

M9.3 Installation Manual (DRAFT Version)

for the development of an STM ATB

DRAFT

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1 Introduction

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.

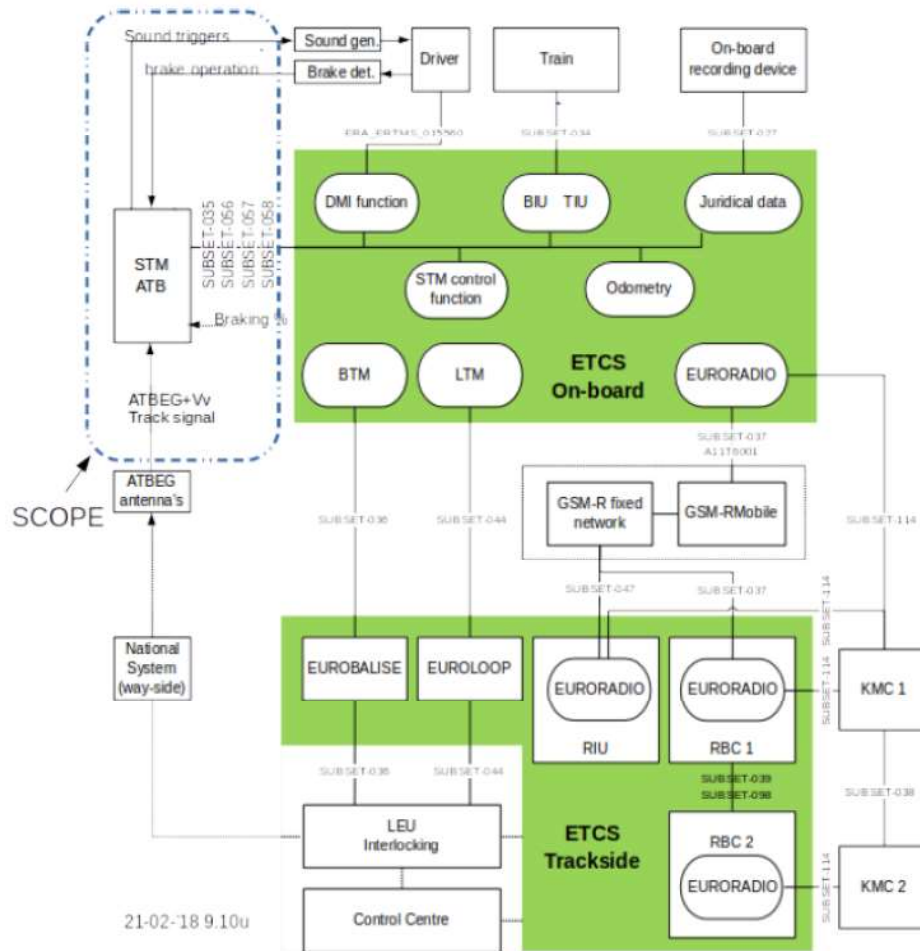
1.2 Purpose

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 1 (**T** STMA-65619) is taken from the ETCS specifications (subset-035). 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.

Text, STMA-65619 - Figure 1: ETCS reference architecture and scope of this manual.



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 <u>HQSE</u> content which must always be avoided.
	WARNING Denotes a risk with medium <u>HQSE</u> content which always requires attention as indicated.
	REMARK Denotes a situation with no or only minor <u>HQSE</u> 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	2018
11	EN 50121	Railway Applications. Electromagnetic Compatibility	2017
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	2017
14	EN 50170	General Purpose Field Communication System	1997
15	EN 50264	Railway Applications – Railway Rolling Stock Power and Control Cables having Special Fire	2008

		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

3.1 Abbreviations, definitions and terminology

Text, STMA-67779 - Table 1: abbreviations [P6.2]

Abbreviation	Legend
AC	Alternating Current
ADC	Analog to Digital Converter
AIN Board	Analog Input Board
ATB	Automatische Trein Beïnvloeding – Dutch national ATP system
ATB-EG	First generation ATB in the Netherlands, based on 75 Hz encoded track signal
ATB-Vv	Improved version of ATB-EG system, with add on balises and signal loops for protection of trains at 0-40 km/h

ATP	Automatic Train Protection
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 (stoptonend 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 system and references to the requirements have been made in this document. Each requirement has been assigned with a unique ID, with the format "STMA-<number>".

4 Audience

Text, STMA-67777 - This STM ATB installation manual is intended to be used by technical staff qualified and responsible for the installation or the replacement of onboard train protection systems.

The staff qualification demands are to be determined by the ECM (Entity in Charge of Maintenance) or workshop management concerned, in accordance with the reglementory and statutory requirements.

5 General requirements

5.1 Organizational requirements

Test Case Result, STMA-68350 - All parts of this installation procedure may only be performed in a qualified workshop and/or ECM (Entity in charge of Maintenance) in compliance with EU Directives 2016/797 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 oversees the adherence thereof.

5.2 Health and Safety requirements

Test Case Result, 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 Quality Assurance requirements

All components to be used in the design and/or installation of the STM ATB shall be:

- Compliant with environmental requirements
- Compliant with requirements for onboard application

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

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

Test Case Result, 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;

Test Case Result, 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;

Test Case Result, STMA-72027 - The integration of the onboard system shall be subject to a DeBo assessment according to Regeling Indienststelling Spoorvoertuigen.

6.1.2 Input documentation

Test Case Result, 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 and installation

6.2.1 Mechanical characteristics

Test Case Result, STMA-67785 -

- The size of STM ATB is 200 (l) x 70 (w) x 128 (h) mm.
- The weight is approximately 2 kg.

Figure 2: STM ATB view with dimensions

6.2.2 Mechanical/environmental installation

Test Case Result, STMA-68351 - Requirements [☒ STMA-41216, ☐ STMA-41249]

The STM ATB shall be mounted:

- in a protective cabinet, equipped with a suitable 19" 3U mounting rack, to ensure sufficiently robust mechanical mounting and resistance against shocks and vibrations;
- in the preferred orientation, which is with the front cover in vertical position, facing towards the cabinet door opening;
- 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 < >, 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 compliant with EN 45545 and EN 50155;
- 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;
- in such way that the cabinet door can be closed/opened without damaging the mounted cables or connectors.

Test Case Result, STMA-68345 - The protective cabinet and the 3U 19" mounting rack shall be suitable for onboard applications in railway vehicles and comply with the following requirements:

- be mounted according to an approved installation design, in compliance with the relevant norms for onboard electronic equipment
- 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)
- be electromagnetically compatible (EN 50121 compliant);
- be mechanical compatible (EN 50155 compliant);
- withstand shocks and vibrations (IEC 61373:2010);
- be able to resist condensed moisture;
- 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 $\pm 3^{\circ}\text{C/s}$,
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 shall be more than the depth of the cable connector plus 5 times the cable diameter, with a minimum of 100 mm;
 - allow physically separated routing of power supply and data cabling in the cabinet.

Test Case Result, STMA-68346 -

It is advised to place the STM ATB:

- in close vicinity of the EVC, if possible in the same cabinet, to limit the length of the Profibus cable;
- away from the GSM-R modems, RF antenna cables or other RF sources;
- in the case of retrofit, at or near the location vacated by the former ATB cabinet to allow the re-use of existing ATB antennas/cables.

6.3 Electrical design and installation requirements

Test Case Result, 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.

Test Case Result, 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 (ETCS onboard system, TIU, BIU) and allowing identification of these connections;
- wiring diagrams of the cabling used, including cable and connector identification and references to cable and connector specifications;
- cable routing diagrams based on the physical layout of the cabinet;
- pin lay-out schemes of all connections between the STM ATB connector pins and the corresponding cabling blocks with their clamps;
- an update of the existing vehicle type specific electrical drawings.

The design shall also include the provision of:

- bill of materials;
- quality assurance requirements (design verification reports, article inspection checklists, installation test protocols, integration test protocols, commissioning test protocols).


6.3.1 Electrical interfaces

Test Case Result, STMA-68344 -

The STM ATB shall be electrically connected to:

- ETCS onboard system (Profibus interface);
- ATB antennas (via vehicle interface / TIU);
- Brake-handle (BHA and/or BSO and/or a 4-20 mA brake pipe pressure sensor via vehicle interface / BIU);
- CAB audio unit in drivers cabin (optional, via vehicle interface / TIU);
- Vehicle earth and ground, using a flexible copper braid bond (200 x 14 x 1.5 mm);
- Onboard power supply, via sealed circuit breaker and vehicle interface / TIU).

Text, STMA-68355 -

The STM ATB pin numbering is shown in Figure 5 ( STMA-68369) and the pin occupation is listed in Table 5

( STMA-68370) in Appendix A: STM ATB connect.

Test Case Result, STMA-68951 - The wiring to be used shall be compliant with normative requirements.



6.3.1.1 Profibus interface

Test Case Result, 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.



Test Case Result, STMA-68349 -


The Profibus in the train/locomotive shall be:

- designed according to EN 50170;
 - only prescribed Sub-D09 connectors should be used;
- include the following connectivity:
 - data line plus (A);
 - data line minus (B);
- tested to be in working order;.


Text, STMA-68353 - The STM ATB pin numbering is shown in Figure 5 ( STMA-68369) and the pin occupation is listed in Table 5 ( STMA-68370) in Appendix A: STM ATB connect.

6.3.1.2 ATB antenna interface

Test Case Result, 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 2  [STMA-68362](#)) and is installed according to supplier installation guidelines. This results in antenna-specific signal levels. In order to adapt various antenna types, each antenna requires a specific cable assembly to be used in correspondence with the ATB antenna installed.

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


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

	WARNING Only the correct antenna-specific cabling set as provided or specified by the STM ATB supplier should be used.
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Definition, STMA-68362 - Table 2: ATB coil specific cabling

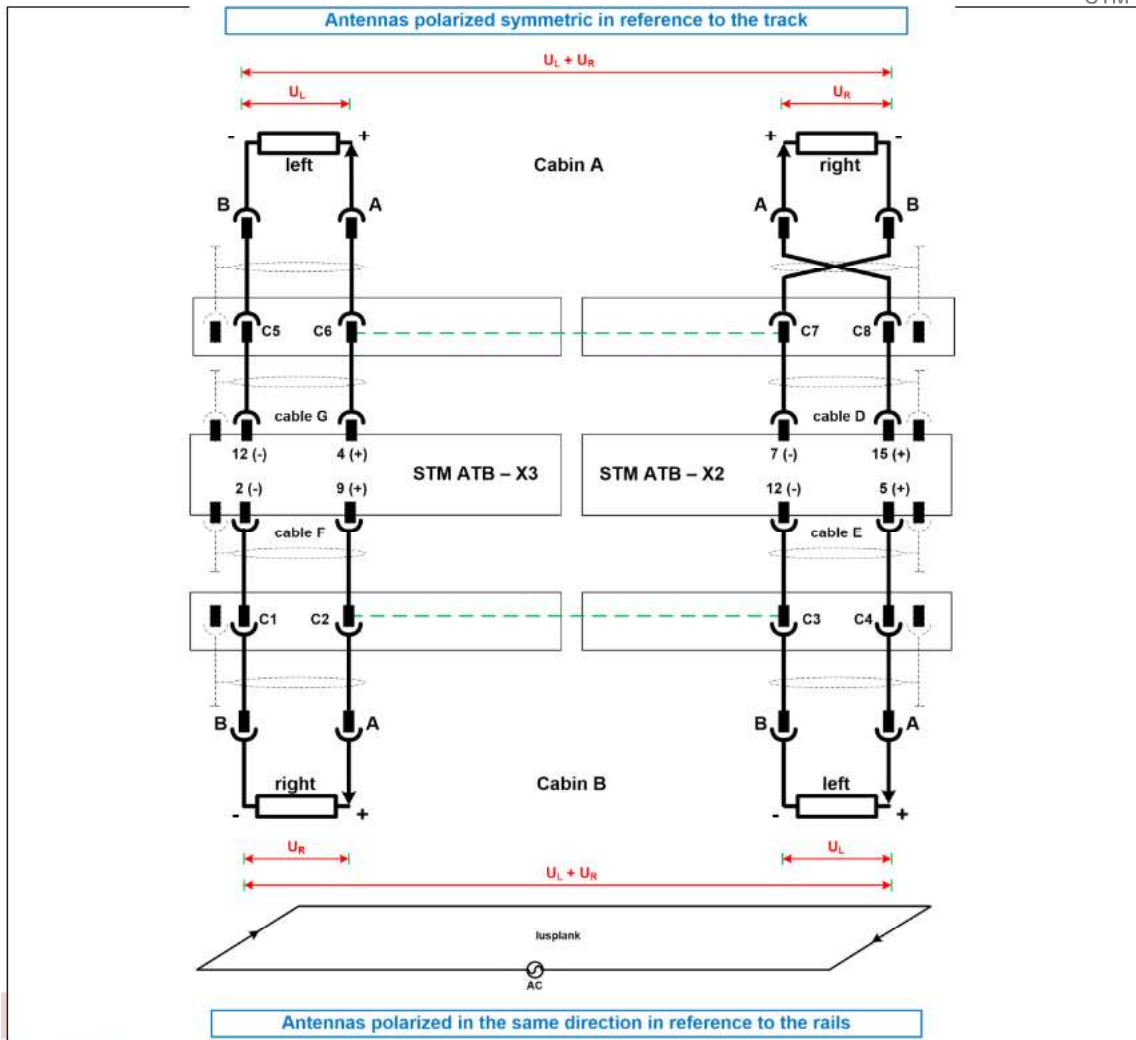
ATB antenna	ATB antenna 75 Hz characteristics		Cable set ^{a)}
	L / R	E_o (relative)	
Alstom Bar	1.4 H / 45 Ω	21.3 mV/A	type 1
Alstom V	1.4 H / 44 Ω	4.7 mV/A	type 2
PW-170	4.7 H / 270 Ω	22.3 mV/A	type 3
PW-225	4.55 H / 270 Ω	14.0 mV/A	type 4
Fase 3	10.8 H / 250 Ω	123 mV/A	type 5
a) to be specified by the supplier; refer to the STM ATB Manufacturing Manual .			

Test Case Result, STMA-72016 - [\[STMA-40591\]](#) The STM ATB requires the 75 HZ input signals to be in phase.

Test Case Result, 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-68352 - Figure 3: Examples of ATB antenna polarity and STM ATB connectivity.



Definition, STMA-72028 - Table 3: STM ATB pinning ATB antenna AIN


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



Test Case Result, STMA-72030 -

The STM ATB requires that the + and – poles of each antenna always to be connected according to

Table 3 ( STMA-72028):

- + pole of the ATB antenna to the AIN+ for that antenna on the STM ATB;
- - pole of the ATB antenna to the AIN- for that antenna on the STM ATB.




This is straightforward if both ATB antennas on one cabin side are polarized in phase (in Figure 3  STMA-68352 as an example shown for cabin B) but requires a “cross-over” in case the ATB antennas on one cabin side are polarized out of phase (in Figure 3 as an example shown for cabin A):

- Prior to the installation of the STM ATB antenna cables, the phases of the antennas shall be checked for each cabin in compliance with Figure 3 ( STMA-68352). For this purpose an external 75 Hz ATB test device and an ATB loop antenna ('ATB lusplank') should be used.
 - first measure the voltage over each antenna individually (in Figure 3 C5-C6 (U_L) and C7-C8 (U_R) under cabin A and C1-C2 (U_R) and C3-C4 (U_L) under cabin B)
 - temporarily connect the AIn- pole for one antenna with the AIn+ pole for the other antenna on the inner side (in Figure 3 C6-C7 under cabin A and C2-C3 under cabin B) and measure the voltage over both antennas (in Figure 3 C5-C8 under cabin A and C1-C4 under cabin B) on each cabin side:
 - if the resulting voltage $U_L + U_R = 2U$, the antennas are connected correctly,
 - if the resulting voltage $U_L + U_R = 0$, the antennas are not connected correctly and the + and – poles of one of the antennas have to be switched (“crossover”, in Figure 3 shown as an example for the ATB antenna on the right hand side of cabin A) – or one of the antennas must be turned;
 - once $U_L + U_R = 2U$ has been measured as above, remove the temporary connection and repeat the same procedure with the ATB antennas under the other cabin;
 - document the polarization of each antenna and ensure the connection as in Table 3 ( STMA-72028).

6.3.1.3 Power supply requirements

Test Case Result, STMA-68354 -

The power supply of STM ATB shall be designed according to EN 50155:2010.

- The STM ATB shall be powered from an onboard Power Supply Unit (PSU);
- 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;
- [ 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 shall be protected by an external overvoltage protection device, suitable for the onboard supply voltage used.

*) STM ATB is equipped with redundant SMPS, which shall be fed through separate power supply circuits. The STM ATB DIO/PSU board shall be modified to allow the separated feeding circuits.

6.3.1.4 Earthing and grounding

Test Case Result, STMA-72019 -

- [41209] the EMC, ESD and surge immunity requires robust earthing and grounding.
- The STM ATB housing 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 train/locomotive interface is provided only via the connection of the cable jacket with the PE pins in each connector and the earthing of the STM ATB housing.
- In order to prevent earth loops, the STM ATB cable shielding shall not be connected to PE at the train/locomotive interface end.

6.3.1.5 Cabling configurations

Test Case Result, STMA-72017 -

The STM ATB electrical connections are to be connected to TIU and ERTMS onboard. This requires a prefabricated cable set consisting of 5 cables per STM ATB. Each prefabricated cable is provided with a specific connector (X1-X5) on one end. The other cable end is open, allowing the cables length to be tailored per application need.

The connector X1 provides for the digital in/outputs with the cables A and C and the power supply with cable B.

The connectors X2 (DB15) (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.

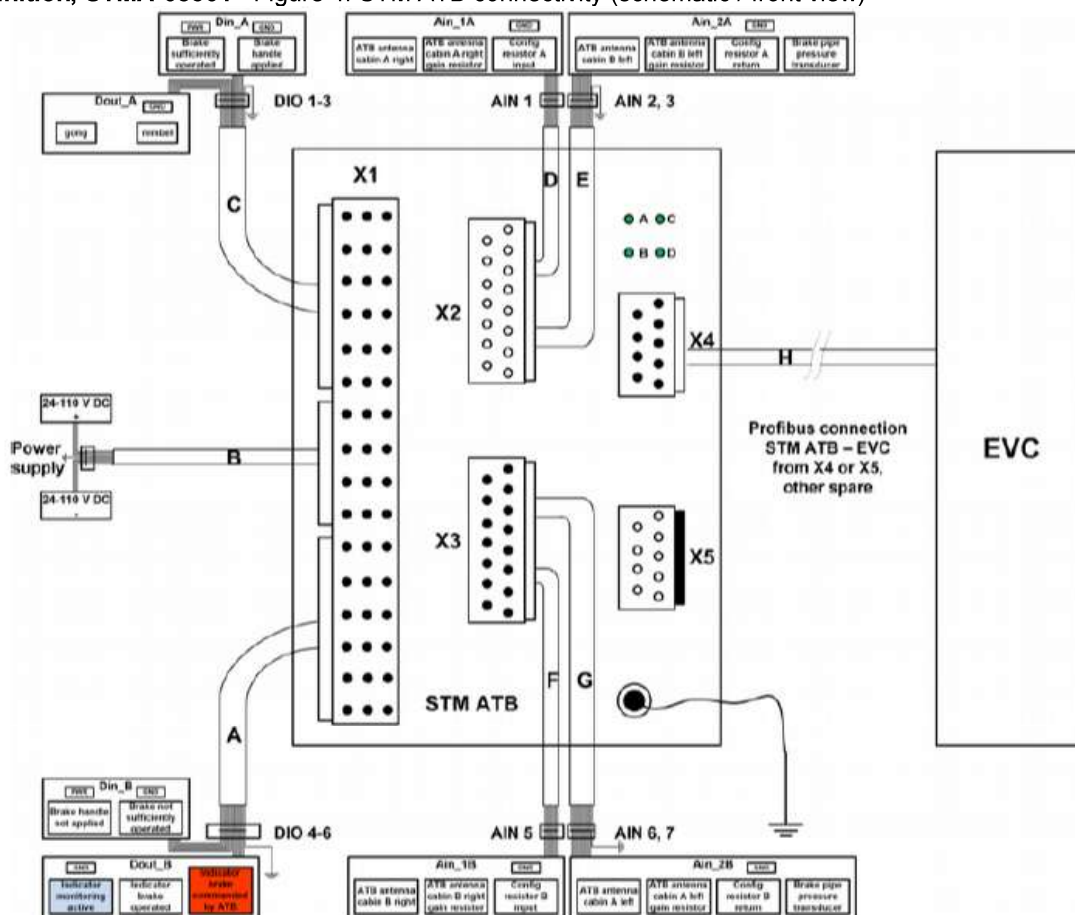
The connectors X4 and X5 are Profibus connectors (DB9), one of which must be used for connecting the STM ATB with the ETCS EVC. The remaining Profibus connector on the STM ATB is spare and should be covered to prevent cumulation of dust/pollution in the connector.

The table below lists the connectors and cable connections and Figure 4 (STMA-68361) gives a schematic overview of the STM ATB connectivity.

Definition, STMA-68357 - Table 4: STM ATB connectors and cables

STM ATB connector	cable		connected	
	code	tag	to	generally with
X1	A	STM ATB DIO4-6	Digital In/Out 4-6	TIU terminal block
	B	STM ATB Supply	Power supply	TIU terminal block
	C	STM ATB DIO1-3	Digital In/Out 1-3	TIU terminal block
X2	D	STM ATB AIN 1	Analog In/Out 1	TIU terminal block
	E	STM ATB AIN 2, 3	Analog In/Out 2,3	TIU terminal block
X3	F	STM ATB AIN 5	Analog In/Out 5	TIU terminal block
	G	STM ATB AIN 6, 7	Analog In/Out 6,7	TIU terminal block
X4	H	STM ATB PROFIBUS 1	Profibus (EVC or spare)	bus connector (EVC) or bus terminator (spare)
X5	J	STM ATB PROFIBUS 2	Profibus (spare or EVC)	bus terminator (spare) or bus connector (EVC)

Definition, STMA-68361 - Figure 4: STM ATB connectivity (schematic / front view)




Test Case Result, STMA-68372 - Only fire-resistant cables supplied or prescribed by the STM ATB supplier shall be used.



The cabling design shall take into account:

- the cable specifications including, but not limited to, permissible curvature and maximum length;
- the minimum cable length and cable slack required to avoid strain in the cable;
- the cable fixings required to ensure correct cable positioning.

Test Case Result, STMA-68374 -

The power supply is brought to the STM ATB via a common connector (X1) with the digital in- and outputs, but with separate cables (see Figure 4,  STMA-68361). It is recommended to route the power supply cable away from the I/O cables as much as possible/practicable.

It is recommended to apply wire end sleeves to all wire connections to the train/locomotive interface.

Test Case Result, STMA-68961 - The STM ATB pin numbering is shown in Figure 5 ( STMA-68369) and the pin occupation is listed in Table 5 ( STMA-68370) in Appendix A: STM ATB connect.

6.3.1.6 STM ATB revision information

Test Case Result, 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

Test Case Result, 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 with ETCS onboard

Test Case Result, STMA-68364 -

1. Check that all HQSE procedures for safe work on the train/locomotive have been fulfilled. In particular, but not limited to:

- The train/locomotive is immobilized and earthed and the battery is isolated and secured. The train/locomotive is released for electrical work;



DANGER

Non-compliance with HQSE procedures for safe work on railways in general and electrical applications therein in particular pose a serious risk to health and life.

2. Preparation:

2.1. 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 with sufficient space for the STM ATB is mounted firmly in place and electrically connected to vehicle PE;
- An ETCS onboard system is 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.

2.2. 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/ring tests on the entire cabling set.

2.3. 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 SVD.

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

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

3. Place the STM ATB in the 19" rack;

4. Hand fasten the STM ATB with 4 M2.5 bolts (max. 1 Nm torque);

5. 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);

6. 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:


- If the design does not specify a particular sequence, choose a convenient sequence for connecting all cables based on the spatial limitations in the CCS cubicle;

7. Connect all STM ATB cables (8 or 9, according to the design) in the sequence established in step 6:

- 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 DB9 cap;

- 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 Table 5 ( STMA-68370) in Appendix A: STM ATB connect.

- Connect each cable connector to the corresponding connector on the STM ATB and fasten the connector hand-tight or as the design requires with the screws/bolts provided by the supplier;

8. 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;

9. Report the STM ATB physically installed and request restoration of power supply to the onboard network and notification thereof;

10. Wait for all other electrical work on the train/locomotive to be finished and for restoration of power supply to the onboard network;

11. After restoration of the power supply to the onboard network, switch the STM ATB overload protection device to "on";

12. The STM ATB immediately loads its parameters;

13. 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;

14. 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 ?? Appendix C: LED status indications;
- ensure that all HQSE procedures (step 1) have been fulfilled once more;
- switch the STM ATB overload protection device "off";
- detach and reinstall the cable(s) which could cause the incorrect LED indications (steps 7-8);
- after restoration of the power supply to the onboard network, switch the STM ATB overload protection device to "on" (step 11);
- check the LED indications and the DMI in the control cabin once more (step 13).

15. 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 ?? Appendix C: LED status indications: LED status indications for the possible cause and report the LED indications observed with their cause as well as the hard- and software versions in the installation protocol.

8 Functional tests / commissioning

Test Case Result, STMA-68365 -

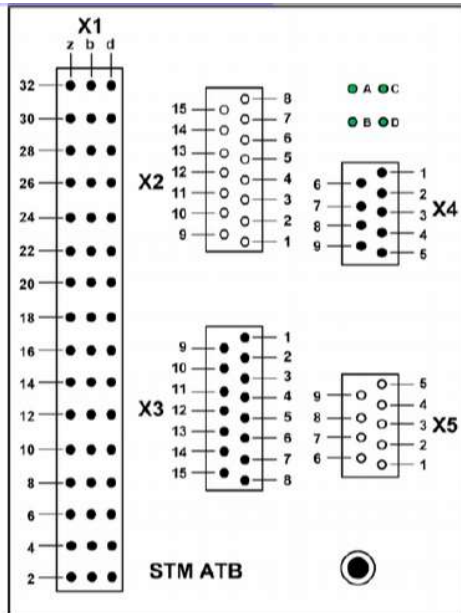
1. Preparation:
 - 1.1 Check that installation of the STM ATB is completed and checked:
 - the LED indicators on the front panel of the STM ATB all show green and the STM ATB is selectable on the DMI in the control cabin;
 - in case one or more of the LED indicators do not show green and/or the STM ATB is not selectable on the DMI in the control cabin: abandon the test, check ?? in Appendix C: LED status indications for the possible cause and initiate appropriate actions (repair of connections / replacement);
 - 1.2 Check that all required tools and materials are available:
 - see Appendix D: Tools and Materials required for STM ATB functional tests/commissioning.
2. Check that the test noise level on the test track meets the test requirements:
 - refer to Appendix E: STM ATB test protocol;
3. Place an ATB test loop perpendicular to the track centered under both ATB antennas on one cabin side of the train/locomotive:
 - refer to Appendix E: STM ATB test protocol;
4. Connect an ATB test generator to the ATB test loop and switch it on;
 - select 180 pulses/minute and an output level of 3 A / 75 Hz;
 - refer to Appendix E: STM ATB test protocol;
5. Ensure that a colleague is present in the active cabin to: -

- carry out a Start of Mission, using the STM ATB test protocol (annex A);
 - register the visible and audible ATB signals (including those on the DMI)
6. Increase the 75 Hz current in steps of 0.5 A until the STM ATB recognizes the ATB code;
 7. Record and document in Appendix E: 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. Repeat the entire test on the other cabin side of the train/locomotive (steps 2 to 7);
 9. Report the all test results in Appendix E: STM ATB test protocol;
 10. Combine the test results with required results in Appendix F: STM ATB commissioning protocol and report the test/commissioning of the STM ATB:
 - successful and the STM ATB is ready for service if the ATB control signal was registered at the correct speed limit;
 - 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);
 - failed and reinstallation of the STM ATB required if the ATB control signal was not registered or not registered at the correct speed limit.
 - with all testing details.

9 Appendices

9.1 Appendix A: STM ATB connectivity checklist

Definition, STMA-68369 - Figure 5: STM ATB pin numbering



Definition, STMA-68370 - Table 5: STM ATB pin occupation [STMA-39055, STMA-39130, STMA-39140, STMA-8172].

Con- nector	cable		Pin	I/ O	pin name	description	Opposite connection (vehicle dependant)		
	code	tag					wire	terminal block	clamp
X1	C	<u>STMATB DIO1-3</u>	32z		PE				
			32b		PE				
			32d		PE				
			30z		<u>DOut_A-GND</u>	Digital Out A ground			
			30b		<u>DOut_A-GND</u>	Digital Out A ground			
			30d		<u>DOut_A-GND</u>	Digital Out A ground			
			28z	O	<u>DOut_3A</u>	Spare output			
			28b	O	<u>DOut_2A</u>	"gong" acoustics signal, cab signal change			
			28d	O	<u>DOut_1A</u>	"rembel" acoustics signal, overspeed			
			26z		PE				
			26b		PE				
			26d		PE				
			24z		<u>DIn_A-GND</u>	Digital In A ground			
			24b		<u>DIn_A-GND</u>	Digital In A ground			
			24d		<u>DIn_A-PWR</u>	Digital In A power			
			22z	I	<u>DIn_3A</u>	Spare Input			
			22b	I	<u>DIn_2A</u>	Brake Sufficiently Operated			
			22d	I	<u>DIn_1A</u>	Brake Handle Applied			
	B	<u>STMATB Supply</u>	20z		PE				
			20b		PE				
			20d		PE				
			18z	I	Supply -	Power Supply negative input			
			18b	I	Supply -	Power Supply negative input			
			18d	I	Supply -	Power Supply negative input			
			16z	I	Supply +	Power Supply positive input			
			16b	I	Supply +	Power Supply positive input			
			16d	I	Supply +	Power Supply positive input			
			14z		PE				
			14b		PE				
			14d		PE				
	A	<u>STMATB DIO4-6</u>	12z		<u>DOut_B-GND</u>	Digital Out B ground			
			12b		<u>DOut_B-GND</u>	Digital Out B ground			
			12d		<u>DOut_B-GND</u>	Digital Out B ground			
			10z	O	<u>DOut_3B</u>	Blue indicator, monitoring active			
			10b	O	<u>DOut_2B</u>	Red indicator, brake commanded by ATB			
			10d	O	<u>DOut_1B</u>	White indicator, brake operated			
			8z		PE				
			8b		PE				
			8d		PE				
			6z		<u>DIn_B-GND</u>	Digital In B ground			
			6b		<u>DIn_B-GND</u>	Digital In B ground			
			6d		<u>DIn_B-PWR</u>	Digital In B power			

			4z	I	<u>DIn_3B</u>	Spare Input			
			4b	I	<u>DIn_2B</u>	Brake Not Sufficiently Operated			
			4d	I	<u>DIn_1B</u>	Brake Handle Not Applied			
			2z		PE				
			2b		PE				
			2d		PE	shield			
X2	D	<u>STM-ATB AIN1</u>	8	I	<u>Rconfig_A</u>	configuration resistor A input			
			15	I	<u>AIn_1A+</u>	ATB antenna cabin A right hand side seen from forward direction cabin A			
			7	I	<u>AIn_1A-</u>	ATB antenna cabin A right hand side seen from forward direction cabin A			
			14	I	<u>Rg_1A+</u>	ATB antenna cabin A right gain resistor			
			6	I	<u>Rg_1A-</u>	ATB antenna cabin A right gain resistor			
			13		<u>AIn_A-GND</u>				
	E	<u>STM-ATB AIN2,3</u>	5	I	<u>AIn_2A+</u>	ATB antenna cabin B left hand side seen from forward direction cabin B			
			12	I	<u>AIn_2A-</u>	ATB antenna cabin B left hand side seen from forward direction cabin B			
			4	I	<u>Rg_2A+</u>	ATB antenna cabin B left gain resistor			
			11	I	<u>Rg_2A-</u>	ATB antenna cabin B left gain resistor			
			3		<u>AIn_A-GND</u>				
			10	I	<u>AIn_3A+</u>	Brake pipe pressure transducer input			
			2	I	<u>AIn_3A-</u>	Brake pipe pressure transducer ground			
			9	I	<u>AIn_A-GND</u>				
			1	I	<u>Rconfig_A_ret</u>	configuration resistor A return			
			Sh		PE	shield			
X3	F	<u>STM-ATB AIN5</u>	1	I	<u>Rconfig_B</u>	configuration resistor B input			
			9	I	<u>AIn_1B+</u>	ATB antenna cabin B right hand side seen from forward direction cabin B			
			2	I	<u>AIn_1B-</u>	ATB antenna cabin B right hand side seen from forward direction cabin B			
			10	I	<u>Rg_1B+</u>	ATB antenna cabin B right gain resistor			
			3	I	<u>Rg_1B-</u>	ATB antenna cabin B right gain resistor			
			11		<u>AIn_B-GND</u>				
	G	<u>STM-ATB AIN6,7</u>	4	I	<u>AIn_2B+</u>	ATB antenna cabin A left hand side seen from forward direction cabin A			
			12	I	<u>AIn_2B-</u>	ATB antenna cabin A left hand side seen from forward direction cabin A			
			5	I	<u>Rg_2B+</u>	ATB antenna cabin A left gain resistor			
			13	I	<u>Rg_2B-</u>	ATB antenna cabin A left gain resistor			
			6		<u>AIn_B_GND</u>				
			14	I	<u>AIn_3B+</u>	Brake pipe pressure			

			7	I	Ain_3B-	transducer input			
			15	I	Ain_B_GND	Brake pipe pressure transducer ground			
			8	I	Rconfig_B_ret	configuration resistor B return			
			Sh		PE	shield			
X4 X5	H J	STM-ATB PROFIBUS 1 STM-ATB PROFIBUS 2	1		not used				
			2		not used				
			3		RxD/TxD-P	data line plus (B)			
			4		not used				
			5		DGND	data ground			
			6		VP	+5 V DC supply for bus termination			
			7		not used				
			8		RxD/TxD-N	data line minus (A)			
			9		not used				

9.2 Appendix B: STM ATB cable set specifications

Definition, STMA-68368 - Table 6

ATB antenna	ATB antenna 75 Hz characteristics		Cable set ^{a)}
	L / R	E _o (relative)	
Alstom Bar	1.4 H / 45 Ω	21.3 mV/A	type 1
Alstom V	1.4 H / 44 Ω	4.7 mV/A	type 2
PW-170	4.7 H / 270 Ω	22.3 mV/A	type 3
PW-225	4.55 H / 270 Ω	14.0 mV/A	type 4
Fase 3	10.8 H / 250 Ω	123 mV/A	type 5

^{a)} to be ordered from the supplier; refer to the STM ATB Manufacturing Manual.

9.3 Appendix C: LED status indications

[359642], [30136]

<to be included>

9.4 Appendix C: Tools and Materials required for STM ATB installation

Tools:

- Standard handtool set for installing electrical equipment;
- Installation protocol.

Materials:

- See Table 7:

Definition, STMA-72032 - Table 7: Materials required for STM ATB installation

material	number	details	parts number
STM ATB	1	-	tbd
STM ATB fastening bolts	4	M2.5 special	tbd
copper braid bond	1	200 x 14 x 1.5 mm	tbd
cabling set specified for the train locomotive to be fitted	1	including: <ul style="list-style-type: none"> 4 connectors with 8 cables and 1 terminator or 5 connectors with 9 cables; connector fastening bolts 	tbd
cable fixes	tbd	tbd	tbd

9.5 Tools and Materials required for STM ATB functional tests/commissioning

Tools:

- See table 8

Definition, STMA-72033 - Table 8: Tools required for STM ATB installation

material	number	details	parts number
noise tester	1	-	tbd
digital multi meter	1	-	tbd
ATB test loop ("lusplank")	1	-	tbd
ATB test generator	1	-	tbd
STM ATB test protocol	1	-	tbd
STM ATB commissioning protocol	1	-	tbd

Materials:

- None

9.6 Appendix E: STM ATB test protocol

Definition, STMA-72034 - Table 9: STM ATB test protocol

testing	measured	limit(s)	acceptable [✓ or -]
LED indicators STM ATB	-	A, B, C, D all green	
STM ATB selectable on cabin DMI	-	selectable	
test noise level	mV	≤ 100 mV	
ATB test loop	-	perpendicular to track	
	-	centered under both ATB antennas	
ATB test generator [180 min ⁻¹ , 75 Hz, 3.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 3.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 4.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 4.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 5.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 5.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 6.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 6.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 7.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 7.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 8.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 8.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	

9.7 Appendix F: STM ATB commissioning protocol

Definition, STMA-72036 - Table 10: STM ATB test protocol

testing	measured	limit(s)	acceptable [✓ or -]
LED indicators STM ATB	-	A, B, C, D all green	
STM ATB selectable on cabin DMI	-	selectable	
test noise level	mV	≤ 100 mV	
ATB test loop	-	perpendicular to track centered under both ATB antennas	
ATB test generator [180 min ⁻¹ , 75 Hz, 3.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 3.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 4.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 4.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 5.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 5.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 6.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 6.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 7.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 7.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 8.0 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	
ATB test generator [180 min ⁻¹ , 75 Hz, 8.5 A]	km/h	ATB code signaled	
	km/h	STM ATB speed limit on DMI	
	-	ATB gong	