms.

note: a shorter time shall be aspired, to allow a longer response time for the driver.

Text, STMA-77902 - After reconnection with the STM ATB the EVC is expected to resent safety critical configuration data (see subset-035 v3.2.0 chapter 10.4).

note: the reconnection could follow a disconnection due to missing a telegram containing new safety critical configuration data.

Requirement, STMA-9496 -

After reconnection with the STM ATB, the STM manager (STM controller) shall resend the maximum train speed and braking percentage.

Requirement, STMA-10382 -

If the ETCS MODE is "SN" and the "override function is activated" then

The ETCS on-board shall still execute EB commands received from the STM ATB as if the override function is not activated.

Requirement, STMA-2686 -

If the STM ATB function (and/or the ETCS on-board) is switched off (i.e. the STM ATB is not responsible) no ATB information shall be shown at the DMI.

Requirement, STMA-2681 -

If the "STM state" of the STM ATB (as reported by the STM) is different from DA, then the ETCS on-board shall not display any ATB information as sent by the STM ATB directly to the DMI. (thus delete the information if the state changes from DA to another state).

Requirement, STMA-2683 -

If the STM ATB reports an "STM state" different from DA, then the ETCS on-board shall ignore (existing) brake commands from the STM ATB, i.e.:

- not brake if an EB command is received.
- release the brake if there is no other reason (from another STM or from ETCS on-board) to command the EB.

Requirement, STMA-2685 -

If

- a cabin is selected and the driver (has) selected level STM ATB, and
- The STM state reported by the STM ATB is CS or HS

then the ETCS on-board shall change the ETCS state to SN and send a DA order to the STM ATB.

Requirement, STMA-2692 -

The response on switching on the ETCS on-board plus STM ATB is a responsibility of the ETCS on-board equipment.

The ETCS on-board shall guarantee a safe response if switched on while driving.

5.4.4 Minimum Profibus safety levels

Text, STMA-77988 - The ETCS onboard equipment determines the safety level of the connection between the ETCS functions and the STM ATB. However to comply with the ATB safety requirements a minimum safety level of the connections is required. Those minimum safety levels are listed below.

Requirement, STMA-17352 - The minimum safety level implemented for the connection between the STM ATB and the STM controller function shall be SL2


Requirement, STMA-17349 - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the BIU function shall be SL2

Requirement, STMA-17350 - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the DMI function (DMI channels) shall be SL2

Requirement, STMA-17347 - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the TIU function shall be SL2

Requirement, STMA-17348 - The minimum safety level implemented (and communicated in packet STM-2) for the connection between the STM ATB and the JRU function shall be SL0

5.4.5 Diagnostic requirements

Requirement, STMA-75420 - If the STM ATB sends the  [STMA-36387 - Event Flag: The driver tries to pass a signal not at danger using the ATBVv over...](#) information to the JRU, then the diagnostic system shall inform the driver that an intervention was caused due to passing a signal not at danger while being in ATBVv overridden state.

6 Installation design

Text, STMA-67775 - This chapter describes the requirements for onboard installation design of STM ATB.

6.1 General requirements

6.1.1 TSI and RIS conformity

STMA-67787 - The STM ATB shall be installed in combination with an ETCS onboard system.

Text, STMA-77889 - To facilitate temporary stand alone use, instead of a full ETCS onboard system, another system together with which all parts of the RIS and ATBVv requirements which are complied with, may be used. At any place in this document where "onboard ETCS system" is written, this may be replaced by such a limited system.

STMA-72024 - The STM ATB shall be integrated with an onboard ETCS system using a fully compliant STM-ETCS interface according to TSI CCS (2016/919/EU) BL3R2 requirement specifications: subset-035, subset-056, subset-057, subset-058 and subset-059;

STMA-72025 - The integration of STM ATB with the ETCS onboard system in the vehicle shall be subject to a NoBo/AsBo assessment and certification procedure according to TSI CCS (2016/919/EU) and 2010/713/EU;

STMA-72027 - The integration of the onboard system shall, concerning the ATB requirements, be subject to a DeBo assessment according to Regeling Indienststelling Spoorvoertuigen.

STMA-76576 - A documented HQSE risk analysis in the installation design phase is required to identify the installation risks.

Such risk analysis shall be carried out in the installation design phase, prior to the commencement of the works. The risks associated with the installation works shall be identified. Appropriate measures shall be defined and implemented to ensure safety and health of staff and prevention of damage to equipment, tools and railway vehicle.

6.1.2 Application Conditions

STMA-76565 - PROFIBUS power lines

The profibus shall be connected according to the applicable standards, e.g. the external supply voltage shall not be used, other than for termination resistors. Connection of an external power supply to the VP and DGND pins will lead to a failing startup test of the STM ATB.

STMA-76578 - All installation materials, including the cable assemblies and cable connectors used to interface with STM ATB shall comply with fire protection requirements as defined in EN 45545-2 and EN 45545-5 (published in 2013, amended in 2015). Detailed requirements for the classification of the operational environment are described in Chapter 2.17 of D4.5.

6.1.3 Input documentation

Definition, STMA-72049 - The installation design for each train/locomotive series should be based on:

- representative electrical drawings for the particular train/locomotive series;
- representative mechanical drawings for the particular train/locomotive series;
- representative manufacturer documentation for the particular train/locomotive series.

The suitability of the input documentation shall be verified.

6.2 Mechanical design

Definition, STMA-76285 - The installation guide lines in this chapter shall be adhered to in the installation design, in order to assure safe and reliable operation of STM ATB.

6.2.1 Mechanical characteristics

Definition, STMA-67785 - The system has the following mechanical characteristics:

- The size of STM ATB is 220 (l) x 72 (w) x 132 (h) mm.
- The weight is approximately 2 kg
- Capable of operating under vibrations, in all directions: 5.72 m/s² at 5-150 Hz.
- Capable of withstanding shocks, in all directions: 50 m/s² during 30 ms.

6.2.2 Mechanical/environmental installation

Text, STMA-77687 - The detailed mechanical installation is vehicle specific and shall therefore be described in the vehicle specific design. The description shall at least include a description and a figure explaining every step in the mounting of the unit:

- Detailed description of the location where the STM ATB shall be mounted.
- Place the unit in the rack.
- A description of the means and tools to fix the unit in the rack.

STMA-68351 - Requirements

The STM ATB shall be mounted:

- in a protective cabinet, equipped with a suitable 19" 3U mounting rack (or another situation with equivalent mounting conditions), to ensure sufficiently robust mechanical mounting and resistance against shocks and vibrations;

- the orientation of the unit shall be as shown in figure 1 STMA-68369, unless an additional temperature analysis is done and the environmental temperature conditions are adapted according to the results;
- in such a way that the front cover is accessible for mounting the cables and for visual inspection;
- with 4 stainless steel mounting screws, type M3, one in each of the 4 mounting holes in the front cover, allowing a firm mounting of the STM ATB to the 19" mounting rack; in such a way that the unit is protected against physical damage;
- using only cabling and connectors as defined in 4 M9.2 Manufacturing Manual ;
- in such a way that the cables can be mounted / dismantled without damaging the cables or connectors;
- in such a way that the indicator LEDs can be read when STM ATB is in operation, without dismantling parts;
- in such way that the cabinet door (if applicable) can be closed/opened without damaging the mounted cables or connectors.

STMA-68345 - The protective cabinet and mounting rack shall be suitable for onboard applications in railway vehicles and comply with the following requirements:

- have sufficient mounting space for the STM ATB and its cables;
 - an installation depth of 220 mm or more;
 - an installation height of 112 mm (-0/+3 mm)
- provide water leak holes, to let out condensation;
- be placed with no direct exposure to sunlight or solar radiation;
- provide a suitable ambient temperature for STM ATB:
 - not exceeding the operational temperature range for STM ATB:
 - 25 ° C to +70 ° C continuous;
 - up to 85 ° C during 10 minutes maximum
(temperature class T3 according to EN 50155:2010 and EN 50125-1:2014);
 - not exceeding temperature changes of +/- 3 ° C/s,
with a maximum variation of 40 ° C/hr;
- provide ample room for all interfaces and cabling:
 - in particular, the cabinet design shall take into account the minimum bending radius of the cabling;
 - the distance between the front cover of the STM ATB and the (closed) cabinet door (if applicable) shall be sufficient for the depth of the cable connector plus space for the cabling.
- Include a means (e.g. a lockable door) to prevent unauthorized access.

Definition, STMA-68346 -

It is advised to place the STM ATB:

- in close vicinity of the EVC to limit the length of the Profibus cable (Profibus standard defines a maximum length of 200m, due to the location and sources of disturbances this length could be reduced);
- in a way EMI is minimized;
- in the case of retrofit, at or near the location vacated by the former ATB cabinet to ease the re-use of existing ATB antennas/cable and other ATB peripherals.

6.3 Electrical design

STMA-76284 - The installation guide lines in this chapter shall be adhered to in the installation design, in order to assure reliable operation of STM ATB.

Definition, STMA-68343 - The electrical design shall include the establishment of all electrical connections between the STM ATB and adjacent equipment, using the connectors on the front cover of the STM ATB.

Definition, STMA-72018 - The electrical design shall be captured in:

- a block diagram showing all electrical connections from STM ATB to the adjacent equipment and interfaces and allowing identification of these connections;
- wiring diagrams of the cabling used, including cable and connector identification and references to cable and connector specifications (including pinning);
- cable routing diagrams based on the physical layout of the cabinet;
- an update of the existing vehicle type specific electrical drawings.

The design shall also include the provision of:


- bill of materials;
- hard- and software configuration data of STM ATB and the cable assemblies used;
- quality assurance requirements (design verification reports, article inspection checklists, installation test protocols, integration test protocols, commissioning test protocols).

6.3.1 Electrical interfaces

STMA-68344 - The STM ATB shall be electrically connected to:

- ETCS onboard system (Profibus interface);
- ATB antennas;
- Brake-handle (BHA and/or BSO and/or a 4-20 mA brake pipe pressure sensor via vehicle interface);
- CAB audio unit in drivers cabin (optional);
- Vehicle earth and ground, using a flexible copper braid bond (200 x 14 x 1.5 mm);
- Onboard power supply, via sealed circuit breaker, which with a second contact provides the STM ATB switched off information for the ETCS onboard (see subset-035 V3.2.0, paragraph 4.2.1.1 and paragraph 10.3.3.5 and subset-119 V0.1.13 2014-10-16, paragraph 5.6.1.2.1).

Text, STMA-68355 -

The STM ATB pin numbering is shown in Figure  STMA-68369 and the pin occupation is listed in Appendix A: STM ATB connect.


STMA-68951 - The wiring to be used shall be compliant with normative requirements with respect to electrical safety and environmental aspects.

6.3.1.1 Profibus interface

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.

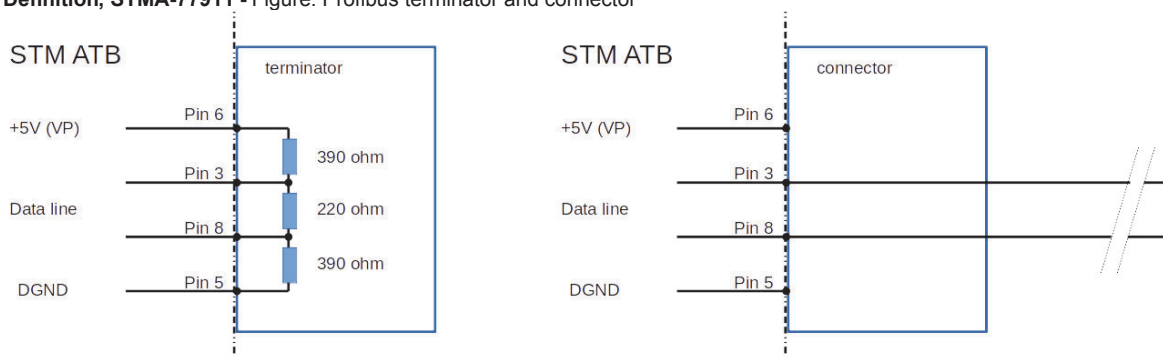
The profibus can be configured as a linear/daisy chain network.

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





STMA-68349 -

The Profibus in the vehicle shall be:

- designed according to EN 50170;
 - only prescribed Sub-D09 connectors should be used;
- include the following connectivity:
 - data line (A);
 - data line (B);
- tested to be in working order;
- exclude power supply lines, because external power supplied to the STM ATB Profibus connectors will lead to a failure during startup tests of the STM ATB.

Text, STMA-68353 - The STM ATB pin numbering is shown in Figure  STMA-68369 and the pin occupation is listed in Appendix A: STM ATB connect.

6.3.1.2 ATB antenna (ATBEG coils) interface


Hardware Design, STMA-68347 - Five types of ATB antennas are currently in use ( STMA-45025). Each type of antenna has its own electro-magnetic characteristics (see Table  STMA-68362) and each type of antenna is installed according to supplier installation guidelines. This results in antenna-specific signal levels.

For retrofit installations, the existing ATB antennas and antenna cables can be re-used.

The existing cables shall be connected to the STM ATB using an ATB antenna type specific cable assembly, which adapts the signal levels from various antenna types.

The cable specifications are defined in the STM ATB manufacturing manual ( M9.2 Manufacturing Manual).


STMA-68940 - The design staff determines the type of ATB antenna installed in the train/locomotive and the corresponding cable set in advance.

	<p>WARNING</p> <p>Only the correct antenna-specific cabling set as provided or specified by the <u>STM ATB</u> supplier should be used.</p>
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STMA-68362 - The ATBEG antennas shall be mounted according to the installation requirements of the ATBEG antenna supplier.

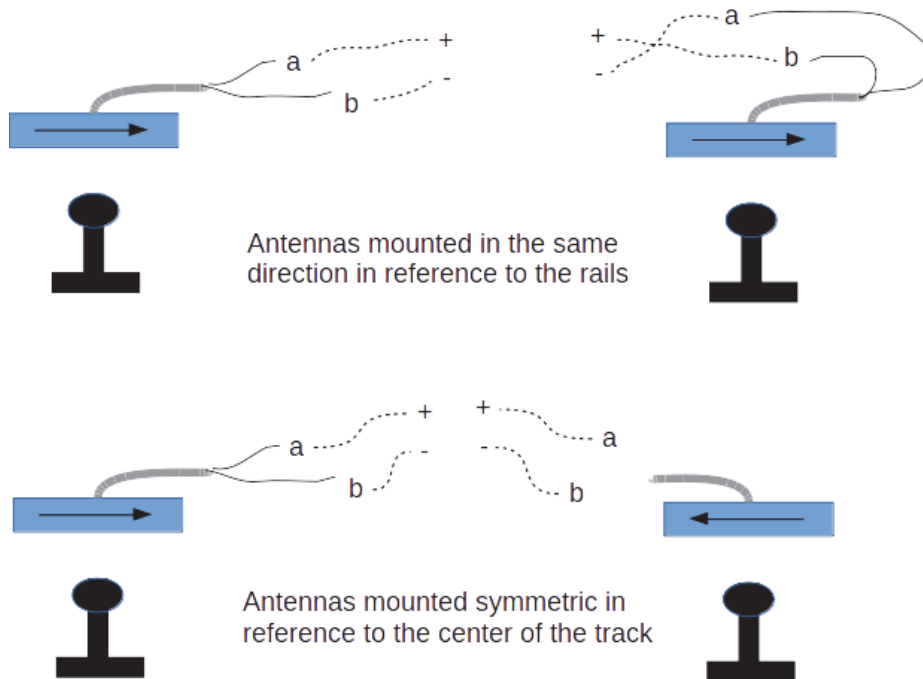
STMA-72016 - The STM ATB requires the 75 Hz input signals to be in phase, therefore the polarity of the antennas is important for the correct operation. If the polarity is inverted, valid ATBEG code will not be recognized by the STM ATB, thus

normal operation is not possible.

STMA-68360 - The two ATB antennas under each cabin can be mounted in different orientations (see Figure 3 ) **STMA-68352**) which will result in a 180° phase difference of the antenna input signals:

- polarized in the same direction in reference to the rails (in phase);
- polarized symmetric in reference to the center of the track (out of phase).

Definition, STMA-14777 - Figure: possible orientations and connection schemes of the antenna's corresponding to one cabin.



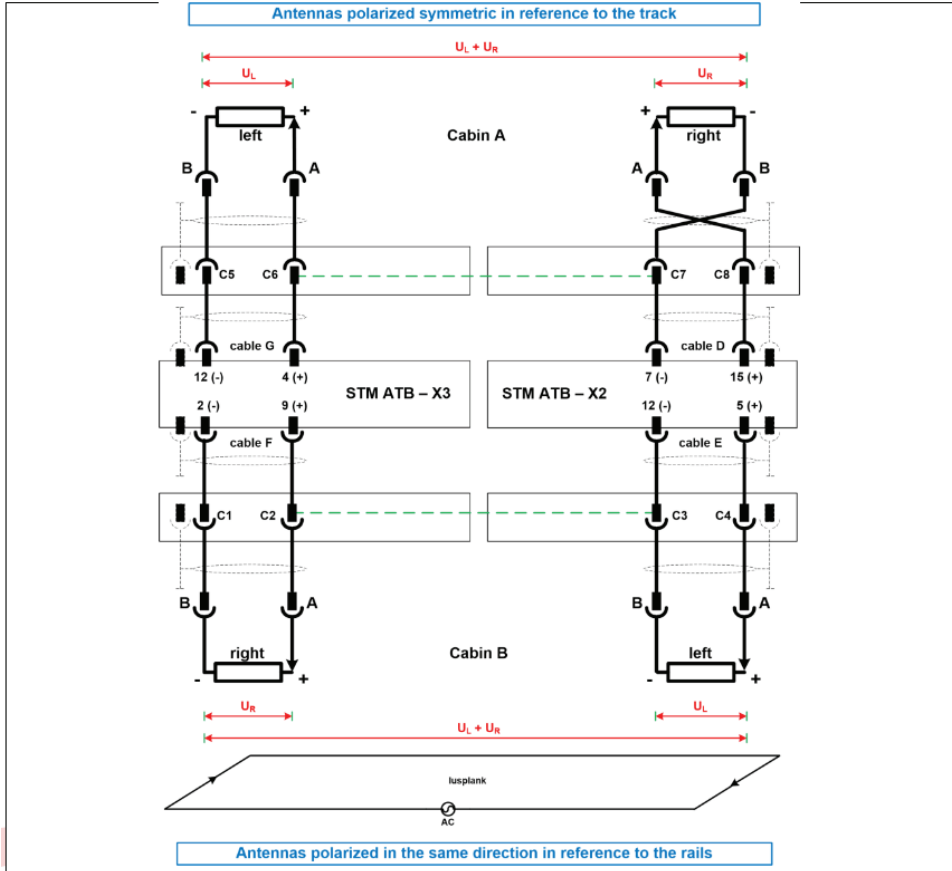
Definition, STMA-68352 - Figure: Examples of ATB antenna polarity and STM ATB connectivity.

Cabin A: symmetric mounting

Cabin B: asymmetric mounting

antenna wire "a" is indicated below with "+"

antenna wire "b" is indicated below with "-"



Definition, STMA-72028 - Table: STM ATB pinning ATB antenna AIN

STM ATB connector	cable	pin		
		nr.	name	description
X2	D	15	AIn_1A+	ATB antenna cabin A right hand side seen from forward direction cabin A
		7	AIn_1A-	ATB antenna cabin A right hand side seen from forward direction cabin A
	E	5	AIn_2A+	ATB antenna cabin B left hand side seen from forward direction cabin B
		12	AIn_2A-	ATB antenna cabin B left hand side seen from forward direction cabin B
X3	F	9	AIn_1B+	ATB antenna cabin B right hand side seen from forward direction cabin B
		2	AIn_1B-	ATB antenna cabin B right hand side seen from forward direction cabin B
	G	4	AIn_2B+	ATB antenna cabin A left hand side seen from forward direction cabin A
		12	AIn_2B-	ATB antenna cabin A left hand side seen from forward direction cabin A

STMA-72030 -

The STM ATB requires that the a and b poles of each antenna always to be connected according to Table [STMA-72028](#) and figure [STMA-68352](#).

The correct connection of the antennas is proven if the STM ATB is able to decode ATB track signals provided with the ATB test generator ("lusplank"), see [STMA-72034 - Table: STM ATB test protocol Cab A testing measured check result LED indicators...](#)

Requirement, STMA-75518 - The correct mounting of all ATB antenna's, the electrical connections to the coils and the mounting of the connectors containing the coil signals at the STM ATB shall be checked independent from the installation engineer who did the installation.

6.3.1.3 Inputs for detection of brake operation


Requirement, STMA-14987 - The train shall provide brake handle supplied information ( STMA-10889)

STMA-73212 - Inputs used for detection of brake operation.

Information concerning brake operation by the driver can be obtained via digital inputs and/or an analogue pressure signal.

One of the following options shall be chosen:

- In case the train is equipped with a position dependent brake handle control including a contact which is switched at a brake handle position equivalent with at least 0.31m/s² deceleration (at flat track), or lead to 0.4 bar brake pipe pressure decrease: connect the BHA/BHN signal, with the contact switched at the indicated brake handle position.
A position dependent brake handle control implies that the brake power requested by the driver is equivalent with the brake handle position.
- In case the train is equipped with a time dependent brake handle control including a contact which is switched if the brake handle is operated, and a digital feed-back from the braking system that the brakes are operated sufficiently to reach at least 0.31m/s² deceleration (at flat track), or lead to 0.4 bar brake pipe pressure decrease in case of freight trains: connect the BHA/BHN to the contact which is switched if the brake handle is operated, and connect the BSO/BSN inputs to the digital feed-back giving the information that the brakes are sufficiently operated.
A time dependent brake handle control implies that the brake power requested by the driver is equivalent with the time the brake handle is operated.
- In case the train is equipped with a brake handle control without a contact which is switched if the brake handle is operated, and with a digital feed-back from the braking system that the brakes are operated sufficiently to reach at least 0.31m/s² deceleration (at flat track), or lead to 0.4 bar brake pipe pressure decrease in case of freight trains: connect the BSO/BSN inputs to the digital feed-back giving the information that the brakes are sufficiently operated.
note: if the delay in the feed-back signal exceeds 300ms, this option will lead to an unacceptable decrease of the available driver reaction time. In concerning cases the option shall not be used.
- In case the train is equipped with a time dependent brake handle control including a contact which is switched if the brake handle is operated, and a analogue feed-back from the braking system providing the brake pipe pressure (or an equivalent signal controlling the brake pipe pressure): connect the BHA/BHN to the contact which is switched if the brake handle is operated, and connect the analogue brake pipe pressure signal.
- In case the train is equipped with a brake handle control without a contact which is switched if the brake handle is operated, and a analogue feed-back from the braking system providing the brake pipe pressure (or an equivalent signal controlling the brake pipe pressure): connect the analogue brake pipe pressure signal.
note: if the time between brake operation and the reduction of the brake pipe pressure to 4.8 bar, exceeds 300ms, this option will lead to an unacceptable decrease of the available driver reaction time. In concerning cases the option shall not be used.

Hardware Design, STMA-76594 - The BHA/BHN and BSO/BSN inputs shall be connected according to table  STMA-19190.


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

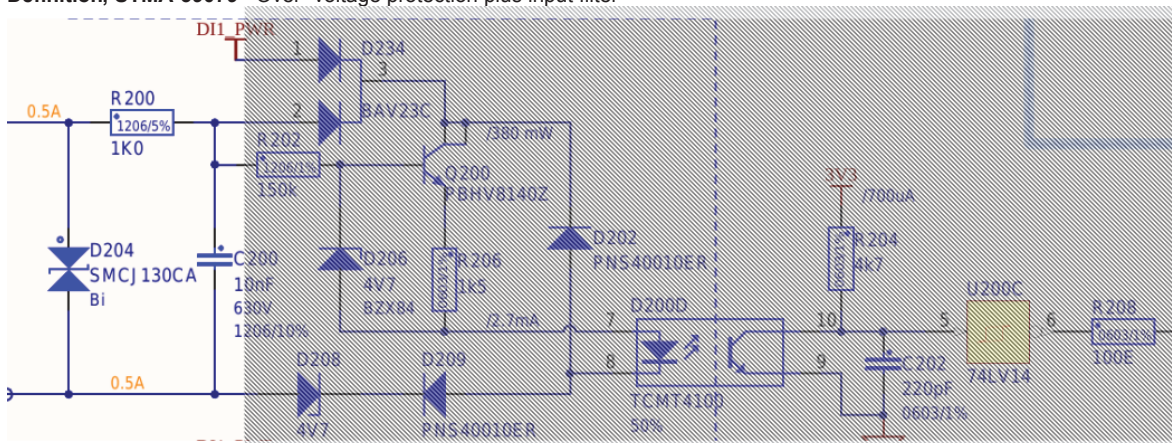
Text, STMA-77908 - Electrotechnical specification of the digital inputs

Two groups of three digital inputs with a common ground are implemented. The nominal voltage may vary between 24Vdc and 110Vdc, taking into account tolerances according to the applicable standards. The switching voltage is 8Vdc +/- 2Vdc.


The digital inputs can be used in two different ways, either per three digital inputs an additional power supply can be used (inputs DIn_A-PWR and DIn_B-PWR) to increase the input resistance of the digital input, see figure  STMA-39079 - Over-voltage protection plus input filter.

Without additional power supply the input current (when the level is high) will be app. 2.7mA. With additional power supply the input impedance can increase to 150k.

Definition, STMA-39079 - Over- voltage protection plus input filter



Text, STMA-77909 - Electrotechnical specification of the analogue brake pipe pressure inputs:

The analogue brake pipe pressure inputs are designed to operate with a 2 or 3 wire 4-20mA pressure sensor with an absolute reference (vacuum). The power supply for the sensor shall be implemented outside the STM ATB. The input resistance for the redundant circuits is app. 100 Ohm (see  STMA-39133 - Figure scheme Buffer:)

Definition, STMA-4898 -

The current level for the analogue inputs for pressure measurement shall be 4-20mA (resolution 0,01mA, 1,6mA/bar), @ =< 200 ohm

5,6mA shall be 1 bar = environmental pressure,

13,6mA shall be 6 bar (= 5 bar + environmental pressure)

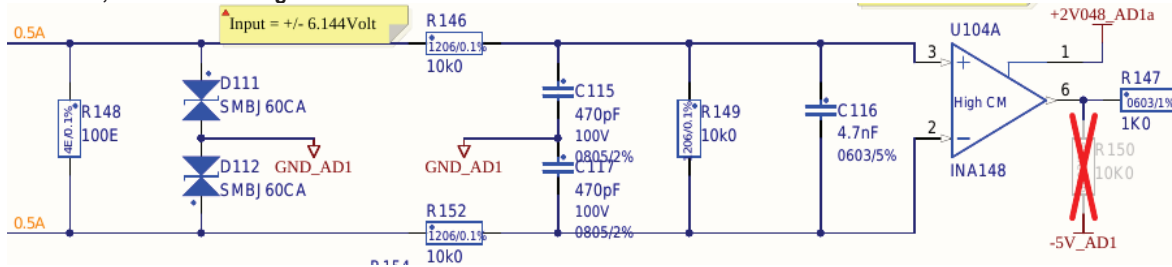
below 4,6 bar: brake applied

above 4,6 bar: brake not applied

below 3,6mA: failure or not connected

above 21mA: failure

Definition, STMA-39133 - Figure scheme Buffer:



6.3.1.4 Outputs to control sound signals

Text, STMA-77897 - The digital outputs are implemented as contacts which are switched to a common return (minus).

STMA-73213 - Digital outputs

The digital outputs have been added to allow for an external sound generator. This sound generator shall play the required sounds as defined in [STMA-8277 - DMI configuration table according to . Description Values NID_STM of the STM 1 \(... in case the transmission of the signals via profibus to the DMI takes too long \(see \[STMA-2760\]\(#\)\).](#)

The concerning signals are the "gong" and "bel" as defined in [STMA-8277 - DMI configuration table according to . Description Values NID_STM of the STM 1 \(... .](#)

The Gong and Bel shall be connected at Dout 2A and Dout 1A (table [STMA-28699](#)). For pinning, see [STMA-8323 - \(table\) For the power supply and digital I/O signals a front connector type DIN4...](#)

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

Requirement, STMA-2760 -

The sum of the following delays:

- The time between the moment the driver operates the brakes and the moment the train provides information to the STM ATB indicating that the brake handle is applied ([STMA-10889](#)).
- The time between the moment the STM ATB provides the information that the "bel" shall sound (via profibus and parallel wiring), and the moment the "bel" sounds in the cabin

shall not exceed 200 ms

note: a shorter delay time shall be aspired, because it will automatically lead to an increased reaction time for the driver

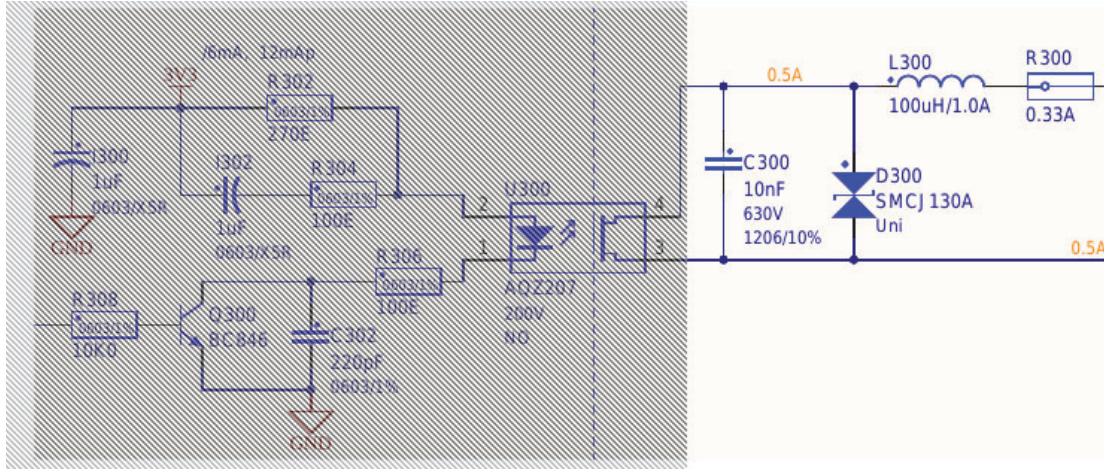
note: A separate sound generator may be used for this purpose.

Definition, STMA-75531 - If the digital outputs are used to control a sound device in the cabin, then the ".wav" files in the DMI configuration table shall be empty (i.e. no sound shall be played if the concerning command via profibus, packet STM-46 is received).

Text, STMA-77915 - Design of the digital outputs:

Text, STMA-77910 - The digital outputs are built in two groups of three outputs with a common return. The outputs consist of a switching element which if activated connects the + pole of the input to the common ground. The outputs are designed for nominal voltages between 24Vdc and 110Vdc.

Definition, STMA-39090 - OC output:



6.3.1.5 Power supply requirements

Hardware Design, STMA-68354 - The power supply voltage provided to the STM ATB shall comply with EN 50155:2010

- The supply voltage shall be provided through 2 separated electrical circuits *), connected through a common (4 pole) circuit breaker.
- The circuit breaker shall be equipped with a separate free electrical contact, to allow Supply Voltage cut-off monitoring by the ETCS onboard system, for STM ATB isolation (see subset-035 V3.2.0, paragraph 4.2.1.1 and paragraph 10.3.3.5 and subset-119 V0.1.13 2014-10-16, paragraph 5.6.1.2.1).
- [STMA-8407, STMA-16108, STMA-16109] the nominal supply voltage for STM ATB shall be 24 V DC to 110 V DC and the nominal power shall be 20 W (total power consumption of STM ATB).
- [STMA-9312] Both poles of the Power Supply of the STM ATB shall be connected to an external overload protection device.

*) STM ATB is equipped with redundant SMPS units, which are fed through a single overvoltage circuitry. In case independent feeding of the SMPS units is deemed necessary, then the onboard installation should support this. For this reason a four pole circuit breaker and separate wiring is to be installed (one spare circuit).

6.3.1.6 Earthing and grounding

STMA-72019 -

- The STM ATB enclosure shall be earthed by connecting the M4 screw on the front plate to PE with a flexible copper braid bond (200 x 14 x 1.5 mm).
- The earthing of the cables between the STM ATB and the vehicle interface shall be connected only via the connection of the cable jacket with the PE pins in each connector and the earthing of the STM ATB enclosure.
- For AC currents the STM ATB cable shielding shall be connected to PE at both ends of the cabling.
Measures to prevent too high DC currents shall be taken, normally the PE circuits in the vehicle will have a sufficiently low impedance to achieve this without further measures.

6.3.1.7 Cabling configurations

Definition, STMA-72017 -

The STM ATB electrical connections require a prefabricated cable set consisting of 5 cables according to chapter [M9.2](#) STMA-69228 - [Cabling requirements](#) in document [M9.2 Manufacturing Manual](#).

The connector X1 provides for the digital in/outputs with the cables A and C and the power supply with cable B. Connector is type DIN41612-F-48P.

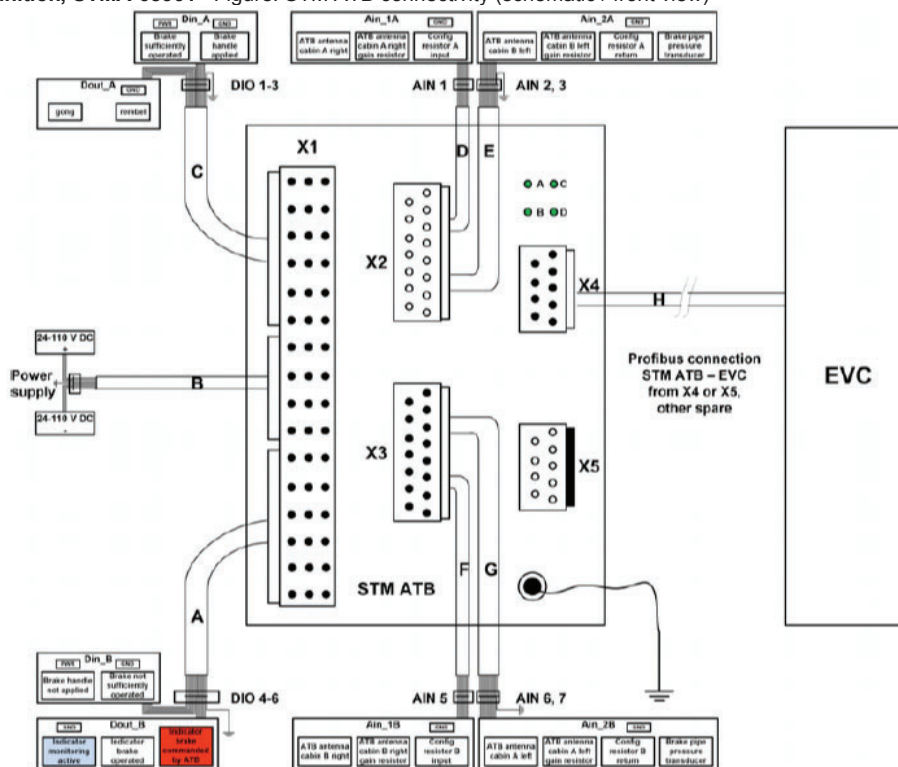
The connectors X2 (Sub-DB15 pins) (with cables D and E) and X3 (DB15) (with cables F and G) provide for the analog in/outputs. The gender of X2 and X3 is different (M/F).

For each ATB antenna type (5 variants), a specific set of cables D, E, F and G is required, as gain compensation resistors are mounted inside the connectors X2 and X3.

The connectors X4 and X5 are Profibus connectors (Sub-DB9 on male, one female), one of which must be used for connecting the STM ATB with the ETCS EVC. The remaining Profibus connector on the STM ATB is spare and should be covered to prevent cumulation of dust/pollution in the connector.

[STMA-68361 - Figure: STM ATB connectivity \(schematic / front view\)](#) gives a schematic overview of the STM ATB connectivity.

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



[Definition, STMA-68961](#) - The STM ATB pin numbering and the pin occupation is listed in [STMA-68320 - Appendix A: STM ATB connectivity checklist](#)

6.3.1.8 STM ATB revision information

STMA-68959 - STM ATB software and hardware revision information shall be documented in the vehicle specific configuration data at (re)installation. The source information is contained in the SVD (System Version Description), which is delivered with the STM ATB unit.

The installation design shall include a check of the version information of the installation and commissioning documentation, referred to in the SVD.

6.4 Installation design verification

STMA-68367 - The installation design of the STM ATB in the train/locomotive as laid down in the electrical and mechanical drawings and installation work instructions shall be subject to a review ("4-eyes principle") against the requirements in this manual. The review shall be performed by a competent engineer and the outcome of the review shall be documented using a design verification checklist at requirement level.

7 Installation and integration checklist

Text, STMA-77689 - The STM ATB shall be mounted according to an approved installation design resulting from the requirements in chapter [STMA-67780 - Installation design](#), in compliance with the relevant norms for onboard electronic equipment. Specific considerations are described in this chapter.

7.1 Installation of peripherals

Text, STMA-77907 - The peripherals to be installed are:

- ATBEG antennas (coils)
- Brake detection circuits
- Optionally (a) sound module in the cabin(s)
- Power supply
- Earthing point

The concerning connections are described in paragraph [STMA-68309 - Electrical design](#). Before installing the unit the concerning signals shall be made available at a location where the prepared STM ATB cable sets can be connected.

In case the STM ATB is replacing an existing ATBEG system, all peripherals necessary will be available, however potentially some adaptations might be necessary (e.g. the connection of a Logi+ sound generator will require additional relays as both, the STM ATB and the Logi+ sound generator have a common ground).

In addition a PE, close enough to the installation location of the STM ATB to allow the connection with the PE connector pin at the STM ATB enclosure with a 200mm long copper braid bond shall be made available.

In case of installation in a vehicle not yet equipped with ATBEG the peripherals shall be added to the vehicle design:

- ATBEG antennas (coils): all currently available ATBEG antennas might be used (see [STMA-68362 - The ATBEG antennas shall be mounted according to the installation requirements o...](#)). The antennas and cabling shall be installed according to the installation requirements from the concerning supplier.
- Brake detection circuits: based on the criteria listed in [STMA-73212 - Inputs used for detection of brake operation. Information concerning brake opera...](#) a concept for detection of brake operation shall be selected and the concerning digital and or analogue signals shall be made available:
 - BHA/BHN: an antivalent input signal depending on the chosen concept indicating:
 - that the brake handle position is equivalent with at least 0.31m/s² deceleration (at flat track) or lead to 0.4

bar brake pipe pressure decrease, **or**

- that the brake handle is operated (used in case of time dependent brake handle control)
- BSO/BSN: a digital feed back from the braking system indicating that based on a safe control parameter the brakes have been operated sufficiently to reach at least 0.31m/s² deceleration (at flat track), or lead to 0.4 bar brake pipe pressure decrease.
- An analogue signal representing the brake pipe pressure.
- A sound module providing a "gong" and a "bel" (sounds defined in the DMI configuration table: [STMA-8277 - DMI configuration table according to . Description Values NID_STM of the STM 1 \(...\)](#)) which can be switched with the digital outputs as described in paragraph [STMA-77896 - Outputs to control sound signals](#).
- A power supply as defined in paragraph [STMA-68312 - Power supply requirements](#)
- A PE, close enough to the installation location of the STM ATB to allow the connection with the PE connector pin at the STM ATB enclosure with a 200mm long copper braid bond.

7.2 Installation considerations for installing the unit

Text, STMA-74446 - The following installation considerations shall be taken into account when installing an STM ATBEG in to a railway vehicle.

Definition, STMA-74435 - Pre-conditions.

2. Check that the following pre-conditions are met:

- Authorised installation drawings and work instructions are available (in correct revision);
- Correct installation materials (STM ATB, mounting kit, earthing kit, correct cable set to match with antenna type (see annex B) and cables of sufficient length) are available;
- Required tooling is available;
- The 19" signalling cabinet (or equivalent) with sufficient space for the STM ATB is mounted firmly in place and electrically connected to vehicle PE;
- An ETCS onboard system is installed or is going to be installed in accordance with the onboard ETCS installation design and in working order;
- The ATB digital and analog input/output interface are wired and tested in accordance with the onboard design;
- Power supply interface is available in accordance with the onboard design. The STM ATBEG should be fed through a monitored switch that can turn the power to the STM ATBEG on and off. The operation of the switch shall be logged in a JRU.

Definition, STMA-74436 - Wiring check.

3. Check on wiring


- Check which type of ATB antennas are installed on the train/locomotive and that a matching cabling set is provided;
- Check that the cable length is appropriate for connecting the STM ATB with the Profibus, ATB input/output and power supply interfaces:
 - Check whether both Profibus connectors will be used;
 - If not, whether connector X4 with cable H or connector X5 with cable J will be used;
- Check cable routes for accessibility and (future) maintenance;
- Cables are long enough to be connected and fastened to all interfaces without strain, but not longer than necessary;
- Sufficient fixes for fastening the cables are available;
- All parts of the cabling set have been tested and valid quality assurance certificates are provided;
- If any cabling set quality assurance certificate is missing, perform connectivity tests on the entire cabling set.

Definition, STMA-74434 - Power off check

4. Check that the STM ATB overload protection device is switched "off":

- If the circuit breaker is switched "on", switch it "off";

Definition, STMA-74438 - Installation

5. Place the STM ATB in the 19" rack (see  STMA-68345);
6. Hand fasten the STM ATB with 4 M2.5 bolts (max. 1 Nm torque);
7. Establish an ground connection between the M4 screw on the front plate of the STM ATB housing and PE with a flexible copper braid bond (200 x 14 x 1.5 mm);

Definition, STMA-74439 - Connecting the STM ATBEG

8. The sequence and way of securing the cabling is vehicle specific and shall therefore be described in the vehicle specific design, choose a convenient sequence for connecting all cables based on the spatial limitations in the CCS cubicle. Check which sequence for connecting the 8 (or 9) cables STM ATB cables (A/B/C/D/E/F/G/H/J) has been specified in the design.

Definition, STMA-74437 - Secure cabling


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

Definition, STMA-74440 - Safety check on cabling

10. Check that all STM ATB connections are physically sound and safe:
 - perform both a visual check and mechanical locking of all interfaces;
 - check that the CCS cabinet door closes without putting strain on any cable;

Definition, STMA-68364 - HQSE procedures.

Check that all HQSE procedures for safe work on the train/locomotive have been fulfilled.

	<p>DANGER Non-compliance with <u>HQSE</u> procedures for safe work on railways in general and electrical applications therein in particular pose a serious risk to health and life.</p>
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11. Switch on the power supply to the onboard power supply;
12. After turning on the power supply to the onboard network, switch the STM ATB overload protection device to "on";
13. After the ETCS on-board provides all relevant ETCS and train data the STM will request Cold Stand-by.

Definition, STMA-76372 -

14. Check the status of the STM ATB:
 - All four status LEDs (A, B, C and D) on the STM ATB front panel shall show continuous green;
 - the STM ATB shall be selectable on the DMI in the control cabin:
 - consult the applicable ETCS manual for further details;

Definition, STMA-76371 -

15. Only in case one or more of the LED indicators do not show green and/or the STM ATB is not selectable in the control

cabin:

- check the probable cause for the incorrect indication in [STMA-63492 - M9.4 Maintenance Manual](#) Chapter [STMA-75451 - Diagnostics](#)
- ensure that all HQSE procedures (step 1) have been fulfilled once more;
- switch the STM ATB overload protection device "off";
- correct the fault.

Definition, STMA-76370 -

16. Report the STM ATB installation:

- successful and ready for testing once the status LEDs all show green and the STM ATB is selectable on the DMI in the control cabin:
- include the hard- and software versions in the installation protocol;
- failed if the status LEDs do not all show green and/or the STM ATB is not selectable on the DMI
- Check that the STM ATB supplied has correct software version installed, using startup information recorded in JRU at startup:
- Compare the software versions installed with the actual version in the Safety Case.

8 Functional tests / commissioning

Text, STMA-77970 - After installation and before putting the vehicle into operation on ATBEG tracks the vehicle with the integrated STM ATB shall be commissioned. The tests to prove the correct installation of the STM ATB are described in this chapter.

Text, STMA-77914 - The functional tests shall prove that all connections have correctly been installed, i.e.:

- Power supply: proven by switching on the unit
- PE: visual check
- The antennas: check that ATBEG code can be found using an ATB test loop ("lusplank")
- Detection of brake operation
- The optional external sound device

Definition, STMA-75666 -

1. Commissioning Test Preparation:

Check that installation of the STM ATB is completed and checked:

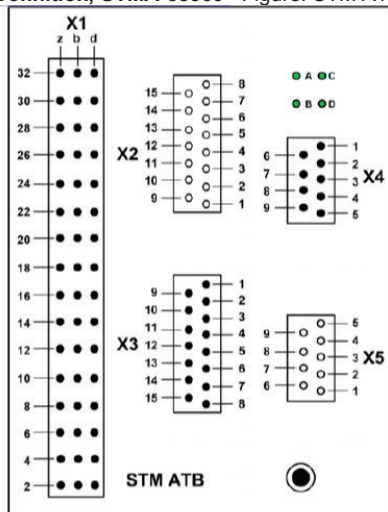
- the LED indicators on the front panel of the STM ATB all show green and the STM ATB is selectable on the DMI in the active cabin;
 - in case one or more of the LED indicators does not show green and/or the STM ATB is not selectable on the DMI in the active cabin: abandon the test, check [STMA-63492 - M9.4 Maintenance Manual](#) chapter [STMA-75451 - Diagnostics](#) for the possible cause and initiate appropriate actions (repair of connections / replacement);
2. Check that the ATB test levels (75Hz current, and 300Hz-1200Hz noise) on the test track meets the test requirements, i.e. < 100mA each.
3. Place an ATB test loop ("Lusplank") perpendicular to the track centered under both ATB antennas on one cabin side of the train/locomotive:
- refer to [STMA-68962 - Appendix D: STM ATB test protocol](#) ;
4. Connect an ATB test generator (ATB codegenerator) to the ATB test loop and switch it on;
- select 180 pulses/minute and an output level equivalent to 0.5A / 75 Hz;

- refer to [STMA-68962 - Appendix D: STM ATB test protocol](#) ;
- 5. Ensure that a colleague is present in the active cabin to:
 - carry out a Start of Mission;
 - register the visible and audible ATB signals (including those on the DMI)
- 6. Increase the 75 Hz current in steps (minimum time 3s) of the equivalent of 0.5 A until the STM ATB recognizes the ATB code;
- 7. Record and document in [STMA-68962 - Appendix D: STM ATB test protocol](#) :
 - the current at which the STM ATB recognizes the ATB code;
 - the visible and audible ATB signals (including those on the DMI) at that current:
 - in particular the speed limit (80 km/h or otherwise) signaled at that current;
- 8. Operate the brakes and check if the white lamp appears.
- 9. Switch BD mode on and off and check if the gong sounds
- 10. Drive above 45km/h or simulate a speed above 45km/h and check if the rembel sounds
- 11. Repeat the entire test on the other cabin side of the train/locomotive (steps 2 to 10);
- 12. Report the all test results in [STMA-68962 - Appendix D: STM ATB test protocol](#) :
- 13. Combine the test results with required results in [STMA-72035 - Appendix E: STM ATB commissioning protocol](#) The STM ATB is ready for service if all check results are OK. In this case only, the security certificate for the train/locomotive may be issues in accordance with the Specific Application Safety Case - Physical Implementation Portion (SASC-PIP).

9 Appendices

9.1 Appendix A: STM ATB connectivity checklist

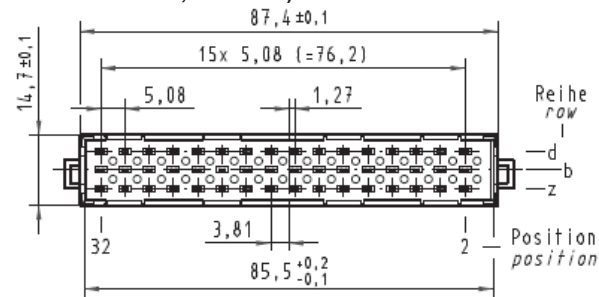
Definition, [STMA-68369](#) - Figure: STM ATB pin numbering



9.2 X1

Definition, STMA-76726 - figure:

Connector X1 pinout (DIO+PS Front connector, DIN41612)



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

9.3 X2

Definition, STMA-8241 - (table)

AD-A Front connector, SubD-15-F

Pin	I/O	Pin name	Description
1	I	<i>Rconfig_A</i>	Configuration resistor input
15	I	<i>Aln_1A+</i>	Coil input
7	I	<i>Aln_1A-</i>	Coil input

14	I	<i>Rg_1A+</i>	Coil gain resistor
6	I	<i>Rg_1A-</i>	Coil gain resistor
13		<i>Aln_A_GND</i>	
5	I	<i>Aln_2A+</i>	Coil input
12	I	<i>Aln_2A-</i>	Coil input
4	I	<i>Rg_2A+</i>	Coil gain resistor
11	I	<i>Rg_2A-</i>	Coil gain resistor
3		<i>Aln_A_GND</i>	
10	I	<i>Aln_3A+</i>	brake pipe pressure input
2	I	<i>Aln_3A-</i>	brake pipe pressure input
9	I	<i>Aln_A_GND</i>	
8	I	<i>Rconfig_A_ret</i>	Configuration resistor return
Sh		<i>PE</i>	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

9.4 X3

Definition, STMA-8276 - (table)

AD-B Front connector, SubD-15-M

Pin	I/O	Pin name	Description
8	I	<i>Rconfig_B</i>	Configuration resistor input
9	I	<i>Aln_1B+</i>	Coil input
2	I	<i>Aln_1B-</i>	Coil input
10	I	<i>Rg_1B+</i>	Coil gain resistor
3	I	<i>Rg_1B-</i>	Coil gain resistor
11		<i>Aln_B_GND</i>	
4	I	<i>Aln_2B+</i>	Coil input
12	I	<i>Aln_2B-</i>	Coil input
5	I	<i>Rg_2B+</i>	Coil gain resistor
13	I	<i>Rg_2B-</i>	Coil gain resistor
6		<i>Aln_B_GND</i>	
14	I	<i>Aln_3B+</i>	brake pipe pressure input
7	I	<i>Aln_3B-</i>	brake pipe pressure input
15	I	<i>Aln_B_GND</i>	
1	I	<i>Rconfig_B_ret</i>	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

9.5 X4/X5

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	

9.6 Appendix C: LED status indications

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

9.7 Appendix D: STM ATB test protocol

Definition, STMA-72034 - Table: STM ATB test protocol Cab A

testing	measured	check	result
LED indicators STM ATB		all green	
STM ATB selectable on cabin DMI		Selectable	
75 Hz level		< 100mA	
noise level		< 100mA	
Install the ATB test loop (lusplank)			
Inject ATB code 180, 0.5A		Cab signal Yellow	
Inject ATB code 180, 1A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 1.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 2A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 2.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 3A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 3.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 4A		Cab signal Yellow8	
Inject ATB code 180, 4.5A		Cab signal Yellow8	
Inject ATB code 180, 5A		Cab signal Yellow8	
Inject ATB code 180, 5.5A		Cab signal Yellow8	
Inject ATB code 180, 6A		Cab signal Yellow8	
Inject ATB code 180, 6.5A		Cab signal Yellow8	
Inject ATB code 180, 7A		Cab signal Yellow8	
Inject ATB code 180, 7.5A		Cab signal Yellow8	
Inject ATB code 180, 8A (leave on)		Cab signal Yellow8	
Operate the brake		white lamp indicator shall be on	
Release the brake		white lamp indicator shall be off	
remove the ATB test loop		Yellow	
the steps below are only necessary in case an external sound device is installed			
Operate the BD button during > 2s		Blue Lamp and Gong	
Operate the attention button during >2s		Yellow and Gong	
Increase speed or simulate speed >45km/h, brake if the rembel sounds		rembel shall sound	

Definition, STMA-77913 - Table: STM ATB test protocol Cab B

testing	measured	check	result
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LED indicators STM ATB		all green	
STM ATB selectable on cabin DMI		Selectable	
75 Hz level		< 100mA	
noise level		< 100mA	
Install the ATB test loop (lusplank)			
Inject ATB code 180, 0.5A		Cab signal Yellow	
Inject ATB code 180, 1A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 1.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 2A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 2.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 3A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 3.5A		Cab signal Yellow or Yellow8	
Inject ATB code 180, 4A		Cab signal Yellow8	
Inject ATB code 180, 4.5A		Cab signal Yellow8	
Inject ATB code 180, 5A		Cab signal Yellow8	
Inject ATB code 180, 5.5A		Cab signal Yellow8	
Inject ATB code 180, 6A		Cab signal Yellow8	
Inject ATB code 180, 6.5A		Cab signal Yellow8	
Inject ATB code 180, 7A		Cab signal Yellow8	
Inject ATB code 180, 7.5A		Cab signal Yellow8	
Inject ATB code 180, 8A (leave on)		Cab signal Yellow8	
Operate the brake		white lamp indicator shall be on	
Release the brake		white lamp indicator shall be off	
remove the ATB test loop		Yellow	
the steps below are only necessary in case an external sound device is installed			
Operate the BD button during > 2s		Blue Lamp and Gong	
Operate the attention button during >2s		Yellow and Gong	
Increase speed or simulate speed >45km/h, brake if the rembel sounds		rembel shall sound	

9.8 Appendix E: STM ATB commissioning protocol

Definition, STMA-72036 - Commissioning protocol

The commissioning report shall consists of:

- all logged data: e.g. versions and serial numbers
- anomalies from the described proces
- test results as logged in the test protocols