



TRM Project

TRM-8AI-AMP

Ether**CAT**® 

Hardware Architecture

User Manual

Technical Documentation

DOCUMENT DATA

Data	10/12/2025
Revision	0
FileName	enTRM-8AI-AMP.pdf
Document type	User manual
Authors	UT – TPA Srl
Department	DIP
Notes	Customer document
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REVISIONS

Revision Number	Data	List of changes
Rev.0	10/12/2025	

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This document is the User Manual for TRM-8AI-AMP device. TRM-8AI-AMP belongs to the TRM series of devices by TPA s.r.l. which are bus field devices to remote the CNC action on a tool machinery or, generally, in a controlled system; the devices are connected to a standard EtherCAT bus. TRM-8AI-AMP is a module which provides 8 x 0-20mA Analog current Input. This document shows how to use TRM-8AI-AMP, to connect it and all the technical specifications regarding the product.

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This description is only intended for the use of trained specialists in control and automation engineering who are invited to always use the currently valid documentation.

It is recommended that the documentation (notes, explanations, diagrams, ecc.) are followed when installing and commissioning these components.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The Company reserves the right to revise and modify the current documentation at any time.

The Company doesn't respond of uncorrect or improper use of the device.

Safeguard clause

If any information about this device will result not clear, please do not esitate to take contacts with TPA.srl Service.



Albatros – Logo



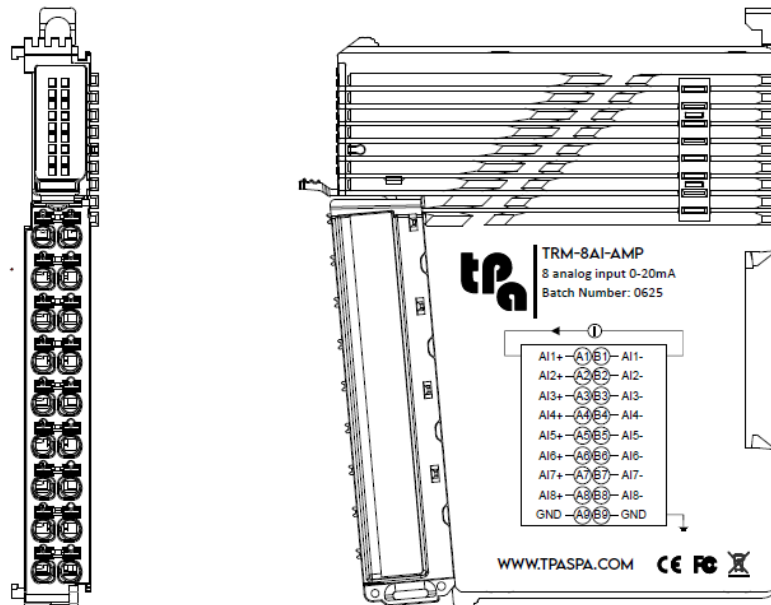
TPA S.r.l - Logo

1 FUNCTIONAL SPECIFICATION

TRM-8AI-AMP is a module which provides 8 Analogic Input for current measure in the range 0 ... 20mA, in differential mode.

The resolution of the measure is 16bit = 0,3μA wiht a range = [0 ... +65535].

It is directly joined to a bus coupler TRM-ECAT or in chain with other modules of the same serie.

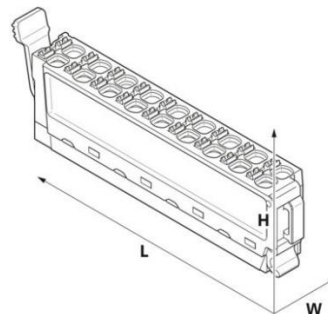


On the right side, a gray silkscreen is printed and it reports:

- the device Name and its main function
- the batch production number
- the consortium EtherCAT logo to specify the environment of use and compatibility
- the TPA reference - TPA's logo, QR code and site address
- CE certification logo
- a simplified schematic for input connections

The connection between TRM-8AI-AMP and other TRM's serie moduls is made by the internal standard E-BUS, as described in IEC61158. It must be used to connect the TRM's serie terminal modules to TRM-ECAT bus coupler. No other application is allowed.

The 8 differential analogic input of TRM-8AI-AMP can be connected by a 18-positions connector provided with the device. The connector used is.



HSCP-SP 1,5-18-IO-7035 color gray
producer code 1569965 - Phoenix

Each input can be connected to two positions of the connector, which means:

- The positive signal must be tied to a "An" position
- The negative signal must be tied to the corresponding "Bn" position
- The 0V Analogic Ground is provided in position [A9], [B9] of the connector.

	TOP LEFT PIN	TOP RIGHT IN	
AI1+ Analogic Input + 01	A1	B1	AI1- Analogic Input – 01
AI2+ Analogic Input + 02	A2	B2	AI2- Analogic Input – 02
AI3+ Analogic Input + 03	A3	B3	AI3- Analogic Input – 03
AI4+ Analogic Input + 04	A4	B4	AI4- Analogic Input – 04
AI5+ Analogic Input + 05	A5	B5	AI5- Analogic Input – 05
AI6+ Analogic Input + 06	A6	B6	AI6- Analogic Input – 06
AI7+ Analogic Input + 07	A7	B7	AI7- Analogic Input – 07
AI8+ Analogic Input + 08	A8	B8	AI8- Analogic Input – 08
Power Supply +24V	A9	B9	Analogic Ground AG
	BOTTOM LEFT PIN	BOTTOM RIGHT PIN	

Attention! Every input of TRM-8AI-AMP is NOT protected against overvoltage. A voltage excess can damage the input. Each input circuit has 240 Ohm resistance for measuring the current. Then, a cut-off filter tuned to 20KHz limits the dynamic of the input and prevents it from induced electrical noise.

Attention! Sampling time (time for Analog-to-Digital Conversion) is about 350µs. TRM-8AI-VOLT continues to execute the conversion in free running mode or it can be synchronized with DC clock.

Attention! The RTC rate of ECAT communication acts as a sort of cut-off filter. Infact, since RTC can be 250µs or 500µs or 1ms or more, this means that RTC is the main frequency limiter in acquisition of analog signals. For RTC=250µs, this time is lower than conversion time (350 µs). To avoid aliasing, the best condition is to get min. 4 samples (4x250µs) which means just 2 measures (2 x 350µs < 1000 µs). This means that the RTC rate acts as a Pass Bass filter tuned to 1KHz for that RTC frequency. The same concept can be extended to other values of RTC.

**LED**

RN	ECAT link status
E1	Analogic Input 1 – in error
E2	Analogic Input 2 – in error
E3	Analogic Input 3 – in error
E4	Analogic Input 4 – in error
E5	Analogic Input 5 – in error
E6	Analogic Input 6 – in error
E7	Analogic Input 7 – in error
E8	Analogic Input 8 – in error
PW	Logic power supply +5V

On the top of the frontal image of TRM-8AI-AMP a list of LED indicators is set.

LED behaviour	ECAT State condition
Exstinguished	INIT State
Blinking (regular)	PreOP State
Single flash	SafeOP State
Bright	Operational

Regarding the RN ECAT status led

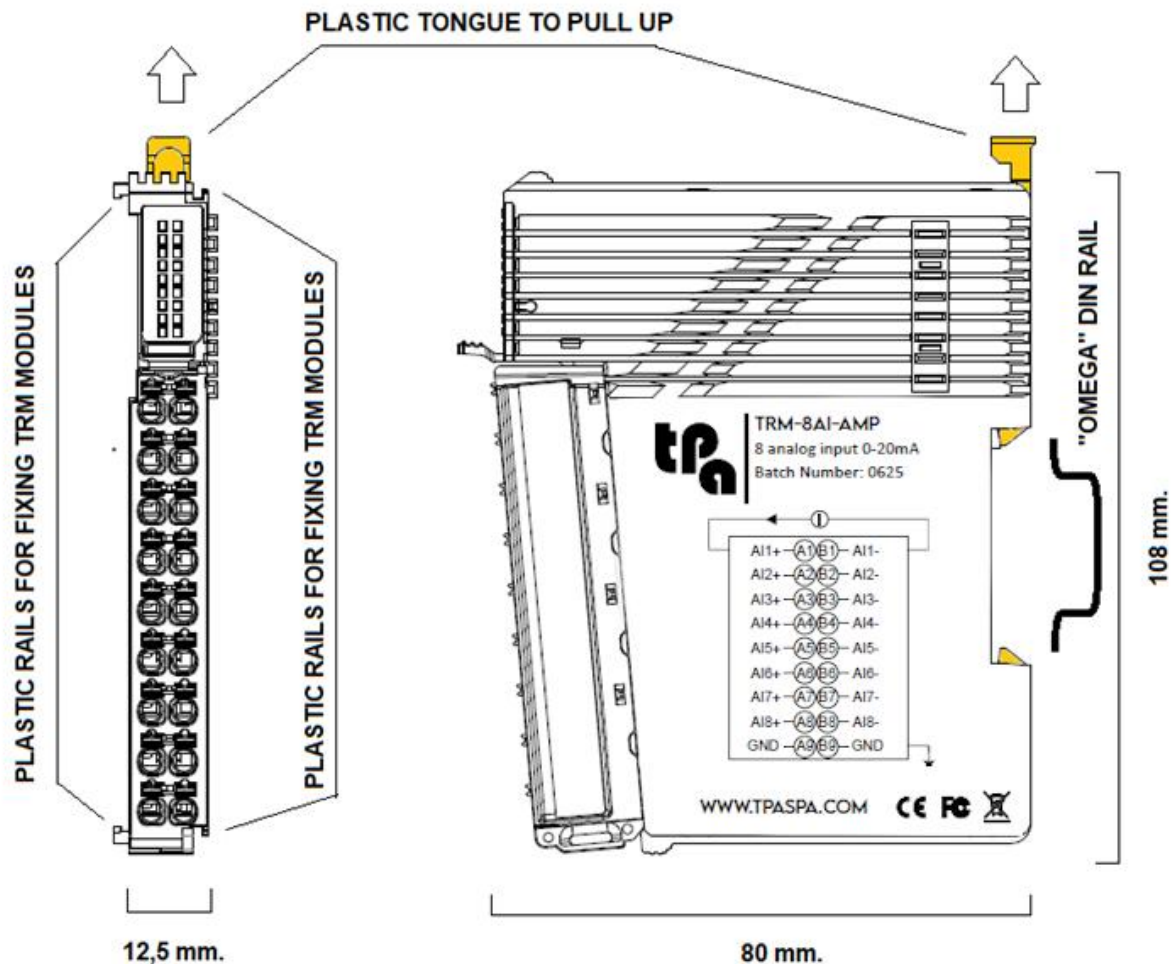
PW led ON means main logic power supply +5V by EBUS is present

Electrical parameters	Values
Input signals	8, differential input
Nominal voltage input range	0 ... +24Vdc (-15% / +20%)
Resolution	16 bit
Resolution voltage step	0,3μA
Measuring error	<±0.1% (0°-55°C, relative to full range)
Internal impedance (resistance)	240 Ohm
Cut Off frequency (filter)	< 20KHz
Conversion time	350μs
RTC rate	500μs, 1ms, 2ms, 4ms
Frequency cut-off by RTC rate	1KHz (250μs), 500Hz (500μs), 250Hz (1ms), ecc.
Electrical isolation	500V (from ECAT signals)
Storage Temperature	-40°C – 60°C
Relative humidity	5 – 95% (not condensating)
Dimensions	108x12,5x80mm.
Net weight	60g.
EMC	CE/FCC
Protection level	IP20

2 MECHANICAL DATA

TRM-8AI-AMP modül can be installed onto a metallic rail DIN 60715, with “OMEGA” profile, model 7,5mm. or 15mm.

To add a TRM-8AI-AMP device to a TRM-ECAT or to another TRM modül in a blackchain, let's introduce it along the right side of the TRM-8AI-AMP modül. There are two plastic rails on the TRM-8AI-AMP that help to get the correct position of the TRM device. Then, throw up the orange tongue to fix it to the DIN rail.



Dimension	Value	Notes
Height	108 mm.	Let's consider the extension of the tongue and the possibility to have a min. extended space to handle it
Dept	80 mm.	Let's consider the extension of the connectors and the curves of the cables
Thickness	12,5 mm.	

3 ETHERCAT COMMUNICATION

The TRM-8AI-AMP modul is compliant with standard EtherCAT normed by ETG in IEC61158. TRM-8AI-AMP is just a simple multi Analog Input sampler and it is addressed as a station into the EtherCAT network; it can run only in an ECAT network.

Other TRM's serie devices can be mechanically and electrically joined to TRM-8AI-AMP, to constitute a I/O remote block, connected in blockchain.



Data communication into the blockchain is supported by E-BUS, a local bus derived from ECAT. The communication is full-duplex, real time clocked and based on 100Base-Tx exchange on internal E-BUS. This bus is coupled toward ECAT by a TRM-ECAT modul. TRM-8AI-AMP cannot be used not joined to TRM-ECAT.

The max exchange rate (the real Time Clock of the network) can be accorded in this range: 250µs, 500µs, 1ms, 2ms, 4ms or more. It is a Master station dependent parameter.

Analog conversion is made in free-run mode, not synchronized with ECAT IRQ.

Methods to access and to run it are provided by a description ESI file (TRM-8AI-AMP.xml is provided for setting up the device into the control system).

TRM-8AI-AMP implements both PDO's communication for synchronous data and SDO's communication for setting and in general for asynchronous data.

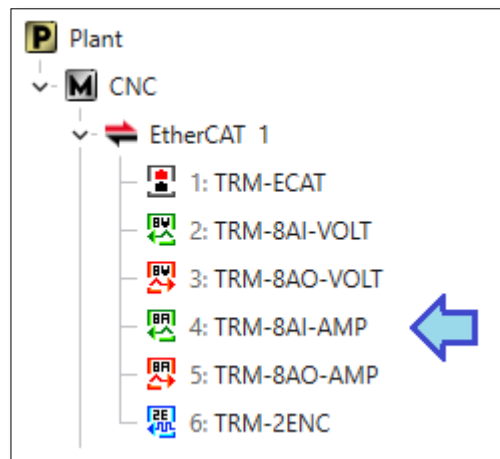
TRM-8AI-AMP supports COE protocol; it presents standard and specific objects in its Object Dictionary.

There are 4 Sync Manager (SM) set to provide COE asynchronous communications (MailBoxes) and buffer mode:

SM0 = Mail Box Out	→ start address 0x1000
SM1 = Mail Box In	→ start address 0x1200
SM2 = buffer mode RxPDO	→ start address 0x1400 (not enabled, since no data output)
SM3 = buffer mode TxPDO	→ start address 0x1800

Passing data and conversion A-to-D can be synchronized in DC mode or in free running (default).

In Albatros SW by TPA, you need to introduce a TRM-ECAT node to convert EtherCAT signals into EBUS format. In the hardware configurator window, under the EtherCAT bus symbol, it is possible to select the TRM-8AI-AMP device.



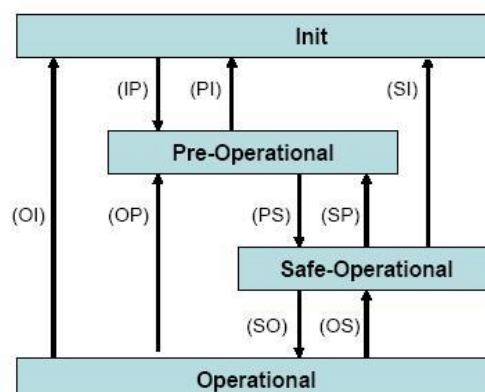
The hardware configuration window in Albatros.

8: TRM-8AI-AMP	Index	In/Out	Sm	Tags	Size	Name
☒	0x1A00	In	3	F	4.0	AI Standard Channel 1
☐	0x1A01	In		F	2.0	AI Compact Channel 1
☒	0x1A02	In	3	F	4.0	AI Standard Channel 2
☐	0x1A03	In		F	2.0	AI Compact Channel 2
☒	0x1A04	In	3	F	4.0	AI Standard Channel 3
☐	0x1A05	In		F	2.0	AI Compact Channel 3
☒	0x1A06	In	3	F	4.0	AI Standard Channel 4
☐	0x1A07	In		F	2.0	AI Compact Channel 4
☒	0x1A08	In	3	F	4.0	AI Standard Channel 5
☐	0x1A09	In		F	2.0	AI Compact Channel 5
☒	0x1A0A	In	3	F	4.0	AI Standard Channel 6
☐	0x1A0B	In		F	2.0	AI Compact Channel 6
☒	0x1A0C	In	3	F	4.0	AI Standard Channel 7
☐	0x1A0D	In		F	2.0	AI Compact Channel 7
☒	0x1A0E	In	3	F	6.0	AI Standard Channel 8
☐	0x1A0F	In		F	4.0	AI Compact Channel 8

Here is the Process Data window in Albatros SW, clicking on TRM-8AI-AMP icon.

TxPDOs to get data output of the 8 Analogic Channel of the device. RxPDOs are preconfigured to provide one INT16 (signed) in odd PDOs or one INT32 (signed) in even PDOs (conversion data + status word) for each channel. TxPDOs range from 0x1A00 to 0x1A0F.

The EtherCAT State Machine shown in figure is applicable to TRM-8AI-AMP. Outputs are operative in PREOPERATIONAL, SAFE OPERATIONAL and OPERATIONAL state.



3.1 PDO's list

Index(hex)	Name	Data	Size(Byte)
0x1A0(2*n-2)	Analog Input Standard Channel n	A-to-D Conversion referred to INT16 bit + status	4.0
0x1A0(2*n-1)	Analog Input Compact Channel n	A-to-D Conversion referred to INT16 bit	2.0

For Channels= 1<n<8 – PDO Mapping

3.2 Object Dictionary

0x1000 Device Type

Index(hex)	Name	Data	Data type	Marker	Default
1000.0	Device Type	EtherCAT type of the device	UINT32	RO	0x00001389 (5001 Dec)

0x1008 Device Name

Index(hex)	Name	Data	Data type	Marker	Default
1008.0	Device Name	EtherCAT name of the device	STRING	RO	TRM-8AI-AMP

0x1009 Hardware version

Index(hex)	Name	Data	Data type	Marker	Default
1009.0	Device HW version	EtherCAT data about HW version	STRING	RO	1.00

0x100A Software version

Index(hex)	Name	Data	Data type	Marker	Default
100A.0	Device SW version	EtherCAT data about SW version	STRING	RO	1.00

0x1018 Id of the node in ECAT net

Index(hex)	Name	Data	Data type	Marker	Default
1018.0	Identity	To identify the device from station information	UINT8	RO	0x04
1018.01	Vendo ID	EtherCAT from the station supplier ID	UINT32	RO	0x000002EA
1018.02	Product Code	EtherCAT from the station product ID	UINT32	RO	0xC0043238
1018.03	Revision	EtherCAT from the station revision NrD	UINT32	RO	0x00000100
1018.04	Serial Number	EtherCAT from the station Serial Nr	UINT32	RO	0x00000000

0x1A0(2*n-2) PDO's format

Index(hex)	Name	Data	Data type	Marker	Default
60n0.00	AI Input Channel n	Maximum Subindex	UINT8	RO	0x11 (17 Dec)
60n0.01	Status_Underrange	Outstanding range	BOOLEAN	RO	0x00 (0 Dec)
60n0.02	Status_Ovrrange	Overflow	BOOLEAN	RO	0x00 (0 Dec)
60n0.03	Status_Limit 1	Limit of 1 - detection: 00 = not enabled 01 = the value is less than the limit of 1 10 = the value is greater than the limit of 1 11 = the value is equal to the limit of 1	BIT2	RO	00 (0 Dec)
60n0.05	Status_Limit 2	Limit of 2 - detection: 00 = not enabled 01 = the value is less than the limit of 2 10 = the value is greater than the limit of 2 11 = the value is equal to the limit of 2	BIT2	RO	00 (0 Dec)
60n0.07	Status_Error	Error 1 condition (broken line, overmeasure or underrange)	BOOLEAN	RO	0x00 (0 Dec)
60n0.0E	Status_Sync_Error	Synchronous error (DC mode only)	BOOLEAN	RO	0x00 (0 Dec)
60n0.0F	Status_TxPDO state	The effectiveness of the TxPDO data (0 valid, 1=invalid)	BOOLEAN	RO	0x00 (0 Dec)
60n0.10	Status_TxPDO toggle	Switch TxPDO when data is updated	BOOLEAN	RO	0x00 (0 Dec)
60n0.11	Value n	Channel voltage	INT16	RO	0x0000 (0 Dec)

4 TRM-8AI-AMP VIEW



TRM-8AI-AMP
Front view

TRM-8AI-AMP
Right side view



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