

[4.1] ATB interfaces

for the development of an STM-ATB

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Sharepoint ID	ERTMS-SID-001549
SVN ID	4.1
Version:	1
Date:	5-12-2016

Authorization

Compiled by:	Date
Signature/E-sign:	
Verified by:	Date
Signature/E-sign:	
Verified by:	Date
Signature/E-sign:	

Document History

version	date	author	remark
1	5-12-2016	JW	initial version for external communication

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1 Preface

In the figure below the STM ATB is shown in the context of the ETCS environment.

The interface between the ETCS on-board and the STM ATB is specified in the ERA subsets 035, 056, 057 and 058, and not an item in this IO specification.

The other interfaces of the STM ATB are:

- Power supply
- The interface to the way-side ATB (EG+Vv) equipment
- Inputs to detect brake operation by the driver
- Outputs to communicate sound information to the driver (time critical information for which ETCS on-board equipment might cause too long delay times.
- A feed-back from the EB command given by the ETCS on-board (not specified in the mentioned ERA subsets

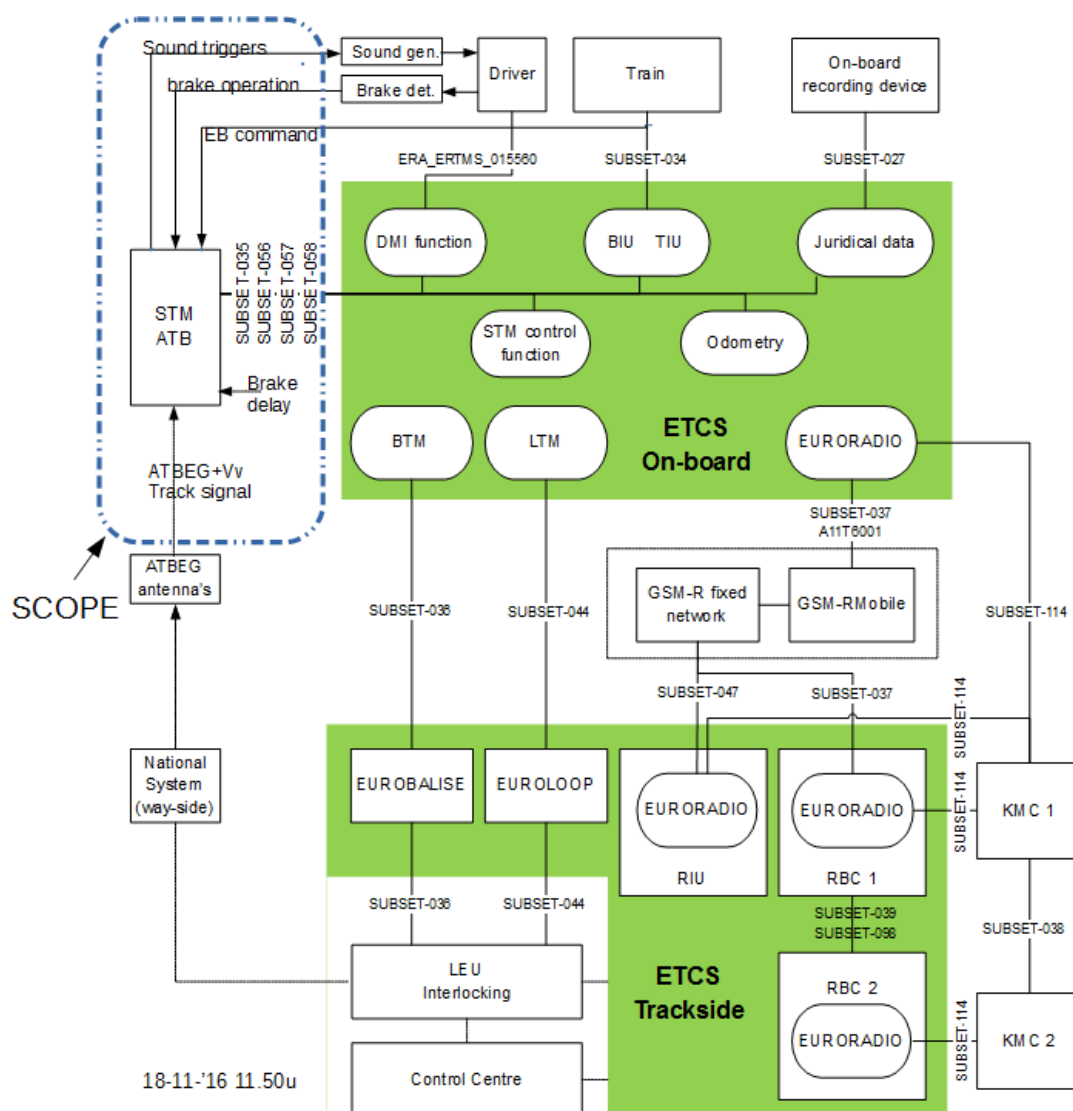


figure 1
STM ATB system scope

2 Interfaces

2.1 Power supply

STMA-4892 -

The STM ATB shall be available for supply voltages used in existing rolling stock.

Voltages used to power existing ATB on-board systems are 24Vdc (nominal) and 110Vdc (nominal) according to the specification described in [4.5] (environmental specifications). Requirements concerning the power supply are described in the latter document and therefore out of the scope of this IO specification.

2.2 ATB antennas

STMA-4894 -

The STM ATB shall be compatible with all ATBEG antenna's used in existing rolling stock without configuration of the unit. Type dependent (i.e. not per unit) configuration at the rolling stock side may be required.

The interface of between the ATB way-side and the ATB on-board equipment is described in [1.1] ("ATBEG+Vv system concept"). In currently used ATBEG on-board equipment five different antenna types are used to "pick-up" the electro magnetic ATBEG signal and translate it into a voltage:

- ATBEG phase3 antenna: old antenna type used in ICM, SGM and a part of the DE6400 fleet
- The standard Alstom antenna: used for bogie mounting in trains equipped with an ATB on-board systems supplied by Alstom.
- The Alstom V-antenna: used for body mounting in trains equipped with an ATB on-board systems supplied by Alstom (Thalys and ICE)
- Antenna type PW170-0: used for bogie mounting in trains equipped with Bombardier ATB on-board systems.
- Antenna type PW225-30: used for body mounting in trains equipped with Bombardier ATB on-board systems.

Equivalent (Thevenin) scheme's for the antenna plus coupling to the rail as a function of the current floating through the rail and peak currents to be taken into account are available below.

Specification of ATBEG antenna's in use, including coupling.

Antenna type	self inductance L in H	resistance R in ohm	output voltage U / rail current (mV/A @75Hz)	output voltage U / di/dt (mV/(kA/s))
Alstom bar	1,4	45	21,3	31
Alstom V	1,4	44	4,7	6
PW170-0	4,7	270	22,3	33
PW225-30	4,55	270	14,0	21
fase 3	10,85	250	123	185

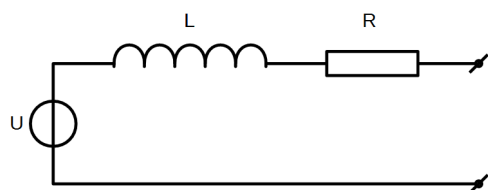


figure 2

Thevenin equivalent scheme of the ATBEG antenna's with U, L and R as defined in the table above

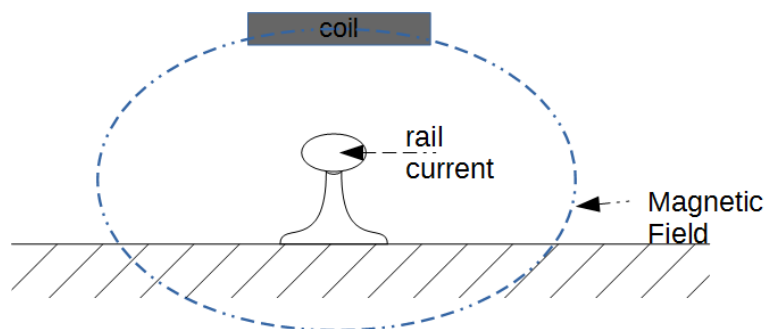


figure 3

EM coupling of an antenna with the rail current

Rail current peaks to be taken into account

Short circuits in the infrastructure can cause high current peaks depending on the self inductance between the short circuit and the sub station, and depending on the capability of switching the current off:

STMA-7002 - The following two short circuit currents have to be taken into account, i.e. the input circuits shall not be damaged in case of a rail current as defined below, independent of the type of antenna used:

- A current raising with a time constant $\tau = 5\text{ms}$, initial di/dt : 20MA/s , end value: 100kA cut-off after 15ms , with a $dI/dt = -40\text{MA/s}$.
- A current raising with a time constant $\tau = 25\text{ms}$, initial di/dt : 2MA/s , end value: 50kA cut-off after 50ms , with a $dI/dt = -6\text{MA/s}$.

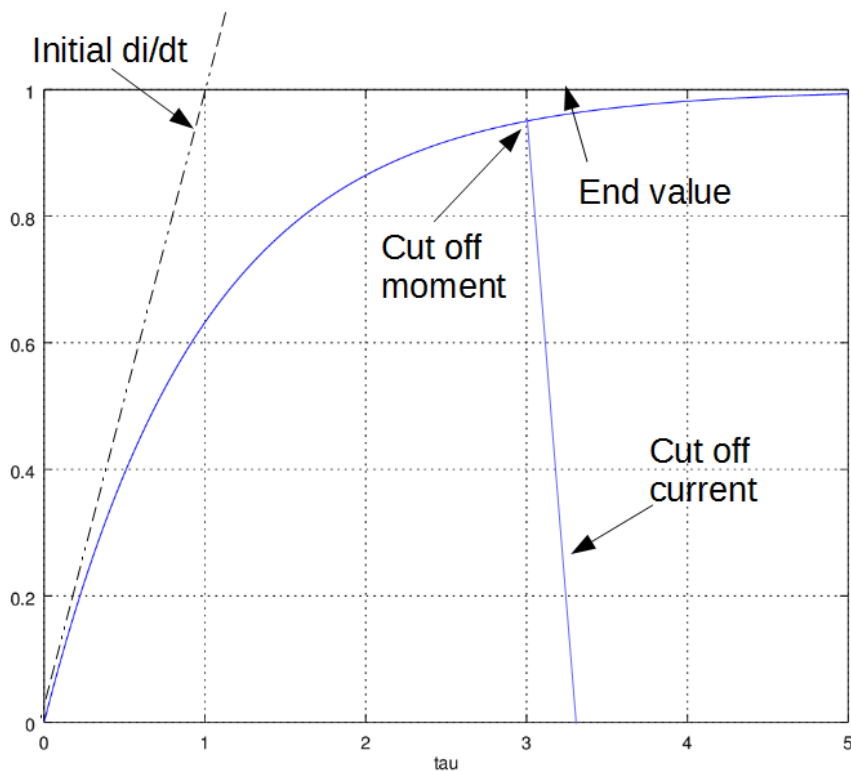


figure 4

Rail current pulses to be taken into account (figures given in requirement  STMA-7002)

Saturation of ATBEG antenna's

In case of saturation of the ATBEG antenna's a "rail current peak" will not lead to a peak in the antenna voltage. Therefore the need for input protection of the STM ATB antenna inputs could be limited if ATBEG antenna's saturate. Below it is calculated at which rail current level the ATB phase 3 antenna saturates ($B=2T$). This antenna type will saturate at app. the same rail current level as the PW-170. However due to the higher voltage (U) in relation to the antenna impedance is more critical for the phase 3 antenna.

$$B_{\text{iron}} = \text{Constant} * I_{\text{rail}}$$

$$I_{\text{rail}} = \text{Amplitude} * \cos(\omega * t)$$

$$\Rightarrow |U| = \left| \frac{d}{dt} \int_A B_{\text{iron}} dA \right| = A_{\text{iron}} * \text{Constant} * N * \text{Amplitude} * \omega$$

Phase 3 antenna characteristics:

- $N = 5000$ windings
- $A_{\text{iron}} = 0,05 * 0,05 = 2,5 * 10^{-3} \text{ m}^2$

Measurements were done at 75Hz ($\omega=471$), result:

- Amplitude (of the current): $4700\text{mA} * \sqrt{2}$
- resulting voltage $|U| = 580\text{mV} * \sqrt{2}$

$$\Rightarrow N * A_{\text{iron}} * \omega * \text{Constant} = 580/4700$$

=> constant $\approx 2,1 \cdot 10^{-5}$ T/A

Assuming $B_{\text{saturation}} = 2T$: => $I_{\text{rail,saturation}} = 2/(2,1 \cdot 10^{-5}) \approx 100\text{kA}$

Therefore:

STMA-7005 - Saturation shall not be taken into account to reduce the input transients as described above.

2.3 Brake application detection

Inputs to detect brake operation by the driver

For currently in use ATB systems different ways are used to detect if the driver is operating the brake at a pre defined level:

- If trains have a brake handle with a direct relation between brake handle position and brake power requested by the driver a contact at a specific position of the brake handle is used. (BHA: "brake handle applied")
- If trains have a "pulse controlled" braking system, i.e. brake power is requested by short operation of the brake handle to lower the brake pipe pressure, then braking may be detected by
 - a contact switching if the brake pipe undershoots a predefined pressure (BSO: "brake operated sufficiently")
 - measuring the brake pipe pressure
 - a contact at the brake handle to detect initial operation by the driver in combination with a contact switching if the brake pipe undershoots a predefined pressure or a measurement of the brake pipe pressure

All inputs are diverse redundant, thus two anti-valent digital inputs for BHA and BSO or redundant pressure measurement.

The voltage level for the digital inputs can vary from 24Vdc to 110Vdc (according to EN50155).

The current level for the analogue inputs is 4-20mA

The above leads to the following requirements:

STMA-4896 -

The STM ATB shall be equipped with the following inputs to detect if the driver is operating the brake:

- An anti valent input "brake handle applied" (BHA), operating at the brake handle
- An anti valent input "brake operated sufficiently (BSO), operating at the brake pipe pressure or another control signal with a constant relation with the requested brake power.
- A redundant analogue input for a brake pipe pressure (or other analogue signal with a constant relation with the requested brake power) (P_brake),.

STMA-4897 -

A voltage level for digital inputs from 24Vdc to 110Vdc shall be supported (might be in different versions of the

product)

STMA-4898 -

The current level for the analogue inputs for pressure measurement shall be 4-20mA (resolution 0,01mA)

STMA-4899 -

The brake shall be assumed to be operated by the driver if:

- Input BHA indicates that the driver operates the brake handle, i.e. "high level" at input 1 and "low level at input 2" **OR**
- Input BHA became true (i.e. "high level" at input 1 and "low level at input 2") less than a configurable time ago (default 3s) **OR**
- Input BSO indicates that the brakes are operated sufficiently, i.e. "high level" at input 1 and "low level at input 2" **OR**
- P_brake indicates that the brakes are operated sufficiently, and the difference between the two inputs is between predefined limit

2.4 EB feed-back**feed-back from the EB command**

To check if an EB command has been received and executed a read-back of the EB command given by the ETCS on-board is foreseen. In currently in use systems the feed-back can be received via the profibus. However in contrast to the ERTMS baseline 2 specification, baseline 3 doesn't define a message for this function.

Therefore an external feed-back using an ambivalent digital input is foreseen (voltage level etc. according to the other digital inputs):

STMA-4903 -

The STM ATB shall be equipped with the following input:

- An ambivalent input to detect EB commands given by the ETCS on-board equipment to the emergency brake.

2.5 DMI**Outputs to communicate sound information**

Currently in use ATB on-board systems use specific devices in the cabin to generate sounds in the cabin. The profibus communication is not used because it leads to delays in the starting moment of the sounds which are time critical (the profibus may be used if it can be proven that the ETCS on-board system communicates fast enough).

The devices in the cabin can be controlled with three 24Vdc or 110Vdc digital signals (zoemer, bel and gong) according to EN50155.

The above leads to the following requirement:

STMA-4901 -

The STM ATB shall be equipped with three digital outputs compatible with the interfaces as described in [4.12].

STMA-6787 -**Profibus**

The STM ATB shall be equipped with a PROFIBUS connection according to "CENELEC EN 50170-2 (1996)"

STMA-6789 - All interfaces of the STM ATB, used in operation, shall comply with the requirements stated in [4.5] (document SID-803)

This includes a.o. galvanic isolation (at 800V)

Information to be sent to the DMI

STMA-7011 - The STM ATB shall sent information to the DMI (via the ETCS on-board) using definitions specified in a DMI configuration table defining, (a.o.) indicator ID's, button ID's, sound ID's, Icon ID's and position ID's.

example:

DMI definition table

Ss035 13.5.1.2 v3.12, for the STM ATBEG:

According to the size and positions:

- the minimum size is (wxh) 12x15mm
- A screen must be 10" (480x640 pixels) diagonal: 800 pixel pixels = 10" = 25,5cm
=> 1 pixel = 0,32mm
- Minimum size: 38x48 (used: 40x50)
- Width area: 272, 6 lamps 240, so 16 additional at each side:
- Position lamp 1: (71,366), soft key(71,351) 71 = 55+16 margin
- ATB status indicator (140,275), softkey (140,260), size: 36x108

For the different indicators fixed positions shall be used, i.e.:

- The "indicator_ID" as sent by the STM will always be equal to the "indicator position_ID"
- The "button_ID" as sent by the STM will always be equal to the "button position_ID"

Description	Values							
NID_STM of the STM	1 (= ATB)							
Number of Indicators	8 6 speed indicators, 1 status (BD, EB, etc.), 1 white lamp							
	Lamp1	Lamp2	Lamp3	Lamp4	Lamp5	Lamp6	White Lamp	ATB Status Indic.
Indicator id (i)	1	2	3	4	5	6	7	8
font size (i)	40	40	40	40	40	40	-	30

Horizontal text alignment (i)	center	center	center	center	center	center	center	center
Vertical text alignment (i)	center	center	center	center	center	center	center	center
Number of Indicator positions in case of touch screen technology	8							
	Lamp1	Lamp2	Lamp3	Lamp4	Lamp5	Lamp6	White Lamp	ATB Status Indic.
Indicator position id (i) touch screen	1	2	3	4	5	6	7	8
X Offset of the upper left corner (i)	71	111	151	191	231	271	60	140
Y Offset of the upper left corner (i)	366	366	366	366	366	366	275	275
Horizontal size (i)	40	40	40	40	40	40	36	36
Vertical size (i)	50	50	50	50	50	50	36	108
Number of Indicator positions in case of soft key technology	8							
	Lamp1	Lamp2	Lamp3	Lamp4	Lamp5	Lamp6	White Lamp	ATB Status Indic.
Indicator position id (i) soft key	1	2	3	4	5	6	7	8
X Offset of the upper left corner (i)	71	111	151	191	231	271	60	140
Y Offset of the upper left corner (i)	351	351	351	351	351	351	260	260
Horizontal size (i)	40	40	40	40	40	40	36	36
Vertical size (i)	50	50	50	50	50	50	36	108
Number of Buttons	6							
	Release	Attention	BD		Test	Override		kwiteren
Button id (i)	1	2	3		4	5		6
Font size (i)	30	30	30		30	30		30
Horizontal text alignment (i)	center	center	center		center	center		center
Vertical text alignment (i)	center	center	center		center	center		center
Number of Button positions in case of touch screen technology	6							
	Release	Attention	BD		override	test		kwiteren
Button position id for touch screen (i)	1	2	3		4	5		6
X Offset of the upper left corner (i)	370	485	370		485	370		485
Y Offset of the upper left corner (i)	31	31	131		131	231		231

Horizontal size (i)	100	100	100	100	100	100
Vertical size (i)	70	70	70	70	70	70
Number of Button positions in case of soft key technology	6					
	Release	Attention	BD	Test	Override	kwiteren
Button position id for soft keys (i)	7	8	9	10	11	12
X Offset of the upper left corner (i)	601	601	601	449	513	577
Y Offset of the upper left corner (i)	29	93	157	431	413	413
Horizontal size (i)	40	40	40	64	64	64

Vertical size (i)							64	64	64	50	50	50										
Linked soft key							Next to H2	Next to H3	Next to H4	Below F8	Below F9	Below F10										
Number of Icons							22 Signal lamps: 4 (yellow_off, yellow_on, green_off and green_on) Status lamp: 3 (active, intervention, BD/override) Brake lamp: 2 (off, on) Touch screen buttons: 8 (white, blue, red, black): pressed/not pressed Soft key buttons: 5 (white, red, blue, blue_horizontal, black)															
Icon id (i)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Icon (i) (.bmp)	Yellow_off	Yellow_on	Green_off	Green_on	Status_active	Status_intervention	Status_BD/override	Brake_off	Brake_on	White_button_touch	blue_button_touch	red_button_touch	black_button_touch	White_button_touch_pressed	blue_button_touch_pressed	red_button_touch_pressed	black_button_touch_pressed	White_button_vertical	blue_button_vertical	blue_button_horizontal	red_button_vertical	black_button_horizontal
Display text upon icon	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
ETCS speed and distance supervision							Yes, display the speed dial (no supervision information)															
ETCS speed dial range							180km/h															
Slow flashing frequency for Buttons and Indicators							1/3Hz															
Fast flashing frequency for Buttons and Indicators							1Hz															
Flashing style							Whole frame															
Number of Sounds							5															
							Sound id (i)		sound (i) (.wav)				type									
gong							1		Gong.wav				One-stroke									
BD-signal							2		BD-signal.wav				One-stroke									
losbel							3		Losbel.wav				One-stroke									
bel							4		Bel.wav				continuous									
zoemer							5		Zoemer.wav				continuous									
Number of moved areas of the ETCS layout							0															