



Epec 2033 Power Switch Module

CANopen slave version

Technical Document



DOCUMENT VERSION HISTORY

Date	Notes
20.11.2009	Updated Sections 2. <i>General Description</i> and 4. <i>Power Supply</i>
10.02.2009	First released version

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1 GENERAL

1.1 Purpose of This Document

This technical document is meant to be used in system development. This document contains necessary data concerning the module in question, which system designer needs in system development work.

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1.2 About Manufacturer

Epec Oy helps its customers to manufacture efficient, safe and environmental friendly mobile working machines and special vehicles which help their customers to maximise their productivity.

Epec is a solution provider specialized in embedded control systems, vehicle computers and information logistics systems for mobile machines. We believe that we know control systems for challenging conditions and we are able to offer a total solution from control units to project services and designing.

1.3 Epec CAN Module Family

Epec CAN Module Family is designed to operate in extreme environments, where vibration, wide temperature changes and moisture are normal conditions. The requirements for the system's reliability and safety have been the key words in module family development. A small and protective module casing keeps inside high performance microcontroller and peripheral electronics.

1.4 Basic skills required

The user of this document must have professional skills on machine controlling and CAN communication.

Please refer CAN and CANopen documentation from CAN in Automation (CiA) for further information on communication issues.

1.5 Safety guidelines

The user of this documentation should follow general machine safety guidelines, directives and regulation appropriate to his/her country or market area.

This product does not comply with SIL2 or SIL3 classifications and should not be used in such applications, e.g. lifting people, where SIL 2 or SIL3 are required by directives or other regulations.

A separate safety analysis is always recommended for the machine and its control system. The features of this product should be well documented in machine and control system documents so that the machine operator has the right information how to operate the machine correctly and safely.

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This product is designed to be used only for machine controlling purposes. The manufacturer does not assume any responsibility for this product being fit for any particular application, unless otherwise expressly stated in writing by the manufacturer.

This product complies with those certifications and standards that are listed below. The manufacturer does not guarantee that this product complies any other certification, standard or test than listed below.

This product is not field serviceable, so it should not be opened at any situation.

An external fuse should be installed for the product or the system power supply.

The system should be designed and constructed according to the Epec general mounting and cabling instruction document.

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1.6 Warranty

The manufacturer does not assume any responsibility for the products being fit for any particular purpose, unless otherwise expressly stated in writing by the manufacturer.

The manufacturer gives the warranty of twelve (12) months to the products and thereto related firmware from commissioning or eighteen (18) months from the date of delivery of the products which ever occurs first

The manufacturer is during the warranty period responsible for defects in the products and thereto related firmware resulting from faults in material, design or workmanship. The manufacturer's only obligation under this warranty is to, at its sole discretion, either to replace the products and/or thereto related firmware or to repair the defective products. The manufacturer shall, at its sole option, repair the products at its manufactory in Seinäjoki, Finland.

The warranty does not cover any costs related to removing or fastening of devices related to the products. Neither does the warranty cover the expenses of sending devices to or from the manufacturer for repairs. The warranty does not cover possible expenses relating to travelling, accommodation, daily benefits, etc. of installers.

The warranty becomes null and void if the buyer and/or a third party alters the products or the firmware in any way or if they are not used in accordance with the Manufacturer's operating instructions.

All claims with respect to defects in the products shall be made to the manufacturer without delay and no later than on the seventh (7th) day after the defect has been or should have been discovered by the buyer. The manufacturer strives to reply to the claim in writing within two (2) weeks from the receipt of the claim. The buyer shall attach to the claim a possible error report or equivalent explanation of the grounds for the claim.

The manufacturer gives no other warranties whatsoever for the products than the warranty set out in this section and thus the warranty given in this section sets forth the warranty given by the manufacturer in its entirety.

1.7 Limited liability

The manufacturer shall under no circumstances be liable for loss of production, loss of profit, loss of use or any other consequential damages and/or indirect losses, whatever their cause may be. In case claims based on product liability are brought against the Manufacturer for which

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claims the manufacturer may be liable, the manufacturer's liability is limited to the extent normally covered under normal product liability insurances.

The buyer shall compensate the manufacturer to the extent that the manufacturer might be liable to pay damages as a result of claims based on product liability according to paragraph above.

1.8 Environmental statement

The manufacturer uses ISO14001 environmental certified processes and materials to manufacture products. The manufacturer undertakes to arrange for the recycling and scrapping of the products that are returned to the manufacturer by the buyer and/or the products that are received by the Manufacturer in connection with maintenance services performed as a result of that repairing of the products is deemed by the manufacturer to be inappropriate.

The manufacturer will charge a scrapping fee from the buyer according to the manufacturer's price list in force from time to time. No scrapping fee will, however, be charged for products that are received by the manufacturer during the warranty period.

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2 POWER SWITCH MODULE GENERAL DESCRIPTION

Power Switch Module is part of the Epec CAN Module Family. The module can be used in CAN bus based control systems for controlling devices which requirements for current endurance are higher than normal, such as machine headlights and working lights. The module is equipped with different types of inputs and outputs to control these aforementioned devices. There are some inputs and outputs reserved in the module for controlling other functions, too.

By using Power Switch Module, one can achieve intelligent and smooth control of heavier loads. Module effectively protects loads against over voltage and high inrush-current. Diagnostics provides more value compared to relay-based power switching, so the operator can be informed about failures.

The amount of switched lights can be controlled depending on the action. This makes it possible to optimize the power consumption of the machine. Further, the cabin can be designed in a new fashion because power switching can be controlled using HMI system, so mechanical switches are not needed anymore.

Features

- Based on standards CiA DS301: Application Layer and Communication Profile and CiA DS401: Device Profile for Generic I/O Modules
- CANopen slave
- Operating voltage 10...30 VDC
- Nominal operating voltage 24 VDC
- Overheating and short-circuit protection for outputs
- Overload protection for low power outputs typical 8 A/pin
- Overload protection for high power outputs min 50 A/group
- Gold plated, locked and sealed connectors:
 - 4 x 8-pin AMPSEAL for power switching
 - 23-pin AMPSEAL for I/O and module connection
- Small outline dimensions: 147 x 113 x 35 mm
- Weight 0.7 kg

Applications

- Forest Machines
- Road Maintenance
- Construction Machines
- Crushing Stations
- Industrial Machines
- Agricultural applications
- Automation applications
- Mining Machines

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3 INPUT / OUTPUT SPECIFICATIONS

Power Switch Module contains inputs and outputs or, in other words, I/O pins of different types. There are, for example, outputs which source current and outputs which sink current. Furthermore, there are I/O pins which can be used as digital inputs or analog inputs, or as PWM outputs or digital outputs at the control of the application programmer.

3.1 I/O Amounts

Max Amount	PWM	DO	DI	AI	Note
	Pulse Width Modulation Capability	Digital Output	Digital Input	Analog Input	
4	X	X			10A, continuous
5		X			3A, continuous
1	X	X			3A, continuous
3			X		
1			X	X	
14	5	10	4	1	

The usage of each I/O pin is determined by the configuration (see chapter 3.8.2 Manufacturer specific profile area).

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3.2 I/O List

Channel	Pin	Status	Control	Type	Notes
CH1	X1.1, X1.2, X1.3 X1.6, X1.7, X1.8	DI1 (output state) AI1 (output current)	DO1 AO1	PWM / DO	Note 1
CH2	X1.4, X1.5	AI2 (voltage)		+24 V	Power supply for CH1
CH3	X2.1, X2.2, X2.3 X2.6, X2.7, X2.8	DI2 AI3	DO2 AO2	PWM / DO	Note 1
CH4	X2.4, X2.5	AI4		+24V	Power supply for CH3
CH5	X3.1, X3.2, X3.3 X3.6, X3.7, X3.8	DI3 AI5	DO3 AO3	PWM / DO	Note 1
CH6	X3.4, X3.5	AI6		+24V	Power supply for CH5
CH7	X4.1, X4.2	AI7 (voltage) AI8 (current)		+24V	Power supply for logic and low power outputs CH8, 9, 10, 11, 12 and 13
CH8	X4.3	DI4	DO4 AO4	PWM / DO	max. 3A
CH9	X4.4	DI5	DO5	DO	max. 3A
CH10	X4.5	DI6	DO6	DO	max. 3A
CH11	X4.6	DI7	DO7	DO	max. 3A
CH12	X4.7	DI8	DO8	DO	max. 3A
CH13	X4.8	DI9	DO9	DO	max. 3A
	X4.9			GND	
	X4.10			GND	
CH14	X4.11	DI10		DI	
CH15	X4.12	DI11		DI	
CH16	X4.13	DI12		DI	
	X4.14			GND	
	X4.15			Reserved	
	X4.16			CAN_H	
	X4.17			CAN_L	
	X4.18			Reserved	
	X4.19			Reserved	
	X4.20			GND	
CH17	X4.21	DI13 AI9		AI	
CH18	X4.22			Reserved	
CH19	X4.23			Reserved	
CH20	X5.1, X5.2, X5.3 X5.6, X5.7, X5.8	DI14 AI10	DO10 AO5	PWM / DO	Note 1
CH21	X5.4, X5.5	AI11		+24V	Power supply for CH20
CH22	-	AI12			Internal temperature sensor

Note 1: Total output current of connector is 10 A max. All output pins of connector are hard-wired together, sharing a common control signal.

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3.3 AMPSEAL Connectors

Epec uses gold plated, locked and sealed AMPSEAL heavy duty connectors for all Epec CAN Module Family products to ensure the endurance of extreme conditions.

- 8-pin AMPSEAL for power and system CAN connections
- 23-pin AMPSEAL for I/Os
- All connectors are mechanically keyed to mate only with identical colours

AMPSEAL connector	Epec ordering code
AMP 23-pin grey plug (female)	KX0007
AMP 23-pin black plug (female)	KX0008
AMP 23-pin blue plug (female)	KX0009
AMP 8-pin black plug (female)	KX0187

3.4 AMPSEAL Cable Dimensions

Size		Insulation diameter range	Strip length $\pm 0,4$
mm²	AWG		
0,5	20	1,7	5,1
0,8	18	to	5,1
1,4	16	2,7	5,1
Typical hand crimping tool e.g.:			AMP Procrimper 58529-1, Epec ordering code TT0018

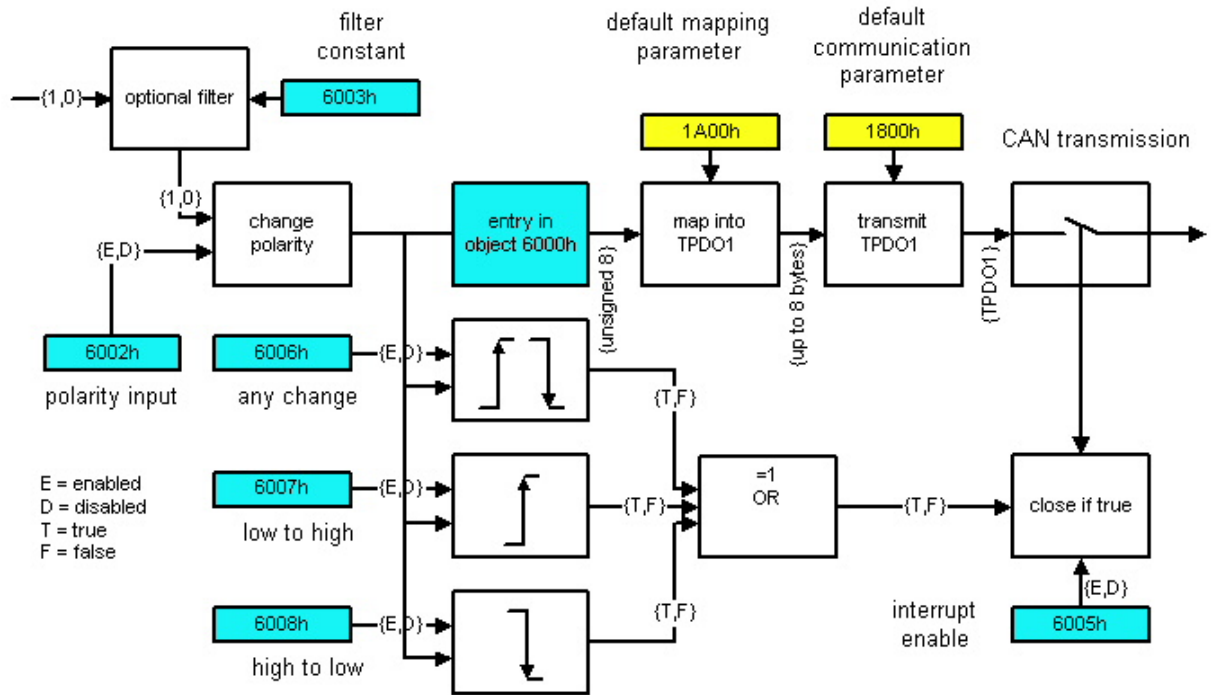
- All applied cables should be properly shielded, bundled and grounded
- See the General Mounting and Cabling Instructions for Epec Modules for more detailed information about the cabling

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3.5 DS-401 functionality

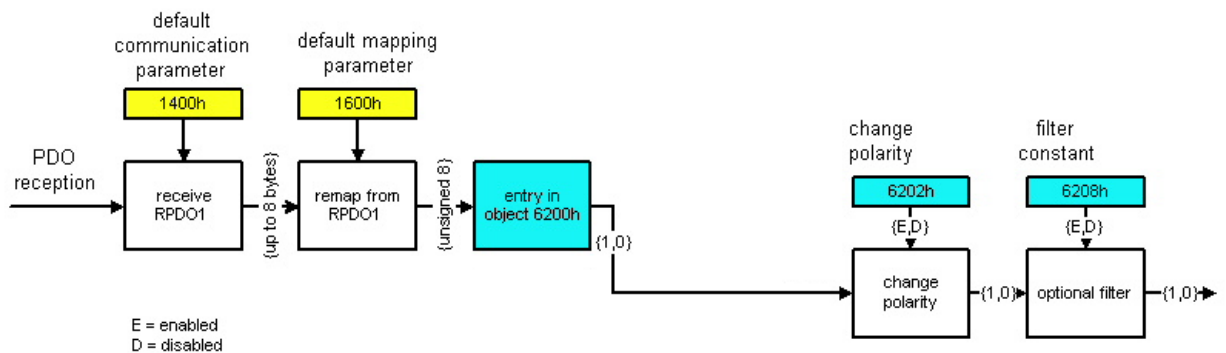
3.5.1 Implemented digital input functionality

Digital Input



3.5.2 Implemented digital output functionality

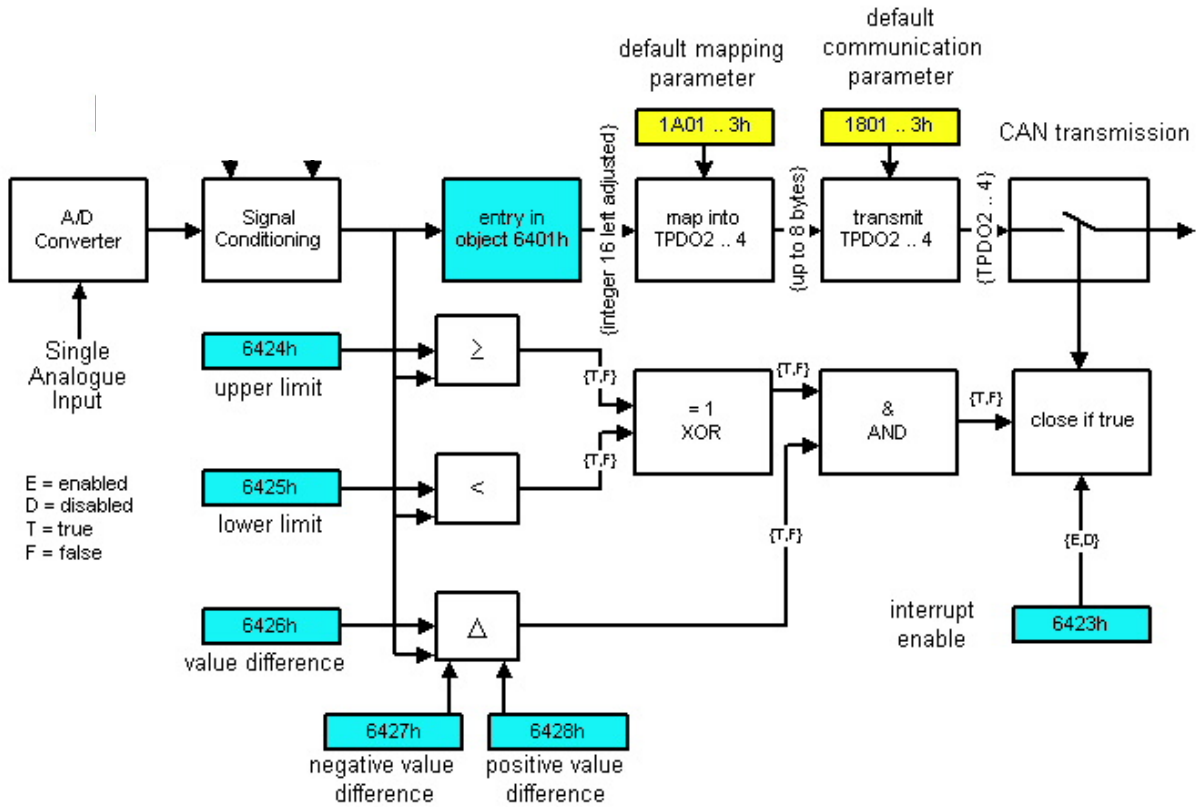
Digital Output



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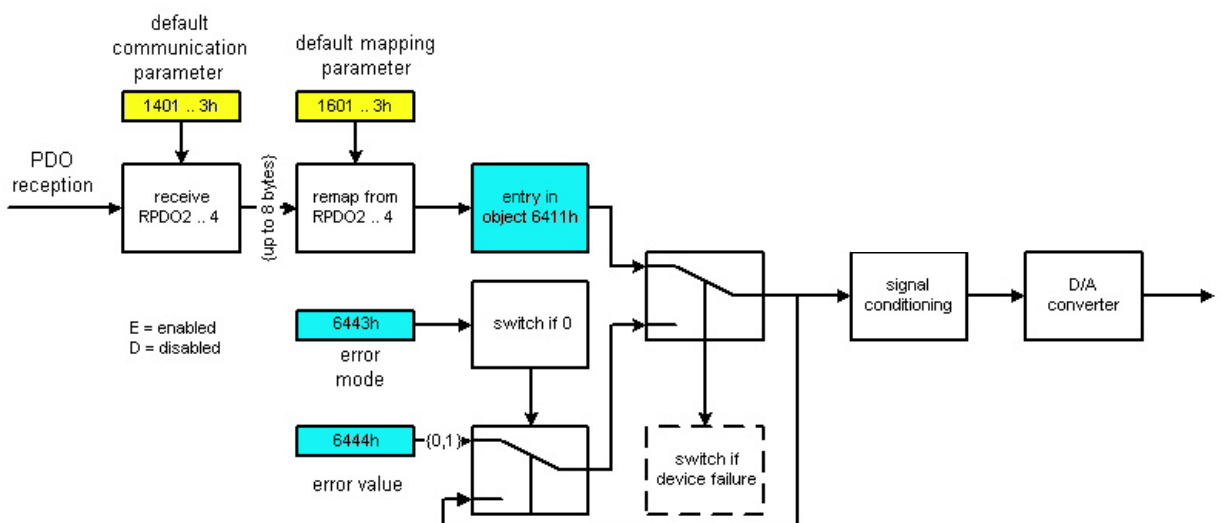
3.5.3 Implemented analogue input functionality

Analogue Input



3.5.4 Implemented analogue output functionality

Analogue Output



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3.6 EMCY Object

Following error codes to DSP-401 and DSP-301 are supported:

Emergency Error Code (byte 0,1)	Manufacturer-specific Error Field (byte 3..7)	Explanation
xxxx	Byte 3:	
8110		CAN Overrun (objects lost)
8120		CAN in Error Passive Mode
8130		Life Guard Error or Heartbeat Error
8140		Recovered from bus off
8150		Transmit COB-ID collision
8210		PDO not processed due to length error
8220		PDO length exceeded

3.7 Default PDO – mapping

3.7.1 TPDO

TPDO1							
COB-ID	180h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
DI 1 to 8h	DI 9 to Eh						
TPDO2							
COB-ID	280h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
AI CH1		AI CH2		AI CH3		AI CH4	
TPDO3							
COB-ID	380h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
AI CH5		AI CH6		AI CH7		AI CH8	
TPDO4							
COB-ID	480h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
AI CH9		AI CH10		AI CH11		AI CH12	

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3.7.2 RPDO

RPDO1							
COB-ID	200h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
DI 1 to 8h	DI 9 to Ah						
RPDO2							
COB-ID	300h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
AO 1 [0..255]		AO2 [0..255]		AO3 [0..255]		AO4 [0..255]	
RPDO3							
COB-ID	400h + NodeID						
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
AO 5 [0..255]							

3.8 Object directory

SDO server COB-ID

COB-ID Client→Server (rx) = 600h + NodeID

COB-ID Server→Client (tx) = 580h + NodeID

3.8.1 Communication Profile Area

Index	Sub-index	Description	Type	Attribute	Default	Comment
1000h	-	Device type	UNSIGNED32	RO	000F0191h	Meaning: DSP-401 device profile, analogue in- and outputs, digital in- and outputs on device
1001h	-	error register	UNSIGNED8	RO	0	
1003h		pre-defined error field				
	0	number of errors	UNSIGNED8	RW	0	
	1	standard error field	UNSIGNED32	RO	0	
	2	standard error field	UNSIGNED32	RO	0	
1005h	-	COB-ID SYNC	UNSIGNED32	RW	0x80	
1006h	-	communication cycle period	UNSIGNED32	RW	0x00000000	
1007h	-	synchronous window length	UNSIGNED32	RW	0x00000000	
1008h	-	manufacturer device name	Vis-String	RO	Power Switch Module	
1009h	-	manufacturer hardware version	Vis-String	RO	2033A02	
100Ah	-	manufacturer software version	Vis-String	RO	-	
100Ch	-	guard time	UNSIGNED16	RW	0	
100Dh	-	life time factor	UNSIGNED8	RW	0	

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1010h		Store Parameters				
	0	largest subindex supported	UNSIGNED8	RO	4	
	1	save all parameters	UNSIGNED32	RW		
	2	save communication parameters	UNSIGNED32	RW		Index 1000h -1FFFh
	3	save application parameters	UNSIGNED32	RW		Index 6000h -9FFFh
	4	save manufacturer defined parameters	UNSIGNED32	RW		Index 2000h -5FFFh
1011h		Restore Default Parameters				
	0	largest subindex supported	UNSIGNED8	RO	4	
	1	restore all default parameters	UNSIGNED32	RW		
	2	restore communication default parameters	UNSIGNED32	RW		
	3	restore application default parameters	UNSIGNED32	RW		
	4	restore manufacturer defined default parameters	UNSIGNED32	RW		
1014h	-	COB-ID emergency message	UNSIGNED32	RO	80h +NodeID	
1015h	-	Inhibit Time EMCY	UNSIGNED16	RW	0	
1017h	-	Producer Heartbeat Time	UNSIGNED16	RW	0	
1018h		Identity Object				
	0	number of entries	UNSIGNED8	RO	4	
	1	vendor ID	UNSIGNED32	RO	30h	EPEC Oy
	2	product code	UNSIGNED32	RO	3002033	E3002033
	3	revision number	UNSIGNED32	RO	00010000h	V1.0
1029h		Error Behaviour				
	0	no. of error classes	UNSIGNED8	RO	1	
	1	communication error	UNSIGNED8	RW	0	0 =Pre-operational (only if current state is Operational) 1 = no state change 2 = stopped
1400h		Receive PDO 1 Parameter				Digital outputs

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	0	largest sub-index supported	UNSIGNED8	RO	2	
	1	COB-ID used by PDO	UNSIGNED32	RO	200h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
1401h		Receive PDO 2 Communication Parameter				Analogue outputs
	0	largest sub-index supported	UNSIGNED8	RO	2	
	1	COB-ID used by PDO	UNSIGNED32	RO	300h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
1402h		Receive PDO 3 Communication Parameter				Analogue outputs
	0	largest sub-index supported	UNSIGNED8	RO	2	
	1	COB-ID used by PDO	UNSIGNED32	RO	400h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
1600h		Receive PDO1 Mapping Parameter				Digital outputs
	0	number of mapped objects	UNSIGNED8	RO	2	
	1	write output 1h to 8h	UNSIGNED32	RO	6200 01 08h	
	2	write output 9h to Ah	UNSIGNED32	RO	6200 02 08h	
1601h		Receive PDO 2 Mapping Parameter				Analogue outputs
	0	number of mapped objects	UNSIGNED8	RO	4	
	1	write analogue output 1h	UNSIGNED32	RO	6411 01 10h	
	2	write analogue output 2h	UNSIGNED32	RO	6411 02 10h	
	3	write analogue output 3h	UNSIGNED32	RO	6411 03 10h	
	4	write analogue output 4h	UNSIGNED32	RO	6411 04 10h	
1602h		Receive PDO 3 Mapping Parameter				Analogue outputs
	0	number of mapped objects	UNSIGNED8	RO	1	
	1	Write Analogue Output 5h	UNSIGNED32	RO	6411 05 10h	
1800h		Transmit PDO 1 Communication Parameter				Digital inputs
	0	largest sub-index supported	UNSIGNED8	RO	5	
	1	COB-ID used by PDO	UNSIGNED32	RO	180h + NodeID	

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	2	transmission type	UNSIGNED8	RW	255	
	3	inhibit time	UNSIGNED16		1000	fixed time 100ms no access from object directory
	4	reserved				
	5	event timer	UNSIGNED16	RW	0	

1801h		Transmit PDO 2 Communication Parameter				Analogue inputs
	0	largest sub-index supported	UNSIGNED8	RO	5	
	1	COB-ID used by PDO	UNSIGNED32	RO	280h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
	3	inhibit time	UNSIGNED16		1000	fixed time 100ms no access from object directory
	4	reserved				
	5	event timer	UNSIGNED16	RW	0	

1802h		Transmit PDO3 Communication Parameter				Analogue inputs
	0	largest sub-index supported	UNSIGNED8	RO	5	
	1	COB-ID used by PDO	UNSIGNED32	RO	380h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
	3	inhibit time	UNSIGNED16		1000	fixed time 100ms no access from object directory
	4	reserved				
	5	event timer	UNSIGNED16	RW	0	

1803h		Transmit PDO4 Communication Parameter				Analogue inputs
	0	largest sub-index supported	UNSIGNED8	RO	5	
	1	COB-ID used by PDO	UNSIGNED32	RO	480h + NodeID	
	2	transmission type	UNSIGNED8	RW	255	
	3	inhibit time	UNSIGNED16		1000	fixed time 100ms no access from object directory
	4	reserved				
	5	event timer	UNSIGNED16	RW	0	

1A00h		Transmit PDO 1 Mapping Parameter				Digital inputs
	0	number of mapped objects	UNSIGNED8	RO	2	
	1	read input 1h to 8h	UNSIGNED32	RO	6000 01 08h	
	2	read input 9h to Eh	UNSIGNED32	RO	6000 02 08h	

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1A01h		Transmit PDO 2 Mapping Parameter				Analogue inputs
	0	number of mapped objects	UNSIGNED8	RO	4	
	1	read analogue input 1h	UNSIGNED32	RO	6401 01 10h	
	2	read analogue input 2h	UNSIGNED32	RO	6401 02 10h	
	3	read analogue input 3h	UNSIGNED32	RO	6401 03 10h	
	4	read analogue input 4h	UNSIGNED32	RO	6401 04 10h	

1A02h		Transmit PDO 3 Mapping Parameter				Analogue inputs
	0	number of mapped objects	UNSIGNED8	RO	4	
	1	read analogue input 5h	UNSIGNED32	RO	6401 05 10h	
	2	read analogue input 6h	UNSIGNED32	RO	6401 06 10h	
	3	read analogue input 7h	UNSIGNED32	RO	6401 07 10h	
	4	read analogue input 8h	UNSIGNED32	RO	6401 08 10h	
1A03h		Transmit PDO 4 Mapping Parameter				Analogue inputs
	0	number of mapped objects	UNSIGNED8	RO	4	
	1	read analogue input 9h	UNSIGNED32	RO	6401 09 10h	
	2	read analogue input Ah	UNSIGNED32	RO	6401 0A 10h	
	3	read analogue input Bh	UNSIGNED32	RO	6401 0B 10h	
	4	read analogue input Ch	UNSIGNED32	RO	6401 0C 10h	

3.8.2 Manufacturer Specific Profile Area

Index	Sub-index	Description	Type	Attribute	Default	Comment
2000h		I/O Configuration				
	0	Number of entries	UNSIGNED8	RO	0x16	
	1	Configuration of channel CH1	UNSIGNED8	RW	0x01	1 = binary output with read back input and current measurement 2 = analog output (PWM) with current measurement
	2	Configuration of channel CH2	UNSIGNED8	RW	0x01	Power supply for CH1 with voltage read: 1 = raw value 16bit 2 = voltage x 0,01V

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3	Configuration of channel CH3	UNSIGNED8	RW	0x01	1 = binary output with read back input and current measurement 2 = analog output (PWM) with current measurement
4	Configuration of channel CH4	UNSIGNED8	RW	0x01	Power supply for CH3 with voltage read: 1 = raw value 16bit 2 = voltage x 0,01V
5	Configuration of channel CH5	UNSIGNED8	RW	0x01	1 = binary output with read back input and current measurement 2 = analog output (PWM) with current measurement
6	Configuration of channel CH6	UNSIGNED8	RW	0x01	Power supply for CH5 with voltage read: 1 = raw value 16bit 2 = voltage x 0,01V
7	Configuration of channel CH7	UNSIGNED8	RW	0x01	Power supply for logic and CH8...CH13 with voltage and current read: 1 = voltage raw value 16bit 2 = voltage x 0,01V
8	Configuration of channel CH8	UNSIGNED8	RW	0x01	1 = binary output with read back input 2 = analog output (PWM)
9	Configuration of channel CH9	UNSIGNED8	RW	0x01	1 = binary output with read back input
10	Configuration of channel CH10	UNSIGNED8	RW	0x01	1 = binary output with read back input
11	Configuration of channel CH11	UNSIGNED8	RW	0x01	1 = binary output with read back input
12	Configuration of channel CH12	UNSIGNED8	RW	0x01	1 = binary output with read back input
13	Configuration of channel CH13	UNSIGNED8	RW	0x01	1 = binary output with read back input
14	Configuration of channel CH14	UNSIGNED8	RW	0x01	1 = digital input
15	Configuration of channel CH15	UNSIGNED8	RW	0x01	1 = digital input
16	Configuration of channel CH16	UNSIGNED8	RW	0x01	1 = digital input
17	Configuration of channel CH17	UNSIGNED8	RW	0x01	1 = analog input 2 = digital input
18	Configuration of channel CH18	UNSIGNED8	RW	0x01	Reserved
19	Configuration of channel CH19	UNSIGNED8	RW	0x01	Reserved
20	Configuration of channel CH20	UNSIGNED8	RW	0x01	1 = binary output with read back input and current measurement 2 = analog output (PWM) with current measurement
21	Configuration of channel CH21	UNSIGNED8	RW	0x01	Power supply for CH20 with voltage read: 1 = raw value 16bit 2 = voltage x 0,01V

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	22	Configuration of channel CH22	UNSIGNED8	RW	0x01	Internal temperature: 1 = raw value 16bit 2 = temperature in celsius
2001h	-	Frequency of PWM-channels	UNSIGNED16	RW	100	
2002h		Node ID Configuration				
	0	Number of entries	UNSIGNED8	RO	0x0D	
	1	Node ID selection	UNSIGNED8	RW	0	Selection of node ID by 0 = 2002sub5h 2 = 1 input pin (2002sub6 - 7h) 4 = 2 input pin (2002sub6 - 9h) 8 = 3 input pin (2002sub6 - Dh)
	2	Input pin 1 (lsb)	UNSIGNED8	RW	0	0x01 = CH14 (X4.11)
	3	Input pin 2	UNSIGNED8	RW	0	0x02 = CH15 (X4.12)
	4	Input pin 3 (msb)	UNSIGNED8	RW	0	0x04 = CH16 (X4.13) 0x08 = CH11 (X4.6) 0x10 = CH12 (X4.7) 0x20 = CH13 (X4.8)
	5	Node ID without pin selection	UNSIGNED8	RW		Node ID without pin selection
	6	Node ID with pin select 0	UNSIGNED8	RW		Node ID with pin select 0
	7	Node ID with pin select 1	UNSIGNED8	RW		Node ID with pin select 1
	8	Node ID with pin select 2	UNSIGNED8	RW		Node ID with pin select 2
	9	Node ID with pin select 3	UNSIGNED8	RW		Node ID with pin select 3
	10	Node ID with pin select 4	UNSIGNED8	RW		Node ID with pin select 4
	11	Node ID with pin select 5	UNSIGNED8	RW		Node ID with pin select 5
	12	Node ID with pin select 6	UNSIGNED8	RW		Node ID with pin select 6
13	Node ID with pin select 7	UNSIGNED8	RW		Node ID with pin select 7	
2003h	-	Baud rate (*)	UNSIGNED8	RW	0x05	0x00 = 10Kb/s 0x01 = 20Kb/s 0x02 = 50Kb/s 0x03 = 100Kb/s 0x04 = 125Kb/s 0x05 = 250Kb/s 0x06 = 500Kb/s 0x08 = 1Mb/s

(*) Baud rate 800Kb/s not supported

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3.8.3 Standardised Device Profile Area

Index	Sub index	Description	Type	Attribute	Default	Comment
Digital Input						
6000h		Read Input 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Read Input 1h to 8h	UNSIGNED8	RO		
	2	Read Input 9h to Eh	UNSIGNED8	RO		
6002h		Polarity Input 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Polarity Input 1h to 8h	UNSIGNED8	RW	0	
	2	Polarity Input 9h to Eh	UNSIGNED8	RW	0	
6003h		Filter Constant Input 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Filter Constant Input 1h to 8h	UNSIGNED8	RW	0	
	2	Filter Constant Input 9h to Eh	UNSIGNED8	RW	0	
6005h	-	Global Interrupt Enable Digital	BOOLEAN	RW	TRUE	
6006h		Interrupt Mask Any Change 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Interrupt Any Change 1h to 8h	UNSIGNED8	RW	FFh	
	2	Interrupt Any Change 9h to Eh	UNSIGNED8	RW	FFh	
6007h		Interrupt Mask Low-to-High 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Interrupt Low to High 1h to 8h	UNSIGNED8	RW	0	
	2	Interrupt Low to High 9h to Eh	UNSIGNED8	RW	0	
6008h		Interrupt Mask High-to-Low 8-bit				
	0	Number of Inputs 8-Bit	UNSIGNED8	RO	2	
	1	Interrupt High to Low 1h to 8h	UNSIGNED8	RW	0	
	2	Interrupt High to Low 9h to Eh	UNSIGNED8	RW	0	
Digital Output						
6200h		Write Output 8-Bit				
	0	Number of Outputs 8-Bit	UNSIGNED8	RO	2	
	1	Write Output 1h to 8h	UNSIGNED8	RW	0	
	2	Write Output 9h to Ah	UNSIGNED8	RW	0	
6202h		Change Polarity Output 8-Bit				
	0	Number of Outputs 8-Bit	UNSIGNED8	RO	2	
	1	Change Polarity Output 1h to 8h	UNSIGNED8	RW	0	
	2	Change Polarity Output 9h to Ah	UNSIGNED8	RW	0	
6208h		Filter Constant Output 8-Bit				
	0	Number of 8-Bit Output bytes	UNSIGNED8	RO	2	
	1	Filter Mask Output 1h to 8h	UNSIGNED8	RW	FFh	
	2	Filter Mask Output 9h to Ah	UNSIGNED8	RW	FFh	
Analogue Input						
6401h		Read Analogue Input 16-Bit				
	0	Number of Analogue Inputs 16-Bit	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	INTEGER16	RO		
Analogue Output						
6411h		Write Analogue Output 16-Bit				
	0	Number of Analogue Outputs 16-Bit	UNSIGNED8	RO	5	
	1..5	Analogue Output 1..5	INTEGER16	RW	0	AO[0 ... 255]
Analogue input set-ups						
6421h		Analogue Input Interrupt Trigger Selection				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	

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	1..12	Analogue Input 1..12	UNSIGNED8	RW	7	Bit no. 0 Upper limit exceeded 1 Input below lower limit 2 Input changed by more than delta 3 Input reduced by more than negative delta 4 Input increased by more than positive delta 5 to 7 reserved for future use.
6422h		Analogue Input Interrupt Source				
	0	Number of Interrupt Source Banks	UNSIGNED8	RO	1	
	1	Interrupt Source Bank 1	UNSIGNED32	RO	0	
6423h	-	Analogue Input Global Interrupt Enable	BOOLEAN	RW	FALSE	
6424h		Analogue Input Interrupt Upper Limit Integer				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	INTEGER32	RW	0	
6425h		Analogue Input Interrupt Lower Limit Integer				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	INTEGER32	RW	0	
6426h		Analogue Input Interrupt Delta Unsigned				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	UNSIGNED32	RW	0	
6427h		Analogue Input Interrupt Negative Delta Unsigned				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	UNSIGNED32	RW	0	
6428h		Analogue Input Interrupt Positive Delta Unsigned				
	0	Number of Analogue Inputs	UNSIGNED8	RO	12	
	1..12	Analogue Input 1..12	UNSIGNED32	RW	0	
Analogue output set-ups						
6443h		Analogue Output Error Mode				
	0	Number of Analogue Outputs	UNSIGNED8	RO	5	
	1..5	Error Mode Analogue Output 1..5	UNSIGNED8	RW	1	0h = actual value rest 1h = reverts to error value integer (6444h)
6444h		Analogue Output Error Value Integer				
	0	Number of Analogue Outputs	UNSIGNED8	RO	5	
	1..5	Analogue Output 1..5	INTEGER32	RW	0	

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4 POWER SUPPLY

- Nominal supply voltage 24 VDC
- Full operating range 10...30 VDC

4.1 Power Supply Pins

Designation	Connector / pin number	Potential
Supply voltage (V_{SUPPLY})	X4.1 X4.2	+24 VDC (+10...30 VDC)
Ground	X4.9 X4.10	GND

4.2 Overvoltage Protection

- Max. 70 VDC (Stresses above this value may cause permanent damage to the module.)
- The module cannot handle greater voltages than 70 V. The Power Switch Module has a shutdown circuit which protects the module and loads against overvoltage. The shutdown circuit cuts off the power feed for the logic and loads in case of overvoltage. The shutdown circuit is activated when voltage reaches circa 32 V. Power feed is restored when supply voltage drops to 30 V.

4.3 Power Consumption

- Approximately 2 W (+24 VDC, no external load)
- Supply Voltage (V_{SUPPLY}) maximum continuous current 46 A (with full external load)
- Full external load for low power outputs is 6 A (ambient temperature +50°C)
- Full external load for high power outputs is 40 A (ambient temperature +50°C)

Alternative examples of full external loads:

Pins X4.3...X4.8 (low power outputs):

$$1A+1A+1A+1A+1A+1A = 6A$$

$$3A+1A+1A+1A+0A+0A = 6A$$

$$2A+2A+2A+0A+0A+0A = 6A$$

$$3A+3A+0A+0A+0A+0A = 6A$$

Pins X1.1...X1.3, X1.6...X1.8, X2.1...X2.3, X2.6...X2.8, X3.1...X3.3, X3.6...X3.8,
X5.1...X5.3, X5.6...X5.8 (high power outputs):

$$10A+10A+10A+10A = 40A$$

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5 DIAGNOSTICS

5.1 High Power Outputs

- Input voltage measurement for each power output
- Load current measurement
- Output status feedback

5.2 Module Temperature

- Module internal temperature measurement

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6 BUS CONNECTIONS

6.1 Bus Connection Pins

<i>Designation</i>	<i>Connector / pin number</i>
CAN High-Speed	X4.16 (CAN H) X4.17 (CAN L)
Ground	X4.20 (GND)

6.2 CAN Interface

- ISO 11898 physical interface
- Supports CAN 2.0B protocol
- Used as main system interface
- Used as programming interface

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7 ENVIRONMENTAL CHARACTERS

Epec CAN module family is designed for extreme environments and the product family is certified with normal automotive (e17) EMC standards and has shock and vibration endurance up to 100 G.

- Operating temperature -40°C ... +50°C
- Storage temperature -50°C ... +85°C

7.1 Protection

- Protection classification IP67 (classification according to IEC 60529)
- Module is equipped with Oil Rating 7 (according to test method AATCC 118-1997ASTM) hydrophobic and oleophobic Gore HPM Membrane Vent
- Protection for plugs depends on cable processing
- All cables, connectors and tools must be of correct type and sufficiently high quality. Also the environmental suitability of equipment should be checked (protection for moisture, mechanical stability, power durability, coupling resistance, etc.)
- Additional module cover for wires and connectors is also available (E10801109)

7.2 EMC Tests

Epec 4G modules are certified according to following tests:

ISO/DIS 14982 (1998) Agricultural and forestry machines-electromagnetic compatibility-test methods and acceptance criteria							
Electrostatic discharge (ESD) immunity test	<ul style="list-style-type: none"> • Test method EN61000-4-2 (1995) • Performance criterion B <table border="1"> <thead> <tr> <th>Discharge mode</th> <th>Test level (kVp)</th> </tr> </thead> <tbody> <tr> <td>Contact</td> <td>± 2, ± 4, ± 6</td> </tr> <tr> <td>Air</td> <td>± 2, ± 4, ± 8</td> </tr> </tbody> </table>	Discharge mode	Test level (kVp)	Contact	± 2, ± 4, ± 6	Air	± 2, ± 4, ± 8
Discharge mode	Test level (kVp)						
Contact	± 2, ± 4, ± 6						
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Transient and surges in vehicular environment immunity test Note: The Mini module (2038) and the Mini display (2029) need the Hub module (2021) in order to reach the full transient immunity.	<ul style="list-style-type: none"> • Test method ISO 7637-2 (1990), pulse 5 • Performance criterion B <table border="1"> <thead> <tr> <th>Pulse</th> <th>Pulse parameters</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>Us=+70V, tr=10ms, td=600ms</td> </tr> </tbody> </table>	Pulse	Pulse parameters	5	Us=+70V, tr=10ms, td=600ms		
Pulse	Pulse parameters						
5	Us=+70V, tr=10ms, td=600ms						
Commission directive 72/245/EEC, as last amended by commission directive 2006/28/EC Requirements to be met by vehicles and electrical/electronic sub-assemblies fitted to a vehicle							

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<p>Radiated disturbance emission test</p>	<ul style="list-style-type: none"> Test method 2005/83/EC, ANNEXES VII and VIII <table border="1" data-bbox="874 315 1414 551"> <thead> <tr> <th>Frequency (MHz)</th> <th>Limit value (dBμV/m)</th> </tr> </thead> <tbody> <tr> <td>30 – 1000</td> <td>62/52/63 (Broadband QP)</td> </tr> <tr> <td>30 – 1000</td> <td>52/42/53 (Narrowband AVE)</td> </tr> </tbody> </table>	Frequency (MHz)	Limit value (dB μ V/m)	30 – 1000	62/52/63 (Broadband QP)	30 – 1000	52/42/53 (Narrowband AVE)																						
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<p>Conducted disturbances emission test</p>	<ul style="list-style-type: none"> Test method 2005/83/EC, ANNEX X <table border="1" data-bbox="874 667 1414 763"> <thead> <tr> <th>Port</th> <th>Limit level (V)</th> </tr> </thead> <tbody> <tr> <td rowspan="2">24V DC input</td> <td>+150</td> </tr> <tr> <td>-450</td> </tr> </tbody> </table>	Port	Limit level (V)	24V DC input	+150	-450																							
Port	Limit level (V)																												
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<p>Immunity to transient disturbances conducted along supply lines test</p> <p>Note: The Mini module (2038) and the Mini display (2029) need the Hub module (2021) in order to have the full transient immunity.</p>	<ul style="list-style-type: none"> Test method 2005/83/EC, ANNEX X Performance criterion: <table border="1" data-bbox="991 904 1334 1133"> <thead> <tr> <th>Pulse</th> <th>Criterion</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>C</td> </tr> <tr> <td>2a</td> <td>B</td> </tr> <tr> <td>2b</td> <td>C</td> </tr> <tr> <td>3a</td> <td>A</td> </tr> <tr> <td>3b</td> <td>A</td> </tr> <tr> <td>4</td> <td>C</td> </tr> </tbody> </table> <table border="1" data-bbox="874 1162 1414 1420"> <thead> <tr> <th>Pulse</th> <th>Pulse parameters</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3/2000μs, -600V, 1000 pulses</td> </tr> <tr> <td>2a</td> <td>1/50μs, +100V, 1000 pulses</td> </tr> <tr> <td>2b</td> <td>20V, 220ms, 2 pulses</td> </tr> <tr> <td>3a</td> <td>5/100ns, -200V, 60minutes</td> </tr> <tr> <td>3b</td> <td>5/100ns, +150V, 60minutes</td> </tr> <tr> <td>4</td> <td>100ms -20,5(8,0)V, 20s - 16,5(12,0)V, 2 pulses</td> </tr> </tbody> </table>	Pulse	Criterion	1	C	2a	B	2b	C	3a	A	3b	A	4	C	Pulse	Pulse parameters	1	3/2000 μ s, -600V, 1000 pulses	2a	1/50 μ s, +100V, 1000 pulses	2b	20V, 220ms, 2 pulses	3a	5/100ns, -200V, 60minutes	3b	5/100ns, +150V, 60minutes	4	100ms -20,5(8,0)V, 20s - 16,5(12,0)V, 2 pulses
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Radiated radio-frequency electromagnetic field immunity test

- Test method 2005/83/EC, ANNEX IX
- Performance criterion: No degradation of 'Immunity-related functions'

Specification	Frequency Range (MHz)	Test level
Modulation AM80% 1kHz Sweep step 1%, time/step 3s	20-800	30V/m
PM 577/4600µs	800-2000	30V/m

EN 61000-6-3 (2001)

Electromagnetic compatibility-generic emission standard
part6-3: residential, commercial and light industry

Radiated disturbance emission test

Note: The Color display (2040) needs extra facilities in order to have the limit B covered.

- Test method EN 55022 (1994)

Limit	Frequency (MHz)	Limit value (dBµV/m)
A	30 – 1000	40/47 (QP)
B	30 – 1000	30/37 (QP)

Conducted disturbance at main ports emission test

- Test method EN 55022 (1994)

Frequency (MHz)	Limit value (dBµV)
0,15 - 30	66/56/60 (QP)
0,15 – 30	56/46/50 (AVE)

EN 61000-6-2 (2005)

Electromagnetic compatibility-generic immunity standard
part6-2: industrial environment

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<p>Conducted radio-frequency common mode immunity test</p>	<ul style="list-style-type: none"> • Test method EN 61000-4-6 (1996) • Performance criterion A <table border="1" data-bbox="858 320 1406 562"> <thead> <tr> <th>Specification</th> <th>Port</th> <th>Test level</th> </tr> </thead> <tbody> <tr> <td>Frequency range 0.150-80MHz Modulation AM80% 1kHz Sweep step 1%, time/step 3s</td> <td>DC input port</td> <td>10Vemf</td> </tr> <tr> <td></td> <td>Signal ports</td> <td>10Vemf</td> </tr> </tbody> </table>	Specification	Port	Test level	Frequency range 0.150-80MHz Modulation AM80% 1kHz Sweep step 1%, time/step 3s	DC input port	10Vemf		Signal ports	10Vemf
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<p>Radiated radio-frequency electromagnetic field immunity test</p>	<ul style="list-style-type: none"> • Test method EN 61000-4-3 • Performance criterion A <table border="1" data-bbox="858 723 1406 1003"> <thead> <tr> <th>Specification</th> <th>Range (MHz)</th> <th>Test level</th> </tr> </thead> <tbody> <tr> <td>Frequency range 80-2700MHz Modulation AM80% 1kHz Sweep step 1%, time/step 3s</td> <td>80-1000</td> <td>20V/m</td> </tr> <tr> <td></td> <td>1000-2700</td> <td>3V/m</td> </tr> </tbody> </table>	Specification	Range (MHz)	Test level	Frequency range 80-2700MHz Modulation AM80% 1kHz Sweep step 1%, time/step 3s	80-1000	20V/m		1000-2700	3V/m
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Frequency range 80-2700MHz Modulation AM80% 1kHz Sweep step 1%, time/step 3s	80-1000	20V/m								
	1000-2700	3V/m								
<p>Electrical fast transient (EFT/B) immunity test</p>	<ul style="list-style-type: none"> • Test method EN 61000-4-4 (1995) • Performance criterion B <table border="1" data-bbox="858 1171 1406 1379"> <thead> <tr> <th>Test pulse</th> <th>Port</th> <th>Test level</th> </tr> </thead> <tbody> <tr> <td>5(Tr)/50(Th) ns, repetition frequency 5kHz, duration 1 minute</td> <td>DC input port</td> <td>± 2,0kVp</td> </tr> <tr> <td></td> <td>Signal ports</td> <td>± 2,0kVp</td> </tr> </tbody> </table>	Test pulse	Port	Test level	5(Tr)/50(Th) ns, repetition frequency 5kHz, duration 1 minute	DC input port	± 2,0kVp		Signal ports	± 2,0kVp
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	Signal ports	± 2,0kVp								
<p>CFR 47 Part 15, Subpart B, Class A and B Code of federal regulations (cfr) title 47 telecommunication, part15 radio frequency devices, subpart b unintentional radiators Class a intended for use in industrial/commercial environments Class b intended for use in residential/small office environments</p>										

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<p>Radiated emissions</p> <p>Note: The Color display (2040) needs extra facilities in order to have the class B covered.</p>	<ul style="list-style-type: none"> Test method ANSI C63.4 and EN55022 <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Class</th> <th style="text-align: center;">Frequency (MHz)</th> <th style="text-align: center;">Limit value (dBμV)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">A</td> <td style="text-align: center;">30 – 1000</td> <td style="text-align: center;">40/47 (QP)</td> </tr> <tr> <td style="text-align: center;">B</td> <td style="text-align: center;">30 – 1000</td> <td style="text-align: center;">30/37 (QP)</td> </tr> </tbody> </table>	Class	Frequency (MHz)	Limit value (dB μ V)	A	30 – 1000	40/47 (QP)	B	30 – 1000	30/37 (QP)
Class	Frequency (MHz)	Limit value (dB μ V)								
A	30 – 1000	40/47 (QP)								
B	30 – 1000	30/37 (QP)								

CLASSIFICATION OF PERFORMANCE CRITERION

- A: All functions of a device/system perform as designed during and after exposure to disturbance.
- B: All functions of a device/system perform as designed during and after exposure to disturbance. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions shall remain class A.
- C: One or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
- D: One or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and a device/system is reset by simple "operator/use" action.
- E: One or more functions of a device/system do not perform as designed during exposure and cannot be returned to operation without repairing the device/system.

7.3 Environmental Tests

The following environmental tests have been performed to Epec 4G modules:

Temperature			
Test	Temperature	Duration/Exposure time	Remarks
Cold IEC 60068-2-1, Test Ab	-45 °C	16 h	-
Dry heat IEC 60068-2-2, Test Bb	70 °C	16 h	-
Damp heat cycling IEC 60068-2-30, Test Db	+25 °C/+55 °C		<ul style="list-style-type: none"> rel. humidity >90% six test cycles
Change of temperature IEC 60068-2-14, Test Na	-50 °C/+60 °C	3 h	<ul style="list-style-type: none"> change time between extreme temperatures 1-2 min 5 test cycles
Change of temperature IEC 60068-2-14, Test Nb	-40 °C/+70 °C	3 h	<ul style="list-style-type: none"> change of temperature 10 °C/min 2 test cycles

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Mechanical resistance			
Test	Duration and direction	Remark	
Shock/Bump test IEC 60068-2-27, and - 29, Tests Ea and Eb	<ul style="list-style-type: none"> • pulse duration 6 ms • 500 impulses in every six directions 	<ul style="list-style-type: none"> • half sine pulse shape • peak acceleration 500 m/s² 	
Vibration, random IEC 60068-2-64, Test Fh	<ul style="list-style-type: none"> • test duration 60 min in every three test direction 	<ul style="list-style-type: none"> • ASD-level 0,5 m²/s³, 10 ... 200 Hz • ASD-level 1,0 m²/s³, 200 ... 500 Hz • total spectral acceleration 3,54 grms 	
Free fall, IEC 60068-2-32, Test Ed	<ul style="list-style-type: none"> • one fall / direction on each surface and corner 	<ul style="list-style-type: none"> • fall height 100 cm 	
Corrosion			
Test	Temperature	Duration	Concentration
Salt spray test ISO 9227	+35 °C	24 h	50 g/l, NaCl

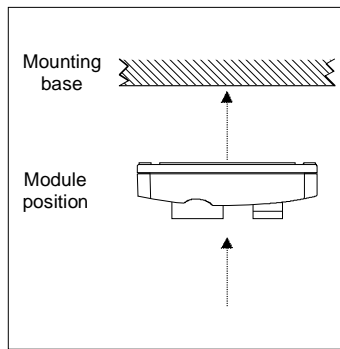
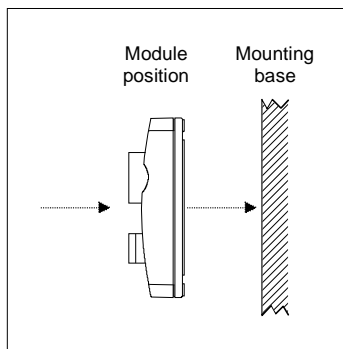
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8 HOUSING

- Closed light cast aluminium housing
- Powder-painted, hexavalent chromium free passivation for aluminium
- Puncture hole fastening

8.1 Mounting

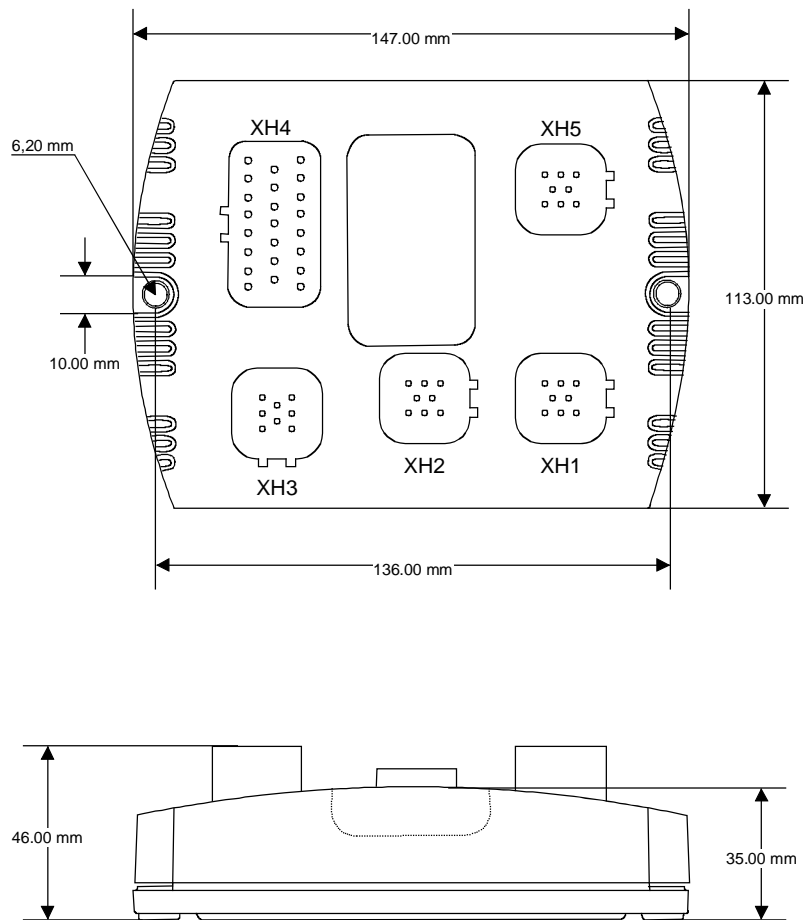
- 2 pieces of M6 screws to DIN 912
- If a separate Epec module shock protection cover (E10801109) is mounted, it is recommended to use Epec E10701038 fastening bolts
- Recommended mounting position horizontal or vertical to allow water etc. flowing away from connectors:



- See the General Mounting and Cabling Instructions for Epec Modules for more detailed information about the module mounting

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8.2 Unit Dimensions



Scale 1:2

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9 ADDITIONAL DOCUMENTS

For more information on Epec control system products, assembly and programming please refer to the following documents:

<i>Document ID</i>	<i>Document name</i>	<i>Document description</i>
MAN000101	Mounting Instructions	General mounting and cabling instructions for Epec modules

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