



TRM Project

TRM-8AO-VOLT

EtherCAT®

Hardware Architecture

User Manual

Technical Documentation

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CONTENTS

This document is the User Manual for TRM-8AO-VOLT device. TRM-8AO-VOLT 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-8AO-VOLT is a module which provides 8 Analog Output: It operates in the range -10..+10V. This document shows how to use TRM-8AO-VOLT, to connect it and all the technical specifications regarding the product.

This document is the User Manual for TRM-ECAT, the bus coupler device to interface EtherCAT bus with other IO devices from the TRM serie.

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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



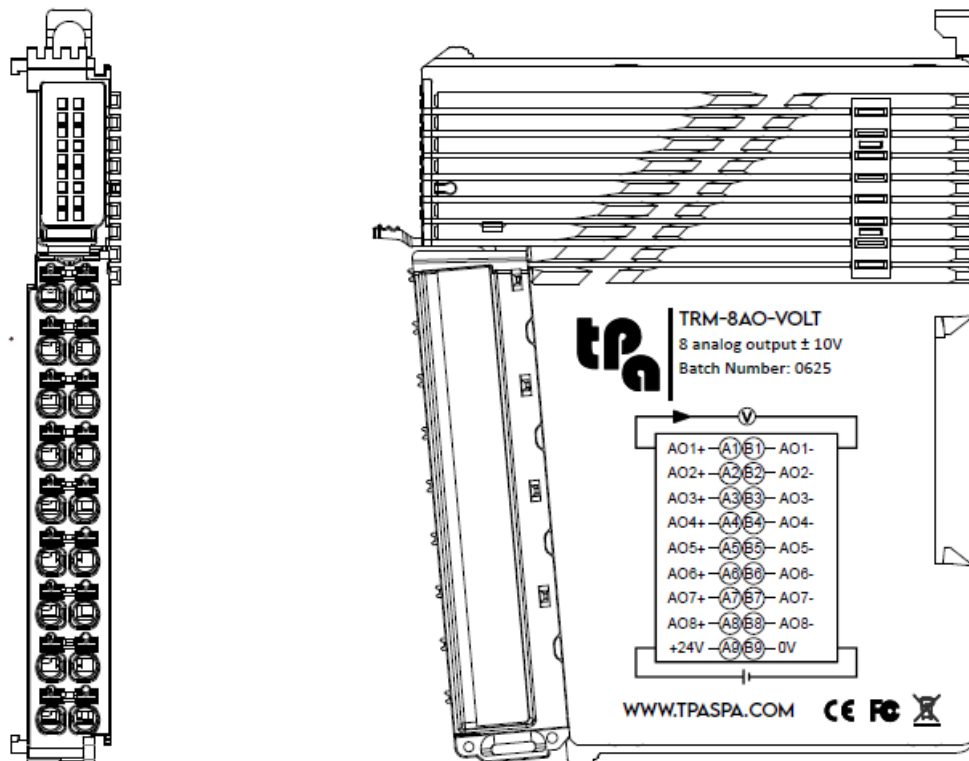
TPA S.r.l - Logo

1 FUNCTIONAL SPECIFICATION

TRM-8AO-VOLT is a module which provides 8 Analog Output as voltage references in the range -10 +10V. The max current available for each output is less than 5mA.

The resolution of the output value is 16bit = 0,3mV with a range = [0 ... +65535].

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

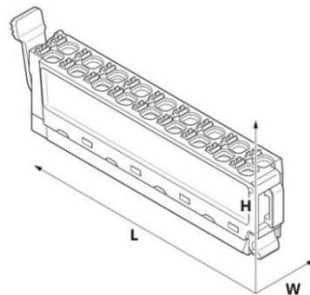


On the right side, a gray silkscreen is printed and it reports:

- 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 output connections

The connection between TRM-8AO-VOLT and other TRM's serie moduls is made by the internal standard E-BUS, as described in IEC61158. It must be directly connected to the TRM-ECAT bus coupler or through another TRM's serie module. No other application is allowed.

The 8 analogic outputs of TRM-8AO-VOLT 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 output is provided by two positions in the connector, which means:

- The output signal AO+ is driven in the range -10..+10V (max 5mA).
- The reference signal AO- is the came-back path for the corresponding output AO+
- The 0V Analogic Ground is provided by position (B9) of the connector.

	TOP LEFT PIN	TOP RIGHT IN	
AO1+ Analogic Output + 01	A1	B1	AO1- Analogic Output – 01
AO2+ Analogic Output + 02	A2	B2	AO2- Analogic Output – 02
AO3+ Analogic Output + 03	A3	B3	AO3- Analogic Output – 03
AO4+ Analogic Output + 04	A4	B4	AO4- Analogic Output – 04
AO5+ Analogic Output + 05	A5	B5	AO5- Analogic Output – 05
AO6+ Analogic Output + 06	A6	B6	AO6- Analogic Output – 06
AO7+ Analogic Output + 07	A7	B7	AO7- Analogic Output – 07
AO8+ Analogic Output + 08	A8	B8	AO8- Analogic Output – 08
Power Supply +24V	A9	B9	Analogic Ground AG
	BOTTOM LEFT PIN	BOTTOM RIGHT PIN	

Attention! Every output of TRM-8AO-VOLT is NOT protected against overvoltage. A voltage excess can damage the output. Each output circuit has a protection to limit current in case of short circuit (26mA).

Attention! Cycle time (time for Digital-to-Analog) is about 500µs. TRM-8AO-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 holding of analog signals. For RTC=250µs, this time is lower than conversion time (500 µs). To avoid lack of signal integrity, the best condition is to provide min. 2 samples (2x500µs = 1000µs). This means that the RTC rate acts as a Low Pass filter tuned to 1KHz for that RTC frequency. The same concept can be extended to other values of RTC.



LED

RN	ECAT link status
PW	Power supply +24V

On the top of the frontal image of TRM-8AO-VOLT 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

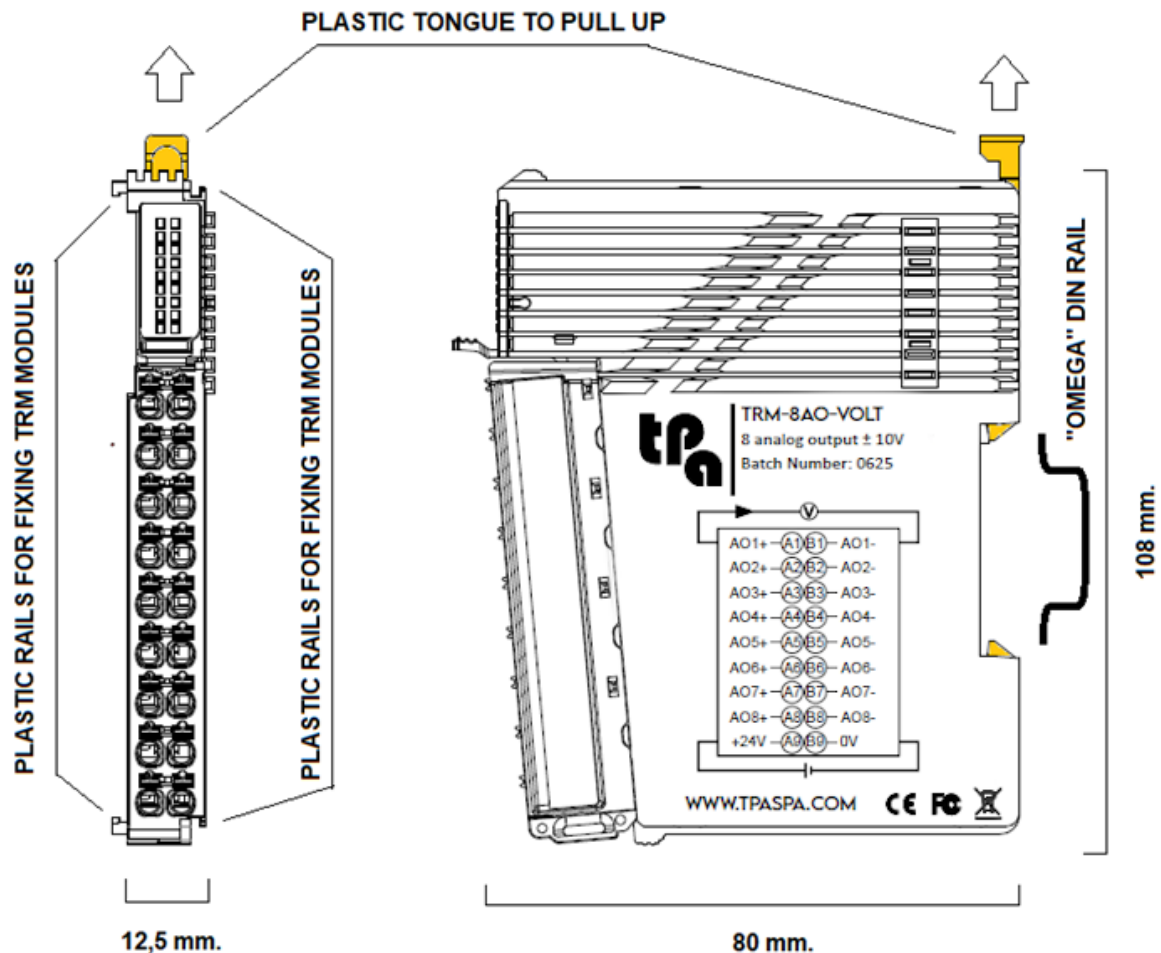
Regarding the RN ECAT status led

Electrical parameters	Values
Input signals	8, analog output
Nominal voltage output range	-10V ... +10Vdc
Resolution	16 bit
Resolution voltage step	0,3mV
Power Supply Voltage	+24Vdc (-15% +20%), not disturbed, regulated
Max current in C.C.	26mA
Cut Off frequency (filter)	< 20KHz
Conversion time	500µs
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-8AO-VOLT module can be installed onto a metallic rail DIN 60715, with "OMEGA" profile, model 7,5mm. or 15mm.

To add a TRM-8AO-VOLT device to a TRM-ECAT or to another TRM module in a blackchain, let's introduce it along the right side of the TRM-8AO-VOLT module. There are two plastic rails on the TRM-8AO-VOLT 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 connector and the curves of the cables
Thickness	12,5 mm.	

3 ETHERCAT COMMUNICATION

The TRM-8AO-VOLT module is compliant with standard EtherCAT normed by ETG in IEC61158.

TRM-8AO-VOLT is just a simple multi Analog Output actuator and it is addressed as a station into the EtherCAT network; it can run only in an EtherCAT net.

Other TRM's serie devices can be mechanically and electrically joined to TRM-8AO-VOLT, 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-8AO-VOLT 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.

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

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

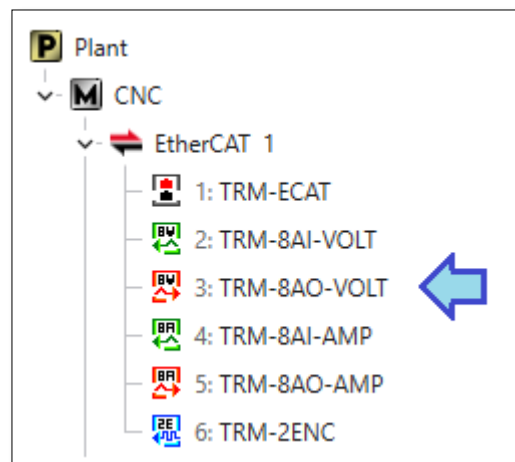
TRM-8AO-VOLT supports COE protocol; it presents standard and specific objects in its Object Dictionary. No PDO Mapping (PDOs are already set); all other objects are accessible by SDO protocol.

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 |
| SM3 = buffer mode TxPDO | → start address 0x1800 (not enabled, since no data input) |

Passing data and conversion D-to-A 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-8AO-VOLT device.



The hardware configuration window in Albatros.

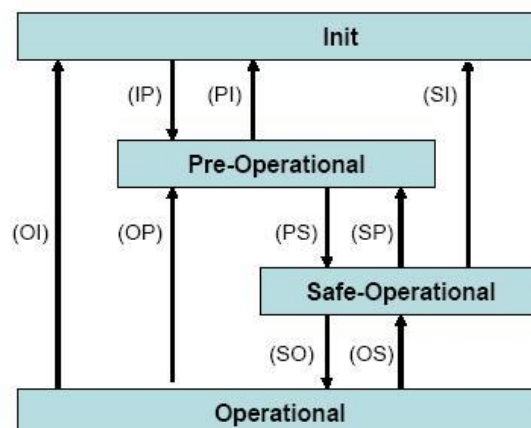
6: TRM-8AO-VOLT							
	Index	In/Out	Sm	Tags	Size	Name	
☒	0x1600	Out	2	M F	2.0	AO Output Channel 1	
☒	0x1601	Out	2	M F	2.0	AO Output Channel 2	
☒	0x1602	Out	2	M F	2.0	AO Output Channel 3	
☒	0x1603	Out	2	M F	2.0	AO Output Channel 4	
☒	0x1604	Out	2	M F	2.0	AO Output Channel 5	
☒	0x1605	Out	2	M F	2.0	AO Output Channel 6	
☒	0x1606	Out	2	M F	2.0	AO Output Channel 7	
☒	0x1607	Out	2	M F	2.0	AO Output Channel 8	

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

RxPDOs to send data output of the 8 Analogic Channel of the device. RxPDOs are preconfigured to provide one INT16 (signed) for each channel.

RxPDOs range from 0x1600 to 0x1607.

The EtherCAT State Machine shown in figure is applicable to TRM-8AO-VOLT. Outputs are exclusively operative in OPERATIONAL state.



3.1 PDO's list

Real Time Objects - PDOs

Index(hex)	Name	Data	Size(Byte)
0x1A00	Analog Output Status	Status	2.0
0x160n	Analog Output Channel n+1	D-to-A Conversion referred to INT16 bit Signed value range from -32768 to +32767	2.0

For Channels= 0≤n≤7 – TxPDO Selection

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-8AO-VOLT

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

0x80(n)0 Analog Output Setting

Index(hex)	Name	Data	Data type	Marker	Default
80n0.00	AO Output Channel n	Maximum Subindex	UINT8	RO	0x16 (22 Dec)
80n0.01	Enable user scale	Calibration parameters for the use of indoor settings. Settings-scale parameters the use of indoor settings	BOOLEAN	RW	0 (0 Dec)
80n0.02	Presentation	000 = the display output is displayed in binary format. The maximum display of 16 is equal to -32768Dec...+32767Dec. 001 = No symbol displays the maximum display of 16bits, so 0..+65535Dec. 010 = The absolute value of the symbol inMSB; the measured value is exported in order of magnitude. The maximum representation of 16 is equal to -32768Dec...+32767Dec. 011 = The absolute value negative is also output positive. 1xx= not supported	BIT3	RW	000 (0 Dec)
80n0.05	WatchDog	The door dog timeout set: 00 = direct output default (0x80n0.13) 01 = the door dog rate replaces the default rate 10 = output final valid data	BIT2	RW	00 (0 Dec)

80n0.07	Enable user calibration	Enable user calibration	BOOLEAN	RW	0 (0 Dec)
80n0.08	Enable vendor calibration	Enable supplier calibration	BOOLEAN	RW	1 (1 Dec)
80n0.11	Offset	Using scaling offset	INT16	RW	0x0000 (0 Dec)
80n0.12	Gain	User zoom gain	INT32	RW	0x00000000 (0 Dec)
80n0.13	Default output	Default output	INT16	RW	0x0000 (0 Dec)
80n0.14	Default output ramp	The default poutput is worth the rate unit digits/ms	UINT16	RW	0xFFFF (65535 Dec)
80n0.15	User calibration offset	User calibration migation	INT16	RW	0x0000 (0 Dec)
80n0.16	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 Dec)

For Channels= 0≤n≤7

0x80(n)E Analog Output Internal data

Index(hex)	Name	Data	Data type	Marker	Default
80nE.00	AO Output Internal data Channel n	Maximum Subindex	UINT8	RO	0x01 (1 Dec)
80nE.01	DAC raw value	DACoriginal value	INT16	RW	0x0000 (0 Dec)

For Channels= 0≤n≤7

0x80(n)F Analog Output Internal data

Index(hex)	Name	Data	Data type	Marker	Default
80nF.00	AO vendor data	Maximum Subindex	UINT8	RO	0x02 (2 Dec)
80nF.01	Calibration Offset	Offset (manufacturer calibration)	INT16	RW	---
80nF.02	Calibration Gain	Gain (manufacturer calibration)	UINT16	RW	---

For Channels= 0≤n≤7

0xF000 Analog Output Device Profile

Index(hex)	Name	Data	Data type	Marker	Default
F000.00	Module device profile	Maximum Subindex	UINT8	RO	0x02 (2 Dec)
F000.01	Module Index Distance	Offset (manufacturer calibration)	INT16	RO	0x0010 (16 dec)
F000.02	Maximum module number	Gain (manufacturer calibration)	UINT16	RO	---0x0010 (8 dec)

For Channels= 0≤n≤7

0xF008 Code word

Index(hex)	Name	Data	Data type	Marker	Default
F008.00	Code word	Vendor retention field	UINT32	RW	0x00000000 (0 Dec)

For Channels= 0≤n≤7

0xF010 Module List (n=1...8)

Index(hex)	Name	Data	Data type	Marker	Default
F010.00	Module list	Maximum Subindex	UINT8	RO	0x08 (8 Dec)
F010.0n	SubIndex 00n	Analog input configurazion file (300)	UINT32	RW	0x0000012C (300 Dec)

For Channels= 0≤n≤7

4 TRM-8AO-VOLT VIEW



TRM-8AO-VOLT
Front view



TRM-8AO-VOLT
Right side view



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