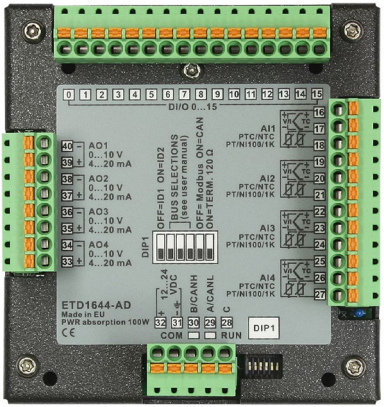
ETD1644-AD

I/O module / Modulo I/O



User manual / Manuale d'uso

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1 Introduction

Thanks for choosing a Pixsys I/O module.
ETD1644 is an I/O expansion board with plug-in connection to Pixsys HMI, allowing acquisition and control of analogue/digital I/O on the HMI via RS485/Modbus RTU or high-speed bus CANopen.

2 Safety guidelines

Programmable logic controllers (PLCs), operating/monitoring devices (industrial PCs, HMI) have been designed, developed and manufactured for conventional use in industrial environments. They were not designed, developed and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical damage or loss of any kind without the implementation of exceptionally stringent safety precautions. In particular, such risks and hazards include the use of these devices to monitor nuclear reactions in nuclear power plants, their use in flight control or flight safety systems as well as in the control of mass transportation systems, medical life support systems or weapons systems.

2.1 Policies and procedures

Electronic devices are never completely failsafe. If the programmable control system, operating/monitoring device or uninterruptible power supply fails, the user is responsible for ensuring that other connected devices, e.g. motors, are brought to a secure state.
When using programmable logic controllers or operating/monitoring devices as control systems together with a soft PLC, safety precautions relevant to industrial control systems must be observed in accordance with applicable national and international regulations. The same applies for all other devices connected to the system, such as drives.
All tasks such as the installation, commissioning and servicing of devices are only permitted to be carried out by qualified personnel. Qualified personnel are those familiar with the transport, mounting, installation, commissioning and operation of devices who also have the appropriate qualifications (e.g. IEC 60364). National accident prevention regulations must be observed.
The safety notices, information on connection conditions (type plate and documentation) and limit values specified in the technical data are to be read carefully before installation and commissioning and must always be observed.

2.2 Installation guidelines

- These devices are not ready for use upon delivery and must be installed and wired according to the specifications in this documentation in order for the EMC limit values to apply.
- Installation must be performed according to this documentation using suitable equipment and tools.
- Devices are only permitted to be installed by qualified personnel without voltage applied. Before installation, voltage to the control cabinet must be switched off and prevented from being switched on again.
- General safety guidelines and national accident prevention regulations must be observed.
- Electrical installation must be carried out in accordance with applicable guidelines (e.g. line cross sections, fuses, protective ground connections).

2.3 Organization of safety notices

Safety notices in this manual are organized as follows:

Safety notice	Description
Danger!	Disregarding these safety guidelines and notices can be life-threatening.
Warning!	Disregarding these safety guidelines and notices can result in severe injury or substantial damage to property.
Caution!	Disregarding these safety guidelines and notices can result in injury or damage to property.
Information!	This information is important for preventing errors.

2.4 Spacing for air circulation and ventilation

In order to guarantee sufficient air circulation, allow 5cm of empty space above, below, to the side and behind the device. No other ventilation system is required. The ETD1644 device is self-ventilated and approved for inclined mounting at angles up to ±35°in stationary cabinets.

Information! If additional space is needed to operate or maintain the device, this must be taken into consideration during installation.

Caution! The spacing specifications for air circulation are based on the worst-case scenario for operation at the maximum specified ambient temperature. The maximum specified ambient temperature must not be exceeded!

3 Model identification

ETD1644-AD	Power supply 24 VDC ±15% 16 digital I/O 4 analogue input 4 analogue output RS485 serial port with Modbus RTU slave protocol CAN port with CanOpen protocol

4 Technical data

4.1 Main features

Operating temperature	Temperature: 0-45°C; Humidity 35..95 RH%
Dimensions	87 x 93 x 35 mm
Material	Box: steel 10/10, Ral 7016;
Protection	IP20 (contenitore and terminal blocks)
Weight	Approx. 200 g

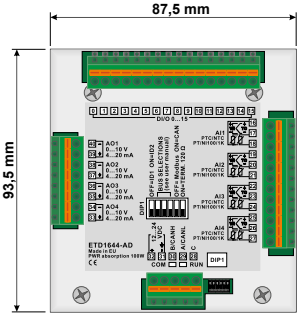
4.2 Hardware features

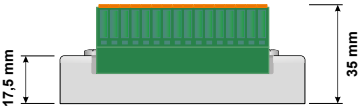
Power supply	12..24 VDC ±15%	Consumption: 100 W max
Analogue input	**4**: AI1..4 Configurable via software. **Input**: Thermocouple type K, S, R, J, T, E, N, B. Automatic compensation of cold junction from 0..50°C. **Thermoresistance**: PT100, PT500, PT1000, Ni100, PTC1K, NTC10K (β 3435K). **Input V/I**: 0-1V, 0-5V, 0-10 V, 0-20 o 4-20 mA, 0-60 mV. **Pot. input**: Configurable 1..150kΩ	Tolerance (25 °C) +/-0.3% ±1 digit (su F.s.) for thermocouple, thermoresistance and V / mA. Cold junction accuracy 0.1 °C/°C **Impedence**: **0-10 V**: Ri>110 kΩ **0-20 mA**: Ri<50 Ω **4-20 mA**: Ri<50 Ω **0-60 mV**: Ri>500 kΩ
Digital input / output	Up to 16 selectable as 24VDC static outputs (up to 700mA per output and maximum 3A total for all outputs*)	
Encoder inputs / Counters	Up to 4 mono / bidirectional encoders overlapped on 12 PNP inputs (32bit, up to 80Khz, counting mode x1 for the mono-directional meters and x2 for the encoders)	

Analogue output	4 0..10V o 4..20 mA. Configurable via software	0..10V 16000 points, ±0.3% su F.S. 4..20 mA 15000 points, ±0.3% su F.S.

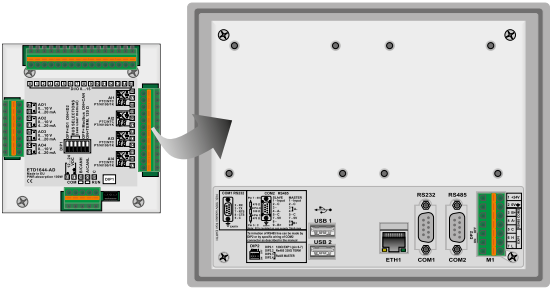
- **Caution!** 24VDC power supply line must be protected by a 5A fuse.
- **Warning**! * up to 700mA per output and maximum 3A total for all outputs.

5 Dimensions and Installation





Cod. ETD1644-AD

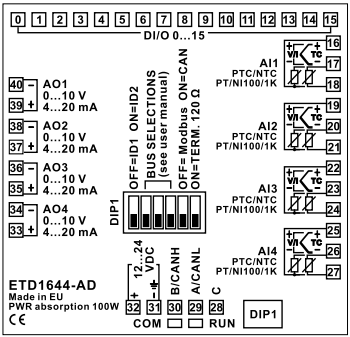


6 Electrical wirings

This device has been designed and manufactured in conformity to Low Voltage Directive 2006/95/EC , 2014/35/EU (LVD) and EMC Directive 2004/108/EC, 2014/30/EU (EMC). For installation in industrial environments please observe following safety guidelines:

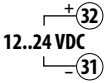
- Separate control line from power wires.
- Avoid proximity of remote control switches, electromagnetic contactors, powerful engines and use specific filters.
- Avoid proximity of power groups, especially those with phase control.
- It is strongly recommended to install adequate mains filter on power supply of the machine where the controller is installed, particularly if supplied 230 VAC. The controller is designed and conceived to be incorporated into other machines, therefore CE marking on the controller does not exempt the manufacturer of machines from safety and conformity requirements applying to the machine itself.

6.1 Wiring diagram



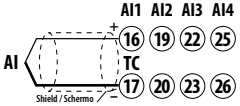
ETD1644-AD

6.1.a Power Supply



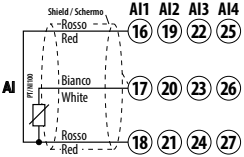
Power supply 12..24 VDC ±15% – 100 VA max (all outputs active)

6.1.b Analogue Inputs



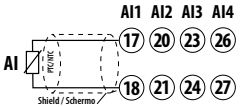
For thermocouples K, S, R, J, T, E, N, B.

- Comply with polarity
- For possible extensions, use compensated cable and terminals suitable for the thermocouples used(compensated)
- When shielded cable is used, it should be grounded at one side only



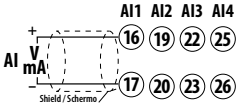
For thermoresistances PT100, Ni100.

- For the three-wire connection use wires with the same section
- For the two-wire connection short-circuit terminals 16 and 18 (AI1), 19 and 21 (AI2), 22 and 24 (AI3), 25 and 27 (AI4).
- When shielded cable is used, it should be grounded at one side only



For thermoresistances NTC, PTC, PT500, PT1000 and linear potentiometers

When shielded cable is used, it should be grounded at one side only to avoid ground loop currents

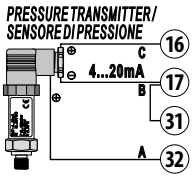


For linear signals in Volt and mA

Comply with polarity

When shielded cable is used, it should be grounded at one side only to avoid ground loop currents

6.1.c Connection examples for Volt and mA inputs



For linear signals 0/4..20 mA with three-wires sensors.

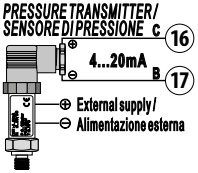
Comply with polarity:

C = Sensor output

B = Sensor ground

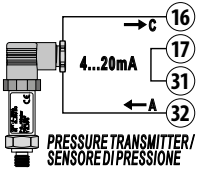
A = Sensor supply (12..24VDC)

Short circuit pins 31 and 17.



For linear signals 0/4..20 mA with external power supply for sensor.

Comply with polarity:
C = Sensor output
B= Sensor ground

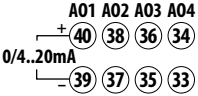


For linear signals 0/4..20 mA with two-wires sensors.

Comply with polarity:
A= Sensor output
C= Sensor supply (12..24VDC)

Short circuit pins 31 and 17.

6.1.d Analogue outputs

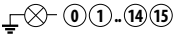


Analogue outputs (galvanically isolated from analogue inputs and communication ports) configurable by parameter as outputs 0..10V or 4..20mA.

6.1.e Digital inputs

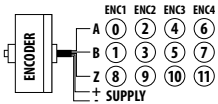
PNP inputs (connect a positive signal to the PIN to activate the corresponding input)
V_{IL} = 4,3 V
V_{IH} = 8,0 V

6.1.f Digital outputs



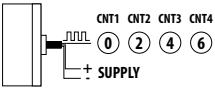
Digital outputs **24VDC** ±15%/ 700mA (Max 3A totals)

6.1.g Connection examples for incremental encoders



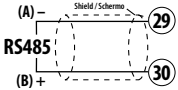
Use push-pull encoders only
Max frequency 80KHz

6.1.h Connection examples for monodirectional counters



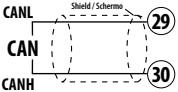
PNP input
Max frequency 80KHz

6.1.i Serial communication



RS485 Modbus RTU Slave communication galvanically insulated from the sensor. When shielded cable is used, it should be grounded at the Master side only.

6.1.j CAN communication



CAN communication with CANopen protocol galvanically isolated.

6.2 Meaning of status lights (LED)

COM ●	• Indicates that serial communication is active
RUN ●	• ON indicates the standard module functioning • Blinks during the program starting

6.3 Dip switch

Dip-switch setting must be done only with device OFF. Dip-switch status reading is executed only at power ON, all modifications done later will not have any effect.

6.3.a Communication protocol selection

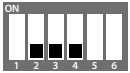
Modbus RTU slave

CANopen

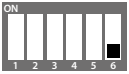
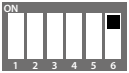
6.3.b Communication address selection

	Address 1
	Address 2

6.3.c Communication speed selection

	Modbus	CANopen
	4800 baud	50 kbit/s
	9600 baud	62.5 kbit/s
	19200 baud	100 kbit/s
	28800 baud	125 kbit/s
	38400 baud	250 kbit/s
	57600 baud	500 kbit/s
	115200 baud	1 Mbit/s
	Loads all default parameters and values.	

6.3.d Terminator Line setting

	Terminator line disconnected
	Terminator line connected (120Ω)

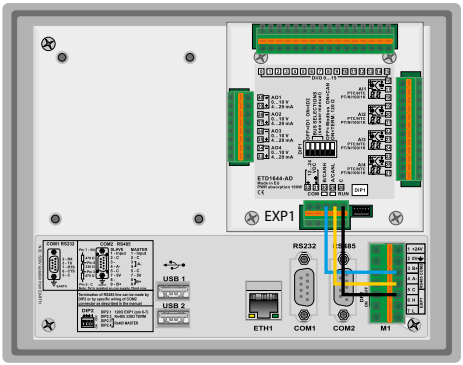
7 Serial communication

ETD1644-AD is equipped with RS485, it can receive and broadcast data via serial communication using Modbus RTU protocol. The device can be configured only as a Slave.
The device address is selected by dip-switch and there must not be controllers with the same address on the same serial line.
Address 255 can be used by the master to communicate with all the connected equipment (broadcast mode), while with 0 all the devices receive the command, but no response is expected.
Also the communication speed is determined by dip-switch.
ETD1644-AD can introduce a delay (in milliseconds) in response to the master request. This delay must be set on parameter 77 (word 2077).
Each parameter change is stored by the controller so it can be kept even in case of power failure.

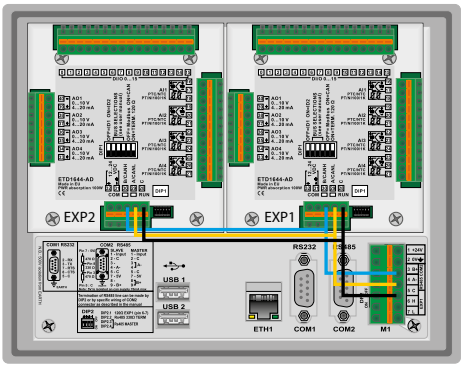
NB: changes made to Words that are different from those reported in the following table can lead to malfunction.

7.1 SET-UP as RS485 Modbus slave node

A RS485 Modbus network must have a 120 Ω terminal line resistance. If more devices have to be connected in cascade, that resistance has to be connected to the last device of network, at the end of the line only.



Connection example of an ETD1644, in RS485 Modbus mode (EXP1 - DIP6: ON)



Connection example of an ETD1644, in RS485 Modbus mode (EXP1 - DIP6: OFF, EXP2 - DIP6: ON)

EDT1644-AD are provided with a terminator line resistance activable by dip-switch *(paragraph 6.3.d)*.

Modbus RTU protocol features		
Baud-rate	Selectable by dip-switch Value 0: 4800bit/s Value 1: 9600bit/s Value 2: 19200bit/s Value 3: 28800bit/s	 Value 4: 38400bit/s Value 5: 57600bit/s Value 6: 115200bit/s
Format	Selectable by parameter 76 Value 0: 8,n,1 Value 1: 8,o,1 Value 2: 8,e,1	 Value 3: 8,n,2 Value 4: 8,o,2 Value 5: 8,e,2
Supported features	WORD READING (max 100 word) (0x03, 0x04) SINGLE WORD WRITING (0x06) MULTIPLE WORDS WRITING (max 100 word) (0x10)	

The following is a list of all the addresses available and the functions supported:

RO = Read Only R/W = Read/Write WO = Write Only

Modbus address	Description	Read Write	Reset value
0	Device type	RO	510
1	Software version	RO	Flash
2	Boot version	RO	Flash
3	Dip-switch status	RO	dip
4			
5	Address slave	RO	dip
6	Error flags: bit 0 = Incorrect parameters bit 1 = Incorrect status data bit 2 = Incorrect calibration data bit 3 = Wrong calibration data bit 4 = Incorrect status CANopen data bit 5 = Missing calibration bit 6 = Parameter out of range bit 7 = FRam failure bit 8 = Cold junction failure bit 9 = - bit 10 = - bit 11 = - bit 12 = Input AI1 out of range bit 13 = Input AI2 out of range bit 14 = Input AI3 out of range bit 15 = Input AI4 out of range	RO	-
7	Cold junction temperature (degree.tenth)	RO	-

Modbus address	Description	Read Write	Reset value
1000	Status data digital inputs I0..I15	RO	-
1001	AI1 input value (degrees with tenth)	RO	-
1002	AI2 input value (degrees with tenth)	RO	-
1003	AI3 input value (degrees with tenth)	RO	-
1004	AI4 input value (degrees with tenth)	RO	
1005	Encoder Counter 1 H	RO	EEprom
1006	Encoder Counter 1 L	RO	EEprom
1007	Encoder Counter 2 H	RO	EEprom
1008	Encoder Counter 2 L	RO	EEprom
1009	Encoder Counter 3 H	RO	EEprom
1010	Encoder Counter 3 L	RO	EEprom
1011	Encoder Counter 4 H	RO	EEprom
1012	Encoder Counter 4 L	RO	EEprom
1013	Counts per 1s Encoder 1 H	RO	0
1014	Counts per 1s Encoder 1 L	RO	0
1015	Counts per 1s Encoder 2 H	RO	0
1016	Counts per 1s Encoder 2 L	RO	0
1017	Counts per 1s Encoder 3 H	RO	0
1018	Counts per 1s Encoder 3 L	RO	0
1019	Counts per 1s Encoder 4 H	RO	0
1020	Counts per 1s Encoder 4 L	RO	0
1021	Counts per 100ms Encoder 1 H	RO	0
1022	Counts per 100ms Encoder 1 L	RO	0
1023	Counts per 100ms Encoder 2 H	RO	0
1024	Counts per 100ms Encoder 2 L	RO	0
1025	Counts per 100ms Encoder 3 H	RO	0
1026	Counts per 100ms Encoder 3 L	RO	0
1027	Counts per 100ms Encoder 4 H	RO	0
1028	Counts per 100ms Encoder 4 L	RO	0
		RO	0
1100	Digital output status O0..O15	R/W	0
1101	AO1 output value	R/W	0
1102	AO2 output value	R/W	0
1103	AO3 output value	R/W	0
1104	AO4 output value	R/W	0
1105	Encoder/Counter 1 commands	R/W	0
1106	Encoder/Counter 2 commands	R/W	0
1107	Encoder/Counter 3 commands	R/W	0
1108	Encoder/Counter 4 commands Bit0 = Loads preset value Bit1 = Loads preset value at the next Z impulse	R/W	0

Modbus address	Description	Read Write	Reset value
2001	Parameter 1	R/W	Eeprom
2002	Parameter 2	R/W	Eeprom
...	Parameter ...	R/W	Eeprom
2100	Parameter 100	R/W	Eeprom
4001	Parameter 1	R/W	Eeprom
4002	Parameter 2	R/W	Eeprom
...	Parameter ...	R/W	Eeprom
4100	Parameter 100 The device stores parameters in eeprom memory with a delay of 10 seconds after last modification.	R/W	Eeprom

8 Configuration parameters table

8.1 GROUP A - ANALOGUE INPUT

1 AI1 Sensor Type *(Word modbus 2001)*
2 AI2 Sensor Type *(Word modbus 2002)*
3 AI3 Sensor Type *(Word modbus 2003)*
4 AI4 Sensor Type *(Word modbus 2004)*

Analogue input configuration / sensor selection

0	disabled	(**Default**)
1	Tc-K	-260 °C..1360 °C
2	Tc-S	-40 °C..1760 °C
3	Tc-R	-40 °C..1760 °C
4	Tc-J	-200 °C..1200 °C
5	Tc-T	-260 °C..400 °C
6	Tc-E	-260 °C..980 °C
7	Tc-N	-260 °C..1280 °C
8	Tc-B	100 °C..1820 °C
9	Pt100	-100 °C..600 °C
10	Ni100	-60 °C..180 °C
11	NTC10K	-40 °C..125 °C
12	PTC1K	-50 °C..150 °C
13	Pt500	-100 °C..600 °C
14	Pt1000	-100 °C..600 °C
15	0..1V	
16	0..5V	
17	0..10 V	
18	0..20 mA	
19	4..20 mA	
20	0..60 mV	
21	Potenziometer (set the value on parameters 14..17)	

5 Degrees type *(Word modbus 2005)*

0	°C	Centigrade (**Default**)
1	°F	Fahrenheit
2	K	Kelvin

6 AI1 Lower Linear Input *(Word modbus 2006)*
7 AI2 Lower Linear Input *(Word modbus 2007)*
8 AI3 Lower Linear Input *(Word modbus 2008)*
9 AI4 Lower Linear Input *(Word modbus 2009)*

Range lower limit only for linear input. Ex: with input 4..20 mA this parameter takes value associated to 4 mA.
-32767..+32767, **Default**: 0.

10 AI1 Upper Linear Input *(Word modbus 2010)*
11 AI2 Upper Linear Input *(Word modbus 2011)*
12 AI3 Upper Linear Input *(Word modbus 2012)*
13 AI4 Upper Linear Input *(Word modbus 2013)*

Range upper limit only for linear input. Ex: with input 4..20 mA this parameter takes value associated to 20 mA.
-32767..+32767. **Default**:1000 (on DRR460 is 10000)

14 AI1 Potentiometer Value *(Word modbus 2014)*
15 AI2 Potentiometer Value *(Word modbus 2015)*
16 AI3 Potentiometer Value *(Word modbus 2016)*
17 AI4 Potentiometer Value *(Word modbus 2017)*

Select potentiometer value
1..150 kohm. **Default**: 10kohm

18 AI1 Linear Input over Limits *(Word modbus 2018)*
19 AI2 Linear Input over Limits *(Word modbus 2019)*
20 AI3 Linear Input over Limits *(Word modbus 2020)*
21 AI4 Linear Input over Limits *(Word modbus 2021)*

If linear input, allows process to go over limits (Parameters 6..9 and 10..13).

0	Disabled (**Default**)	1	Enabled

22 AI1 Offset Calibration *(Word modbus 2022)*
23 AI2 Offset Calibration *(Word modbus 2023)*
24 AI3 Offset Calibration *(Word modbus 2024)*
25 AI4 Offset Calibration *(Word modbus 2025)*

Value added / subtracted to the process visualization (usually correcting the value of environmental temperature).
-10000..+10000 [digit] (degrees.tenths for temperature sensors). **Default** 0.

26 AI1 Gain Calibration *(Word modbus 2026)*
27 AI2 Gain Calibration *(Word modbus 2027)*
28 AI3 Gain Calibration *(Word modbus 2028)*
29 AI4 Gain Calibration *(Word modbus 2029)*

Percentage value that is multiplied for the process value (allows to calibrated the working point). Ex: to correct the range from 0..1000°C showing 0..1010°C, set the par. to -1.0.
-1000 (100.0%)...+1000 (+100.0%), **Default**: 0.0.

30 Reserved *(Word modbus 2030)*
31 Reserved *(Word modbus 2031)*
32 Reserved *(Word modbus 2032)*
33 Reserved *(Word modbus 2033)*

34 AI1 input filter *(Word modbus 2034)*
35 AI2 input filter *(Word modbus 2035)*
36 AI3 input filter *(Word modbus 2036)*
37 AI4 input filter *(Word modbus 2037)*

Analogue input reading filter: increases process stability on word 1001, 1002, 1003, 1004. Indicates the number of samplings to be mediated during the process calculation.
1...50. (**Default**: 5)

38 AI1 and AI2 conversion frequency *(Word modbus 2038)*
39 AI3 and AI4 conversion frequency *(Word modbus 2039)*

Sampling frequency of the analog / digital converter.
NB: Low conversion speeds increase reading stability while high conversion speeds will decrease reading stability (example: for fast transients, as pressure, it is advisable to increase sampling frequency).

0	4 Hz	7	33 Hz
1	6 Hz	8	39 Hz
2	8 Hz	9	50 Hz
3	10 Hz	10	62 Hz
4	12 Hz	11	123 Hz
5	17 Hz (**Default**)	12	242 Hz
6	20 Hz	13	470 Hz

8.2 GROUP B - ANALOGUE OUTPUTS

40 AO1 output type *(Word modbus 2040)*
41 AO2 output type *(Word modbus 2041)*
42 AO3 output type *(Word modbus 2042)*
43 AO4 output type *(Word modbus 2043)*

Select the type of analogue output.

0	0..10 V (**Default**)
1	4..20 mA.

44 AO1 lower limit analogue output *(Word modbus 2044)*
45 AO2 lower limit analogue output *(Word modbus 2045)*
46 AO3 lower limit analogue output *(Word modbus 2046)*
47 AO4 lower limit analogue output *(Word modbus 2047)*

Analogue output lower limit range (value related to 0/4 mA)
-32767..+32767 [digit] **Default**: 0.

48 AO1 upper limit analogue output *(Word modbus 2048)*
49 AO2 upper limit analogue output *(Word modbus 2049)*
50 AO3 upper limit analogue output *(Word modbus 2050)*
51 AO4 upper limit analogue output *(Word modbus 2051)*

Analogue output upper limit range (value related to 10 V / 20 mA)
-32767..+32767 [digit] **Default**: 1000.

52 AO1 output value error *(Word modbus 2052)*
53 AO2 output value error *(Word modbus 2053)*
54 AO3 output value error *(Word modbus 2054)*
55 AO4 output value error *(Word modbus 2055)*

Determine the analogue output value in case of error or anomaly.
The value must be included between the upper and lower limit output values.
-32767..+32767 [digit], **Default**: 0.

56 Reserved *(Word modbus 2056)*
57 Reserved *(Word modbus 2057)*
58 Reserved *(Word modbus 2058)*
59 Reserved *(Word modbus 2059)*

8.3 GROUP C - DIGITAL INPUTS

60 Digital inputs filter *(Word modbus 2060)*

Define the time during which the digital input must be steady before being considered valid
0..250 [ms], **Default**: 5 ms.

61 Encoder/counter 1 setup *(Word modbus 2061)*
62 Encoder/counter 2 setup *(Word modbus 2062)*
63 Encoder/counter 3 setup *(Word modbus 2063)*
64 Encoder/counter 4 setup *(Word modbus 2064)*

Determine the operatin mode of the encoder or the undirectional counter input.

0	Disabled (**Default**).
1	Encoder phase A-B.
2	Encoder pase A-B-Z.
3	Counter Up.
4	Counter Down.

65 Encoder/counter 1 H preset value *(Word modbus 2065)*
66 Encoder/counter 1 L preset value*(Word modbus 2066)*
67 Encoder/counter 2 H preset value*(Word modbus 2067)*
68 Encoder/counter 2 L preset value*(Word modbus 2068)*
69 Encoder/counter 3 H preset value *(Word modbus 2069)*
70 Encoder/counter 3 L preset value*(Word modbus 2070)*
71 Encoder/counter 4 H preset value*(Word modbus 2071)*
72 Encoder/counter 4 L preset value*(Word modbus 2072)*

Determine the value that will be loaded to the encoder/counter registry in case of "load preset value" command (see address 1108). This register is a 32bit value so, in case of Modbus communication, It will be assigned using two concecutives 16bit words.
-32767..+32767 [digit], **Default**: 0.

73 Digital outputs status in offline *(Word modbus 2073)*

Determine the digital outputs state in case the module goes offline (only in Modbus communication, see param. 75). Disabled = 0, Enabled = 1.

bit 0	Output O1 status (**Default 0**).
...	
bit 15	Output O15 status.

74 Reserved *(Word modbus 2074)*

8.4 GROUP D - SERIAL

75 Modbus offline time *(Word modbus 2175)*

If Modbus protocol is active, determine the time of serial inactivity before offline status.

0	Offline disabled (**Default**)
1..60000 [ms]	Inactivity before offline.

76 Modbus serial format *(Word modbus 2076)*

Determine the data format for the Modbus port.

0	8,n,1 (**Default**).
1	8,o,1
2	8,e,1
3	8,n,2
4	8,o,2
5	8,e,2

77 Modbus serial delay *(Word modbus 2077)*

Determine the dealy between the answer of the module after an interrogation of the master (only in Modbus communication).

0..+100 [ms], **Default**: 5.

9 CANopen

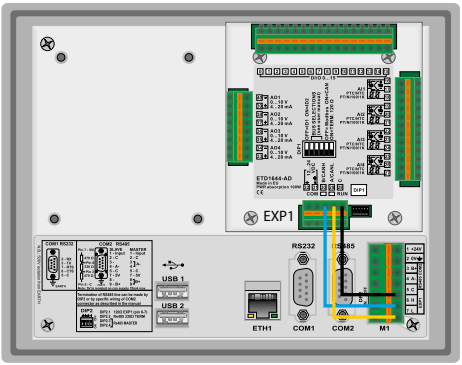
Each LED RUN blinking type indicates a specific CANopen status.

Blinking name LED COM	Blinking type
Blink_fast	Fast blinking 50msec
Blink_medium	Blinking 200msec
Blink_slow	Blinking 600msec
LED_on	LED always on
Blink_3_on	LED on for 1sec, 3 blink 150msec
Blink_1_off	Slow blink 40msec every 1.2sec
Blink_3_off	LED off for 1sec, 3 blink 150msec

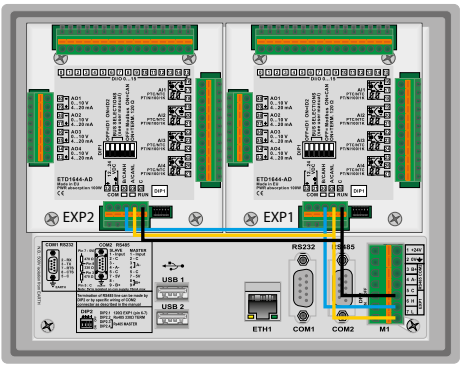
Status	Led RUN blinking
Boot-up	Blink_fast
Pre-Operational	Blink_slow
Operational	LED_on
Stopped	Blink_1_off
Pre-Operational con Emergency	Blink_medium
Operational con Emergency	Blink_3_on
Stopped con Emergency	Blink_3_off

9.1 SET-UP as CANopen slave node

A CANopen network must have a 120 Ω terminal line resistance. If more devices have to be connected in cascade, that resistance has to be connected to the last device of network, at the end of the line only.



Connection example of an ETD1644, in CANOpen mode (EXP1 - DIP6: ON)



Connection example of an ETD1644, in CANOpen mode (EXP1 - DIP6: OFF, EXP2 - DIP6: ON)

EDT1644-AD are provided with a termnator line resistance activable by dip-switch *(paragraph 6.3.d)*.

9.2 Operation as CANopen slave node

After boot-up, device will be in Pre-Operational status automatically (LED RUN Blink_slow blinking). PDO transmission/reception aren't allowed, SDO transmission/reception are only allowed. To change into Operational status, an NMT[1] messages from a master is needed.

9.3 Object Dictionary

The following object dictionary table is divided in 3 parts. The first one is **Communication Profile Area**, where all parameters necessary for communication like setting identifier and PDO configuration are described.
The second one is **Manufacturer Specific Parameter Area**, where all special manufacturer features are described. The third one is **Standard Device Profile Area**, where digital/Analogue input/output transmission type is described.

9.4 Communication Profile Area

Idx	S - Idx	Name	Type	Default	Description	R/W
0x1000	0	Device type	32bit unsigned	0x000F0191	ETD1644-AD	CONST
0x1001	0	Error register	8bit unsigned	-	Emergency messages	R
0x1003	0	Pre-defined Error Field	Array 8bit unsigned	-	Numero di Sub-index	R/W
	1		Array 32bit unsigned	-	Standard error field (sempre ultimo errore)	R
	...		...	-		...
	10		Array 32bit unsigned	-	Standard error field (always first error)	R
0x1005	0	COB-ID SYNC message	32bit unsigned	0x00000080	COB-ID per messaggi SYNC	R
0x1006	0	Communi-cation Cycle Period	32bit unsigned	0	Time between 2 SYNC messages	R/W
0x1008	0	Manufactu-rer Device Name	String	ETD1	-	CONST
0x1009	0	Manufactu-rer Hardware Version	String	Current hardware version	-	CONST
0x100A	0	Manufactu-rer Software Version	String	Current hardware version	-	CONST

[1] *For details on CANopen, see Chapter 11.*

Idx	S - Idx	Name	Type	Default	Description	R/W
0x100B	0	Node ID	8bit unsigned	0	Node address	R
0x100C	0	Guard Time	16bit unsigned	0	Time between 2 Guard time interrogations	R/W
0x100D	0	Life Time Factor	8bit unsigned	0	If this value is 0, the Node Guarding is not monitored	R/W
0x1010	0	Store Parameters	Array 8bit unsigned	1	Number of Sub-index	R
	1		Array 32bit unsigned	1	Write "save" to save user parameters	R/W
0x1011	0	Restore default Parameter	Array 8bit unsigned	2	Number of Sub-index	R
	1		Array 32bit unsigned	1	Write "load" to load default parameters	R/W
0x1014	0	COB-ID Emergency Object	32bit unsigned	0x80 + module-ID	-	R
0x1015	0	Inhibit time Emergency Object	16bit unsigned	0	Time to be spent before sending another Emergency	R/W
0x1017	0	Producer Heartbeat Time	16bit unsigned	0	Time between 2 Heartbeat messages	R/W
0x1018	0	Identity Object	Record 8bit unsigned	4	Number of Sub-index	R
	1		Record 32bit unsigned	PIX	Manufacturer ID	R
	2		Record 32bit unsigned	ETD1	Device description	R
	3		Record 32bit unsigned	-	Revision number	R

Idx	S - Idx	Name	Type	Default	Description	R/W
	4		Record 32bit unsigned	-	Serial number	R
0x1029	0	Error Behaviour	Array 8bit unsigned	1	Number of Sub-index	R
	1		Array 8bit unsigned	0	Communication error	R/W
0x1400 0x1401 0x1402 0x1403	0	Receive PDO commu-nication parameter	Record 8bit unsigned	2	Number of Sub-index	R
	1		Record 32bit unsigned	- Idx 0x1400 0x200 + module-ID - Idx 0x1401 0x300 + module-ID - Idx 0x1402 0x400 + module-ID - Idx 0x1403 0x500 + module-ID	COB-ID used by PDO	R/W
	2		Record 32bit unsigned	255	Transmission type	R/W
0x1600 0x1601 0x1602 0x1603	0	Receive PDO mapping parameter	Record 8bit unsigned	-	Number of Sub-index	R/W
	1 to 8		Record 32bit unsigned	-	PDO mapping object1 to object 8	R/W
0x1800 0x1801 0x1802 0x1803	0	Transmit PDO commu-nication parameter	Record 8bit unsigned	5	Number of Sub-index	R

Idx	S - Idx	Name	Type	Default	Description	R/W
	1		Record 32bit unsigned	- Idx 0x1800 0x180 + module-ID - Idx 0x1801 0x280 + module-ID - Idx 0x1802 0x380 + module-ID - Idx 0x1803 0x480 + module-ID	COB-ID used by PDO	R/W
	2		Record 8bit unsigned	255	Transmission type	R/W
	3		Record 16bit unsigned	0	Inhibit time	R/W
	5		Record 16bit unsigned	0	Event timer	R/W
0x1A00 0x1A01 0x1A02 0x1A03	0	Transmit PDO mapping parameter	Record 8bit unsigned	-	Number of Sub-index	R/W
	1...8		Record 32bit unsigned	-	PDO mapping object	R/W

9.5 Manufacturer Specific Parameter Area - ETD1644-AD

Idx	S - Idx	Name	Type	Default	Description	R/W
0x2000	0	Device specifications	Array 8bit unsigned	19	Number of Sub-index	R
	1		Array 16bit signed	6 (1Mbps)	Canbus speed	R
	2		Array 16bit signed	120	Boot-up time	R/W
	3		Array 16bit signed	0x7F (Pre-Ope-rational)	CANopen status after boot-up	
	4 ... 19		Reserved			R/W
0x3000	0	ETD1644-AD parameters	Array 8bit unsigned	100	Number of Sub-index	R

Idx	S - Idx	Name	Type	Default	Description	R/W
	1		Array 16bit signed	0	AI1 Sensore type	R/W
	2		Array 16bit signed	0	AI2 Sensore type	R/W
	3		Array 16bit signed	0	AI3 Sensore type	R/W
	4		Array 16bit signed	0	AI4 Sensore type	R/W
	5		Array 16bit signed	0	Degres type	R/W
	6		Array 16bit signed	0	AI1 lower limit	R/W
	7		Array 16bit signed	0	AI2 lower limit	R/W
	8		Array 16bit signed	0	AI3 lower limit	R/W
	9		Array 16bit signed	0	AI4 lower limit	R/W
	10		Array 16bit signed	1000	AI1 upper limit	R/W
	11		Array 16bit signed	1000	AI2 upper limit	R/W
	12		Array 16bit signed	1000	AI3 upper limit	R/W
	13		Array 16bit signed	1000	AI4 upper limit	R/W
	14		Array 16bit signed	10	AI1 potentiometer value	R/W
	15		Array 16bit signed	10	AI2 potentiometer value	R/W
	16		Array 16bit signed	10	AI3 potentiometer value	R/W
	17		Array 16bit signed	10	AI4 potentiometer value	R/W
	18		Array 16bit signed	0	AI1 linear input beyond the limits	R/W
	19		Array 16bit signed	0	AI2 linear input beyond the limits	R/W
	20		Array 16bit signed	0	AI3 linear input beyond the limits	R/W
	21		Array 16bit signed	0	AI4 linear input beyond the limits	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	22		Array 16bit signed	0	AI1 offset calibration	R/W
	23		Array 16bit signed	0	AI2 offset calibration	R/W
	24		Array 16bit signed	0	AI3 offset calibration	R/W
	25		Array 16bit signed	0	AI4 offset calibration	R/W
	26		Array 16bit signed	0	AI1 gain calibration	R/W
	27		Array 16bit signed	0	AI2 gain calibration	R/W
	28		Array 16bit signed	0	AI3 gain calibration	R/W
	29		Array 16bit signed	0	AI4 gain calibration	R/W
	30 .. 33		Array 16bit signed	0	Reserved	R/W
	34		Array 16bit signed	5	AI1 input filter	R/W
	35		Array 16bit signed	5	AI2 input filter	R/W
	36		Array 16bit signed	5	AI3 input filter	R/W
	37		Array 16bit signed	5	AI4 input filter	R/W
	38		Array 16bit signed	5	AI1 and AI2 conversion frequency	R/W
	39		Array 16bit signed	5	AI3 and AI4 conversion frequency	R/W
	40		Array 16bit signed	0	AO1 output type	R/W
	41		Array 16bit signed	0	AO2 output type	R/W
	42		Array 16bit signed	0	AO3 output type	R/W
	43		Array 16bit signed	0	AO4 output type	R/W
	44		Array 16bit signed	0	AO1 lower limit	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	45		Array 16bit signed	0	AO2 lower limit	R/W
	46		Array 16bit signed	0	AO3 lower limit	R/W
	47		Array 16bit signed	0	AO4 lower limit	R/W
	48		Array 16bit signed	1000	AO1 upper limit	R/W
	49		Array 16bit signed	1000	AO2 upper limit	R/W
	50		Array 16bit signed	1000	AO3 upper limit	R/W
	51		Array 16bit signed	1000	AO4 upper limit	R/W
	52 .. 59		Array 16bit signed	0	Reserved	R/W
	60		Array 16bit signed	5	Digital inputs filter	R/W
	61		Array 16bit signed	0	Encoder/counter 1 setup	R/W
	62		Array 16bit signed	0	Encoder/counter 2 setup	R/W
	63		Array 16bit signed	0	Encoder/counter 3 setup	R/W
	64		Array 16bit signed	0	Encoder/counter 4 setup	R/W
	65		Array 16bit signed	0	Encoder/counter 1 H preset value	R/W
	66		Array 16bit signed	0	Encoder/counter 1 L preset value	R/W
	67		Array 16bit signed	0	Encoder/counter 2 H preset value	R/W
	68		Array 16bit signed	0	Encoder/counter 2 L H preset value	R/W
	69		Array 16bit signed	0	Encoder/counter 3 H preset value	R/W
	70		Array 16bit signed	0	Encoder/counter 3 L preset value	R/W
	71		Array 16bit signed	0	Encoder/counter 4 H preset value	R/W
	72		Array 16bit signed	0	Encoder/counter 4 L preset value	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	73 .. 100		Array 16bit signed	0	Reserved	R/W
0x3001	0	Encoder/ counter counts	Array 8bit signed	4	Sub-index number	R
	1		Array 32bit signed	0	Encoder/counter 1 counts	R
	2		Array 32bit signed	0	Encoder/counter 2 counts	R
	3		Array 32bit signed	0	Encoder/counter 3 counts	R
	4		Array 32bit signed	0	Encoder/counter 4 counts	R
0x3002	0	Encoder/ counter preset counts	Array 8bit signed	4	Sub-index number	R
	1		Array 32bit signed	0	Encoder/counter 1 preset counts	R/W
	2		Array 32bit signed	0	Encoder/counter 2 preset counts	R/W
	3		Array 32bit signed	0	Encoder/counter 3 preset counts	R/W
	4		Array 32bit signed	0	Encoder/counter 4 preset counts	R/W
0x3003	0	Encoder/ counter commands	Array 8bit unsigned	4	Sub-index number	R
	1		Array 8bit unsigned	0	Encoder/counter 1 commands	R/W
	2		Array 8bit unsigned	0	Encoder/counter 2 commands	R/W
	3		Array 8bit unsigned	0	Encoder/counter 3 commands	R/W
	4		Array 8bit unsigned	0	Encoder/counter 4 commands	R/W
0x3004	0	Counts per 1 sec Encoder/ counter	Array 8bit signed	4	Sub-index number	R
	1		Array 32bit signed	0	Encoder/counter 1 counts per 1 sec	R/W
	2		Array 32bit signed	0	Encoder/counter 2 counts per 1 sec	R/W
	3		Array 32bit signed	0	Encoder/counter 3 counts per 1 sec	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	4		Array 32bit signed	0	Encoder/counter 4 counts per 1 sec	R/W
0x3005	0	Counts per 100ms Encoder/ counter	Array 8bit signed	4	Sub-index number	R
	1		Array 32bit signed	0	Encoder/counter 1 counts per 100ms	R/W
	2		Array 32bit signed	0	Encoder/counter 2 counts per 100ms	R/W
	3		Array 32bit signed	0	Encoder/counter 3 counts per 100ms	R/W
	4		Array 32bit signed	0	Encoder/counter 4 counts per 100ms	R/W

9.6 Standard Device Profile Area

Idx	S - Idx	Name	Type	Default	Description	R/W
0x6000	0	Digital inputs	Array 8bit unsigned	2	Sub-index number	R
	1		Array 8bit unsigned	0	1° digital inputs block	R
	2		Array 8bit unsigned	0	2° digital inputs block	R
0x6005		Global Interrupt Enable Digital 8 bit	8 bit signed	1	Enables the retransmission of digital inputs on PDO	R/W
0x6006	0	Interrupt Mask Any Change 8 bit	Array 8 bit unsigned	2	Sub-index number	R
	1		Array 8 bit unsigned	255	Inputs 1..8 transmission in case of variation	R/W
	2		Array 8 bit unsigned	255	Inpust 9..16 transmission in case of variation	R/W
0x6007	0	Interrupt Mask Low-to-High 8 bit	Array 8 bit unsigned	2	Sub-index number	R
	1		Array 8 bit unsigned	0	Inputs 1..8 transmission in case of positive transition	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	2		Array 8 bit unsigned	0	Inputs 9..16 transmission in case of positive transition	R/W
0x6008	0	Interrupt Mask High-to-Low 8 bit	Array 8 bit unsigned	2	Sub-index number	R
	1		Array 8 bit unsigned	0	Inputs1..8 transmission in case of negative transition	R/W
	2		Array 8 bit unsigned	0	Inputs 9..16 transmission in case of negative transition	R/W
0x6200	0	Digital Output	Array 8bit unsigned	1	Sub-index number	R
	1		Array 8bit unsigned	0	1° outputs block	R/W
	2		Array 8bit unsigned	0	2° outputs block	R/W
0x6206	0	Error Mode Output 8bit	Array 8bit unsigned	1	Sub-index number	R
	1		Array 8bit unsigned	255	1° outputs block (Outputs 1..8 loaded with default value in case of error)	R/W
	2		Array 8bit unsigned	255	2° outputs block (Outputs 9..16 loaded with default value in case of error)	R/W
0x6207	0	Error Value Output 8bit	Array 8bit unsigned	1	Sub-index number	R
	1		Array 8bit unsigned	0	1° outputs block (**Default** values outputs 1..8 in case of error)	R/W
	2		Array 8bit unsigned	0	2° outputs block (**Default** values outputs 9..16 in case of error)	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
0x6401	0	Analogue Input 16bit	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	-	Input AI1	R
	2		Array 16bit unsigned	-	Input AI2	R
	3		Array 16bit unsigned	-	Input AI3	R
	4		Array 16bit unsigned	-	Input AI4	R
0x6411	0	Analogue Output 16bit	Array 8bit unsigned	4	Number of analogue outputs	R
	1		Array 16bit unsigned	0	Output AO1	R/W
	2		Array 16bit unsigned	0	Output AO2	R/W
	3		Array 16bit unsigned	0	Output AO3	R/W
	4		Array 16bit unsigned	0	Output AO4	R/W
0x6421	0	Analogue Input Interrupt Trigger Selection	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 8bit unsigned	7	AI1 Input trigger	R/W
	2		Array 8bit unsigned	7	AI2 Input trigger	R/W
	3		Array 8bit unsigned	7	AI3 Input trigger	R/W
	4		Array 8bit unsigned	7	AI4 Input trigger	R/W
0x6423	0	Analogue Input Global Interrupt Enable	Boolean	0	Enable/Disable analogue inputs transmission	R/W
0x6424	0	Analogue Input Interrupt Upper Limit Integer	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	0	AI1 Upper limit	R/W
	2		Array 16bit unsigned	0	AI2 Upper limit	R/W
	3		Array 16bit unsigned	0	AI3 Upper limit	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	4		Array 16bit unsigned	0	AI4 Upper limit	R/W
0x6425	0	Analogue Input Interrupt Lower Limit Integer	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	0	AI1 Lower limit	R/W
	2		Array 16bit unsigned	0	AI2 Lower limit	R/W
	3		Array 16bit unsigned	0	AI3 Lower limit	R/W
	4		Array 16bit unsigned	0	AI4 Lower limit	R/W
0x6426	0	Analogue Input Interrupt Delta Unsigned	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	0	AI1 Delta	R/W
	2		Array 16bit unsigned	0	AI2 Delta	R/W
	3		Array 16bit unsigned	0	AI3 Delta	R/W
	4		Array 16bit unsigned	0	AI4 Delta	R/W
0x6427	0	Analogue Input Interrupt Negative Delta Unsigned	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	0	AI1 Negative Delta	R/W
	2		Array 16bit unsigned	0	AI2 Negative Delta	R/W
	3		Array 16bit unsigned	0	AI3 Negative Delta	R/W
	4		Array 16bit unsigned	0	AI4 Negative Delta	R/W
0x6428	0	Analogue Input Interrupt Positive Delta Unsigned	Array 8bit unsigned	4	Number of analogue inputs	R
	1		Array 16bit unsigned	0	AI1 Positive Delta	R/W
	2		Array 16bit unsigned	0	AI2 Positive Delta	R/W

Idx	S - Idx	Name	Type	Default	Description	R/W
	3		Array 16bit unsigned	0	AI3 Positive Delta	R/W
	4		Array 16bit unsigned	0	AI4 Positive Delta	R/W
0x6443	0	Analogue Output Error Mode	Array 8bit unsigned	4	Number of analogue outputs	R
	1		Array 16bit unsigned	1	AO1 Error Mode	R/W
	2		Array 16bit unsigned	1	AO2 Error Mode	R/W
	3		Array 16bit unsigned	1	AO3 Error Mode	R/W
	4		Array 16bit unsigned	1	AO4 Error Mode	R/W
0x6444	0	Analogue Output Error Value Integer	Array 8bit unsigned	4	Number of analogue outputs	R
	1		Array 16bit unsigned	0	AO1 Error Value	R/W
	2		Array 8bit unsigned	0	AO2 Error Value	R/W
	3		Array 8bit unsigned	0	AO3 Error Value	R/W
	4		Array 8bit unsigned	0	AO4 Error Value	R/W
0x67FE	0	Error Behaviour	Array 8bit unsigned	1	Sub-index number	R
	1		Array 8bit unsigned	0	Communication error (see object 0x1029)	R/W

9.7 EDS Files

EDS files of the different models are available on the download area of www.pixsys.net.

10 CANopen in details

CAN (Controller Area Network) is a Multimaster bus system. Messages are sent to the bus with a certain priority, defined by COB ID (Communication Object Identifier). CANopen is a networking concept defined as an application layer by DS 301 CIA specification (CAN in automation). CANopen is built on top of CAL (CAN Application Layer, an high layer communication protocol for CAN-based network). CAL defines 4 application layer service elements:

- **CMS** (CAN-based Message Specification): it defines a set of objects (Variable, Event, Domain) to specify how CAN interface can access to the network node features.

- **NMT** (Network Management): it defines all typical services of a master-slave concept network as initialisation, start and stop node, detection of failures.
- **DBT** (Distributor): it defines a dynamic distribution of CAN identifiers to the nodes of the network, called COB-ID (Communication Object Identifier)
- **LMT** (Layer Management): it offers the possibility to change parameters as NMT address of a node, bit-timing and baud rate of CAN interface.

CMS defines 8 priority levels, 220 **COB-ID** each. Others identifiers are reserved for NMT, DBT and LMT.

CAN Application Layer (CAL)

COB-ID	Description
0	NMT start/stop services
1..220	CMS object priority 0
221..440	CMS object priority 1
441..660	CMS object priority 2
661..880	CMS object priority 3
881..1100	CMS object priority 4
1101..1320	CMS object priority 5
1321..1540	CMS object priority 6
1541..1760	CMS object priority 7
1761..2015	NMT Node Guarding
2016..2031	NMT, LMT, DBT services

10.1 Object Dictionary

The object dictionary is the most important point of a CANopen device where all configuration information and data are stored. It is an ordered group of objects, where each one is addressed using a 16bit index. Organization of dictionary is based on tables and contains three areas of CANopen objects:

- **Communication Profile Area** (addresses 0x1000-0x1FFF): this profile contains all parameters relevant for CANopen communication and it is common for all CANopen devices.
- **Manufacturer Specific Profile Area** (addresses 0x2000-0x5FFF): in this profile, each manufacturer can implement its own company specific objects.
- **Standardized Device Profile Area** (addresses 0x6000-0x9FFF): this profile contains all objects which are assisted by a certain device profile. The bus coupler assists the device profile DS-401 (Device Profile for Generic I/O Modules).

In the object dictionary, a logical addressing scheme is used for the access to communication and device parameters, data and functions.
Each entry into the dictionary is identified by a 16 bit index which indicates the row address of the table. A maximum of 65536 entries are permitted.
If an object is composed of several components, the components are identified by means of an 8 bit sub-index. The sub-index indicates the individual column address of the table allowing a maximum of 256 entries.

If index only consists of simple variables (8bit unsigned, 16bit unsigned, ecc.), sub-index is always zero. For more objects, as array, records, ecc. sub-index 0 indicates the maximum number of the following sub-indexes.

Data are encoded in these sub-index:
- Name of the object: describe funtions
- Attribute: indicates the data type
- Access attribute: read only, wirte only. read/write.

CANopen object dictionary structure

Index (Exadecimal)	Object
0x0000	Not used
0x0001- 0x001F	Static data types
0x0020 - 0x003F	Complex data types
0x0040 - 0x005F	Manufacturer specific data types
0x0060 - 0x007F	Profile specific static data types
0x0080 - 0x009F	Profile specific complex data types
0x00A0 - 0x0FFF	Reserved
0x1000 - 0x1FFF	Communication Profile (DS-301)
0x2000 - 0x5FFF	Manufacturer specific parameters
0x6000 - 0x9FFF	Parameters from standardized device profiles
0xA000 - 0xFFFF	Reserved

10.1.1 CANopen communication model

CANopen defines 4 message types:

1 **Administrative message**: layer management, network management and identifier distribution services (initialisation, configuration and supervision network). Services and protocols are according to LMT, NMT and DBT elements.

2 **Service Data Object (SDO)**: it provides client access to objects of object dictionary of the device (server) using index and subindex. A replay is generated for every CAN message: one SDO requires 2 CANidentifiers. SDO request and reply message always contains 8 bytes.

3 **Process Data Object (PDO)**: it provides transfer real-time data. Data transfer is limited from 1 to 8 bytes, and it's content is defined by its CAN-identifier only.
Each PDO is described by 2 object in the object dictionary:
- **PDO Communication Parameter**: it contains COB-ID used, transmission type, inhibit time and time period
- **PDO Mapping Parameter**: it contains a list of entries of object dictionary mapped in PDO. It's configurable using SDO messages if "variable PDO mapping" is supported by devices.

There are 2 types of PDO transmission:

1 **Synchronous**: it's regulated by receipt of a SYNC object (**acyclic**, means not periodically, or cyclic, means that transmission is periodically triggered every 1,2,..,240 by SYNC messages).

2 **Asynchronous**: transmission is triggered by a remote transmission request from another device, or it's triggered by configuration of an object specific event specified in the device profile (input change of value, or a timer event...)

- **Inhibit time** for a PDO defines minimum time between two consecutive PDO transmission. It's a part of PDO Communication Parameter and it's defined as an unsigned 16bit integer (unit is 100µsec).
- **Event time period** for a PDO defines where PDO transmission is periodically triggered when a specific time has elapsed. It's defined as an unsigned 16bit integer (unit is millisecond). PDO transmit data without overhead and messages aren't confirmed: one PDO requires one CAN-identifier (no more than 8 bytes can be transferred with 1 PDO).

4 **Predefined Messages or Special Function Objects**. It's a list of predefined and important messages:

- **Synchronization (SYNC)**: it regulates input/output transmission and update through PDO synchronization. It is in the highest priority COBID and no data bytes are transferred to ensure message as short as possible.
- **Time Stamp**: It provides application devices a common time frame reference.
- **Emergency**: the event is triggered by device internal errors.
- **Node/Life Guarding**: NMT master monitors nodes status (node guarding). Nodes optionally monitor NMT master status (life guarding): it starts on the NMT slave after it has received the first node guarding message from NMT master. It detects errors in the network interfaces of devices: a remote transmission request from NMT master to a particular node triggers a reply containing node status.
- **Boot-up**: NMT slave send this message when it has transitioned from Initialising to Pre-Operational status.

SDO is typically used for device configuration in a CANopen network, while PDO is used for fast data transfer. All CANopen devices should have at least one PDO, all other communication objects are optional.

10.1.2 CANopen Pre-defined Connection Set

When a device has to reply a master request, a default CAN-identifier scheme is used. It's based on a 11bit frame, where the first 7bit (LSB) are used for **Node-ID** (range 1...127, defined by specific manufacturer configuration), and the last 4bit (MSB) are used for **Function Code**.

MSB									LSB
10	9	8	7	6	5	4	3	2	1
Function code				Node-ID					

Pre-defined connection set defines 4 Rx PDOs, 4 TX PDOs, 1 SDO, 1 Emergency Object and 1 Node-Error-Control Identifier1. It also support broadcasting of non-confirmed NMT Module Control Services, SYNC and Time Stamp objects.

Complete CAN-identifier scheme is shown below:

Broadcast objects of CANopen Pre-defined Connection Set

Object	Function Code (bit 7...10)	COB-ID	Communication parameters
NMT Module Control	0000	0x000	-
SYNC	0001	0x080	0x1005, 0x1006, 0x1007
Time Stamp	0010	0x100	0x1012, 0x1013

Peer-to-Peer objects of CANopen Pre-defined Connection Set

Object	Function Code (bit 7...10)	COB-ID	Communication parameters
Emergency	0000	0x81 – 0xFF	0x1024, 0x1015
PDO1 (transmit)	0011	0x181 – 0x1FF	0x1800
PDO1 (receive)	0100	0x201 – 0x27F	0x1400
PDO2 (transmit)	0101	0x281 – 0x2FF	0x1801
PDO2 (receive)	0110	0x301 – 0x37F	0x1401
PDO3 (transmit)	0111	0x381 – 0x3FF	0x1802
PDO3 (receive)	1000	0x401 – 0x47F	0x1402
PDO4 (transmit)	1001	0x481 – 0x4FF	0x1803
PDO4 (receive)	1010	0x501 – 0x57F	0x1403
SDO (transmit/receive)	1011	0x581 – 0x5FF	0x1200
SDO (receive/client)	1100	0x601 – 0x67F	0x1200
NMT Error Control	1110	0x701 – 0x77F	0x1016, 0x1017

All peer-to-peer identifiers are different so only one master device can communicate to each slave node (up to 127 nodes). Two slaves aren't able to communicate because they don't know each other's node-ID, master only knows them.

10.1.3 CANopen identifier distribution

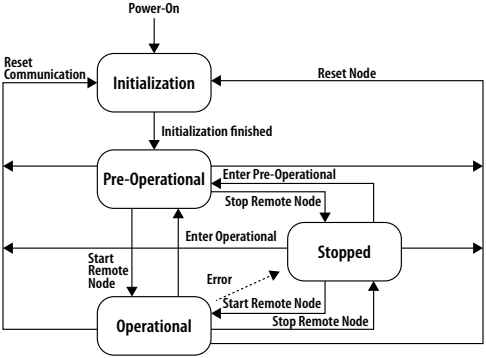
COB-ID's allocation can be made in 3 ways:

- **Pre-defined Connection Set:** it's mode shown in the previous section. Allocation is default setting, no others configuration is needed.
- **PDO identifiers (COB-IDs):** can be modified after powering-up device, when it's in Pre-Operational status (see next section). In this status, it's possible to write new values to Object Dictionary allocation by SDO.
- **Using DBT (Distributor, a CAL service):** nodes are initially identified by their configured node-ID. Node-ID of slave nodes may be configured by internal dip-switches or LMT (Layer Management, a CAL service). When network initialises and boots, master provides a connectionì with each connected slave with a 'telegram' (NMT service). Once this connection has been established, DBT

provides allocation of CAN identifiers for communication of SDOs and PDOs to the node.

10.1.4 CANopen boot-up process

Networks initialisation supports two boot-up process: Minimum boot-up and Extended boot-up. The first one is a pre-required process for a CANopen device, the second one is optional, but necessary if COB-IDs have to be allocated by DBT services1. State-transition diagram shows a CANopen minimum bootup node.



NMT services allow changing status nodes at any time. NMT message consists of CAN-header (COB-ID = 0) and 2 data bytes. One byte contains the requested service (NMT command specifier) and other byte contains Node-ID (0 for broadcasting mode). A CANopen network can only have one NMT master, which brings NMT messages and controls initialisation process. CANopen device supporting only minimum boot-up enter Pre-Operational status automatically after ending device initialisation. In this status setting device parameters and COB-ID allocation are possible by SDO only. ETD1644-AD module switches automatically to Pre-Operational status when boot-up is completed.

10.1.5 Communication profile: initialization

In the most common case, a default configuration is assigned to Object dictionary, if there aren't other configuration saved by user. ETD1644-AD module has no mapped PDO by default.

10.2 Communication Profile Area

The following table shows all the supported communication profile objects:

Index	Name	Type	R/W
0x1000	Device type	32bit unsigned	CONST
0x1001	Error register	8bit unsigned	R

0x1003	Pre-defined Error Field	Array 32bit unsigned	R/W
0x1005	COB-ID SYNC message	32bit unsigned	R
0x1006	Communication Cycle Period	32bit unsigned	R/W
0x1008	Manufacturer Device Name	String	CONST
0x1009	Manufacturer Hardware Version	String	CONST
0x100A	Manufacturer Software Version	String	CONST
0x100B	Node ID	8bit unsigned	R
0x100C	Guard Time	16bit unsigned	R/W
0x100D	Life Time Factor	8bit unsigned	R/W
0x1010	Store Parameters	Array 32bit unsigned	R/W
0x1011	Restore default Parameter	Array 32bit unsigned	R/W
0x1014	COB-ID Emergency Object	32bit unsigned	R
0x1015	Inhibit time Emergency Object	16bit unsigned	R/W
0x1017	Producer Heartbeat Time	16bit unsigned	R/W
0x1018	Identity Object	Record 32bit unsigned	R
0x1029	Error Behaviour	Array 8bit unsigned	R/W
0x1400	Receive PDO1 communication parameter	Record 32bit unsigned	R/W
0x1401	Receive PDO2 commun. parameter	Record 32bit unsigned	R/W
0x1402	Receive PDO3 commun. parameter	Record 32bit unsigned	R/W
0x1403	Receive PDO4 commun. parameter	Record 32bit unsigned	R/W
0x1600	Receive PDO1 mapping parameter	Record 32bit unsigned	R/W
0x1601	Receive PDO2 mapping parameter	Record 32bit unsigned	R/W
0x1602	Receive PDO3 mapping parameter	Record 32bit unsigned	R/W
0x1603	Receive PDO4 mapping parameter	Record 32bit unsigned	R/W
0x1800	Transmit PDO1 communication parameter	Record 32bit unsigned	R/W
0x1801	Transmit PDO2 commun. parameter	Record 32bit unsigned	R/W
0x1802	Transmit PDO3 commun. parameter	Record 32bit unsigned	R/W
0x1803	Transmit PDO4 commun. parameter	Record 32bit unsigned	R/W
0x1A00	Transmit PDO1 mapping parameter	Record 32bit unsigned	R/W
0x1A01	Transmit PDO2 mapping parameter	Record 32bit unsigned	R/W
0x1A02	Transmit PDO3 mapping parameter	Record 32bit unsigned	R/W
0x1A03	Transmit PDO4 mapping parameter	Record 32bit unsigned	R/W

10.2.1 Device Type

This object indicates device type profile:

Index	Subindex	Name	Type	Default	R/W
0x1000	0	Device type	32bit unsigned	-	CONST

Structure:

Bit 24…31 MSB	Bit 16…23	Bit 8...15	Bit 0...7 LSB
0x00	$0000b_{19}\ b_{18}\ b_{17}\ b_{16}$	0x01	0x91

b_{16}	0	If no **digital input** is connected
	1	If at least one **digital input** is connected
b_{17}	0	If no **digital output** is connected
	1	If at least one **digital output** is connected
b_{18}	0	If no **analogue input** is connected
	1	If at least one **analogue input** is connected
b_{19}	0	If no **analogue output** is connected
	1	If at least one **analogue output** is connected

For ETD1644-AD the value is 0x000E0191.
Least significant word (LSW) is always 0x0191 = 401_{dec}CAN DS standard.

10.2.2 Error Register

This object contains internal errors and it's a subset of emergency message.

Index	Sub - index	Nome	Tipo	Default	R/W
0x1001	0	Error register	8bit unsigned	-	R

Structure:

Bit number	Meaning
0	General error
1	Current
2	Voltage
3	Temperature

Bit number	Meaning
4	Communication
5	Device profile specific
6	Reserved
7	Manufacturer specific

If an error occurs, bit 0 is always set 1.

10.2.3 Pre-defined Error Field

This object contains information about last 10 errors occurred. New errors will be entered in subindex 1, and error in subindex 10 will be lost.

Index	Subindex	Name	Type	Default	R/W
0x1003	0	Number of error	Array 8bit unsigned	-	R/W
	1	Standard error field (always last error)	Array 32bit unsigned	-	R
	...	...	...	-	...
	10	Standard error field (first error)	Array 32bit unsigned	-	R

Structure:

Bit 16..31 MSW	Bit 0..15 LSW
Additional info	Error code

Additional info are first 2 bytes of additional code of Emergency telegram.
Error code is error code in the Emergency telegram.

10.2.4 COB-ID SYNC message

This object contains COB-ID for synchronization message.

Index	Subindex	Name	Type	Default	R/W
0x1005	0	COB-ID SYNC	32bit unsigned	0x00000080	R

Structure:

Bit 16..31 MSW	Bit 0..15
0 (reserved)	COB-ID

10.2.5 Communication Cycle Period

This object contains maximum time (msec) between 2 SYNC messages (resolution 2msec). If value is 0, no SYNC monitoring is realized.

Index	Subindex	Name	Type	Default	R/W
0x1006	0	Communication Cycle Period	32bit unsigned	0	R/W

10.2.6 Manufacturer Device Name

Index	Subindex	Name	Type	Default	R/W
0x1008	0	Manufacturer Device Name	String	ETD1	CONST

10.2.7 Manufacturer Hardware Version

Index	Subindex	Name	Type	Default	R/W
0x1009	0	Manufacturer Hardware Version	String	Actual hardware version	CONST

10.2.8 Manufacturer Software Version

Index	Subindex	Name	Type	Default	R/W
0x100A	0	Manufacturer Software Version	String	Actual software version	CONST

10.2.9 Node ID

Index	Subindex	Name	Type	Default	R/W
0x100B	0	Node ID	8bit unsigned	0	R

10.2.10 Guard Time

This object defines Guarding Time (time between 2 interrogation, in msec).

Index	Subindex	Name	Type	Default	R/W
0x100C	0	Guard Time	16bit unsigned	0	R/W

10.2.11 Life Time Factor

This object is a part of Node Guarding Protocol. If it's equal to 0, no monitoring is realized.

Index	Subindex	Name	Type	Default	R/W
0x100D	0	Life Time Factor	8bit unsigned	0	R/W

10.2.12 Store Parameters

This object stores user's setting parameters permanently, if signature "save" (ASCII 0x65766173) is written into subindex 1.

Index	Subindex	Name	Type	Default	R/W
0x1010	0	Number of sub-index	Array 8bit unsigned	1	R
	1	Store all parameters	Array 32bit unsigned	1 (string "save" to store)	R/W

10.2.13 Restore Default Parameters

This object allows to reset user stored parameters and load default values. If signature "load" (ASCII 0x64616F6C) is written on Sub-index 1, standard default parameters are loaded each power on (until next "save" command is written).

Index	Subindex	Name	Type	Default	R/W
0x1011	0	Number of sub-index	Array 8bit unsigned	2	R
	1	Load standard default parameters	Array 32bit unsigned	1 (string "load" for standard default)	R/W

10.2.14 COB-ID Emergency Object

Index	Subindex	Name	Type	Default	R/W
0x1014	0	COB-ID EMCY	32bit unsigned	0x80 + module - ID	R

Structure:

Bit 31	Bit 11...30	Bit 0...10
0(valid) / 1(invalid)	0 Reserved	COB-ID

10.2.15 Inhibit Time Emergency Object

This object indicates time have to be elapsed before sending another Emergency (minutes).

Index	Subindex	Name	Type	Default	R/W
0x1015	0	Inhibit Time EMCY	16bit unsigned	0	R/W

10.2.16 Producer Heartbeat Time

This object contains time between two Heartbeat messages (milliseconds). If it's equal to 0, no Heartbeat is sent.

Index	Subindex	Name	Type	Default	R/W
0x1017	0	Producer Heartbeat Time	16bit unsigned	0	R/W

10.2.17 Identity Object

This object specifies device and manufacturer.

Index	Subindex	Name	Type	Default	R/W
0x1018	0	Number of Sub-index	Record 8bit unsigned	4	R
	1	Manufacturer ID	Record 32bit unsigned	PIX	R
	2	Device description	Record 32bit unsigned	ETD1	R
	3	Revision number	Record 32bit unsigned	-	R
	4	Serial number	Record 32bit unsigned	-	R

10.2.18 Error Behaviour

This object specifies into which states modules changes in case of communication error.

Index	Subindex	Name	Type	Default	R/W
0x1029	0	Number of Sub-index	Array 8bit unsigned	1	R
	1	Communication error	Array 8bit unsigned	0	R/W

Structure:

Communication error	Action
0	Change into status PRE-OPERATIONAL (only if actual status were OPERATIONAL)
1	No status change
2	Change into status STOPPED

10.2.19 Receive PDO Communication Parameter

This object set communication parameters of Rx PDO supported. **Default** COB-ID of PDO is set by DS301 standard.

Index	Subindex	Name	Type	Default	R/W
0x1400 0x1401 0x1402 0x1403	0	Number of Sub-index	Record 8bit unsigned	2	R
	1	COB-ID	Record 32bit unsigned	- 0x1400 0x200 + Module-ID - 0x1401 0x300 + Module-ID - 0x1402 0x400 + Module-ID - 0x1403 0x500 + Module-ID	R/W
	2	Transmission type	Record 8bit unsigned	255	R/W

COB-ID Structure:

Bit 31	Bit 30	Bit 29...11	Bit 0...10
0(valid) / 1(invalid)	0(RTR allowed) / 1(RTR not allowed)	0 Reserved	COB-ID

Digital and Analogue inputs are transmitted as Change Of Value (COV). Type of transmission depending upon set transmission type and it's explained in the following table (RTR = Remote Transmission Request received):

Transmis-sion Type	PDO transmission						
	cyclic	acyclic	synchro-nous	asynchro-nous	only RTR	TxPDO (inputs)	RxPDO (outputs)
0		X	X			If COV is transmitted with each SYNC	Set outputs after each SYNC as requested by last PDO received
1...240	X		X			Transmis-sion with each i SYNC (i = 1...240)	Set outputs after each SYNC as requested by last PDO received
241..251	Reserved						

252	X		X	Data is read again with a SYNC, but not sent, request via RTR	Not supported
253		X	X	Request via RTR	COV
254		X		COV	COV
255		X		COV	COV

10.2.20 Receive PDO Mapping Parameter

This object defines data transmitted by PDO. Subindex 0 contains number of objects valid for PDO.

Index	Subindex	Name	Type	Default	R/W
0x1600 0x1601 0x1602 0x1603	0	Number of object	Record 8bit unsigned	-	R/W
	1...8	PDO mapping object	Record 32bit unsigned	-	R/W

Object structure:

Bit 16..31	Bit 8..15	Bit 0..7
Index	Sub-index	Object size

Index: object index to be transmitted
Subindex: object subindex to be transmitted
Object size: object size in bits (no more than 8 bytes can be transmitted in a PDO, so sum of valid object lengths have not to exceed 64.

10.2.21 Transmit PDO Communication Parameter

This object set communication parameters of Tx PDO supported. **Default** COB-ID of PDO is set by DS301 standard.

Index	Subindex	Name	Type	Default	R/W
0x1800 0x1801 0x1802 0x1803	0	Number of Sub-index	Record 8bit unsigned	5	R

1	COB-ID	Record 32bit unsigned	- 0x1800 0x180 + Module-ID - 0x1801 0x280 + Module-ID - 0x1802 0x380 + Module-ID - 0x1803 0x480 + Module-ID	R/W
2	Transmission type	Record 8bit unsigned	255	R/W
3	Inhibit Time	Record 16bit unsigned	0	R/W
5	Event Timer	Record 16bit unsigned	0	R/W

COB-ID Structure:

Bit 31	Bit 30	Bit 29...11	Bit 0...10
0(valid) / 1(invalid)	0(RTR allowed) / 1(RTR not allowed)	0 Reserved	COB-ID

Digital and Analogue inputs are transmitted as Change Of Value (COV). Type of transmission depending upon set transmission type and it's explained in the following table:

Transmis-sion Type	PDO transmission						
	cyclic	acyclic	synchro-nous	asynchro-nous	only RTR	TxPDO (inputs)	RxPDO (outputs)
0		X	X			If COV is transmitted with each SYNC	Set outputs after each SYNC as requested by last PDO received
1...240	X		X			Transmissi on with each i SYNC (i = 1...240)	Set outputs after each SYNC as requested by last PDO received
241..251	Reserved						

252	X		X	Data is read again with a SYNC, but not sent, request via RTR	Not supported
253		X	X	Request via RTR	COV
254		X		COV	COV
255		X		COV	COV

Inhibit Time is minimum time between two consecutive PDOs with same COB-ID (unit time 100msec).
Event Timer defines time after the elapsed of a sent PDO, even if no change of data has occured (millisecond). It can be used only for transmission types 254 and 255.

10.2.22 Transmit PDO Mapping

This object defines data transmitted by PDO. Subindex 0 contains number of objects valid for PDO.

Index	Subindex	Name	Type	Default	R/W
0x1A00 0x1A01 0x1A02 0x1A03	0	Number of object	Record 8bit unsigned	-	R/W
	1...8	PDO mapping object	Record 32bit unsigned	-	R/W

Object structure:

Bit 16...31	Bit 8...15	Bit 0...7
Index	Sub-index	Object size

Index: object index to be transmitted
Subindex: object subindex to be transmitted
Object size: object size in bits (no more than 8 bytes can be transmitted in a PDO, so sum of valid object lengths have not to exceed 64.

10.3 Manufacturer Specific Parameter Area

The following table shows all Pixsys specific parameters objects supported:

Index	Name	Type	R/W
0x2000	Device specifications	Array 16bit signed	R/W
0x3000	ETD1644-AD Parameters	Array 16bit signed	R/W
0x3001	Encoder/counters counts	Array 32bit signed	R/W
0x3002	Encoder/counters preset counts	Array 32bit signed	R/W
0x3003	Encoder/counters counts	Array 8bit unsigned	R/W
0x3004	Encoder/counters counts per 1s	Array 32bit signed	R/W
0x3005	Encoder/counters counts per 100ms	Array 32bit signed	R/W

10.3.1 Device specification

This object defines some EDT1644-AD configuration parameters:

Index	Subindex	Name	Type	Default	R/W
0x2000	0	Number of Sub-index	Array 16bit signed	7	R
	1	Baud rate	Array 16bit signed	6	R
	2	Boot-up time	Array 16bit signed	120	R/W
	3	CANopen state after boot-up	Array 16bit signed	0x7F	R/W
	4...7	...	Reserved		R/W

1 Baud rate *(idx 0x2000, s-idx 1)*

Only reading. Can be modified by dip switch.

0 50 kbit/s
1 62.5 kbit/s
2 100 kbit/s
3 125 kbit/s
4 250 kbit/s
5 500 kbit/s
6 1 Mbit/s (**Default**)

2 Tempo boot-up *(idx 0x2000, s-idx 2)*

Defines boot-up time duration (units of 10 ms)
10..1000 centimes of s (10 = 100ms .. 100 = 1s). (**Default**: 120)

3 Stato CANopen dopo boot-up *(idx 0x2000, s-idx 3)*

CANopen standard defines that, once ended boot-up, the device will automatically switch to Pre-Operational status. This is the default configuration (0x7F), but it is possible to switch to other status:

0 Boot-up
4 Stopped
5 Operational
0x7F Pre-operational (**Default**)

10.3.2 ETD1644-AD Parameters

The object index 0x3000 defines all ETD1644-AD configuration parameters.
The sub-index (1..143) identifies each parameter described below:

Index	Subindex	Name	Type	Default	R/W
0x3000	0	Number of Sub-index	Array 16bit signed	100	R
	1..100	ETD1644-AD parameters	Array 16bit signed	-	R/W

10.3.2.1 GROUP A - ANALOGUE INPUT

1 AI1 Sensor type *(idx 0x3000, s-idx 1)*
2 AI2 Sensor type *(idx 0x3000, s-idx 2)*
3 AI3 Sensor type *(idx 0x3000, s-idx 3)*
4 AI4 Sensor type *(idx 0x3000, s-idx 4)*

Analogue input configuration / sensor selection

0	Disabled	(**Default**)
1	Tc-K	-260 °C..1360 °C
2	Tc-S	-40 °C..1760 °C
3	Tc-R	-40 °C..1760 °C
4	Tc-J	-200 °C..1200 °C
5	Tc-T	-260 °C..400 °C
6	Tc-E	-260 °C..980 °C
7	Tc-N	-260 °C..1280 °C
8	Tc-B	100 °C..1820 °C
9	Pt100	-100 °C..600 °C
10	Ni100	-60 °C..180 °C
11	NTC10K	-40 °C..125 °C
12	PTC1K	-50 °C..150 °C
13	Pt500	-100 °C..600 °C
14	Pt1000	-100 °C..600 °C
15	0..1V	
16	0..5V	
17	0..10 V	
18	0..20 mA	
19	4..20 mA	
20	0..60 mV	
21	Potenziometer (set the value on parameters 14..17)	

5 Degrees type *(idx 0x3000, s-idx 5)*

0	°C	Centigrade (**Default**)
1	°F	Fahrenheit
2	K	Kelvin

6 AI1 Lower Linear Input *(idx 0x3000, s-idx 6)*
7 AI2 Lower Linear Input *(idx 0x3000, s-idx 7)*
8 AI3 Lower Linear Input *(idx 0x3000, s-idx 8)*
9 AI4 Lower Linear Input *(idx 0x3000, s-idx 9)*

Range lower limit only for linear input. Ex: with input 4..20 mA this parameter takes value associated to 4 mA.
-32767..+32767, **Default**: 0.

10 AI1 Upper Linear Input *(idx 0x3000, s-idx 10)*
11 AI2 Upper Linear Input *(idx 0x3000, s-idx 11)*
12 AI3 Upper Linear Input *(idx 0x3000, s-idx 12)*
13 AI4 Upper Linear Input *(idx 0x3000, s-idx 13)*

Range upper limit only for linear input. Ex: with input 4..20 mA this parameter takes value associated to 20 mA.
-32767..+32767. **Default**:1000

14 AI1 Potentiometer Value *(idx 0x3000, s-idx 14)*
15 AI2 Potentiometer Value *(idx 0x3000, s-idx 15)*
16 AI3 Potentiometer Value *(idx 0x3000, s-idx 16)*
17 AI4 Potentiometer Value *(idx 0x3000, s-idx 17)*

Select potentiometer value
1..150 kohm. **Default**: 10kohm

18 AI1 Linear Input over Limits *(idx 0x3000, s-idx 18)*
19 AI2 Linear Input over Limits *(idx 0x3000, s-idx 19)*
20 AI3 Linear Input over Limits *(idx 0x3000, s-idx 20)*
21 AI4 Linear Input over Limits *(idx 0x3000, s-idx 21)*

If linear input, allows process to go over limits (Parameters 6..9 and 10..13).

0	Disabled (**Default**)
1	Enabled

22 AI1 Offset Calibration *(idx 0x3000, s-idx 22)*
23 AI2 Offset Calibration *(idx 0x3000, s-idx 23)*
24 AI3 Offset Calibration *(idx 0x3000, s-idx 24)*
25 AI4 Offset Calibration *(idx 0x3000, s-idx 25)*

Value added / subtracted to the process visualization (usually correcting the value of environmental temperature).
-10000..+10000 [digit] (degrees.tenths for temperature sensors). **Default** 0.

26 AI1 Gain Calibration *(idx 0x3000, s-idx 26)*
27 AI2 Gain Calibration *(idx 0x3000, s-idx 27)*
28 AI3 Gain Calibration *(idx 0x3000, s-idx 28)*
29 AI4 Gain Calibration *(idx 0x3000, s-idx 29)*

Percentage value that is multiplied for the process value (allows to calibrated the working point). Ex: to correct the range from 0..1000°C showing 0..1010°C, set the par. to -1.0.
-1000 (100.0%)...+1000 (+100.0%), **Default**: 0.0.

30 Reserved *(idx 0x3000, s-idx 30)*
31 Reserved *(idx 0x3000, s-idx 31)*
32 Reserved *(idx 0x3000, s-idx 32)*
33 Reserved *(idx 0x3000, s-idx 33)*
34 AI1 input filter *(idx 0x3000, s-idx 34)*
35 AI2 input filter *(idx 0x3000, s-idx 35)*
36 AI3 input filter *(idx 0x3000, s-idx 36)*
37 AI4 input filter *(idx 0x3000, s-idx 37)*

Analogue input reading filter: increases process stability on word 1001, 1002, 1003, 1004. Indicates the number of samplings to be mediated on the process calculation.
1...50. (**Default**: 5)

38 AI1 and AI2 conversion frequency *(idx 0x3000, s-idx 38)*
39 AI3 and AI4 conversion frequency *(idx 0x3000, s-idx 39)*

Sampling frequency of the analog / digital converter.
NB: Low conversion speeds increase reading stability while high conversion speeds will decrease reading stability (example: for fast transients, as pressure, it is advisable to increase sampling frequency).

0	4 Hz
1	6 Hz
2	8 Hz
3	10 Hz
4	12 Hz
5	17 Hz (**Default**)
6	20 Hz
7	33 Hz
8	39 Hz
9	50 Hz
10	62 Hz
11	123 Hz
12	242 Hz
13	470 Hz

10.4 GROUP B - ANALOGUE OUTPUTS

40 AO1 output type *(idx 0x3000, s-idx 40)*
41 AO2 output type *(idx 0x3000, s-idx 41)*
42 AO3 output type *(idx 0x3000, s-idx 42)*
43 AO4 output type *(idx 0x3000, s-idx 43)*

Select the type of analogue output.

0	0..10 V (**Default**)
1	4..20 mA.

44 AO1 lower limit analogue output *(idx 0x3000, s-idx 44)*
45 AO2 lower limit analogue output *(idx 0x3000, s-idx 45)*
46 AO3 lower limit analogue output *(idx 0x3000, s-idx 46)*
47 AO4 lower limit analogue output *(idx 0x3000, s-idx 47)*

Analogue output lower limit range (value related to 0/4 mA)
-32767..+32767 [digit] **Default**: 0.

48 AO1 upper limit analogue output *(idx 0x3000, s-idx 48)*
49 AO2 upper limit analogue output *(idx 0x3000, s-idx 49)*
50 AO3 upper limit analogue output *(idx 0x3000, s-idx 50)*
51 AO4 upper limit analogue output *(idx 0x3000, s-idx 51)*

Analogue output upper limit range (value related to 10 V / 20 mA)
-32767..+32767 [digit] **Default**: 1000.

52 Reserved *(idx 0x3000, s-idx 52)*
53 Reserved *(idx 0x3000, s-idx 53)*
54 Reserved *(idx 0x3000, s-idx 54)*
55 Reserved *(idx 0x3000, s-idx 55)*

56 Reserved *(idx 0x3000, s-idx 56)*
57 Reserved *(idx 0x3000, s-idx 57)*
58 Reserved *(idx 0x3000, s-idx 58)*
59 Reserved *(idx 0x3000, s-idx 59)*

10.5 GROUP C - DIGITAL INPUTS

60 Digital inputs filter *(idx 0x3000, s-idx 60)*

Define the time during which the digital input must be steady before being considered valid
0..250 [ms], **Default**: 5 ms.

61 Encoder/counter 1 setup *(idx 0x3000, s-idx 61)*
62 Encoder/counter 2 setup *(idx 0x3000, s-idx 62)*
63 Encoder/counter 3 setup *(idx 0x3000, s-idx 63)*
64 Encoder/counter 4 setup *(idx 0x3000, s-idx 64)*

Determine the operating mode of the encoder or the undirectional counter input.

0	Disabled (**Default**).
1	Encoder phase A-B.
2	Encoder phase A-B-Z.
3	Counter Up.
4	Counter Down.

65 Encoder/counter 1 H preset value*(idx 0x3000, s-idx 65)*
66 Encoder/counter 1 L preset value*(idx 0x3000, s-idx 66)*
67 Encoder/counter 2 H preset value*(idx 0x3000, s-idx 67)*
68 Encoder/counter 2 L preset value*(idx 0x3000, s-idx 68)*
69 Encoder/counter 3 H preset value *(idx 0x3000, s-idx 69)*
70 Encoder/counter 3 L preset value*(idx 0x3000, s-idx 70)*
71 Encoder/counter 4 H preset value*(idx 0x3000, s-idx 71)*
72 Encoder/counter 4 L preset value*(idx 0x3000, s-idx 72)*

Determine the value that will be loaded to the encoder/counter registry in case of "load preset value" command (see address 1108). This register is a 32bit value so, in case of Modbus communication, It will be assigned using two concecutives 16bit words.
-32767..+32767 [digit], **Default**: 0.

73 Reserved *(idx 0x3000, s-idx 73)*

74 Reserved *(idx 0x3000, s-idx 74)*

10.6 GROUP D - SERIAL

75 Modbus offline time *(idx 0x3000, s-idx 75))*

If Modbus protocol is active, determine the time of serial inactivity before offline status.

0	Offline disabled (**Default**)
1..60000 [ms]	Inactivity before offline.

76 Modbus serial format *(idx 0x3000, s-idx 76))*

Determine the data format for the Modbus port.

0	8,n,1 (**Default**).
1	8,o,1
2	8,e,1
3	8,n,2
4	8,o,2
5	8,e,2

77 Modbus serial delay (idx 0*x3000, s-idx* 77

Determine the dealy between the answer of the module after an interrogation of the master (only in Modbus communication).
0..+100 [ms], **Default**: 5.

78÷100 Reserved *(idx 0x3000, s-idx 78..100)*

10.6.1 Encoder/counters counts

Number of encoder/counters *(idx 0x3001, s-idx 0)* **8bit unsigned**
Encoder/counter 1 counts *(idx 0x3001, s-idx 1)* **32bit signed**
Encoder/counter 2 counts *(idx 0x3001, s-idx 2)* **32bit signed**
Encoder/counter 3 counts *(idx 0x3001, s-idx 3)* **32bit signed**
Encoder/counter 4 counts *(idx 0x3001, s-idx 4)* **32bit signed**

This object contains the registers of encoder/counters counts
-2147483648...2147483647 [digit]

10.6.2 Encoder/counters preset counts

Number of encoder/counters *(idx 0x3002, s-idx 0)* **8bit unsigned**
Encoder/counter 1 preset counts *(idx 0x3002, s-idx 1)* **32bit signed**
Encoder/counter 2 preset counts *(idx 0x3002 s-idx 2)* **32bit signed**
Encoder/counter 3 preset counts *(idx 0x3002, s-idx 3)* **32bit signed**
Encoder/counter 4 preset counts *(idx 0x3002, s-idx 4)* **32bit signed**

This object contains the registers of the preset values of encoder/counters
-2147483648...2147483647 [digit]

10.6.3 Encoder/counters commands

Number of encoder/counters *(idx 0x3003, s-idx 0)* **8bit unsigned**
Encoder/counter 1 commands *(idx 0x3003, s-idx 1)* **8bit signed**
Encoder/counter 2 commands *(idx 0x3003 s-idx 2)* **8bit signed**
Encoder/counter 3 commands *(idx 0x3003, s-idx 3)* **8bit signed**
Encoder/counter 4 commands *(idx 0x3003, s-idx 4)* **8bit signed**

This object contains the registers of all commands to control encoder/counters

0	No command
1	Loading encoder with preset value
2	Loading encoder with preset value at the next Z signal

10.6.4 Encoder/counters counts - 1s

Number of encoder/counters *(idx 0x3004, s-idx 0)* **8bit unsigned**
Encoder/counter 1 counts - 1s *(idx 0x3004, s-idx 1)* **32bit signed**
Encoder/counter 2 counts - 1s *(idx 0x3004 s-idx 2)* **32bit signed**
Encoder/counter 3 counts - 1s *(idx 0x3004, s-idx 3)* **32bit signed**
Encoder/counter 4 counts - 1s *(idx 0x3004, s-idx 4)* **32bit signed**

This object contains the registers of the values in counts of the encoder / counters variation detected each 1s
-2147483648...2147483647 [digit]

10.6.5 Encoder/counters counts - 100ms

Number of encoder/counters *(idx 0x3005, s-idx 0)* **8bit unsigned**
Encoder/counter 1 counts - 100ms *(idx 0x3005, s-idx 1)* **32bit signed**
Encoder/counter 2 counts - 100ms *(idx 0x3005 s-idx 2)* **32bit signed**
Encoder/counter 3 counts - 100ms *(idx 0x3005, s-idx 3)* **32bit signed**
Encoder/counter 4 counts - 100ms *(idx 0x3005, s-idx 4)* **32bit signed**

This object contains the registers of the values in counts of the encoder / counters variation detected each 100ms
-2147483648...2147483647 [digit]

10.7 Standard Device Profile Area

The table below indicates all supported Pixsys parameters:

Index	Name	Type	R/W
0x6000	Digital Input	Array 8bit unsigned	R
0x6005	Global Interrupt Enable Digital	Array 8bit unsigned	R/W
0x6006	Interrupt Mask Any Change	Array 8bit unsigned	R/W
0x6007	Interrupt Mask Low-to-High	Array 8bit unsigned	R/W
0x6008	Interrupt Mask High-to-Low	Array 8bit unsigned	R/W
0x6200	Digital Output	Array 8bit unsigned	R/W
0x6206	Digital Output Error Mode	Array 8bit unsigned	R/W
0x6207	Digital Output Error Value	Array 8bit unsigned	R/W
0x6401	Read Analogue input 16bit	Array 16bit unsigned	R
0x6411	Write Analogue output 16bit	Array 16bit unsigned	R/W
0x6421	Analogue input Trigger Selection	Array 8bit unsigned	R/W
0x6423	Analogue input Global Interrupt Selection	Boolean	R/W
0x6424	Analogue input Interrupt Upper Limit Integer	Array 16bit unsigned	R/W
0x6425	Analogue input Interrupt Lower Limit Integer	Array 16bit unsigned	R/W
0x6426	Analogue input Interrupt Delta Unsigned	Array 16bit unsigned	R/W
0x6427	Analogue input Negative Delta Unsigned	Array 16bit unsigned	R/W
0x6428	Analogue input Positive Delta Unsigned	Array 16bit unsigned	R/W
0x6443	Analogue Output Error Mode	Array 16bit unsigned	R/W
0x6444	Analogue Output Error Value	Array 16bit unsigned	R/W
0x67FE	Error Behaviour	Array 8bit unsigned	R/W

10.7.1 Digital Input

This object contains data of digital output modules. Sub-index 1 first 8 inputs (1..8) Sub-index 2 last 8 inputs (9..16).

Index	Subindex	Name	Type	Default	R/W
0x6000	0	Number of entries	Array 8bit unsigned	-	R
	1	1st output block	Array 8bit unsigned	0	R/W
	2	2nd output block	Array 8bit unsigned	0	R/W

10.7.2 Global Interrupt Enable digital

This object allows digital input transmission by PDO. If value is 1, transmission is generally released and it's regulated by objects 0x6006, 0x6007, 0x6008 and type of PDO transmission. If value is 0, digital input isn't transmitted.

Index	Subindex	Name	Type	Default	R/W
0x6005	0	Global Interrupt Enable Analogue input 16bit	Boolean	1	R/W

10.7.3 Interrupt Mask Any Change

This object is used to define digital input channel, which will send its data in a event of a change (Global Interrupt has to be enabled, 0x6005=1).

Index	Subindex	Name	Type	Default	R/W
0x6006	0	Number of entries	Array 8bit unsigned	2	R
	1	1st output block	Array 8bit unsigned	255	R/W
	2	2nd output block	Array 8bit unsigned	255	R/W

b_i	0	Transmission channel i blocked in a bi event of a change
	1	Transmission channel $_i$ released in a event of a change

Example: if Subindex 0 = 1, Subindex 1 = 57 = 0x41 = 00111001_2 means that channel 1, 4, 5 and 6 will transmit their data in the event of a change.

10.7.4 Interrupt Mask Low-to-High

This object defines which digital input channel will send its data in a event of a positive transition (Global Interrupt has to be enabled, 0x6005=1).

Index	Subindex	Name	Type	Default	R/W
0x6007	0	Number of entries	Array 8bit unsigned	2	R
	1	1st output block	Array 8bit unsigned	0	R/W
	2	2nd output block	Array 8bit unsigned	0	R/W

b_i	0	Transmission channel $_i$ blocked with a positive transition
	1	Transmission channel $_i$ released with a positive transition

Example: if 0x6006, Subindex 0 = 1, Subindex 1 = 57 = 0x41 = 00111001_2 0x6007, Subindex 0 = 1, Subindex 1 = 11 = 0xB = 000010112 means that channel 1, 4, 5 and 6 will transmit their data in the event of a change, while channel 2 will only transmit with a positive transition.
If Sub 0x6006 Sub-index 0 = 1, Sub-index 1 = 57 = 0x41 = 00111001_2 means that inputs 1, 4, 5, 6 will transmit their status after the commutation.

10.7.5 Interrupt Mask High-to-Low

This object defines which digital input channel will send its data in a event of a negative transition (Global Interrupt has to be enabled, 0x6005=1).

Index	Subindex	Name	Type	Default	R/W
0x6008	0	Number of entries	Array 8bit unsigned	2	R
	1	1st output block	Array 8bit unsigned	0	R/W
	2	2nd output block	Array 8bit unsigned	0	R/W

b_i	0	Transmission channel $_i$ blocked with a negative transition
	1	Transmission channel $_i$ released with a negative transition

Example: if 0x6006, Subindex 0 = 1, Subindex 1 = 57 = 0x41 = 00111001_2 0x6007, Subindex 0 = 1, Subindex 1 = 11 = 0xB = 00001011_2 means that channel 1, 4, 5 and 6 will transmit their data in the event of a change, while channel 2 will only transmit with a negative transition.

10.7.6 Digital Output

This object contains data of digital output modules.

Index	Subindex	Name	Type	Default	R/W
0x6200	0	Number of entries	Array 8bit unsigned	-	R
	1	1st output block	Array 8bit unsigned	0	R/W
	2	2nd output block	Array 8bit unsigned	0	R/W

10.7.7 Error Mode Output 8bit

This object defines if output change to a pre-defined error status in a event of an error or not. If error is eliminated, outputs are maintained in their pre-defined error status.

Index	Subindex	Name	Type	Default	R/W
0x6206	0	Number of entries	Array 8bit unsigned	-	R
	1	1st output block	Array 8bit unsigned	255	R/W
	2	2nd output block	Array 8bit unsigned	255	R/W

b_i	0	Output channel $_i$ doesn't change in a event of an error
	1	Output channel $_i$ change to a pre-defined error

10.7.8 Error Value Output 8bit

This objects defines values outputs have to change to in a event of an error (corresponding bit in Error Mode Output has to be enabled, 0x6206).

Index	Subindex	Name	Type	Default	R/W
0x6207	0	Number of entries	Array 8bit unsigned	-	R
	1	1st output block	Array 8bit unsigned	0	R/W
	2	2nd output block	Array 8bit unsigned	0	R/W

b_i	0	Output channel $_i$ change to 0 in case of an error
	1	Output channel $_i$ change to 1 in case of an error

Example: if 0x6206, Subindex 0 = 1, Subindex 1 = 57 = 0x41 = 00111001_2 0x62607, Subindex 0 = 1, Subindex 1 = 11 = 0xB = 00001011_2 means that channels 1 and 4 are set to 1, channels 5 and 6 are set to 0, while all other output doesn't change in an event of an error.

10.7.9 Analogue Input 16bit

This object contains the value of Analogue 16 bit input channels.

Index	Subindex	Name	Type	Default	R/W
0x6401	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	1st channel (AI1)	Array 16bit unsigned	-	R
	2	2nd channel (AI2)	Array 16bit unsigned	-	R
	3	3rd channel (AI3)	Array 16bit unsigned	-	R
	4	4th channel (AI4)	Array 16bit unsigned	-	R

10.7.10 Analogue Output 16bit

This object contains the value of Analogue 16 bit output channels.

Index	Subindex	Name	Type	Default	R/W
0x6411	0	Number of Analogue output channels	Array 8bit unsigned	4	R
	1	1st channel (AO1)	Array 8bit unsigned	0	R/W
	2	2nd channel (AO2)	Array 8bit unsigned	0	R/W
	3	3rd channel (AO3)	Array 8bit unsigned	0	R/W
	4	4th channel (AO4)	Array 8bit unsigned	0	R/W

10.7.11 Analogue Input Interrupt Trigger Selection

This object defines condition of transmission: when 1 is entered in object 0x6423, then transmission is released.

Index	Subindex	Name	Type	Default	R/W
0x6421	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Trigger 1st channel	Array 8bit unsigned	7	R
	2	Trigger 2nd channel	Array 8bit unsigned	7	R
	3	Trigger 3rd channel	Array 8bit unsigned	7	R
	4	Trigger 4th channel	Array 8bit unsigned	7	R

Sub-index structure:

Bit	Transmission conditions	Index
0	Threshold value exceeded (>)	0x6424
1	Threshold value fallen short (<)	0x6425
2	Change of input value exceeding delta value for last transmission	0x6426
3	Reduction of input value by more than delta value for last transmission	0x6427
4	Increase of input value by more than delta value for last transmission	0x6428
5..7	Reserved	-

10.7.12 Analogue Input Global Interrupt Enable

This object is used to control Analogue input transmission by PDO. If its value is 1, transmission is released and it only depends on object 0x6421 and PDO transmission type. If value is 0, Analogue input transmission is not allowed.

Index	Subindex	Name	Type	Default	R/W
0x6423	0	Global Interrupt Enable Analogue input 16bit	Boolean	0	R/W

10.7.13 Analogue Input Interrupt Upper Limit Integer

This object allows a threshold value monitoring for Analogue input transmission. If it's configured in object 0x6423, transmission will take place if input value is ≥ threshold value when a trigger condition is set.

Index	Subindex	Name	Type	Default	R/W
0x6424	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Upper limit 1st channel	Array 16bit unsigned	0	R/W
	2	Upper limit 2nd channel	Array 16bit unsigned	0	R/W
	3	Upper limit 3rd channel	Array 16bit unsigned	0	R/W
	4	Upper limit 4th channel	Array 16bit unsigned	0	R/W

10.7.14 Analogue Input Interrupt Lower Limit Integer

This object allows a threshold value monitoring for Analogue input transmission. If it's configured in object 0x6423, transmission will take ≤ place if input value is £ threshold value when a trigger condition is set.

Index	Subindex	Name	Type	Default	R/W
0x6425	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Lower limit 1st channel	Array 16bit unsigned	0	R/W
	2	Lower limit 2nd channel	Array 16bit unsigned	0	R/W
	3	Lower limit 3rd channel	Array 16bit unsigned	0	R/W
	4	Lower limit 4th channel	Array 16bit unsigned	0	R/W

10.7.15 Analogue Input Interrupt Delta Unsigned

If this object is allowed, it conditions actual Analogue input transmission with previously sent value. New value is transmitted only if it's larger than previously sent value + Delta, or if it's smaller than previously sent value – Delta.

Index	Subindex	Name	Type	Default	R/W
0x6426	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Delta 1st channel	Array 16bit unsigned	0	R/W
	2	Delta 2nd channel	Array 16bit unsigned	0	R/W
	3	Delta 3rd channel	Array 16bit unsigned	0	R/W
	4	Delta 4th channel	Array 16bit unsigned	0	R/W

10.7.16 Analogue Input Interrupt Negative Delta Unsigned

If this object is allowed, it conditions actual Analogue input transmission with previously sent value. New value is transmitted only it's smaller than previously sent value – Delta.

Index	Subindex	Name	Type	Default	R/W
0x6427	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Delta 1st channel	Array 16bit unsigned	0	R/W
	2	Delta 2nd channel	Array 16bit unsigned	0	R/W
	3	Delta 3rd channel	Array 16bit unsigned	0	R/W
	4	Delta 4th channel	Array 16bit unsigned	0	R/W

10.7.17 Analogue Input Interrupt Positive Delta Unsigned

If this object is allowed, it conditions actual Analogue input transmission with previously sent value. New value is transmitted only if it's larger than previously sent value + Delta.

Index	Subindex	Name	Type	Default	R/W
0x6428	0	Number of Analogue input channels	Array 8bit unsigned	4	R
	1	Delta 1st channel	Array 16bit unsigned	0	R/W
	2	Delta 2nd channel	Array 16bit unsigned	0	R/W
	3	Delta 3rd channel	Array 16bit unsigned	0	R/W
	4	Delta 4th channel	Array 16bit unsigned	0	R/W

10.7.18 Analogue Output Error Mode

This object defines if the output must assume a pre-selected state in case of error (see object 0x6444). If error is solved, the outputs will keep the pre-selected state.

Index	Subindex	Name	Type	Default	R/W
0x6443	0	Number of Analogue output channels	Array 8bit unsigned	4	R
	1	Error Mode 1st output	Array 8bit unsigned	1	R/W
	2	Error Mode 2nd output	Array 8bit unsigned	1	R/W
	3	Error Mode 3rd output	Array 8bit unsigned	1	R/W
	4	Error Mode 4th output	Array 8bit unsigned	1	R/W

b_i	0	Output state bi remains unchanged
	1	Output state changes in case of error

10.7.19 Analogue Output Error Value Integer

Value assumed by analog output in case of error. For this purpose the object 0x6443 must be set to 1.

Index	Subindex	Name	Type	Default	R/W
0x6444	0	Number of Analogue output channels	Array 8bit unsigned	4	R
	1	Error Value 1st output	Array 16bit signed	0	R/W
	1	Error Value 2nd output	Array 16bit signed	0	R/W
	1	Error Value 3rd output	Array 16bit signed	0	R/W
	1	Error Value 4th output	Array 16bit signed	0	R/W

10.7.20 Error Behaviour

This object has the same functionality of Error Behaviour 0x1029.

Index	Subindex	Name	Type	Default	R/W
0x67FE	0	Number of entries	Array 8bit unsigned	1	R
	1	Communication error	Array 8bit unsigned	0	R/W

Structure:

Communication error	Action
0	Change into status PRE-OPERATIONAL (only if actual status was OPERATIONAL)
1	No status change
2	Change into status STOPPED

10.8 PDO Transmission

Data transmission with PDO is only allowed in Operational status. When device changes its status into Operational, TX PDO is transmitted once with transmission type 254 and 255.

In order to prevent CAN bus overflow, default value for object 0x6423 is false, so Analogue changes aren't transmitted. To prevent overflow with 0x6423=true, a long Inhibit Time can be selected, or properly values for Threshold and Delta (0x6421...0x6428) can be set.

10.8.1 PDO Mapping

If stored customer specific configuration isn't used, object dictionary is assigned with default configuration according to standard device profile DS401 (see paragraph 6.1.5).

If device is in Pre-Operational status, its mapping can be modified via SDO.

10.9 SYNC Monitoring

In Operational status, if communication cycle period isn't equal to 0, monitoring is released with the first SYNC message.
If SYNC message isn't received within monitoring time (communication cycle period), a blink code is provided and status doesn't change. An emergency message (Error Code:0x8100, Error Register: 0x81, Additional Code 00 04 00 00 00) is sent. Failure of SYNC message will be displayed even if master provides a status change.
LEDs return to their normal operating status only after new SYNC message receipt in Operational status, and another emergency message is sent to show SYNC monitoring works correctly again (Error Code:0x0000, Error Register: 0x81, Additional Code 00 04 00 00 00).

10.10 Node Guarding

Node Guarding starts when the first remote transmit request message (RTR) is received on the COB-ID for Node Guarding (0x700+ Module-ID).
If device doesn't receive corresponding message, Node Guarding isn't monitored. **Default** configuration provides Node Guarding is deactivated (Guard Time 0x100C=0, Life Time Factor 0x100D=0).
NMT master polls other devices at regular intervals, triggered by Guard Time 0x100C, and reply message contains device internal status.
In a event of an RTR request with Guard Time not set, Node Guarding isn't monitored, anyway device replies with its internal status.

Status codes:

Code	Status
127	Pre-Operational
5	Operational
4	Stopped

If Node Guarding message isn't received within Life Time, a blink code is provided. An emergency message (Error Code:0x8130, Error Register:
0x11, Additional Code 00 04 00 00 00) is sent and device changes to predefined status according to object 0x67FE.
As soon as Node Guarding is restored, another emergency message is sent (Error Code:0x0000, Error Register: 0x11, Additional Code 00 04 00 00 00), and device status doesn't change.
N.B. It's only possible to use Node Guarding protocol or Heartbeat protocol.

10.11 Heartbeat Monitoring

Heartbeat generator cyclically provides a message (triggered by object 0x1017). During this time it transmits device status. Monitoring start when the first Heartbeat message occurs.
If corresponding Heartbeat message isn't received within time configured in object 0x1016, a blink code is provided. An emergency message (Error Code:0x8130, Error Register: 0x11, Additional Code 00 05 JJ 00 00, where JJ is the node number which

has triggered EMCY) is sent and device changes to pre-defined status according to object 0x67FE.
As soon as Heartbeat protocol is restored, another emergency message is sent (Error Code:0x0000, Error Register: 0x11, Additional Code 00 05 JJ 00 00) to display Heartbeat works correctly again, and device status doesn't change.
Heartbeat protocol is always used if (and only if) producer time is configured 0x1017. (Producer Heartbeat Time).

10.12 Emergency

There are four type of event which provides emergency messages:

- Critical error situation occurred / overcome in the device
- Important information has to be communicated to other devices
- Restore from an error
- Power-on with loaded settings equal to default settings (when setting haven 't yet been saved or when saved settings were discarded by device)

Structure of emergency object are shown in the table below:

Error Code	Error Register	Additional Code	Meaning
0x0000	0x00	00 00 00 00 00	Pre-defined Error Field 0x1003 Subindex0 set to 0 or all error are cleared
0x5000	0x81	00 01 00 00 00	Changed hardware configuration after power-on or reset node / communication
0x5000	0x81	00 02 00 00 00	Flash errors An error has occurred when configuration has been saved in flash memory
0x5000	0x81	00 03 AA BB CC	Programmed configuration doesn't coincide with actual one AA: physical module where error has occurred BB: logic module where error has occurred CC: Cause of error
0x5000	0x81	00 09 00 00 00	Queue overflow for emergency messages
0x8100	0x81	00 04 00 00 00	Time between two SYNC is longer than Communication Cycle Period
0x8110	0x11	00 01 00 00 00	Internal receive buffer overflow Status changes as defined in object 0x67FE
0x8110	0x11	00 02 00 00 00	Internal receive buffer overflow Status changes as defined in object 0x67FE
0x8120	0x11	00 03 00 00 00	CAN Controller in Error Passive Mode
0x8130	0x11	00 04 00 00 00	Time between two Node Guarding telegrams is greater than Guard Time x Life Time Factor

0x8130	0x11	00 05 DD 00 00	Time between two Heartbeat telegrams is greater than configured one DD: node has tripped time overflow
0x8210	0x81	00 05 EE FF GG	PDO was sent with a number of bytes smaller than configured one in communication profile PDO data is discarded EE: configured value FF: actual value, number of bytes sent GG: number of PDO
0x8220	0x81	00 06 HH II JJ	PDO was sent with a number of bytes larger than configured one in communication profile Only the first n data is used (n = total length configured in object dictionary) HH: configured value II: actual value, number of bytes sent JJ: number of PDO
0xFF00	0x81	00 06 KK 00 00	Module bus error Status is changed to Stopped PP: Module position
0xFF00	0x81	LL 07 MM NN PP	Diagnosis message LL: diagnosis byte MM: Module position NN: Error status and channel number PP: Number of actual module error

Note / Updates

Read carefully the safety guidelines and programming instructions contained in this manual before using/connecting the device.

Prima di utilizzare il dispositivo leggere con attenzione le informazioni di sicurezza e settaggio contenute in questo manuale.

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