CES31
FULL MANUAL

Introduction

CAN **E**xtender **S**witch is designed for tough climates to be used as a bridge between CAN bus and hydraulic valves, DC motors or other equipment which make use of the 31 general inputs/outputs.

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Product Overview

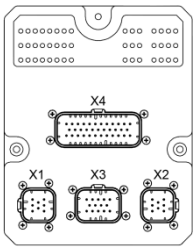
Technical data

- Can be driven from 9-32Vdc power supply
- Designed for use in vehicles and mobile machinery
- 31 general input/outputs with the capability to drive up to 3.5A @ 32Vdc per channel (On/Off)
- 3 analog current inputs, 0-23mA
- 45 LEDs for I/O monitoring, status and error indication
- Built in over-current/over-voltage protection on all ports
- Module temperature and supply voltage surveillance

Mechanical data

- Designed to withstand vibrations and extreme weather conditions (IP67)
- Dimensions: 127x162x44mm. Mounting hole diameter: 4mm

Connectors



- **X1, X2** AMPSEAL 8pole: CAN bus, power supply, safety signals for outputs
- **X3** AMPSEAL 14pole: General I/O, ground connections
- **X4** AMPSEAL 35pole: General I/O, analog inputs, ground connections

Communication

- Supports CAN 2.0A and 2.0B with bus speed up to 1Mbit/s
- Software configurable CAN-termination of 120ohm
- Electrum Automation AB is a member of *CAN in Automation* and supports the CANopen protocol

Test standards

- Immunity conducted interference ISO7637-2, pulse 1, 2a, 2b, 3a, 3b, 4
- Immunity conducted interference ISO7637-2, pulse 5: +123V, 2 Ω drive impedance
- Immunity to interfering fields ISO11452 100V/m
- Current injection ISO11452 120mA
- Transient emission ISO7637
- Interference emission CISPR 25
- ESD ISO10605, class C

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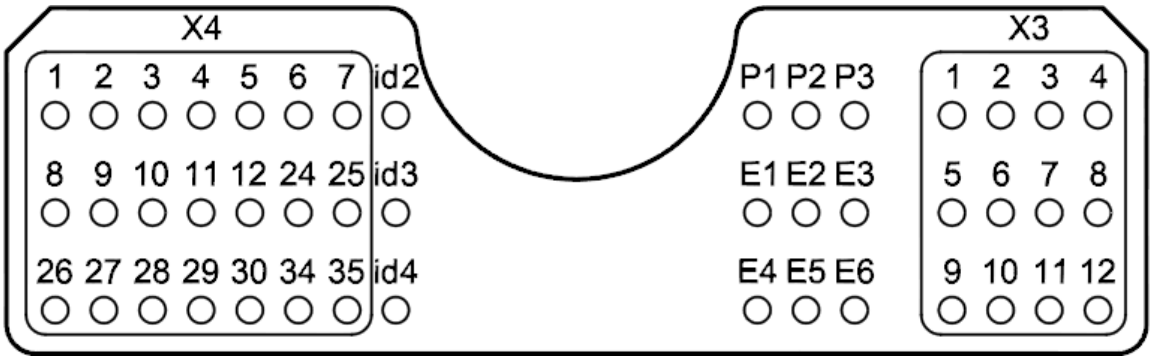
1 LED indication



CES31 is equipped with status LEDs which alerts the operator of the status of inputs/outputs and potential errors.

X3-4

All LEDs under X3 and X4 displays the current electrical state in respective connector. If an LED is active this means that this pin number is interpreted as logic high, (>5V). Either as an output or an input. Should the LED blink with a frequency of 5Hz and LED E1 be active as well, this is an indication that the corresponding pin number is an output which is short circuited/overloaded.

ID2-4

Indicates the node ID which CES31 uses on the CAN bus. In case of no ID led active, node ID is software configured. Should an ID LED blink with 5Hz this is an indication that a Node ID offset is present. Refer to SDO index 0x3000, s-idx 0x04.

Ex: “id 2” blinks with 5Hz: The node is not using node id 2 on CAN bus, it is using node id 2 + node id offset. The “id 2” LED alerts the operator that “Controlled Supply input 2” is used to control all digital outputs. When “id 3” LED is lit, “Controlled Supply input 3” is used, and so on.

P1-3

E1: General error, should the LED be active it’s an indication that something is faulty, either shorted output, CAN error, analog error, overcurrent/overvoltage protection.

E2: General CAN Error. This can be caused by bad termination, wrong CAN baud rate or other malfunction.

E3: Overcurrent/overvoltage protection main switch. CES31 is equipped with a main switch which protects the module from current in excess of 20A and voltages over 34V. This state is displayed by lighting up E3 for a minimum time of 2 seconds.

E4-E6: Over/under current analog in caused by malfunctioning gauge / faulty wiring. Lights up in case input current is lower than limit described in index 0x3000, s-idx 0x05-0x07, or if current exceeds 22mA. Warning! These LEDs should never light up for longer time periods since this may cause permanent damage to the CES31 module (when over-current is present).

2 Electrical characteristics

Parameter	Condition	Min.	Typ.	Max.	Units
Operational voltage[1]		9	24	32	V_{DC}
Power consumption[2]	32V < V_{IN} > 9V	0.5	1.2	2	W
CAN termination	$CAN_{termination}$ = On	118	120	122	Ω
Operating temperature		-40		85	°C
Max digital output current[3]		3.0[4]		3.5[5]	A
Max total output current drive[6]				20	A
Analog current input range		0		24	mA
Input high voltage level		5			V_{DC}
Digital I/O input impedance	Fixed pull-down		3.5k		Ω
Analog current input impedance	Fixed pull-down		290		Ω
Controlled supply input impedance	Fixed pull-up		1.2k		Ω

Note:
1. Module fully operational.
2. No input or output signal active. All "controlled supply" input signals unconnected. Node ID software configured.
3. This parameter specifies the output current capacity with one output being active. Caution must be taken in order to not go beyond: Max total output current drive. For applications which require multiple high current outputs simultaneously, extra care should be taken when determining which I/O's to use. Refer to header Internal I/O Mapping.
4. Min limit specifies minimum drive current at max Operating temperature.
5. Max limit specifies output current capacity at min Operating temperature.
6. Above this limit the CES31 will automatically turn of all outputs in order to prevent malfunction.

3 Absolute maximum ratings[1]

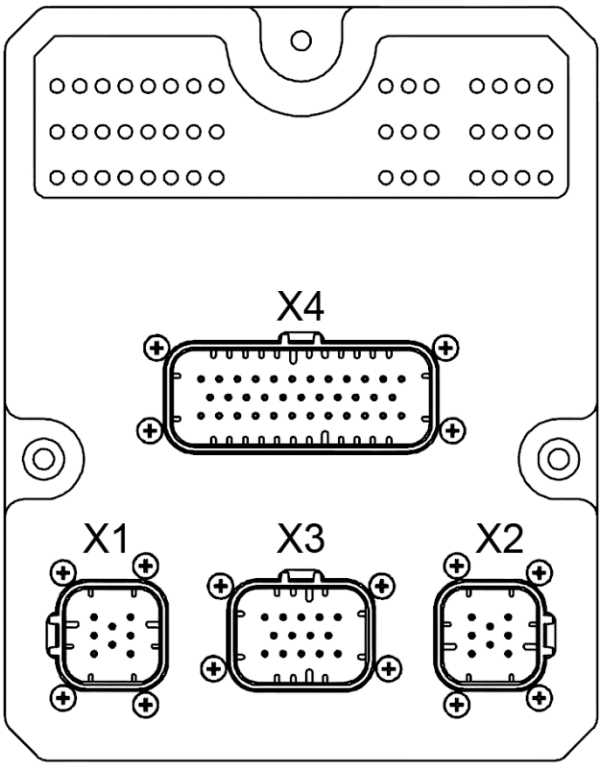
Parameter	Condition	Min.	Typ.	Max.	Units
Input voltage		0		33[2]	V_{DC}
Input voltage digital input		0		32	V_{DC}
Input voltage analog input				32[3]	V_{DC}
Input voltage CAN_L & CAN_H		-36		36V	V_{DC}
Storage temperature		-55		125	°C

Note:
1. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. Tolerant to Load-dump according to ISO7637-2, pulse 5: +123V, 2 Ω drive impedance.
3. Designed to withstand this treatment for shorter periods of time. E4-E6 will indicate error. Operating under these circumstances for a long period of time will cause permanent damage to CES31 module.

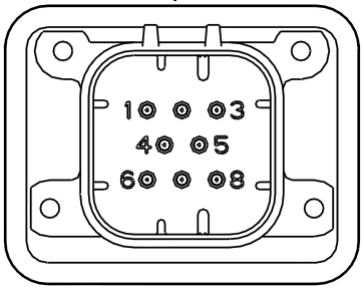
4 I/O characteristics

Parameter	Function
Digital input	Positive logic. Fixed internal pull-down.
Digital output	**High**: B+ (Refer to Electrical Characteristics, Max digital output current). **Low**: Fixed internal pull-down. All outputs are short circuit and over-temperature protected.
Constant voltage source VCC1-3	Always high. Short circuit and over-temperature protected.

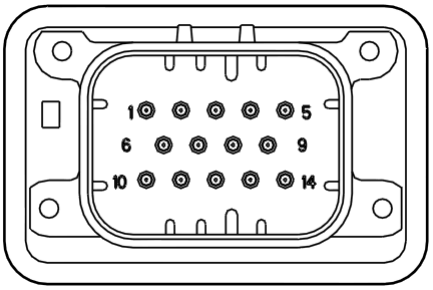
5 Pin/Port configuration



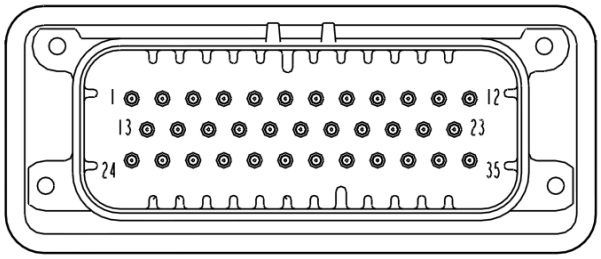
X1, X2



X3



X4



X1 Ampseal 8p (mirrored X2)		
1	B+	From power supply
2	GND	From power supply
3	Can H	
4	Can L	
5	Controlled Supply 3	Active low
6	Controlled Supply 2	Active low
7	Controlled Supply 4	Active low
8	Shared Output	7.3A inductive load

X2 Ampseal 8p (mirrored X1)		
1	B+	From power supply
2	GND	From power supply
3	Can H	
4	Can L	
5	Controlled Supply 3	Active low
6	Controlled Supply 2	Active low
7	Controlled Supply 4	Active low
8	Shared Output	7.3A inductive load

X4 Ampseal 35p		
1	I/O 1	3A inductive load
2	I/O 2	3A inductive load
3	I/O 3	3A inductive load
4	I/O 4	3A inductive load
5	I/O 5	3A inductive load
6	I/O 6	3A inductive load
7	I/O 7	3A inductive load
8	I/O 8	3A inductive load
9	I/O 9	3A inductive load
10	I/O 10	3A inductive load
11	I/O 11	3A inductive load
12	I/O 12	3A inductive load
13	Gnd	
14	Gnd	
15	Gnd	
16	Gnd	
17	Gnd	
18	Gnd	
19	Gnd	
20	Gnd	
21	Analog In 1	Signal 0-20mA
22	Analog In 2	Signal 0-20mA
23	Analog In 3	Signal 0-20mA
24	I/O 13	3A inductive load
25	I/O 14	3A inductive load
26	I/O 15	3A inductive load
27	I/O 16	3A inductive load
28	I/O 17	3A inductive load
29	I/O 18	3A inductive load
30	I/O 19	3A inductive load
31	Node ID 1	
32	Node ID 2	
33	VCC1 (constant drive)	3A inductive load
34	VCC1 (constant drive)	3A inductive load
35	VCC2 (constant drive)	3A inductive load

X3 Ampseal 14p		
1	I/O 20	3A inductive load
2	I/O 21	3A inductive load
3	I/O 22	3A inductive load
4	I/O 23	3A inductive load
5	I/O 24	3A inductive load
6	I/O 25	3A inductive load
7	I/O 26	3A inductive load
8	I/O 27	3A inductive load
9	I/O 28	3A inductive load
10	I/O 29	3A inductive load
11	I/O 30	3A inductive load
12	I/O 31	3A inductive load
13	Gnd	
14	Gnd	

6 Internal I/O mapping

The CES31 module has 10 output drivers with 4 channels each. Each output driver can drive a total of 7.3A on all four outputs combined before thermal shutdown protection failure is no longer guaranteed. This is only valid if the currents are shared evenly across all four outputs. The limit is 4.7A when only two outputs are active. Care must be taken when mapping the outputs which will operate simultaneously in order to avoid unnecessary stress on the output drivers.

Output driver	Driver channel	I/O Pin number	Combined current drive capacity
#1	1.1	1	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	1.2	2	
	1.3	3	
	1.4	4	
#2	2.1	5	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	2.2	6	
	2.3	7	
	2.4	8	
#3	3.1	9	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	3.2	10	
	3.3	11	
	3.4	12	
#4	4.1	13	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	4.2	14	
	4.3	15	
	4.4	16	
#5	5.1	17	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	5.2	18	
	5.3	19	
	5.4		
#6	6.1	20	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	6.2	21	
	6.3	22	
	6.4	23	
#7	7.1	24	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	7.2	25	
	7.3	26	
	7.4	27	
#8	8.1	28	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	8.2	29	
	8.3	30	
	8.4	31	
#9	9.1	VCC1	4 outputs: 7.3A Continuously 2 outputs: 4.7A Continuously
	9.2	VCC3	
	9.3	VCC2	
	9.4		
#10	10.1	Shared output	7.3A Continuously
	10.2		
	10.3		
	10.4		

7 Controlled supply inputs & Node ID truth table

CES31 is equipped with three safety “controlled supply inputs” which can be used together with an emergency stop or similar device in order to override CAN-bus commands and turn off all outputs (accept for VCC1-3 which always remain in a high state).

Depending on the node Id configuration different “controlled supply”-inputs channels are used.

If Node ID inputs are left unconnected (internal pull-down), the “controlled supply”-inputs should be left unconnected as well. In this setup the outputs are only controlled through CAN-bus.

Below is a table describing different states of “controlled supply”-input versus Node ID input and the corresponding output state.

Controlled supply input			Node ID input		CAN Node ID	Outputs enabled
2	**3**	**4**	**1**	**2**		
X	X	X	Low	Low	SW defined (Node ID)	**Yes**
High	X	X	High	Low	2 + (Node ID offset)	No
Low	X	X	High	Low	2 + (Node ID offset)	**Yes**
X	High	X	Low	High	3 + (Node ID offset)	No
X	Low	X	Low	High	3 + (Node ID offset)	**Yes**
X	X	High	High	High	4 + (Node ID offset)	No
X	X	Low	High	High	4 + (Node ID offset)	**Yes**

X = Doesn’t matter
Low = Representing logic level Low (GND)
High = Representing logic level High (B+)

Node ID refers to SDO, index 0x3000, s-idx 0x02
Node ID Offset refers to SDO, index 0x3000, s-idx 0x04

8 CANopen object dictionary

Index	S-idx	Name	Type		Default	Description	Saveable
0x1000	0x00	Moduletype	ro	u32	0x00000000	Nonstandard description of CES31 module.	
0x1001	0x00	Error register	ro	u8	0x00		
0x1005	0x00	COB ID SYNC	rw	u32	0x00000080		x
0x1008	0x00	Module name	ro	str	Electrum CES31		
0x1009	0x00	Revision HW	ro	str	REV X	Starting at char ”A”.	
0x100A	0x00	Revision SW	ro	str	REV X	Starting at char ”A”.	
0x100C	0x00	Guard time	rw	u16	0x0000	Time in ms. Within this time the module expects a “node guarding” of the network master. 0 = Node guarding deactivated.	x
0x100D	0x00	Life time factor	rw	u8	0x00	If no “node guarding” is received for “guard time” x “life time”, the module generates an EMCY. The result of “guard time” x “life time” must be between 0 and 65535.	x
0x1010	0x00	Number of save options	ro	u8	0x01		
	0x01	Save parameter	rw	u32	0x00000002	0x00000000 = No save. 0x00000001 = Saving all parameters after string ”save” is written to this entry. 0x00000002 = Auto store.	x
0x1011	0x00	Number of restore options	ro	u8	0x01		
	0x01	Restore default parameters	rw	u32	0x00000001	Restores all parameters to default values if string ’load’ is written to this entry.	
0x1014	0x00	COB ID EMCY	rw	u32	0x00000080 +$NODEID	Module generates EMCY messages (bit 31=0)	x
0x1016	0x00	Number of monitored devices	ro	u8	0x01		
	0x01	Consumer heartbeat time	rw	u32	0x00000000	Heartbeat monitoring time for node n monitoring only one node is supported. 0x00nn**tttt** = monitoring time (ms) 0x00**nn**tttt = node number (If nn or tttt = 0, no monitoring is carried out.)	x
0x1017	0x00	Producer heartbeat time	rw	u16	0x00FA	Time interval (ms) where the module generates a producer heartbeat.	x
0x1018	0x00	Number of identity objects	ro	u8	0x04		
	0x01	Vendor ID	ro	u32	0x00000356		
	0x02	Product code	ro	u32	0x00000000		
	0x03	Revision number	ro	u32	0x00000000		
	0x04	Unique serial nr	ro	u32	0x00000000		
0x1400	0x00	Number of entries	ro	u8	0x05	RPDO1 communication parameter	
	0x01	COB-ID used by RPDO1	rw	u32	0x00000200 +$NODEID		x
	0x02	Transmission type	rw	u8	0x01	0x01-0xF0	x
	0x03	Inhibit time	rw	u16	0x0000		x
	0x05	Event-timer	rw	u16	0x0000		x

Index	S-idx	Name	Type		Default	Description	Saveable
0x1600	0x00	Number of entries	ro	u8	0x05	RPDO1 mapping parameter	
	0x01	PDO Mapping Entry 1	ro	u32	0x62000108		
	0x02	PDO Mapping Entry 2	ro	u32	0x62000208		
	0x03	PDO Mapping Entry 3	ro	u32	0x62000308		
	0x04	PDO Mapping Entry 4	ro	u32	0x62000408		
	0x05	PDO Mapping Entry 5	ro	u32	0x62000508		
0x1800	0x00	Number of entries	ro	u8	0x05	TPDO1 communication parameter	
	0x01	COB-ID used by TPDO1	rw	u32	0x00000180 +$NODEID		x
	0x02	Transmission type	rw	u8	0x03	0x01-0xF0	x
	0x03	Inhibit time	rw	u16	0x0000		x
	0x05	Event-timer	rw	u16	0x0000		x
0x1801	0x00	Number of entries	ro	u8	0x05	TPDO2 communication parameter	
	0x01	COB-ID used by TPDO2	rw	u32	0x00000280 +$NODEID		x
	0x02	Transmission type	rw	u8	0x0A	0x01-0xF0	x
	0x03	Inhibit time	rw	u16	0x0000		x
	0x05	Event-timer	rw	u16	0x0000		x
0x1A00	0x00	Number of entries	ro	u8	0x07	TPDO1 mapping parameter	
	0x01	PDO Mapping Entry 1	ro	u32	0x60000108		
	0x02	PDO Mapping Entry 2	ro	u32	0x60000208		
	0x03	PDO Mapping Entry 3	ro	u32	0x60000308		
	0x04	PDO Mapping Entry 4	ro	u32	0x60000408		
	0x05	PDO Mapping Entry 5	ro	u32	0x60000508		
	0x06	PDO Mapping Entry 6	ro	u32	0x43210008		
	0x07	PDO Mapping Entry 7	ro	u32	0x64040510		
0x1A01	0x00	Number of entries	ro	u8	0x04	TPDO2 mapping parameter	
	0x01	PDO Mapping Entry 1	ro	u32	0x64040110		
	0x02	PDO Mapping Entry 2	ro	u32	0x64040210		
	0x03	PDO Mapping Entry 3	ro	u32	0x64040310		
	0x04	PDO Mapping Entry 4	ro	u32	0x64040410		
0x2000	0x00	Number of I/O	ro	u8	0x1F		
	0x01	Direction I/O 1	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x02	Direction I/O 2	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x03	Direction I/O 3	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x04	Direction I/O 4	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x05	Direction I/O 5	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x06	Direction I/O 6	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x07	Direction I/O 7	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x08	Direction I/O 8	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x09	Direction I/O 9	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x0A	Direction I/O 10	rw	u8	0x00	0x00 = Input, 0x01 = Output	x

Index	S-idx	Name	Type		Default	Description	Saveable
	0x0B	Direction I/O 11	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x0C	Direction I/O 12	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x0D	Direction I/O 13	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x0E	Direction I/O 14	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x0F	Direction I/O 15	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x10	Direction I/O 16	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x11	Direction I/O 17	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x12	Direction I/O 18	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x13	Direction I/O 19	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x14	Direction I/O 20	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x15	Direction I/O 21	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x16	Direction I/O 22	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x17	Direction I/O 23	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x18	Direction I/O 24	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x19	Direction I/O 25	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1A	Direction I/O 26	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1B	Direction I/O 27	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1C	Direction I/O 28	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1D	Direction I/O 29	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1E	Direction I/O 30	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
	0x1F	Direction I/O 31	rw	u8	0x00	0x00 = Input, 0x01 = Output	x
0x20F2	0x00	CAN baudrate	rw	u8	0x00	0=125kbit/s, 1=250kbit/s, 2=500kbit/s, 3=1Mbit/s	x
0x20F3	0x00	CAN baudrate	rw	u8	0x00	Baudrate must be written to index 20F2 first, and then written to this index.	x
0x3000	0x00	Number of CES31 parameters	ro	u8	0x07		
	0x01	CAN termination	rw	u8	0x00	0x00 = Termination off. 0x01 = Termination on.	x
	0x02	Node ID	rw	u8	0x7F	2-127. Node ID + Node ID Offset can't be greater than 127 or lower than 2.	x
	0x03	LED test	rw	u8	0x00	0x00 = LED test off. 0x01 = LED test on. In case of LED test activated all LEDs will light up in order to guarantee proper LED function.	
	0x04	Node ID Offset	rw	u8	0x00	0-127. This offset will add an ID offset to the ID number. Node ID + Node ID Offset can't be greater than 127 or lower than 2.	x
	0x05	Min current A in 1 alarm.	rw	u16	0x0000	0-19000. Defined in uA. If input current is below this limit, an alarm is raised (E4-E6 LED).	x
	0x06	Min current A in 2 alarm.	rw	u16	0x0000		x
	0x07	Min current A in 2 alarm.	rw	u16	0x0000		x

9 CANopen PDO

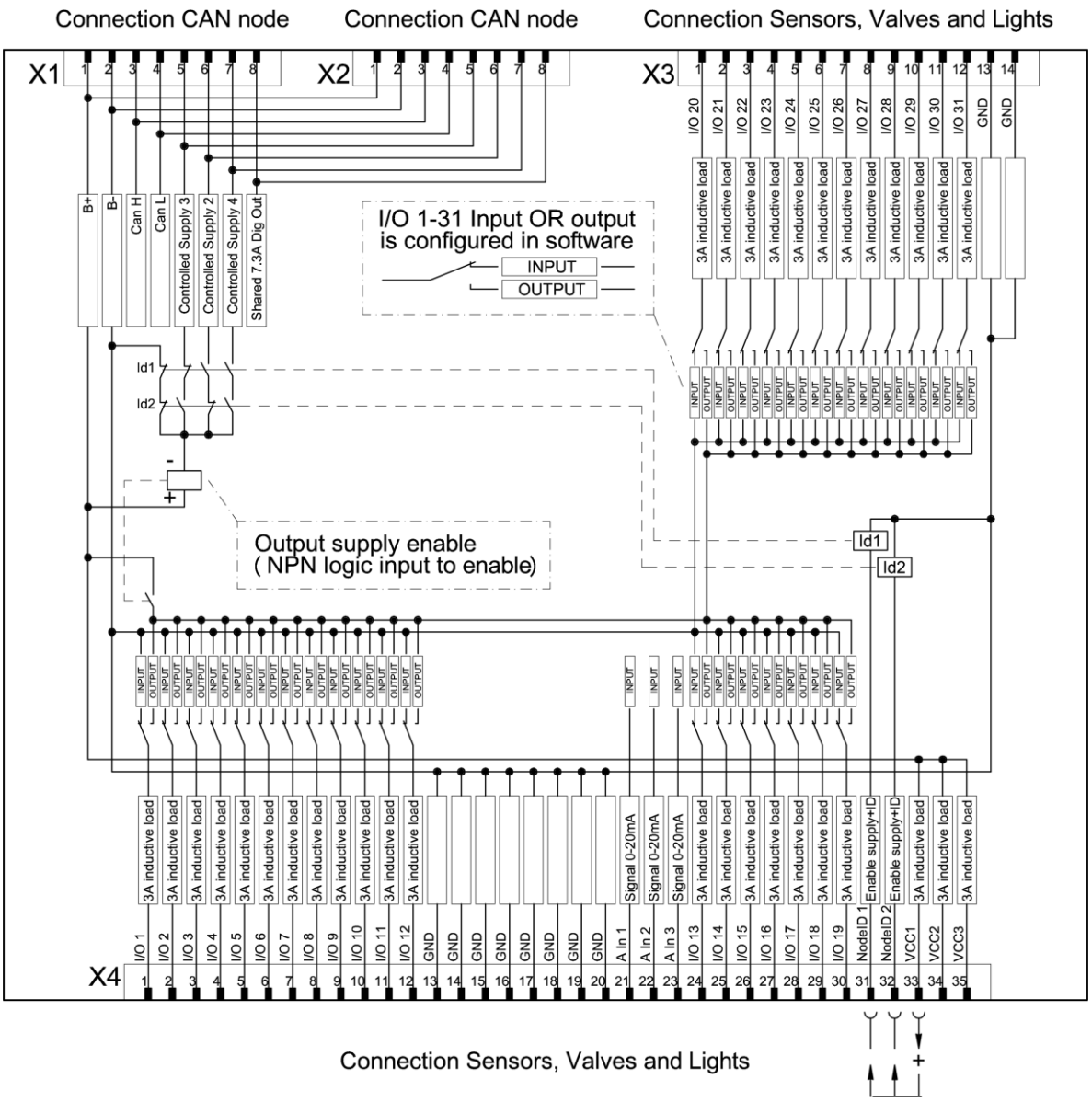
TX	ID	Data							
		0	1	2	3	4	5	6	7
PDO1	180+Node ID	I/O 1-8	I/O 9-16	I/O 17-24	I/O 25-31 Shared Output (bit8)	Main switch		B+ Voltage Low Byte	B+ Voltage High Byte
PDO2	280+Node ID	A In 1 Low Byte	A In 1 High Byte	A In 2 Low Byte	A In 2 High Byte	A In 3 Low Byte	A In 3 High Byte	CES31 Temperature_Low	CES31 Temperature_High

All analog readings are in format uint16, unit mV and uA.

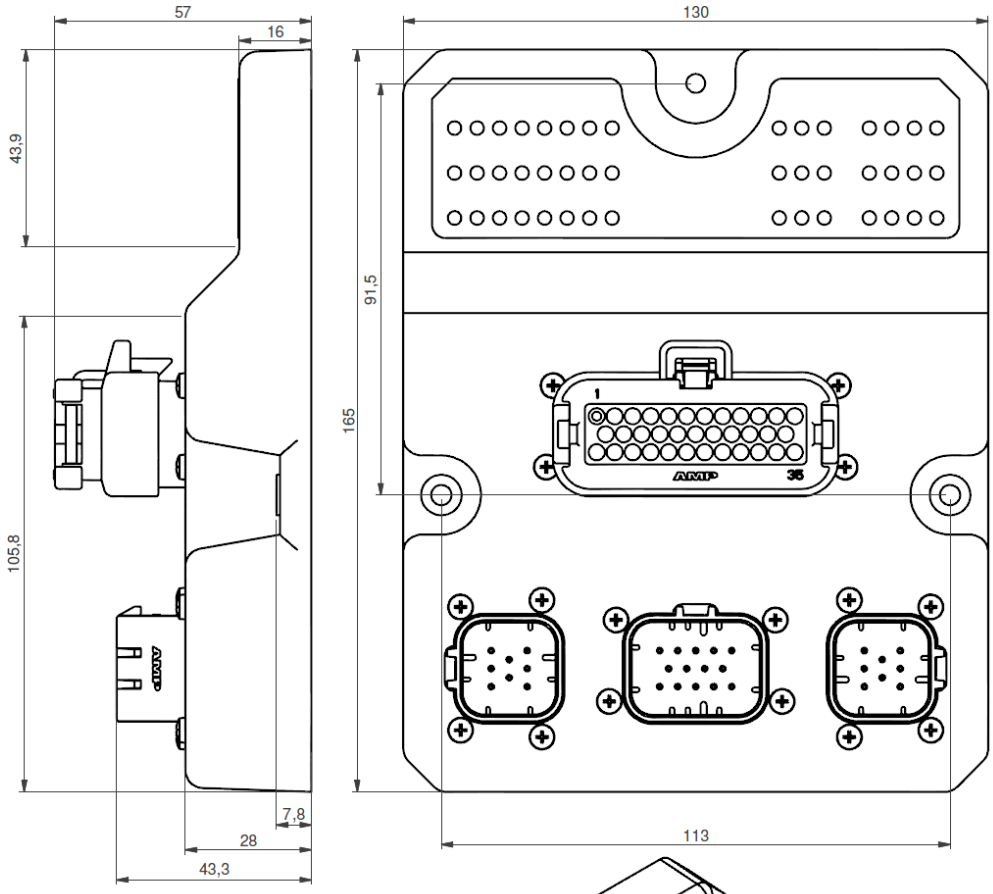
Temperature is read as int16, unit Celsius.

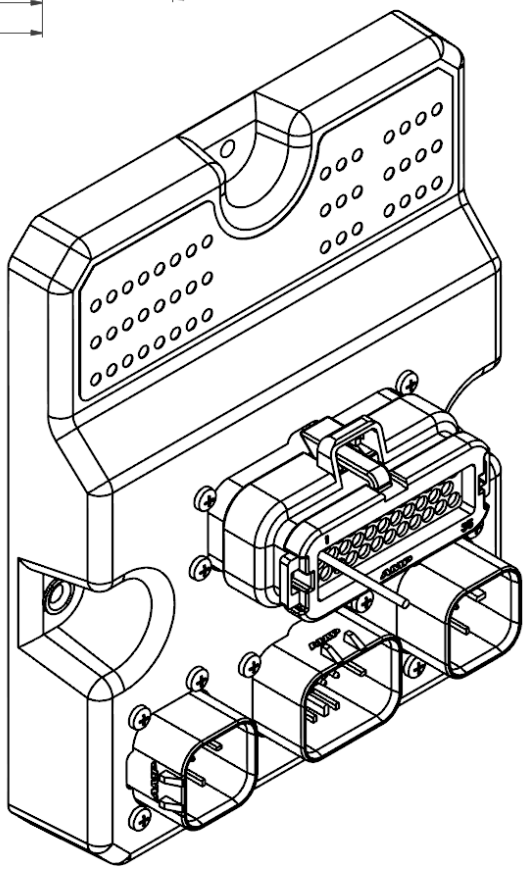
RX	ID	Data							
		0	1	2	3	4	5	6	7
PDO1	200+Node ID	I/O 1-8	I/O 9-16	I/O 17-24	I/O 25-31 Shared Output (bit8)	Main switch	-	-	-

10 Internal wiring



11 Mechanical properties





12 Document history

Document revision	Description	Release date
A	Initial release	2012-06-01
B	• Changed simultaneous current load description. • Fixed typographical error in TX PDO2. Data[5] contains A3_H not A2_H. • Added column in SDO Index Dictionary which defines the parameters which are stored in non-volatile memory. • Added internal wiring	2014-02-04
C	• Changed document layout	2014-11-19
D	• Fixed error in I/O table. Connector X4, was previously marked connector X2	2015-07-02

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13 Contact us

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