Epec SL84 Safety Control Unit

Technical Document

MAN000728

Document version history:

Date	***Notes***
10.11.2020	First released version

Table of Contents

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

1 PREFACE

1.1 Use of Symbols

This manual uses the following symbols to point out important information or safety instructions:

The information icon indicates important information and issues to be noted for the reader.

The caution icon indicates very important information or a warning. If the advices are ignored, it can result in personal injury or damage to software or equipment.

The (electrical) warning icon indicates a hazard which could cause an electrical danger and/or a personal injury.

The following symbols may be used on Epec's product labels:

CE compatibility
This symbol indicates that the product complies with the requirements set in the CE Standard.

WEEE symbol
This symbol indicates that the product must be sent to separate collection facilities for recovery and recycling when the end-user wishes to discard the product.

E17 Approval
This symbol indicates that the product is certified with normal automotive (E17) EMC (electromagnetic compatibility) standards.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

1.2 Required Skills

The user of this document must have sufficient knowledge of machine controlling, functional safety, CAN communication, PLCopen programming according to IEC61131-3 and should have skills to use CODESYS 3.5 programming environment.

Refer to the CODESYS manual and CODESYS Safety SIL2 manual for further information concerning the programming environment and required installations.

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

1.3 Safety Guidelines

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

A separate safety analysis is always required 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.

This document must be used together with the product's *Safety Manual* and *Programming & Libraries manual*. The *Safety Manual* overrides all other manuals in case of discrepancies.

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 mentioned in this manual. The manufacturer does not guarantee that this product complies with any other certification, standard or test other than mentioned in this manual.

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

External fuses 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.

Epec Oy reserves a right to improve its products without a further notice.

1.4 Warranty

Information concerning the warranty of this product can be found from *Epec General Sales and Warranty Terms.*

For more information, contact *sales@epec.fi*

1.5 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 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.

1.6 Environmental Statement

The manufacturer has a certified ISO 14001: 2015 environmental management system and certified processes to manufacture products. The manufacturer acts in an environmentally responsible manner and always complies with valid environmental legislation and directives .

The manufacturer is committed to comply with all relevant product regulations and directives concerning product safety, and responsible sourcing of raw materials and components. The position paper on *REACH and RoHS compliance and Conflict Minerals* can be found from Epec Oy's website.

The manufacturer undertakes to arrange for the recycling and scrapping of products that are returned to the manufacturer by the buyer and/or products that are received by the manufacturer in connection with maintenance services and deemed unusable by the manufacturer.

This product complies with the European Community Directive 2012/19/EU on waste electrical and electronic equipment (WEEE) encouraging and setting specific criteria for the collection, handling and recycling of electric and electronic waste. Outside of the European Union, local guidelines for recycling shall be followed.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

2 PRODUCT OVERVIEW

Epec SL84 Safety Control Unit is a programmable controller targeted for various control system applications including software-based safety functions. The main features of the product are summarized below.

Functional Safety

- Flexible solution for software-based safety functions
- Up to Safety Integrity Level 2 (IEC 61508 and IEC 62061) and Performance level d, Category 2 (EN ISO 13849)
- 32-bit multicore processor with lock-step processing and memory protection for the application
- CODESYS® V3 Safety SIL 2 programming according to the IEC 61131-3
- CANopen® Safety protocol for safety-related communication according to the EN 50325-5
- Extensive pre-certified function library to streamline safety application development

Mechanics & hardware

- Design of the housing together with LEAVYSEAL connectors optimize the unit footprint and enables easy installation and maintenance
- Three point anchorage confirms firm mounting also on irregular surfaces
- Signal LED for quick status check and fault detection
- Robust aluminum housing with IP69 protection and robust lever locked LEAVYSEAL connectors

Scaleable and Efficient System Integration

- Epec SL84 Safety Control Unit is a feasible solution for centralized and distributed control system architectures
- The software configurable I/O interface and ready-made libraries provides a flexible integration of components from 3rd party manufacturers to optimize performance
    - accurate measurement of a wide variety on sensors
    - easy connection of joysticks and pedals
    - current-controlled control of electro-hydraulic actuators
    - diagnostic and calibration functions for several types of components
- Higher level CAN protocols for standardized communication between sub-systems to support modular development and efficient system integration during the project
    - CANopen
    - CANopen Safety
    - SAE J1939
- Efficient system setup by using Epec MultiTool and PLCopen libraries
    - Configuration of both non-safety related (PDO) and safety related (SRDO) communication
    - Configuration of both non-safety related and safety related parameters (object dictionary)
    - Initialization of I/O interface

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Reliability

- Designed to withstand harsh operating conditions of on-road and off-road machinery applications
- High resistance against mechanical shocks and vibration, electro-magnetic interference, and temperature variation
- Diagnostic functions and log files enable efficient monitoring and problem-solving during the whole lifecycle of the system
- Made in Finland

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

3 TECHNICAL DATA SL84

Processor	32 bit CPU, 200 MHz
Power	Nominal supply voltage 12/24 VDC systems (8,5 ... 33 VDC) Idle power consumption 4 W (+24 VDC, no external load) Undervoltage reset typ. 5,5 V
REF voltage outputs	+5 V
Diagnostics	Signal LED (green/red/blue) Supply voltage Unit temperature REF voltage monitoring Internal voltage monitoring
Protection functions	Overvoltage protection Short-circuit protection for outputs
Programming	CODESYS 3.5
Protection class	IP69
Size / Outer dimensions	180 x 150 x 55 mm 7.09 x 5.91 x 2.17 in
Weight	1,02 kg 2.25 lbs
Case material	Aluminum
Operating temperature	-40... +85 °C -40...+185 °F
Storage temperature	-40... +85 °C -40...+185 °F
Connectors	1 x LEAVYSEAL 46 pos A code 1 x LEAVYSEAL 46 pos B code 1 x LEAVYSEAL 21 pos A code
Communications / Interfaces	2 x CAN 2.0 B
REF pins total	4

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

GND pins total	24	
I/O pins total	69	
Outputs	20 x	PWM/DO/CM 3 A (with high side current measurement up to 3A) (sourcing, up to 3 A, PWM frequency by application) 10 outputs belong to the cut-off group (power supply 2)
	4 x	DO/CM 5 A (sourcing, up to 5 A)
	8 x	DO 3 A (8 outputs, 10 pins)
	2 x	DO (GND) 3 A (sinking, up to 3 A)
Inputs	15 x	AI/DI (0-5 V / 0-22 mA configurable by software) (pull-up / pull-down configurable by software)
	10 x	PI/DI (rising threshold 3,3 V, falling threshold 1,7 V) (pull-up / pull-down selection by application)
	6 x	PI/DI (threshold 2,6 V)
	4 x	DI pins for defining communication parameters PI/DI (threshold 2,6 V)

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

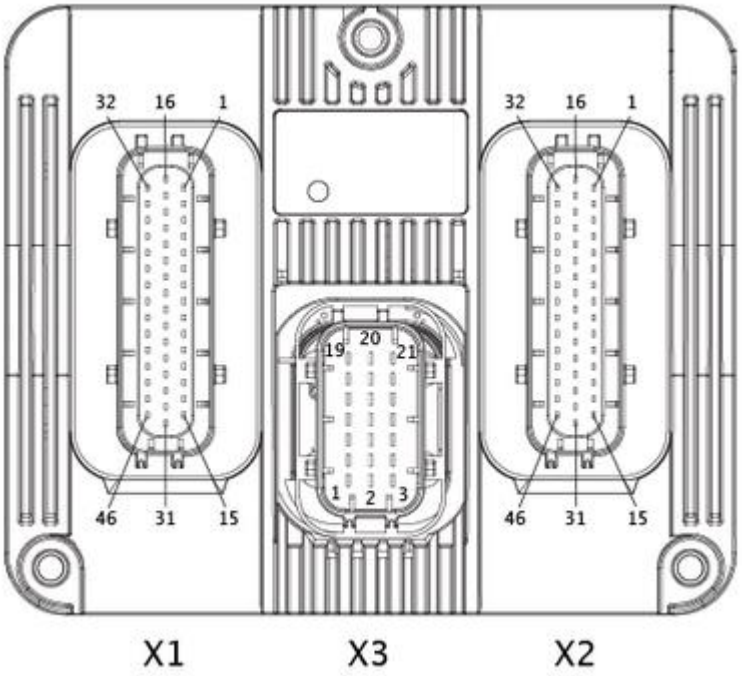
Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4 INPUT/OUTPUT SPECIFICATIONS

4.1 I/O List

The Epec SL84 Unit has three connectors according to the following figure.



The following tables list the connector's pins according to their pin number. Other columns offer quick information about the pin and links for more information.

* Group column: VIN1/VIN2/VIN3 indicates the power source for the pin.

Pair column: **UPPER CASE CHARACTERS indicate outputs in the same physical component case.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.1.1 First Connector (X1)

LEAVYSEAL 46 pin (A code)

4.1.1.1 I/O table

Pin number	Pin type	Details	Group*	Pair**	Current /Voltage	Information
X1.1	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.2	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.3	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.4	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.5	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.6	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.7	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.8	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X1.9	REF +5 V_Type_128_1_0_SL84				+5 V 600 mA	Shared current with pin 1.9, 1.10,1.11, 2.20
X1.10						
X1.11						
X1.12	DO/CM 5 A Type_124_1_1_SL84	10 kΩ GND	VIN3		5 A	
X1.13	DO/CM 5 A Type_124_1_1_SL84	10 kΩ GND	VIN3		5 A	
X1.14	DO/CM 5 A Type_124_1_1_SL84	10 kΩ GND	VIN3		5 A	
X1.15	DO/CM 5 A Type_124_1_1_SL84	10 kΩ GND	VIN3		5 A	
X1.16	Loader BSL	For Factory use only				
X1.17	AI_GND				10 A	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

X1.18	AI_GND				10 A	
X1.19	AI_GND				10 A	
X1.20	AI_GND				10 A	
X1.21	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	K	3 A	
X1.22	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	L	3 A	
X1.23	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	M	3 A	
X1.24	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X1.25	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X1.26	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X1.27	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X1.28	IO_GND				10 A	
X1.29	IO_GND				10 A	
X1.30	IO_GND				10 A	
X1.31	IO_GND				10 A	
X1.32	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X1.33	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X1.34	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X1.35	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X1.36	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	K	3 A	
X1.37	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	L	3 A	
X1.38	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN1	M	3 A	
X1.39	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	A	3 A	
X1.40	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	A	3 A	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

X1.41	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	B	3 A	
X1.42	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	B	3 A	
X1.43	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	C	3 A	
X1.44	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	C	3 A	
X1.45	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	D	3 A	
X1.46	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN1	D	3 A	

4.1.2 Second Connector (X2)

LEAVYSEAL 46 pin (B code)

4.1.2.1 I/O Table

Pin number	Pin type	Details	Group*	Pair**	Current /Voltage	Information
X2.1	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN3	N	3 A	
X2.2						
X2.3	DO 3 A_type_125_1_0_SL84	10 kΩ GND	VIN3	N	3 A	
X2.4						
X2.5	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	E	3 A	Cut-off output
X2.6	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	E	3 A	Cut-off output
X2.7	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	F	3 A	Cut-off output
X2.8	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	F	3 A	Cut-off output
X2.9	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	G	3 A	Cut-off output
X2.10	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	G	3 A	Cut-off output

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

X2.11	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	H	3 A	Cut-off output
X2.12	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	H	3 A	Cut-off output
X2.13	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	I	3 A	Cut-off output
X2.14	PWM/DO/CM 3 A Cut-off_114_2_0_SL84	10 kΩ GND	VIN2	I	3 A	Cut-off output
X2.15	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN3	J	3 A	
X2.16	AI_GND				10 A	
X2.17	AI_GND				10 A	
X2.18	AI_GND				10 A	
X2.19	AI_GND				10 A	
X2.20	REF +5 V_Type_128_1_0_SL84				+5 V 600 mA	Shared current with pin X1.9, X1.10, X1.11, X 2.20
X2.21	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X2.22	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X2.23	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X2.24	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X2.25	PI/DI_2_type_039_0_2_SL84	10 kΩ GND			Threshold 2,6 V	
X2.26	IO_GND				10 A	
X2.27	IO_GND				10 A	
X2.28	IO_GND				10 A	
X2.29	IO_GND				10 A	
X2.30	IO_GND				10 A	
X2.31	PWM/DO/CM 3A_type114_1_4_SL84	10 kΩ GND	VIN3	J	3 A	
X2.32	AI/DI_Type116_0_0_SL84	84,2 kΩ GND /			0-5 V / 0-22 mA	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

		220 Ω GND / 2,2 kΩ +5 V				
X2.33	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.34	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.35	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.36	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.37	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.38	AI/DI_Type116_0_0_SL84	84,2 kΩ GND / 220 Ω GND / 2,2 kΩ +5 V			0-5 V / 0-22 mA	
X2.39	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.40	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.41	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.42	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.43	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.44	PI/DI_Type075_2_0_SL84	12,2 kΩ GND / 2,2 kΩ +5 V			Threshold 3,3 V / 1,7 V	
X2.45	DO_GND 3 A_Type048_3_1_SL84	10 kΩ VIN3			3 A	
X2.46	DO_GND 3 A_Type048_3_1_SL84	10 kΩ VIN3			3 A	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.1.3 Third Connector (X3)

LEAVYSEAL 21 pin (A code)

4.1.3.1 I/O Table

Pin number	Pin type	Details	Group*	Current /Voltage	Information
X3.1	Power Supply 3				Power supply for I/O
X3.2	Power Supply 1				Power supply for logic and I/Os
X3.3	Power Supply 2				Power supply for cut-off group
X3.4	Power Supply 3				Power supply for I/O
X3.5	Power Supply 1				Power supply for logic and I/Os
X3.6	Power Supply 2				Power supply for cut-off group
X3.7	GND	Supply GND			
X3.8	GND	Supply GND			
X3.9	GND	Supply GND			
X3.10	GND	Supply GND			
X3.11	GND	Supply GND			
X3.12	GND	Supply GND			
X3.13	PI/DI_2_type_039_0_2_SL84	10 kΩ GND		Threshold 2,6 V	
X3.14	CAN 1 L TERM				
X3.15	CAN GND				
X3.16	CAN 2 L				
X3.17	CAN 1 L				
X3.18	CAN 1 L				

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

X3.19	CAN 2 H				
X3.20	CAN 1 H				
X3.21	CAN 1 H				

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.2 AI/DI_Type116_0_0_SL84

Possible pin modes:

- +5 V AI voltage mode
- +5 V AI voltage mode (pull-up)
- +22 mA AI current mode
- DI mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

Overcurrent protection must be added to the application using Epec libraries. For more information refer to *Epec Programming and Libraries Manual.*

Use AI_GND pins for sensor return paths.

4.2.1 AI (analog input) Mode

- This block is designed to measure 0...5V range voltage signal or 0...22 mA current signal
- The configurable features are controlled by two control signals:
  - One for selecting:
    - Voltage mode: High impedance input for signal from 0 to 5 V
    - Current mode: Low impedance input for signal from 0 to 22 mA
  - One control signal is for selecting (when in voltage mode):
    - Pull-up mode to +5 V by a resistor
    - Pull-down mode to GND by a resistor

When configured to current mode, analog inputs are protected against overvoltage automatically by switching to voltage mode during overvoltage situations.

4.2.2 DI (digital input) Mode

- These pins can also be used as digital inputs by configuring the pin to DI mode
- This pin has a configurable pull-up feature

4.2.3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
V_I	Input Voltage measuring range	Voltage mode	0	5	V
R_I	Input Resistance	Pull-up voltage mode (referenced to +5 V) (Note 4)	typ. 2,2		kΩ
		Pull-down voltage mode (referenced to GND)	typ. 84,2		kΩ
		Current mode	typ. 220		Ω
I_I	Input Current measuring range		0	22,7	mA
I_E	Input Error	Voltage mode		2	%
		Current mode		2	%
BW	Input Low Pass Filter Bandwidth	-3 dB cut-off frequency	typ. 41		Hz
V_{IH}	Input High Voltage	DI mode	3,3	33	V
V_{IL}	Input Low Voltage	DI mode	-0,5	1,7	V
C_I	Input pin capacitance		typ. 47		nF
$V_{I-range}$	Input Voltage Range	(Note 1) (Note 3)	-0,5	33	V
	Cable length			30	m

Note 1: Exceeding the max value might cause damage to input.
Note 3: Unit automatically changes to voltage mode when overcurrent occurs in current mode
Note 4: In unit startup, pull-up mode is on max. 150 ms (max. 5 V/ 2,3 mA)

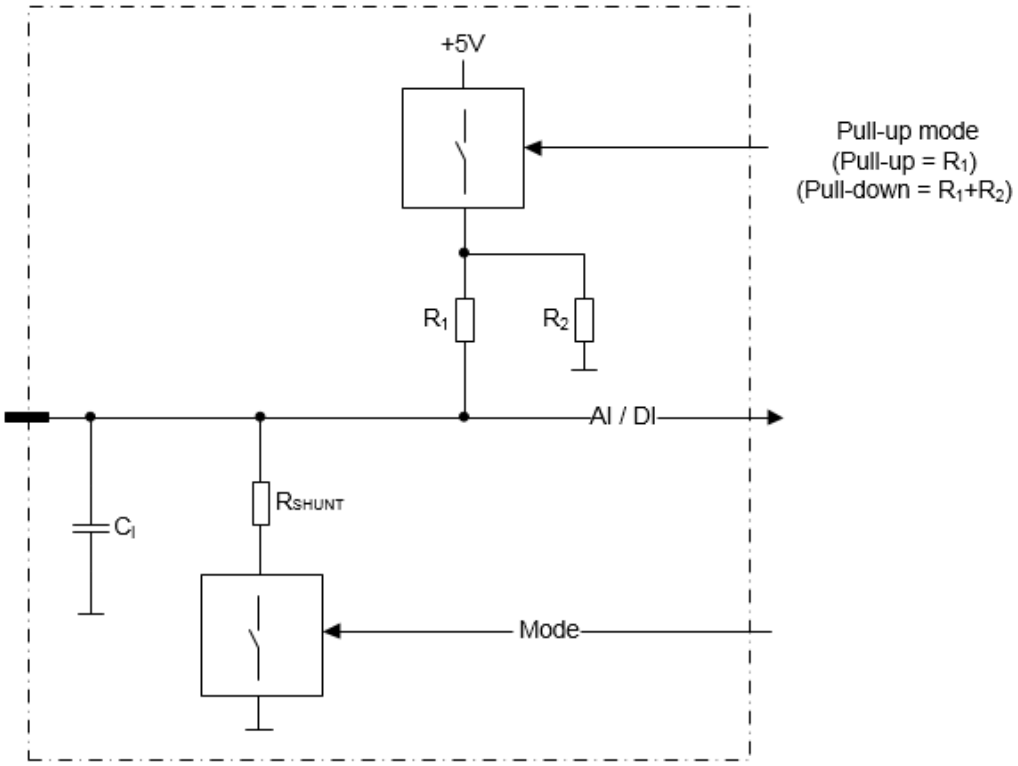
Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.2.4 Functional Block Diagram



4.3 PI/DI_Type075_2_0_SL84

Possible pin modes:

- DI mode
- PI mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

This pin type includes hysteresis. See the *Electrical Characteristics* table below for more information.

4.3.1 DI (digital input) Mode

- These pins can be configured as digital inputs
- These pins have a pull-up/pull-down selection by configuration

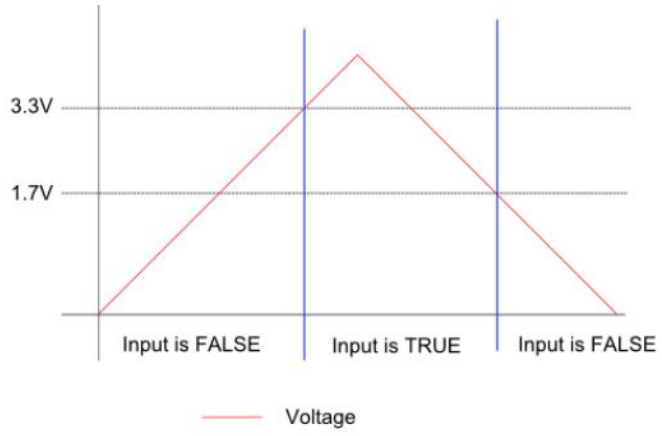
4.3.2 PI (pulse input) Mode

- This input mode has a pulse counting feature and measurements for pulse width, frequency and ratio
- These pins have a pull-up/pull-down selection by configuration
- Pulse input mode can be used as a 1 or 2 channel pulse counter
  - 1 channel pulse counter, it is possible to use a specific pin as reset channel
  - 2 channel pulse counter, the reset feature is done by software
- This mode is also suitable for quadrature sensor position counting

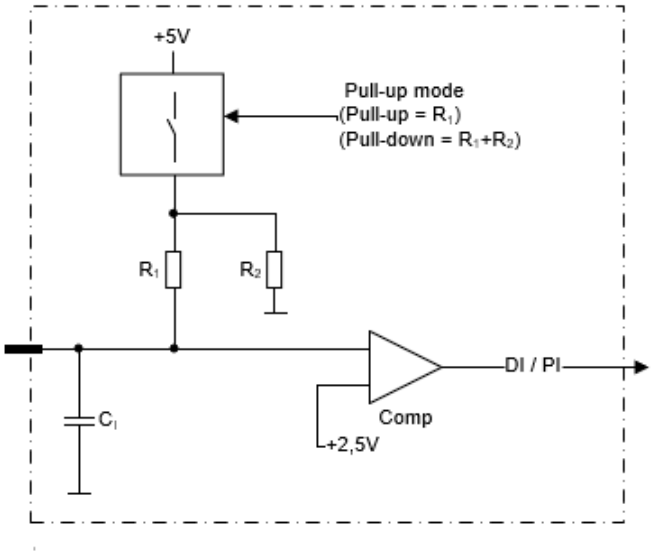
4.3.3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_I	Input Resistance	Pull-down voltage mode (referenced to GND)	typ. 12,2		kΩ
		Pull-up voltage mode (referenced to +5 V)	typ. 2,2		kΩ
V_{level}	Voltage Level	Unconnected pin, no pull-up selected	typ. 0		V
		Unconnected pin, pull-up selected	typ. 4,6		V
V_{IH}	Input High Voltage	Overload conditions (Note 1, 5)	3,3	33	V
V_{IL}	Input Low Voltage	(Note 5)	-0,5	1,7	V
f_I	Input Frequency (frequency measurement and pulse counting)	(Note 4)	1	20000	Hz
	Input Frequency (digital inputs)	(Note 2, 3)		1/ $2t_C$	kHz
t_I	Input Pulse Width		0,1	500	ms
C_I	Input Capacitance		typ. 1		nF
	Cable length			30	m

Note 1: Exceeding the max value might cause damage to input.
Note 2: t_C denotes the software cycle time in milliseconds.
Note 3: The pulse width must be greater that the software cycle time (approx. 1 ms with full I/O load). For example with 50/50 pulse ratio, the pulse frequency is 1 / (2*pulse width)
Note 4: The maximum value can be reached with 50 % duty cycle
Note 5: Includes hysteresis. The input state is maintained until the second voltage limit is exceeded.



4.3.4 Functional Block Diagram



4.5 PI/DI_2_type_039_0_2_SL84

Possible pin modes:

- DI mode
- PI mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

4.5.1 DI (digital input) Mode

- These pins can be configured as digital inputs

4.5.2 PI (pulse input) Mode

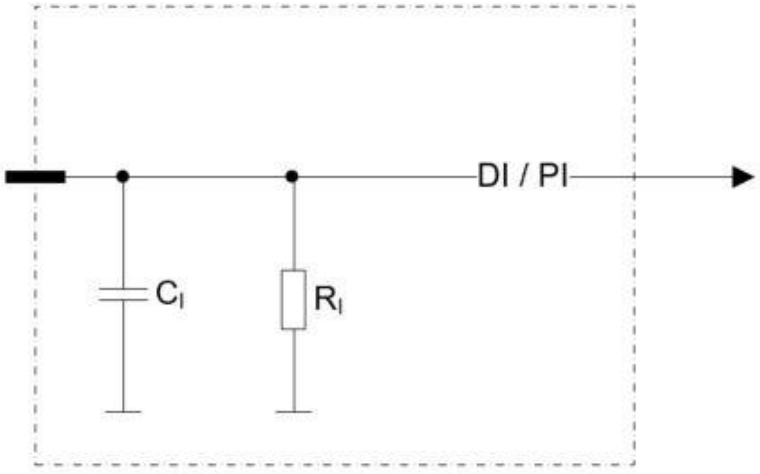
- This input mode has a pulse counting (PI), pulse width measuring, pulse frequency and pulse ratio features
- Pulse input mode can be used as a 1 or 2 channel pulse counter
  - 1 channel pulse counter, it is possible to use a specific pin as reset channel
  - 2 channel pulse counter, the reset feature is done by software
- This mode is also suitable for quadrature sensor position counting

4.5.3 Electrical characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_I	Input Resistance	Referenced to GND	typ. 10		kΩ
V_{IH}	Input High Voltage	Overload conditions (Note 1)	3,3	33	V
V_{IL}	Input Low Voltage		-0,5	1,7	V
f_I	Input Frequency (frequency measurement and pulse counting)	(Note 2, 3)		20	kHz
	Input Frequency (digital inputs)	(Note 3, 4)		1/ $2t_C$	kHz
t_I	Input Pulse Width		0,1	500	ms
C_I	Input Capacitance		typ. 1		nF
	Cable length			30	m

Note 1: Exceeding the max value might cause damage to input.
Note 2: The maximum value can be reached with 50 % duty cycle.
Note 3: t_C denotes the software cycle time in milliseconds.
Note 4: The pulse width must be greater that the software cycle time. For example with 50/50 pulse ratio, the pulse frequency is 1 / (2*pulse width)

4.5.4 Functional block diagram



4.6 PWM/DO/CM 3 A_type114_1_4_SL84

Possible pin modes:

- PWM mode with high side current measurement
- DO mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

4.6.1 PWM/DO (output) Mode

- This type of pin is a current sourcing output with a high side current measurement feature (the pin connects the load to a positive supply voltage through the shunt resistors).
    - These outputs have a switching element called a smart FET. It has integrated features to protect itself and also the external pin, wiring and actuator
    - These outputs are capable of generating pulse width modulated (PWM) output signals
    - The DI status feature indicates the possible DO output faults
    - The pulse width measurement feature indicates the possible PWM output faults

The FET outputs are grouped into pairs:

- The maximum continuous current for a single output in the pair is 3 A.
- The maximum continuous current for the pair is 5 A.

The pairs are indicated with upper case characters in the pin table's **Pair** column in section *I/O List.*

4.6.2 High Side Current Measurement

- The application can control the current with a current measurement feature
- The firmware limits the maximum current to 3 A (when the current exceeds the value by more than the predefined time, the output is switched off)

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

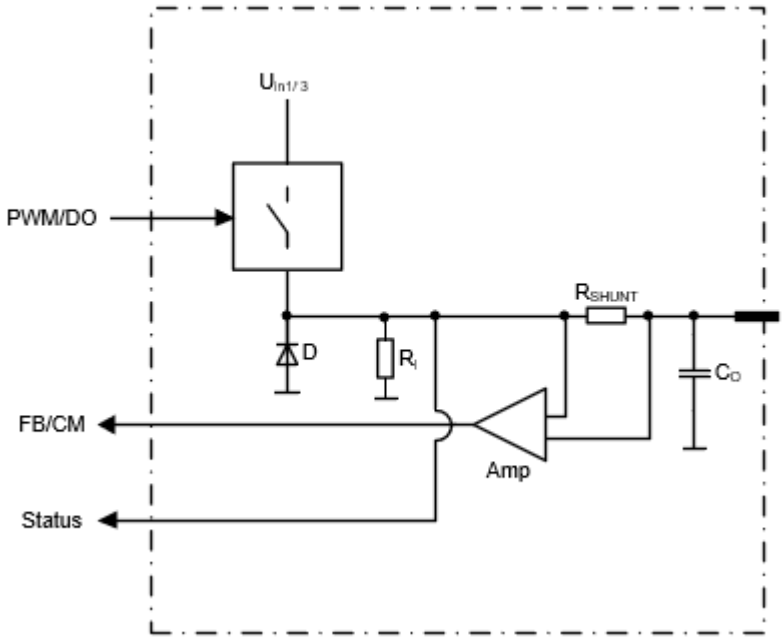
4.6.3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_{Shunt}	Shunt resistance		typ. 25		mΩ
$I_{o-range}$	Nominal Current Measuring Range		0	3	A
$I_{acc-zero}$	Offset error	Calculated 'worst case'		+/-16	mA
$I_{acc-prop}$	Accuracy Proportional factor	Calculated 'worst case'		+/-2	% (FS)
I_o	Nominal Output Current	Output On (Note 4, 6)	0	3	A
I_{o-lim_fw}	Internal current limitation (fw)	Output On (Note 5)		3,2	A
I_{o-lim_hw}	Internal current limitation (hw)	Output On (Note 8)	typ. 56		A
f_{PWM}	PWM Frequency	In current control mode (Note 1)	10	500	Hz
		In PWM mode (Note 1)	10	3000	Hz
$Duty_{PWM}$	PWM Duty cycle	(Note 2, 7)	0 to 100		%
Res_{PWM}	PWM Resolution	(Note 3)	0,1		%
Digital status					
R_I	Resistance	Output Off, referenced to U_{in2}	10		kΩ
V_{IH}	Input High Voltage		3,3	33	V
V_{IL}	Input Low Voltage		-0,5	1,7	V
C_O	Output pin capacitance		typ. 1		nF
Pulse width value					
PWM_{width}	Measured PWM width		10	100000	µs

Note 1: Frequency of a (PWM) Pulse Width Modulation is = 1 / Period
Note 2: The duty cycle is defined as the percentage of digital 'high' to digital 'low' signals present during a PWM period.
Note 3: The PWM resolution is defined as the maximum number of pulses that you can pack into a PWM period.
Note 4: The maximum output current depends on the load, PWM frequency and temperature.
Note 5: Firmware protects the internal shunt resistor in case of overcurrent. Firmware overcurrent protection reacts typically within 10-20ms in case the current exceeds 3A. This over current limit cannot be adjusted by software and is meant only for protection

of the hardware. It is possible to set the lower limiting value for overcurrent protection in the application by using current feedback and ready library POUs
Note 6: When both outputs in the pair are used, the maximum continuous current for the pair is 5 A.
Note 7: When the frequency increases, the actual duty cycle may be bigger than the value that has been set.
Note 8: For high inrush currents hardware limitation reacts faster than firmware protection.

4.6.4 Functional Block Diagram



4.8 PWM/DO/CM 3 A Cut-off_type114_2_0_SL84

This type of pin supports an additional safety function; functional safety is implemented using the unit, in addition to external components.
External voltage supply shall be cut-off reliably from Power Supply Group 2 (pin X3.3). In order to use the unit in systems with functional safety level Cat 2 or higher, the voltage from Power Supply Group 2 must be verified that there is no remaining voltage by diagnosing pin X3.6 with a safety unit in system level.

The output leakage current is less than 1 mA, when the Power Supply Group 2 is de-energized.

Possible pin modes:

- PWM mode with high side current measurement
- DO mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

4.8.1 PWM/DO (output) Mode

- This type of pin is a current sourcing output with a high side current measurement feature (the pin connects the load to a positive supply voltage through the shunt resistors).
    - These outputs have a switching element called a smart FET. It has integrated features to protect itself and also the external pin, wiring and actuator
    - These outputs are capable of generating pulse width modulated (PWM) output signals
    - The DI status feature indicates the possible DO output faults
    - The pulse width measurement feature indicates the possible PWM output faults

The FET outputs are grouped into pairs:

- The maximum continuous current for a single output in the pair is 3 A.
- The maximum continuous current for the pair is 5 A.

The pairs are indicated with upper case characters in the pin table's **Pair** column in section *I/O List*.

4.8.2 High Side Current Measurement

- The application can control the current with a current measurement feature
- The firmware limits the maximum current to 3 A (when the current exceeds the value by more than the predefined time, the output is switched off)

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

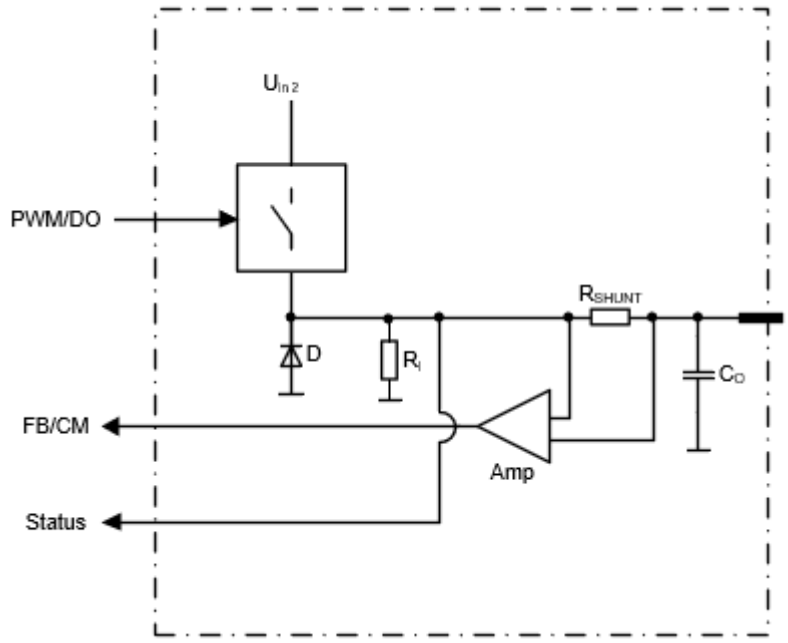
4.8.3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_{Shunt}	Shunt resistance		typ. 25		mΩ
$I_{o-range}$	Nominal Current Measuring Range		0	3	A
$I_{acc-zero}$	Offset error	Calculated 'worst case'		+/-16	mA
$I_{acc-prop}$	Accuracy Proportional factor	Calculated 'worst case'		+/-2	% (FS)
I_o	Nominal Output Current	Output On (Note 4, 6)	0	3	A
I_{o-lim_fw}	Internal current limitation (fw)	Output On (Note 5)		3,2	A
I_{o-lim_hw}	Internal current limitation (hw)	Output On (Note 8)	typ. 56		A
f_{PWM}	PWM Frequency	In current control mode (Note 1)	10	500	Hz
		In PWM mode (Note 1)	10	3000	Hz
$Duty_{PWM}$	PWM Duty cycle	(Note 2, 7)	0 to 100		%
Res_{PWM}	PWM Resolution	(Note 3)	0,1		%
Digital status					
R_I	Resistance	Output Off, referenced to U_{in2}	10		kΩ
V_{IH}	Input High Voltage		3,3	33	V
V_{IL}	Input Low Voltage		-0,5	1,7	V
C_O	Output pin capacitance		typ. 1		nF
Pulse width value					
PWM_{width}	Measured PWM width		10	100000	µs

Note 1: Frequency of a (PWM) Pulse Width Modulation is = 1 / Period
Note 2: The duty cycle is defined as the percentage of digital 'high' to digital 'low' signals present during a PWM period.
Note 3: The PWM resolution is defined as the maximum number of pulses that you can pack into a PWM period.
Note 4: The maximum output current depends on the load, PWM frequency and temperature.
Note 5: Firmware protects the internal shunt resistor in case of overcurrent. Firmware overcurrent protection reacts typically within 10-20ms in case the current exceeds 3A. This over current limit cannot be adjusted by software and is meant only for protection of the hardware. It is possible to set the lower limiting value for overcurrent protection in the application by using current feedback and ready library POUs

Note 6: When both outputs in the pair are used, the maximum continuous current for the pair is 5 A.
Note 7: When the frequency increases, the actual duty cycle may be bigger than the value that has been set.
Note 8: For high inrush currents hardware limitation reacts faster than firmware protection.

4.8.4 Functional Block Diagram



4.9 DO/CM 5 A Type_124_1_1_SL84

Possible pin modes:

- DO mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

Overcurrent protection must be added to the application using Epec libraries. For more information refer to *Epec Programming and Libraries Manual.*

4.9.1 DO (digital output) Mode

- This type of pin is a current sourcing output with current measurement capability. Current measurement is intended for diagnostics purposes.
  - These outputs have a switching element called a smart FET. It has integrated features to protect itself and also the external pin, wiring and actuator
  - The DI status feature indicates the possible DO output faults

4.9.2 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_O	Output Resistance	Output On		22	mΩ
I_O	Output Current	Output On (Note 1)	0	5	A
$I_{o-range}$	Nominal Current Measuring Range		0	10,8	A
I_{o-lim_hw}	Internal current limitation (hw)	Output On (Note 3)	typ. 58		A
I_{acc}	Current measurement accuracy	See picture below			
Digital status input					
R_I	Input Resistance	Output Off; Referenced to GND	10		kΩ
V_{IH}	Input High Voltage		3,3	33	V
V_{IL}	Input Low Voltage		-0,5	1,7	V
C_O	Output pin capacitance		typ. 1		nF

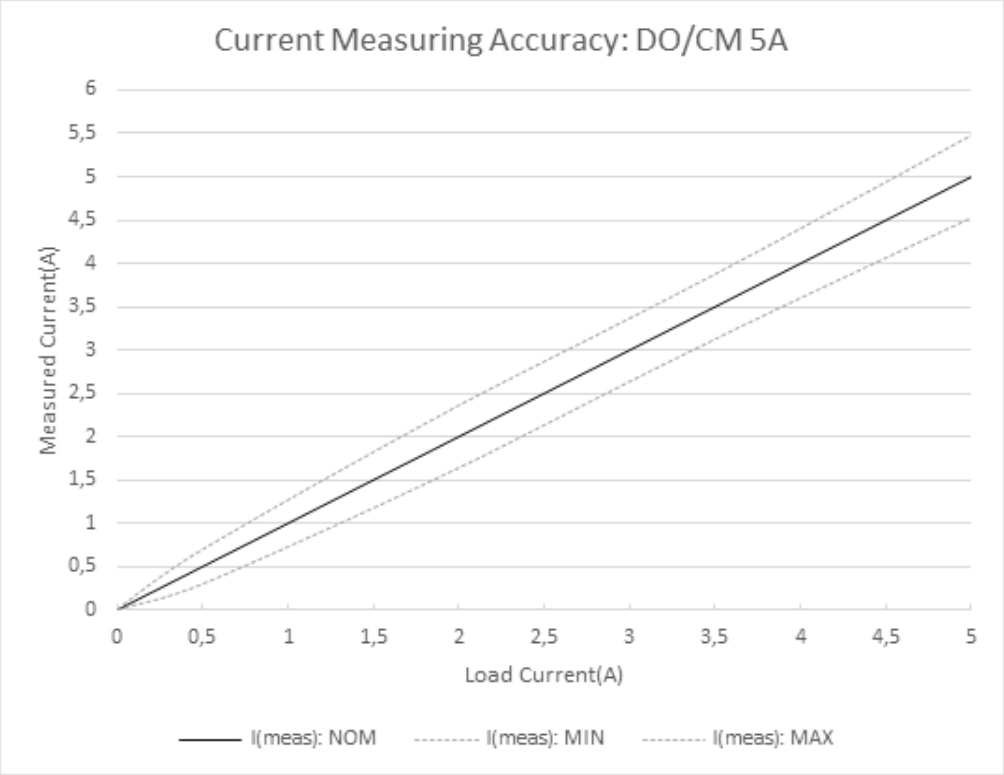
Note 1: Exceeding the max value might cause permanent damage.
Note 3: For high inrush currents hardware limitation reacts faster than firmware protection.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

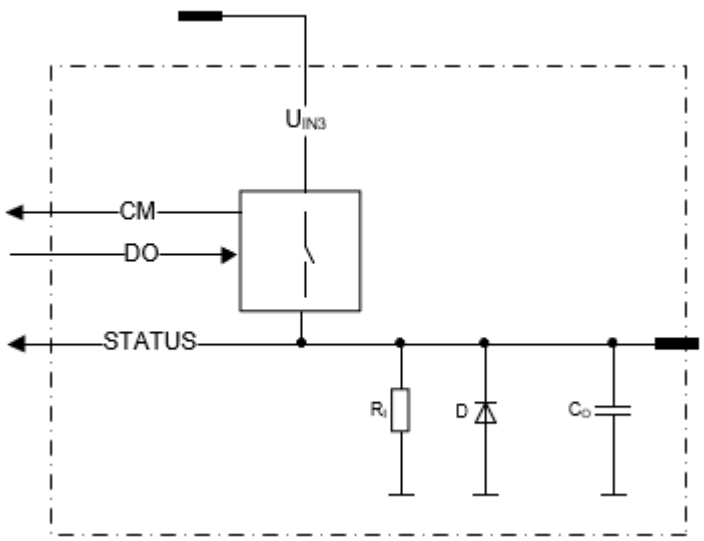
Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi



4.9.3 Functional Block Diagram



4.10 DO 3 A_type_125_1_0_SL84

Possible pin modes:

- DO mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* library. For more information refer to *Epec Programming and Libraries Manual* and *MultiTool Manual*.

4.10.1 DO (digital output) Mode

- This type of pin is a current sourcing output
  - These outputs have a switching element called a smart FET. It has integrated features to protect itself and also the external pin, wiring and actuator
  - The DI status feature indicates the possible DO output faults

The FET outputs are grouped into pairs:

- The maximum continuous current for a single output in the pair is 3 A.
- The maximum continuous current for the pair is 5 A.

The pairs are indicated with upper case characters in the pin table's **Pair** column in section *I/O List*

4.10.2 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_O	Output Resistance	Output On		62	mΩ
I_O	Output Current	Output On	0	3	A
I_{o-lim}	Internal current limitation	Output On (Note 1)	typ. 35		A
Digital status input					
R_I	Input Resistance	Output Off; Referenced to GND	10		kΩ
V_{IH}	Input High Voltage		3,3	33	V
V_{IL}	Input Low Voltage		-0,5	1,7	V
C_O	Output pin capacitance		typ. 1		nF

Note 1: Current limit for short circuit protection to protect cabling and to limit internal power dissipation.

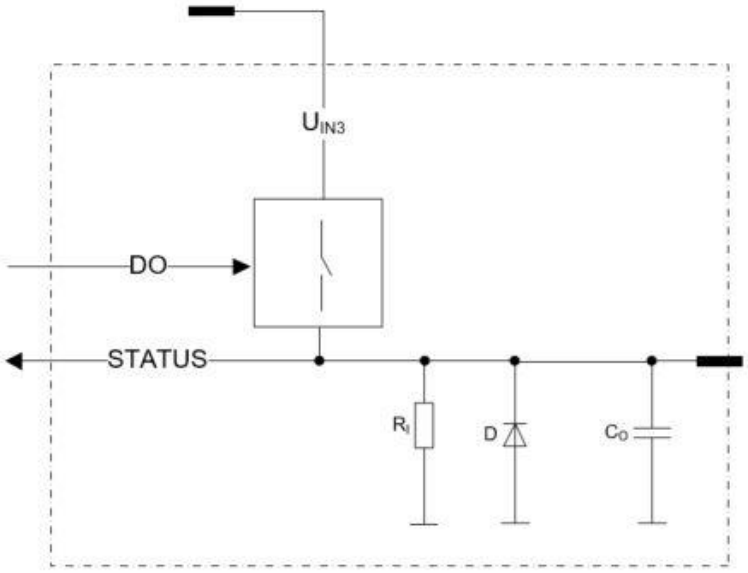
Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.10.3 Functional Block Diagram



4.11 DO_GND 3 A _Type048_3_1_SL84

Possible pin modes:

- DO (GND) mode

Select the mode using MultiTool. MultiTool generates the needed code using functions from *SafeSSeriesIODriverExt* **library. For more information refer to** *Epec Programming and Libraries Manual* **and** *MultiTool Manual*.

Closed circuit loops are recommended when using this pin.
Closed circuit loop means that the current from the control unit to the sensor must return to the same control unit, see the figures in section *I/O Cabling*.

4.11.1 DO (digital output, GND) Mode

- This kind of pin is a current sinking output. The pin connects the load to the ground
- The DI status feature indicates the possible DO output faults

4.11.2 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
R_O	Output Resistance	Output On		0,12	Ω
I_I	Nominal Input Current	Output On		3	A
I_L	Leak Sourcing Current	Output Off	typ. 3		mA
I_{o-lim}	Internal Current Limitation	Output On	30		A
Digital status input					
R_I	Input Resistance	Output Off (referenced to VIN3)	typ. 10		kΩ
V_{IH}	Input High Voltage	Output Off	3,3	33	V
V_{IL}	Input Low Voltage	Output Off	-0,5	1,7	V
C_I	Input Pin Capacitance		typ. 1		nF

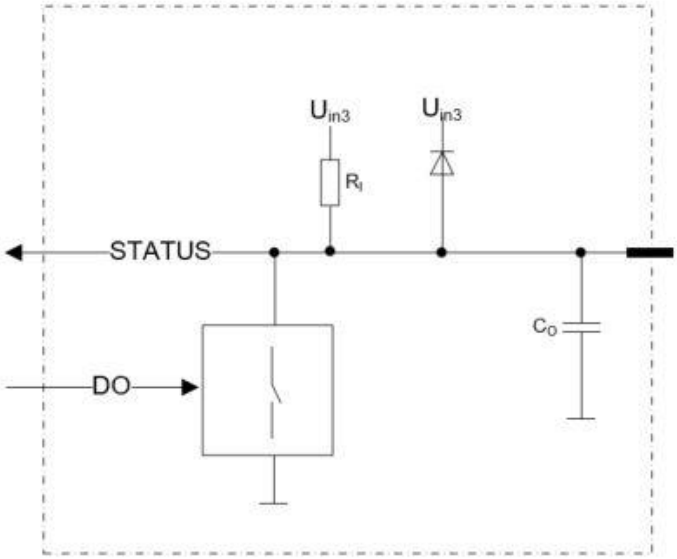
Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

4.11.3 Functional Block Diagram



4.12 REF +5 V_Type128_1_0_SL84

- This is an internally regulated and monitored reference voltage supply for external devices.
- This reference output can be switched on/off by application.

4.12.1 Protection Features

- Overcurrent
- External voltage protection

4.12.2 Voltage Monitoring

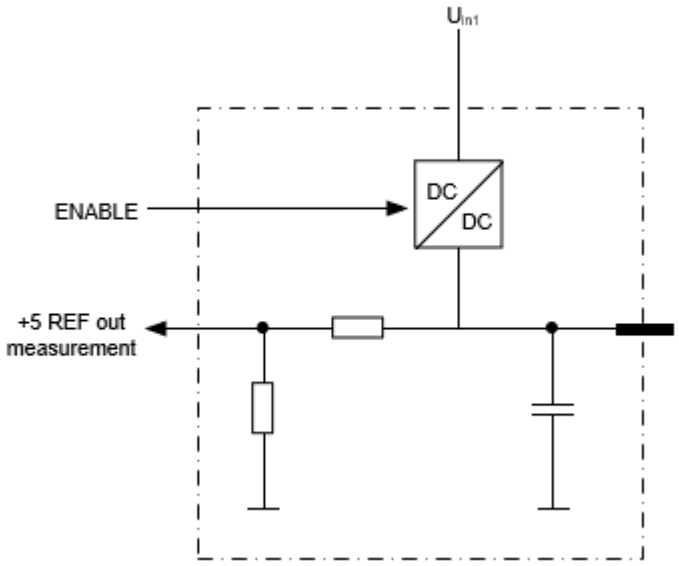
The level of the output voltage can be monitored.

4.12.3 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
$V_{o-level}$	Output voltage	Output On; Unconnected pins	typ. 5		V
I_o	Nominal Output Current	Output On; Max total for all pins together	0	600	mA
I_{o-lim}	Internal Current Limitation	Output On (Note 2, 3)	typ. 1200		mA
C_o	Output Capacitance		typ. 22		uF
V_{I-max}	Max Input voltage	Overload conditions (Note 1)		33	V
Voltage monitoring					
$V_{I-range}$	Nominal Voltage measuring range		0	5,73	V

Note 1: When output voltage is under overload conditions, for example, short circuit to supply voltages. Exceeding the max value might cause damage to output.
Note 2: Current limit for overcurrent protection to limit internal power dissipation.
Note 3: When the limit is exceeded, the internal current limiter is activated.

4.12.4 Functional Block Diagram



4.13 Power Supply

4.13.1 Power Supply Pins and Limitations

Power supply pins are located in the following pins:

Pin number	Pin Type	Current/Pin	Note
X3.2	Logic/Power Supply 1	20 A	The maximum total current of Power Supply 1 cannot exceed 20 A.
X3.5	Logic/Power Supply 1	20 A	
X3.3	Power Supply 2	20 A	The maximum total current of Power Supply 2 cannot exceed 20 A. Power supply for cut-off group
X3.6	Power Supply 2	20 A	
X3.1	Power Supply 3	20 A	The maximum total current of Power Supply 3 cannot exceed 20 A.
X3.4	Power Supply 3	20 A	
X3.7	GND	20 A	The maximum total current of GND cannot exceed 60 A.
X3.8	GND	20 A	
X3.9	GND	20 A	
X3.10	GND	20 A	
X3.11	GND	20 A	
X3.12	GND	20 A	

The following table describes Power Supply groups for each output:

Pin number	Pin Type	Powered by	Current
X1.39	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.40	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.41	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.42	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.43	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.44	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.45	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A
X1.46	PWM/DO/CM 3A	Logic/ Power Supply 1	3 A

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

X2.5	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.6	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.7	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.8	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.9	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.10	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.11	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.12	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.13	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.14	PWM/DO/CM 3A	Cut-off / Power Supply 2	3 A
X2.15	PWM/DO/CM 3A	Power Supply 3	3 A
X2.31	PWM/DO/CM 3A	Power Supply 3	3 A
X1.12	DO 5A	Power Supply 3	5 A
X1.13	DO 5A	Power Supply 3	5 A
X1.14	DO 5A	Power Supply 3	5 A
X1.15	DO 5A	Power Supply 3	5 A
X1. – X1.31 X2.26 – X2.30	IO GND	GND for DO	10 A /pin (Note 1)
X1.17 – X1.20 X2.16 – X2.19	AI GND	GND for AI	10 A /pin (Note 1)

Note 1: The maximum sum of IO GND and AI GND pin currents cannot exceed 60 A.

Always use an external fuse to protect the control unit. The fuse is needed for reverse voltage and overload protection. For more information, see section *Power Supply Cabling*.

4.13.2 Electrical Characteristics

Symbol	Parameter	Conditions	Min	Max	Units
$V_{I-\ Power\ Supply\ 1}$	Nominal Input Voltage	(Note 5)	8,5	33	V
$V_{I-\ Power\ Supply\ 2}$			6	36	V
$V_{I-\ Power\ Supply\ 3}$			6	36	V
$P_{Power\ Supply\ 1}$	Logic Power Consumption	No external loads, Uin = 24 V	typ. 2,4		W
$I_{TOT-max}$	Max Total Current Output	All 3 Power Supply Groups together		60	A
$V_{I-Load-dump}$	Max Input transient Voltage level	(Note 1, 4)	150		V
$V_{I-max-Power\ Supply\ 1}$	Max Continuous Input Voltage Level	(Note 2)	-0,5	70	V
$V_{I-max-Power\ Supply\ 2}$		(Note 7)	-0,5	36	V
$V_{I-max-Power\ Supply\ 3}$		(Note 7)	-0,5	36	V
$V_{OVP-Reg}$	Regulated Overvoltage threshold level	(Note 3)	typ. 34		V
V_{UVP}	Undervoltage Threshold Level	(Note 3, 6)	typ. 5,5		V
Voltage monitoring					
$V_{I-range}$	Nominal Input Voltage measuring range	(Note 4)	0	46	V

Note 1: Load dump protection according to ISO 7637-2: 2004 pulse 5, Us=+123 V
Note 2: The overvoltage protection cuts off the power feed for the X1.9 – X1.11, X2.20, X1.21 – X1.23, X1.36 – X1.38 and X1.39 – X1.46 pins when the voltage is higher than the nominal.
Note 3: This parameter is only related to the Power Supply 1 input.
Note 4: This parameter relates to all Power Supply groups.
Note 5: Limited functionality when the voltage is lower or higher than the nominal.
Note 6: If the voltage is less than 5,5 V, the control unit is in non-operational state.
Note 7: When using mains voltage power supply in safety critical application, it is required to use a power supply which fulfills Hardware Fault Tolerance (HFT) = 1.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

5 BUS CONNECTIONS

5.1 CAN Bus

CAN Interface

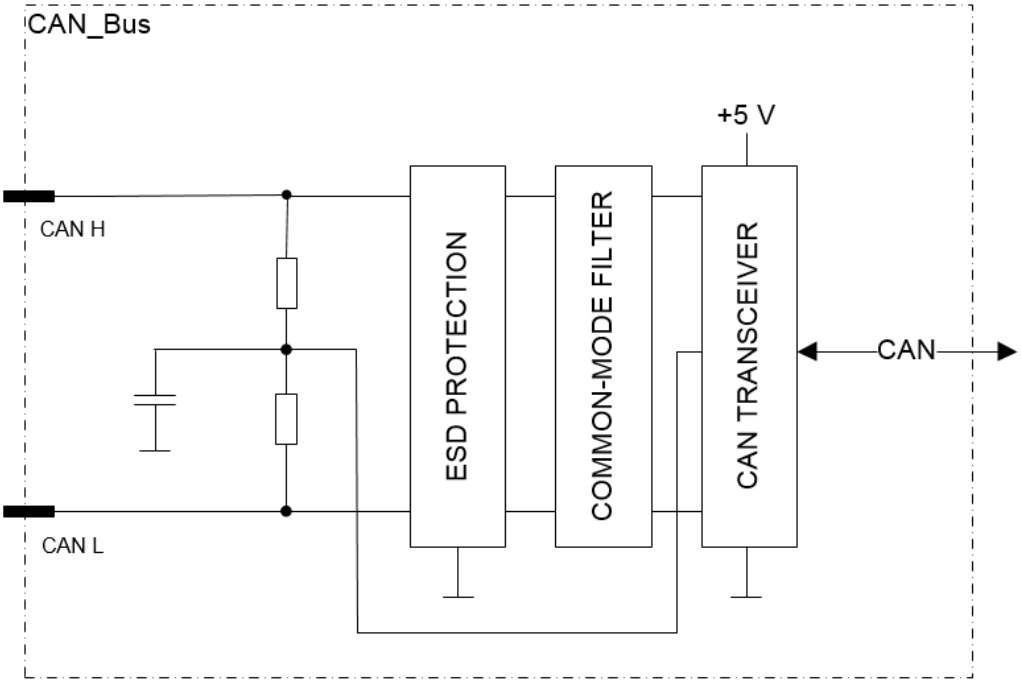
- The physical interface of CAN interface is according to ISO 11898 and CAN 2.0B protocol
- The downloading of the PLCopen application can only be done via CAN1
- All interfaces support bit rates 50, 125, 250, 500, 800, 1000 kbit/s
- CAN1 and CAN2 are CANopen compatible and user programmable
- CANopen and SAE J1939 are available for both CANs
- 11-bit and 29-bit message receive and transmit are supported.
- Transmitting and receiving remote frames is supported in all CAN interfaces

5.1.1 CAN Bus Connection Pins

The CAN communication pins are connected in the control unit's LEAVYSEAL 21 connector as follows:

Designation	Pin number
CAN1 interface, system interface	X3.20 (CAN H) X3.21 (CAN H) X3.17 (CAN L) X3.18 (CAN L) X3.14 (CAN L terminator)
CAN2 interface	X3.19 (CAN H) X3.16 (CAN L)

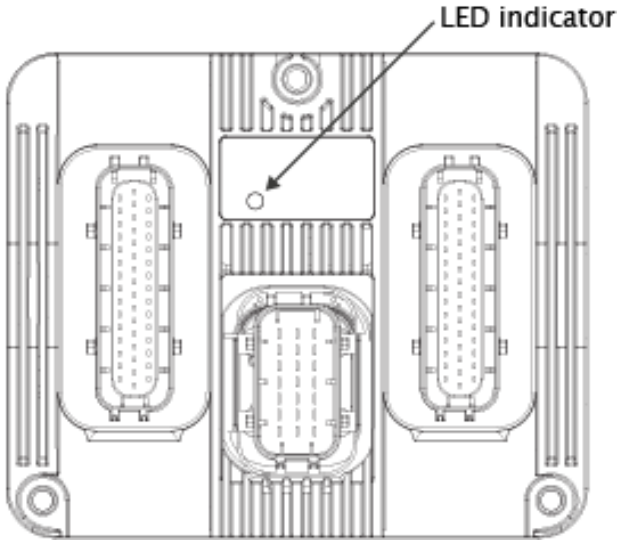
5.1.2 Functional block diagram



6 DIAGNOSTICS

6.1 LED Indicator

The LED indicator light is situated on the top side of the unit according to the following figure:



Some of the states must be implemented to application by using EXT programming library. For more information about EXT programming library, refer to *Epec Programming and Libraries Manual*.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Green, blue and red LED indicate different operating conditions according to the following table:

State	Green LED	Red LED	Blue LED	Implemented by	Explanation
Power off	-	-	-	-	No supply voltage
Power on and no SW running	-	ON	-	HW	Supply voltage is on, software is not running.
Power on and SW at init phase with no errors	ON	-	-	Boot/Firmware	Boot/Firmware is at init phase.
No application	5 Hz	-	-	Firmware	Firmware is running, no PLCopen application
Application stopped	ON	-	-	Firmware	Application is stopped. Depending on the application I/O configuration, firmware might diagnose this as an error situation, which leads to the red LED to turn ON.
Fatal error	-	ON	-	Boot/Firmware/HW	Control unit boot-up failed or a critical error while running.
Update	Blinks alternately with red LED	Blinks alternately with green LED	-	Boot	After firmware update boot-up, during the installation phase, red and green LEDs are flashed alternately.
Update Successful	ON	-	ON	Boot	After new firmware is successfully installed, green and blue LEDs are set ON. Reboot is required.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Erasing	ON	ON	-	Boot	During new firmware installation, LED is yellow when downloaded firmware is being erased
Application init	ON	-	-	Application	LED is continuously on also during the initialization: starting from power on until the application is running and the I/O / CAN initializations are done.
ApplicationOk + Safe Operational	2 Hz	-	-	Application	Application is running and the system is OK and in safe operational state
Application Error (system not OK)	-	2 Hz	-	Application	Application error. The system is not OK.
Application custom control	Application specific	Application specific	Application specific	Application	Application can override code template's LED control by application specific implementation

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

6.2 Temperature Monitoring

6.2.1 PCB area temperature

This temperature measurement point monitors the PCB area temperature.

Symbol	Parameter	Conditions	Min	Max	Units
PCB_{Temp}	Nominal PCB Temperature measuring range		-40	125	°C
T_{prop}	Temperature measuring accuracy Proportional factor		+/-5		%

6.3 Voltage Monitoring

The voltages of the control unit can be monitored.

Symbol	Parameter	Min	Max	Units
$U_{in1}, U_{in2}, U_{in3}$	Nominal Supply Voltage measuring range	0	46	V
U_{ref}	Ref voltage measuring range	0	5,73	V
U_{AI_bias}	Internal voltage measuring range	0	9,15	V
U_{meas_acc}	Voltage measuring accuracy	+/- 3		%

For additional electrical characteristics refer to section *Power Supply*.

6.4 Error Log

The control unit's internal error log stores the firmware errors in a log.

For more information about the logs and how to read them, refer to *Epec Programming and Libraries Manual.*

7 APPROVALS

7.1 EMC tests

Epec SL84 Safety Control Units are certified according to EMC tests that are described in this section.

The following tables provide a summary of performed EMC tests:

Emission tests according to the test specification EN 61000-6-3 (2007), Amd. A1 (2011)

Emission test	Test method
Radiated Emissions, Class B	EN 55032
Conducted Emissions from the Mains Cable, Class B	EN 55032

Immunity tests according to the test specification EN 61000-6-2 (2005)

Immunity test	Test method
Electrostatic discharge (ESD)	EN 61000-4-2
	ISO 10605
Radiated radio-frequency electromagnetic field	EN 61000-4-3
Electrical fast transients (EFT/B)	EN 61000-4-4
Surges	EN 61000-4-5
Conducted radio-frequency field immunity	EN 61000-4-6
Power frequency magnetic field immunity	EN 61000-4-8
Voltage dips, short interruptions and voltage variations on DC input power	EN 61000-4-29
Conducted common mode voltage immunity	EN 6100-4-16

Emission tests according to the E/ECE Regulation No. 10, Revision 6

Emission test	Test method	Conclusion
Measurement of radiated interference field strength in the frequency range 30 – 1000 MHz	CISPR 25	Pass [1)]
Measurement of conducted disturbances	ISO 7637-2	Pass [2)]

[1)] Limit values according to the E/ECE Regulation No. 10, rev 6
[2)] Limit values according to the E/ECE Regulation No. 10, rev 6

Immunity tests according to the E/ECE Regulation No. 10, Revision 6

Immunity test	Test method	Conclusion
Radiated radio-frequency electromagnetic field	ISO 11452-2, ISO 11452-4	Pass [1)]
Immunity to transient disturbances conducted along supply lines	ISO 7637-2, ISO 16750-2	Pass [2)]

[1)] The requirements defined in the E/ECE Regulation No. 10, rev 6
[2)] The requirements defined in the E/ECE Regulation No. 10, rev 6

The following tables provide more detailed descriptions about the performed EMC tests:

<table>
<tr><th colspan="2">Emission tests according to the E/ECE Regulation No. 10, Revision 6</th></tr>
<tr><td>Radiated disturbance emission test</td><td>• Test method E/ECE Reg. No. 10, Annexes 7 and 8, CISPR 25

<table><tr><th>Frequency (MHz)</th><th>Limit value (dBmV/m)</th></tr><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></table></td></tr>
<tr><td>Conducted disturbances emission test</td><td>• Test method E/ECE Reg. No. 10, Annex 10, ISO 7637-2: 2004/Amd.1:2008

<table><tr><th>Port</th><th>Limit level (V)</th></tr><tr><td rowspan="2">13,5 V DC input</td><td>+75</td></tr><tr><td>-100</td></tr><tr><td rowspan="2">27 V DC input</td><td>+150</td></tr><tr><td>- 450</td></tr></table></td></tr>
</table>

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

<table>
<tr><th colspan="2">Immunity tests according to the E/ECE Regulation No. 10, Revision 6</th></tr>
<tr><td>Immunity to transient disturbances conducted along supply lines test</td><td>

Test method E/ECE Reg. No. 10, Annex 10, ISO 7637-2: 2004/Amd.1:2008, ISO 16750-2:2010
Performance criterion:
<table>
<tr><th>Pulse</th><th>Criterion</th></tr>
<tr><td>1</td><td>C</td></tr>
<tr><td>2a</td><td>A</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 (12 V)
A (24 V)</td></tr>
<tr><td>5a</td><td>*C</td></tr>
</table>
*Test pulse applied to all three power supply groups together.
12 V input, Pulse:
<table>
<tr><th>Pulse</th><th>Pulse parameters</th></tr>
<tr><td>1</td><td>-75 V, R_i 10 Ω, 1 s, 5000 pulses</td></tr>
<tr><td>2a</td><td>+37 V, R_i 2 Ω, 0,2 s, 5000 pulses</td></tr>
<tr><td>2b</td><td>+10 V, 220 ms, 10 pulses</td></tr>
<tr><td>3a</td><td>-112 V, 10/90 ms, 60min</td></tr>
<tr><td>3b</td><td>+75 V, 10/90 ms, 60min</td></tr>
<tr><td>4</td><td>t_d 25 ms, -6,0 V, 5 s, -2,5 V, 10 pulses</td></tr>
</table>
24 V input, Pulse:
<table>
<tr><th>Pulse</th><th>Pulse parameters</th></tr>
<tr><td>1</td><td>-450 V, R_i 50 Ω, 1 s, 5000 pulses</td></tr>
<tr><td>2a</td><td>+37 V, R_i 2 Ω, 0,2 s, 5000 pulses</td></tr>
<tr><td>2b</td><td>+20 V, 220 ms, 10 pulses</td></tr>
<tr><td>3a</td><td>-150 V, 10/90 ms, 60min</td></tr>
<tr><td>3b</td><td>+150 V, 10/90 ms, 60min</td></tr>
<tr><td>4</td><td>t_d 50 ms, -12 V, 5 s, -5 V, 1 pulse</td></tr>
<tr><td>5a</td><td>t_d 350ms, R_i 1 Ω, +151 V, 10 pulses, 1min interval</td></tr>
</table>

</td></tr>
</table>

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Immunity of ESAs to electromagnetic radiation

- Test method E/ECE Reg. No. 10, Annex 9, ISO 11452-2:2004, ISO 11452-4:2005, Cor 1: 2009
- Performance criterion: A

Specification	Step	Dwell time	Frequency Range (MHz)	Test level
Modulation AM80% 1 kHz	5%	3 s	20-400	200 mA
Modulation AM80% 1 kHz	2%	3 s	80-800	30 V/m
Modulation AM80% 1 kHz	1%	3 s	150-800	100 V/m
PM 577/4600 µs	2%	3 s	800-1000	30 V/m (constant peak)
PM 577/4600 µs	1%	3 s	800-1000	100 V/m
PM 577/4600 µs	2%	3 s	1000-2000	30 V/m (constant peak)
PM 577/4600 µs	1%	3 s	1000-2700	30 V/m

Classification of functional status

Class A:
All functions of a device/system perform as designed during and after exposure to disturbance.

Class 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.

Class 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.

Class 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.

Class 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.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

<table>
<tr><td colspan="2">EN 61000-6-3 (2007), Amd. A1 (2011)
Electromagnetic compatibility-generic emission standard
part6-3: residential, commercial and light industry</td></tr>
<tr><td>Radiated disturbance emission test</td><td>• Test method EN 55032
<table><tr><th>Frequency (MHz)</th><th>Limit value (dBmV/m)</th></tr><tr><td>30 - 1000</td><td>30/37 (QP)</td></tr><tr><td>1000 - 6000</td><td>70/74 (QP)</td></tr></table></td></tr>
<tr><td>Conducted disturbance at main ports emission test</td><td>• Test method EN 55032
<table><tr><th>Frequency (MHz)</th><th>Limit value (dBmV)</th></tr><tr><td>0,15 - 30</td><td>66/56/60 (QP)</td></tr><tr><td>0,15 - 30</td><td>56/46/50 (AVE)</td></tr></table></td></tr>
<tr><td colspan="2">EN 61000-6-2 (2005) EN 61000-6-7:2014
Electromagnetic compatibility-generic immunity standard
part 6-2: industrial environment, part 6-7: safety related system in industrial location</td></tr>
<tr><td>Conducted radio-frequency common mode immunity test</td><td>• Test method EN 61000-4-6
• Performance criterion A/DS
<table><tr><th>Specification</th><th>Port</th><th>Test level</th></tr><tr><td rowspan="3">Frequency range 0,150-80 MHz, Modulation AM80% 1 kHz, Dwell time 2 s</td><td>DC input port</td><td>20 V_{RMS}</td></tr><tr><td>Signal ports</td><td>20 V_{RMS}</td></tr><tr><td>IO ports</td><td>20 V_{RMS}</td></tr></table></td></tr>
</table>

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

<table>
<tr>
<td>Radiated radio-frequency electromagnetic field immunity test</td>
<td>

Test method EN 61000-4-3
Performance criterion A/DS

<table>
<tr><th>Specification</th><th>Range (MHz)</th><th>Test level</th></tr>
<tr><td rowspan="2">Modulation AM 80% 1 kHz, Dwell time 2 s</td><td>80-1000</td><td>20 V/m</td></tr>
<tr><td>1000-6000</td><td>10 V/m</td></tr>
</table>
</td>
</tr>
<tr>
<td>Electrical fast transient (EFT) immunity test</td>
<td>

Test method EN 61000-4-4
Performance criterion B/DS

<table>
<tr><th>Test pulse</th><th>Port</th><th>Test level</th></tr>
<tr><td rowspan="3">Repetition frequency 5 kHz, Duration 1 minute</td><td>DC input port</td><td>± 2,0 kV</td></tr>
<tr><td>Signal ports</td><td>± 2,0 kV</td></tr>
<tr><td>IO ports</td><td>± 2,0 kV</td></tr>
</table>
</td>
</tr>
<tr>
<td>Surge Immunity</td>
<td>

Test method EN 61000-4-5
Performance criterion B/DS

<table>
<tr><th>Specification</th><th>Port</th><th>Path</th><th>Test level</th></tr>
<tr><td rowspan="2">Pulses: 5
Repetition rate: 60 s</td><td rowspan="2">DC Input port</td><td>Line to Line</td><td>± 0,5 kV
± 1,0 kV</td></tr>
<tr><td>Line to Ground</td><td>± 1,0 kV
± 2,0 kV</td></tr>
</table>
</td>
</tr>
</table>

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

<table>
<tr>
<td>Electrostatic discharge (ESD) immunity test</td>
<td>

Test method EN61000-4-2
Performance criterion B/DS

<table>
<tr><th>Discharge mode</th><th>Test level (kVp)</th></tr>
<tr><td>Contact</td><td>± 8</td></tr>
<tr><td>Indirect contact</td><td>± 8</td></tr>
<tr><td>Air</td><td>± 2, ± 4, ± 8, ± 15</td></tr>
</table>

Test method ISO 10605
Performance criterion B

<table>
<tr><th>Discharge mode</th><th>Test level (kVp)</th></tr>
<tr><td>Contact</td><td>± 15</td></tr>
<tr><td>Indirect contact</td><td>± 15</td></tr>
<tr><td>Air</td><td>± 25</td></tr>
</table>
</td>
</tr>
<tr>
<td>Power frequency magnetic field immunity</td>
<td>

Test method EN 61000-4-8
Performance criterion A/DS

<table>
<tr><th>Polarization</th><th>Dwell time (min)</th><th>Test level (A/m)</th></tr>
<tr><td>x</td><td>5</td><td>100</td></tr>
<tr><td>y</td><td>5</td><td>100</td></tr>
<tr><td>z</td><td>5</td><td>100</td></tr>
</table>
</td>
</tr>
<tr>
<td>Voltage dips, short interruptions and voltage variations on DC input power port</td>
<td>

Test method EN 61000-4-8
Performance criterion DS

<table>
<tr><th>Input voltage</th><th>24 V</th></tr>
<tr><td>10 ms, 40%</td><td>DS</td></tr>
<tr><td>20 ms, 0%</td><td>DS</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr>
<td>Conducted common mode voltage immunity</td>
<td>

Test method EN 61000-4-16
Performance criterion DS

<table>
<tr><th>Test (27/13,5 V)</th><th>Dwell/test time (s)</th><th>Test level (V)</th></tr>
<tr><td>sweep 1,5 - 15 kHz</td><td>4</td><td>1-10</td></tr>
<tr><td>sweep 15 - 150 kHz</td><td>4</td><td>10</td></tr>
<tr><td>continuous</td><td>5</td><td>10</td></tr>
<tr><td>short duration</td><td>1</td><td>100</td></tr>
</table>
</td>
</tr>
</table>

Performance criteria for immunity tests

Performance criterion A (EN 61000-6-2:2016):
The EUT shall continue to operate as intended during and after the test. No degradation of performance is allowed.

Performance criterion B (EN 61000-6-2:2016):
The EUT shall continue to operate as intended after the test. However, moderate degradation of performance is allowed. No change of actual operating state or loss of memory functions is allowed.

Performance criterion C (EN 61000-6-2:2016):
Temporary loss of function is allowed if the function is self-recoverable or can be restored by the operation of controls.

Performance criterion DS (EN 61000-6-7:2014):
Performance criteria are used to describe and to assess the reaction of the EUT when exposed to electromagnetic phenomena. With regard to safety applications for equipment
within the scope of this standard, a particular performance criterion DS is defined as follows:

a) The functions of the EUT intended for use in safety applications
- 1) are not affected outside their specification, or
- 2) may be affected temporarily or permanently (even by destruction of components), if the EUT reacts to a disturbance in a way that a detectable and defined state (or states) of the EUT is(are)
  - i) maintained, or
  - ii) achieved within a stated time.

b) The functions not intended for use in safety applications may be disturbed temporarily or permanently.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

7.2 Environmental Tests

The following environmental tests have been performed to Epec SL84 Safety Control Units:

Temperature			
Test	**Temperature**	**Duration/ Exposure time**	**Remarks**
Cold IEC 60068-2-1 (2007-03) Test Ae	-40 °C	16 h	• 1 °C/min
Cold IEC 60068-2-1 (2007-03) Test Ad	-40 °C	16 h	• 1 °C/min
Dry heat IEC 60068-2-2 (2007-03) Test Bd	+85 °C	16 h	• 1 °C/min
Dry heat IEC 60068-2-2 (2007-03) Test Be	+85 °C	16 h	• 1 °C/min
Damp heat cycling IEC 60068-2-30 (2005-08) Test Db	+25 °C/+55 °C	cycle duration 24 h	• rel. humidity >90% • six test cycles
Change of temperature IEC 60068-2-14 (2009-01) Test Na	-50 °C/+60 °C	3 h	• change time between extreme temperatures 1-2 min • 5 test cycles
Change of temperature IEC 60068-2-14 (2009-01) Test Nb	-40 °C/+85 °C	3 h	• change of temperature 4 °C/min • 2 test cycles

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Mechanical resistance		
Test	**Duration and direction**	**Remark**
Shock test IEC 60068-2-27 (2008-02) Test Ea	• pulse duration 6 ms • 500 impulses in every six directions	• half sine pulse shape • peak acceleration 500 m/s2 (50g)
Shock test IEC 60068-2-27 (2008-02) Test Ea	• pulse duration 4 ms • 100 impulses in every six directions	• half sine pulse shape • peak acceleration 750 m/s2 (75g)
Shock test IEC 60068-2-27 (2008-02) Test Ea	• pulse duration 4 ms • 100 impulses in every six directions	• half sine pulse shape • peak acceleration 1000 m/s2 (100g)
Vibration, random IEC 60068-2-64 (2008-04) Test Fh	• 60 min in every three test directions	• ASD-level 5 m2/s3, 10 … 200 Hz • ASD-level 1,0 m2/s3, 200 … 500 Hz • total spectral acceleration 3,54 grms
Vibration, sinusoidal IEC 60068-2-6 (2007-12) Test Fc	• 90 min in each axis	• Frequency range 5...100 Hz • Amplitude +/- 1,6 mm, 5 … 25 Hz • Constant peak acceleration 4 gn, 25...100 Hz • Sweep rate 1 oct/min • Uncertainty of measurements +/- 5,0% • The endurance tests (4gn) at 30 Hz

Vibration, broadband random IEC 60068-2-24 (2008-04) Test Fh	• 10 min in each test level • 3 mutually perpendicular axes	• ASD-level 10 m2/s3, 10 ... 200 Hz • ASD-level 2 m2/s3, 200 ... 500 Hz, 5,00 grms • ASD-level 20 m2/s3, 10 ... 200 Hz • ASD-level 4 m2/s3, 200 ... 500 Hz, 7,05 grms • ASD-level 40 m2/s3, 10 ... 200 Hz • ASD-level 8 m2/s3, 200 ... 500 Hz, 9,96 grms • ASD-level 80 m2/s3, 10 ... 200 Hz • ASD-level 16 m2/s3, 200 ... 500 Hz, 14,08 grms • ASD-level 145 m2/s3, 10 ... 200 Hz • ASD-level 29 m2/s3, 200 ... 500 Hz, 19,04 grms
Free fall, IEC 60068-2-31 (2008-05) Test Ec	• one fall on each surface and corner	• fall height 100 cm

Corrosion			
Test	**Temperature**	**Duration**	**Concentration**
Salt spray test ISO 9227	+35 °C	24 h	5 % NaCl

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

Tightness tests for IP67		
Test	**Duration and procedure**	**Remark**
Dust test for IP6X according to IEC 60529	• exposed to the free settling dust for 8 hours • under pressure during the test 2 kPa • flow rate of the air 0, 1 l/min	• no deposit of dust noticed inside • complies with the requirements stated for the protection class IP6X
Water test for IPX7 according to IEC 60529	• immersion duration 30 minutes • immersion depth 1000 mm • water temperature +22 °C	• no ingress of water noticed inside • complies with the requirements stated for the protection class IPX7
Water test for IPX9 according to IEC 60529	• protected against close-range high pressure, high temperature spray downs at 0°, 30°, 60°, 90. Distance 100 to 150mm • 14-16l/mm • approx. 8000 to 10 000 kPa • 80+/-5 °C • 30s per position	• no ingress of water noticed inside • complies with the requirements stated for the protection class IPX9

7.3 Simplified EU Declaration of Conformity

Epec Oy hereby declares that this device is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:
https://extranet.epec.fi/Public/Declarations/EpecSL84_DeclarationOfConformity.pdf

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

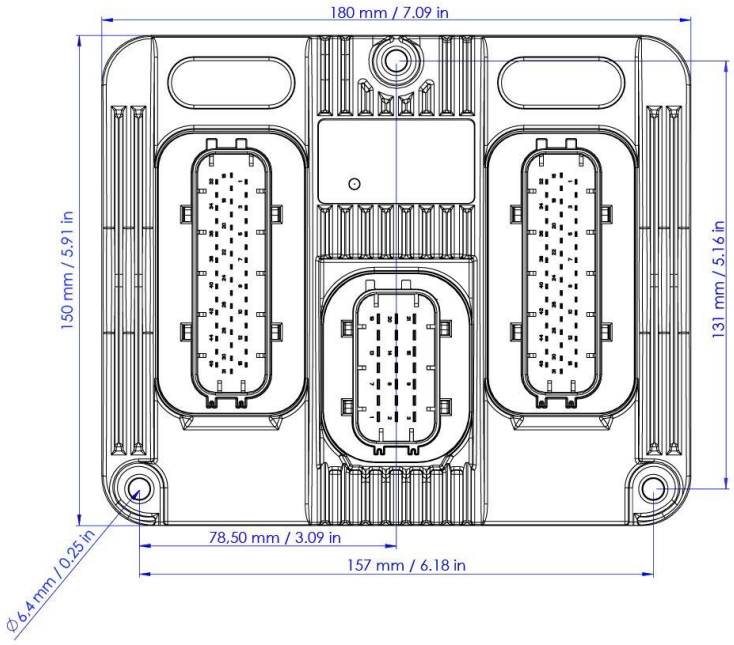
Phone
+358-(0)20-7608 111

Internet
www.epec.fi

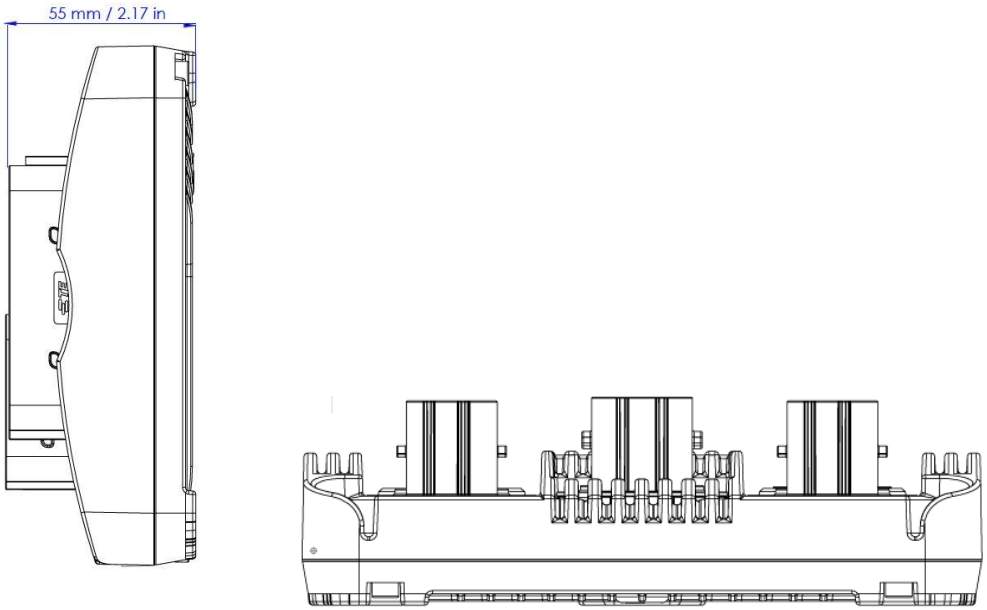
8 MECHANICS AND CABLING

8.1 Unit Dimensions

Unit dimensions from the top:



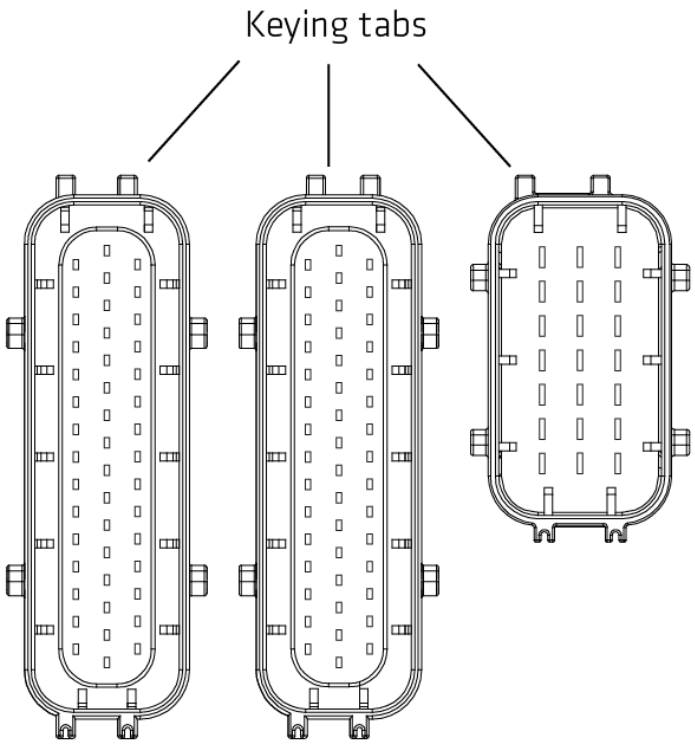
Unit dimensions from the side:



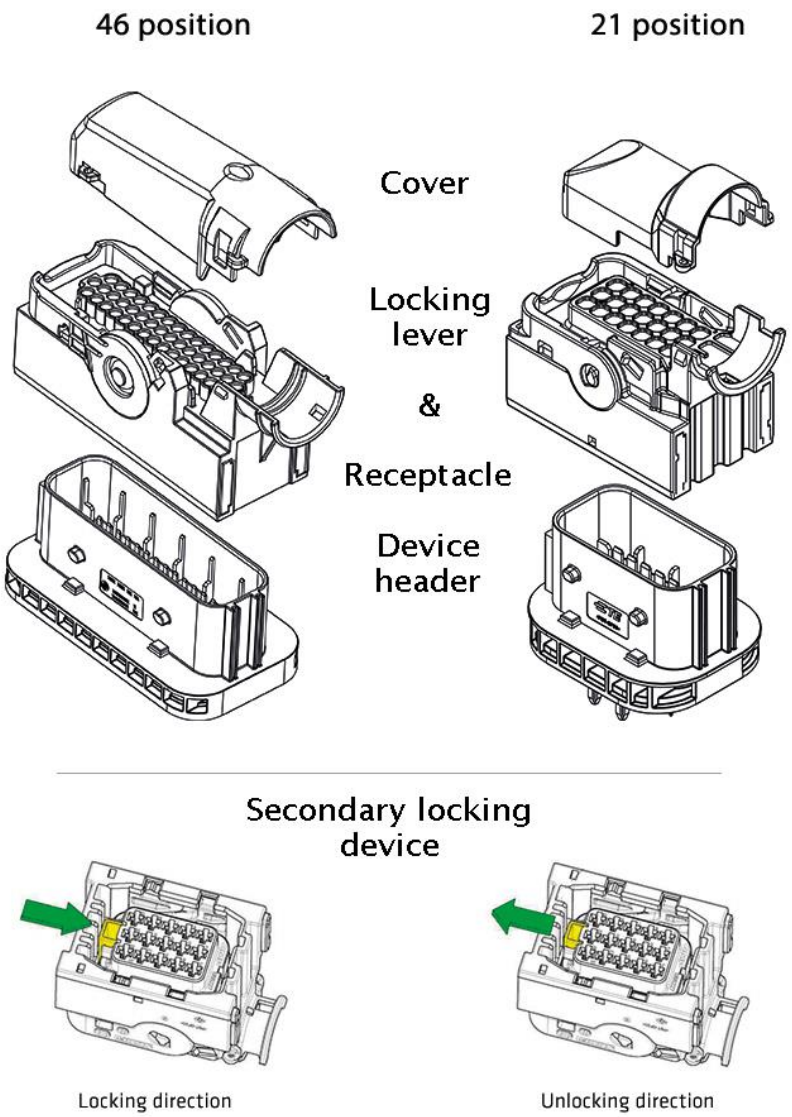
8.2 Plugging and unplugging the connectors

LEAVYSEAL connectors have silver-plated TE MCP contacts; Epec SL84 has two 46 position connectors and one 21 position connector.

- 46 position module tabs are color coded (black and grey) and keyed so they will mate with only correct receptacles



8.2.1 Connector components



When inserting contacts, make sure that:

- contacts are pressed down to the bottom and that they are locked
- contacts are clean (avoid moisture or dirt inside the connector)
- unused cavities should be plugged with cavity plugs to keep the control unit connectors dry and protected
- all cables, connectors and tools are of correct type, and sufficiently high quality, and suitable for this kind of use (protection for moisture, mechanical stability, power durability, coupling resistance among other things)
- there is a sufficient margin (slack) left in the cables to prevent the torsion of the connectors
- wires are bound to the connector base knob with cable ties

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.2.2 Inserting contacts

Step 1:
Grasp crimped contact approximately one inch behind the contact barrel.

Step 2:
Verify the integrated secondary lock is in the unlocked position. Make sure the contact is in the correct orientation. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.

Step 3:
Push the integrated secondary lock into the locked position with a DT-RT1 or a screwdriver.

8.2.3 Removing contacts

Step 1:
Using a DT-RT1 or a screwdriver, unlock the integrated secondary lock.

Step 2:
Using the appropriate extraction tool, insert the blades into the contact

Step 3:
Pull contact wire assembly out of connector.

8.2.4 Additional documentation

Refer to documents listed below for more detailed information on connectors and cable recommendations.

Position count	Document type	TE document number
21 posltion	Product specification	108-18696
	Application specification	114-18376
	Crimp instruction MCP2.8	114-13295
46 position	Product specification	108-94216
	Application specification	114-94012
	Application specification	114-18455
	Crimp instruction MCP1.5	114-18386

Ordering codes for the LEAVYSEAL connectors, crimps and tools are listed in Section *Accessories and Ordering Codes*.

8.3 Mounting and Cleaning

Control unit mounting location should be planned so that the machine's washing does not damage the unit.

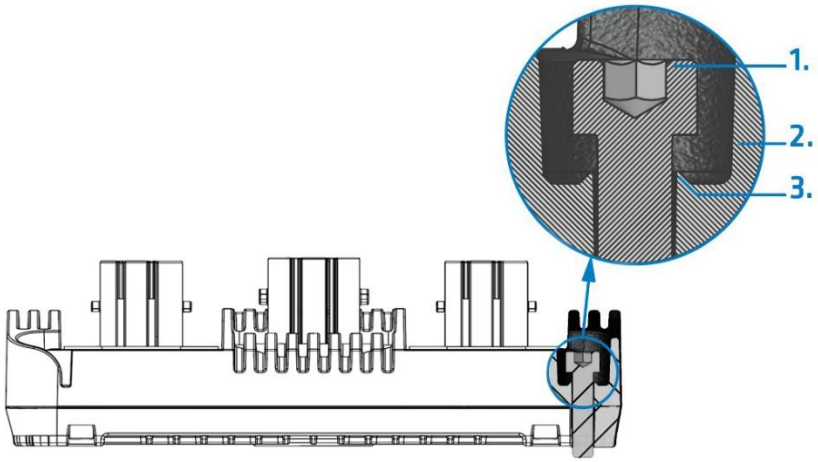
A direct water jet towards the control units should be avoided, especially when using high pressure. Also, the use of any such solvent that causes damage to electronic devices should be avoided when handling the control units.

When cleaning the control unit, do not use highly alkaline / acidic substances, too hot water, or too heavy mechanical abrasion.

In moist conditions, the unit must be mounted and oriented so that the connectors are not filled with water.

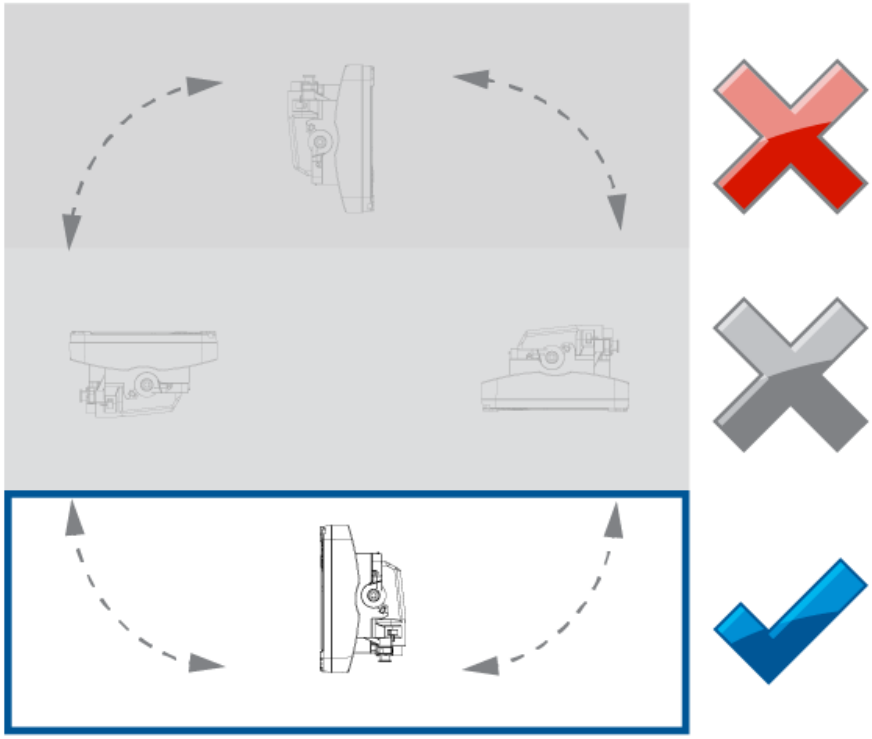
If the product's assembly screws or product labels have been removed or damaged or the unit housing has been opened in any way, the warranty becomes null and void.

- Mounting recommendation: 3 x M6/M5 DIN912 Torx/Allen head bolts, no washers of any kind. Machine ground connection is required to mounting bolt threads.
- Mounting must be done on to a conductive metal base. The control unit's aluminum housing must have a galvanic connection to the machine frame.
- 3 point mounting allows mounting on a slightly uneven surface.



1. Unit mounting bolt
2. Unit housing
3. Mounting hole detail; paint on the sharp edge is designed to shatter when the mounting screw is tightened. This provides a galvanic connection between the mounting screw and the unit housing.

- The mounting position must allow water, etc. to flow away from connectors, see the figure below. The ideal orientation is shown at the bottom of the figure, where the leads go downwards
- Do not mount the unit in a position where the leads go upwards (shown at thte top of the following figure)
- Do not mount the unit in a horizontal (connectors face up or down) position in wet or moist environments (shown in the middle of the following figure)
- Reserve 10 cm installation space for the connector cables



Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.4 Cabling

8.4.1 System Topologies

Generally, cabling should be properly designed and documented to help the initial assembly and maintenance.
It is highly recommended to mark each cable on both ends to avoid confusion and errors.

The cables must be run in a safe route along the machine frame.
When routing cables, avoid interfering objects and pay particular attention to moving parts of the machine.
It is also good to minimize the amount of the connection points of the cable harness to maximize reliability.
Also, all valid safety instructions should be observed when coupling.

Control units are connected with each other using standardized CAN bus. The idea of the Epec embedded control system, is that all the control units are installed close to sensors, encoders and other equipment connected to them. This way the amount of the traffic on the CAN bus is minimized and connections can be made using short wires.

8.4.1.1 Termination resistors

Generally, the bus cable is terminated at both ends with termination resistors (ISO 11898:1993).

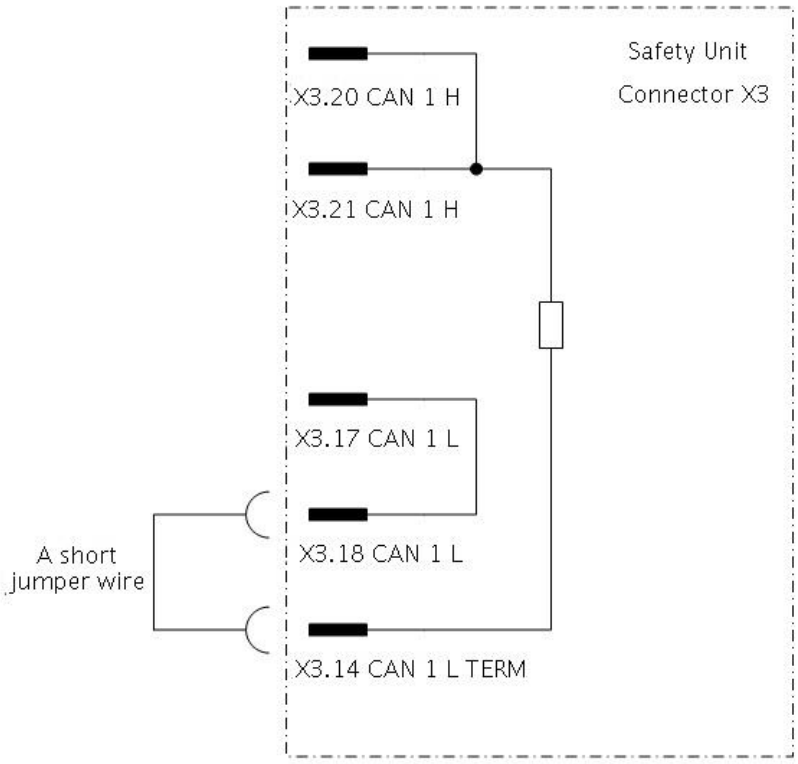
The cable lengths presented here are approximates. Actual cable lengths also depend on the cable quality, the cable type and also on the machine environment (possible interference).

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

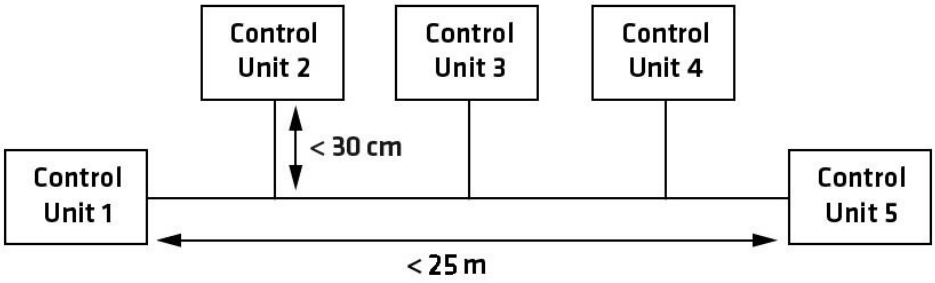
Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi



Example1. Internal termination resistor connection in CAN1 (the resistor is 120 Ω)



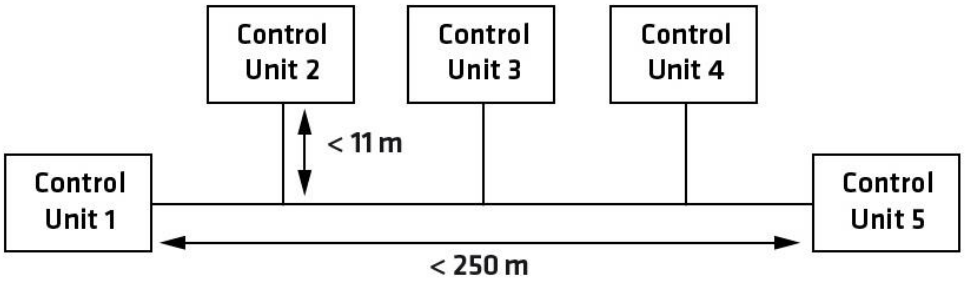
Example 2. Control system topology in theory with maximum bus speed (1000 kbit/s); Control Units in traditional bus arrangement. Termination resistor must be connected at control unit 1 and control unit 5. For more information about the bus speeds, refer to CiA DS-102 standard.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

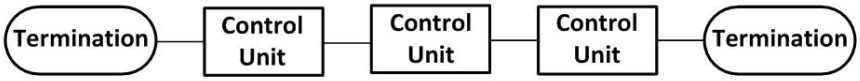
Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi



Example 3. Control system topology in theory with 250 kbit/s bus speed; Control Units in traditional bus arrangement. Termination resistor must be connected at control unit 1 and control unit 5. For more information about the bus speeds, refer to CiA DS-102 standard.



Example 4. The usage of the termination resistor (TR) in a conventional bus. The maximum recommended bus length is directly dependent on the bus speed.
In theory, the maximum length with the maximum speed can be up to 25 meters. If the bus speed is lower, the length can be extended.
The maximum length of the bus depends on the bus speed. For more information about the bus speeds, see the table below / refer to CiA DS-102 standard.

The following table shows some baud rates in general purpose CAN bus networks as well as the maximum bus length for a given baud rate, that CAN in Automation (CiA) international users and manufacturers group has recommended to be used. For more information, refer to CiA DS-102 standard.

CAN bus baud rates and bus lengths according to CiA DS-102 standard:

Baudrate	Bus length
1 Mbits/s	25 m
800 kbits/s	50 m
500 kbits/s	100 m
250 kbits/s	250 m
125 kbits/s	500 m
50 kbits/s	1000 m

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.4.2 CAN Bus Cabling

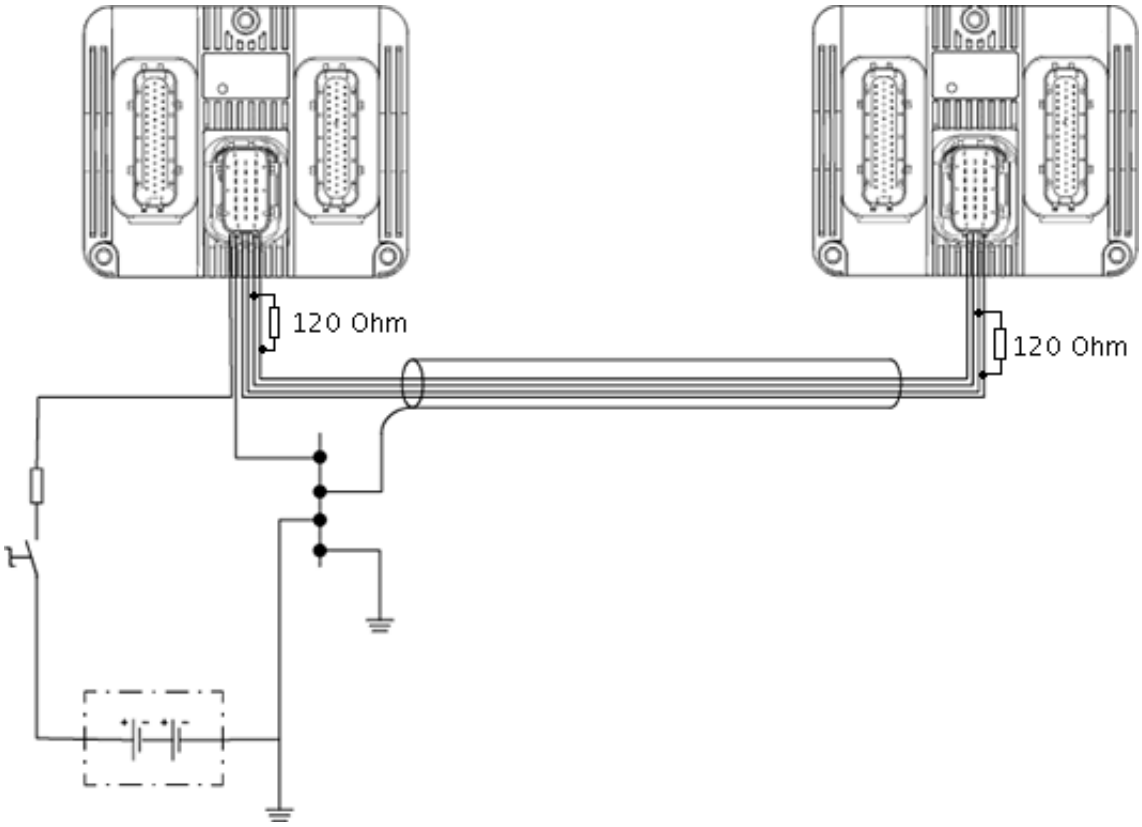
The CAN bus cable is the neural backbone of the whole system and should be designed and constructed with extra care.

For information about the CAN bus lengths and baud rates, refer to section *System Topologies* .

8.4.2.1 Cable

- It is recommended to use high quality and twisted (approx. 1 round / 1 inch) CAN bus cable.
- Normal UTP (Unshielded Twisted Pairs) cable is well suited for distances under approximately 10 meters.
- In longer distances, and especially if there is possibility for electromagnetic interference, it is highly recommended to use shielded and twisted cable for CAN bus, also for shorter distances.
- To avoid electromagnetic interference (EMI), locate the bus cable as far away from high-current carrying cables as possible. Generally, the amount of the connections and connectors should be minimized to maximize security; also all connections should be done carefully.
- The shield grounding must be done only in one end of the cable

8.4.2.2 Cable shield grounding



Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

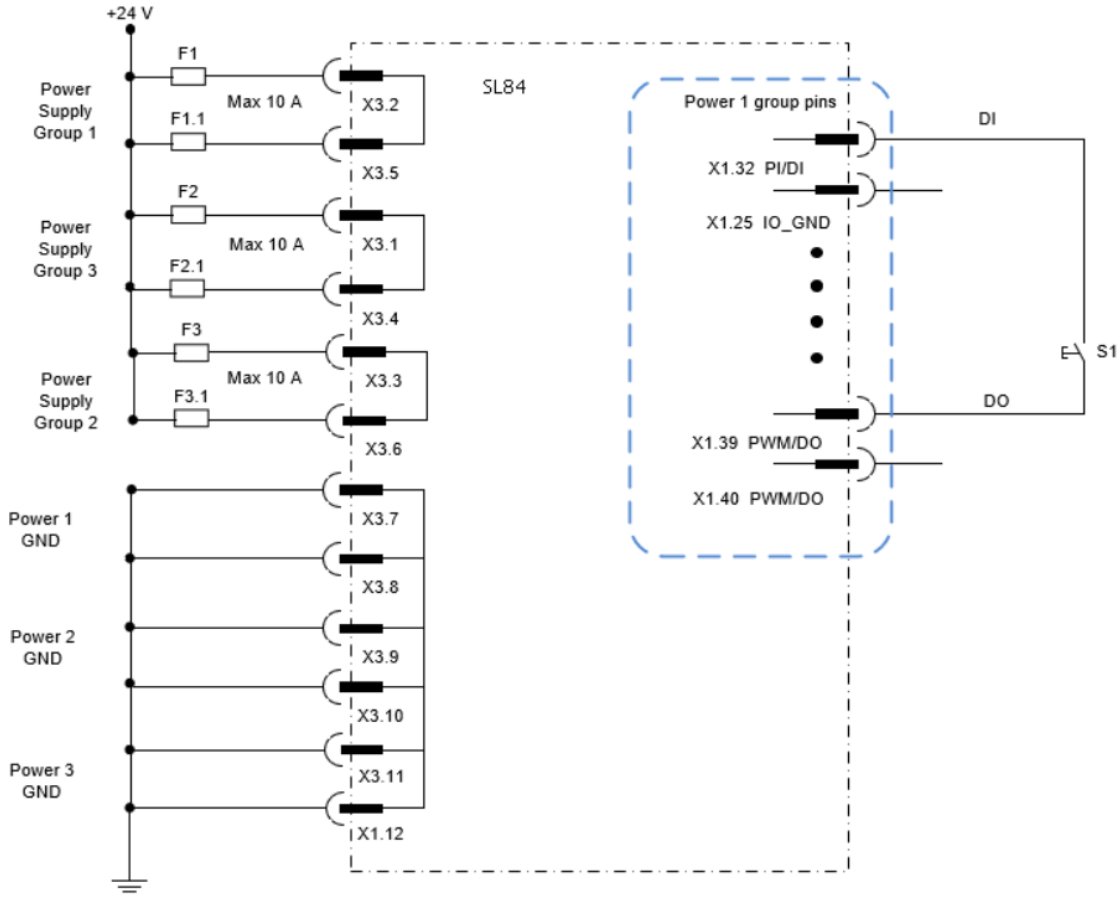
8.4.3 I/O Cabling

Closed circuit loops are always recommended when using DO or PWM. Closed circuit loop means that the current from the control unit to the sensor must return to the same control unit, see the figures below.

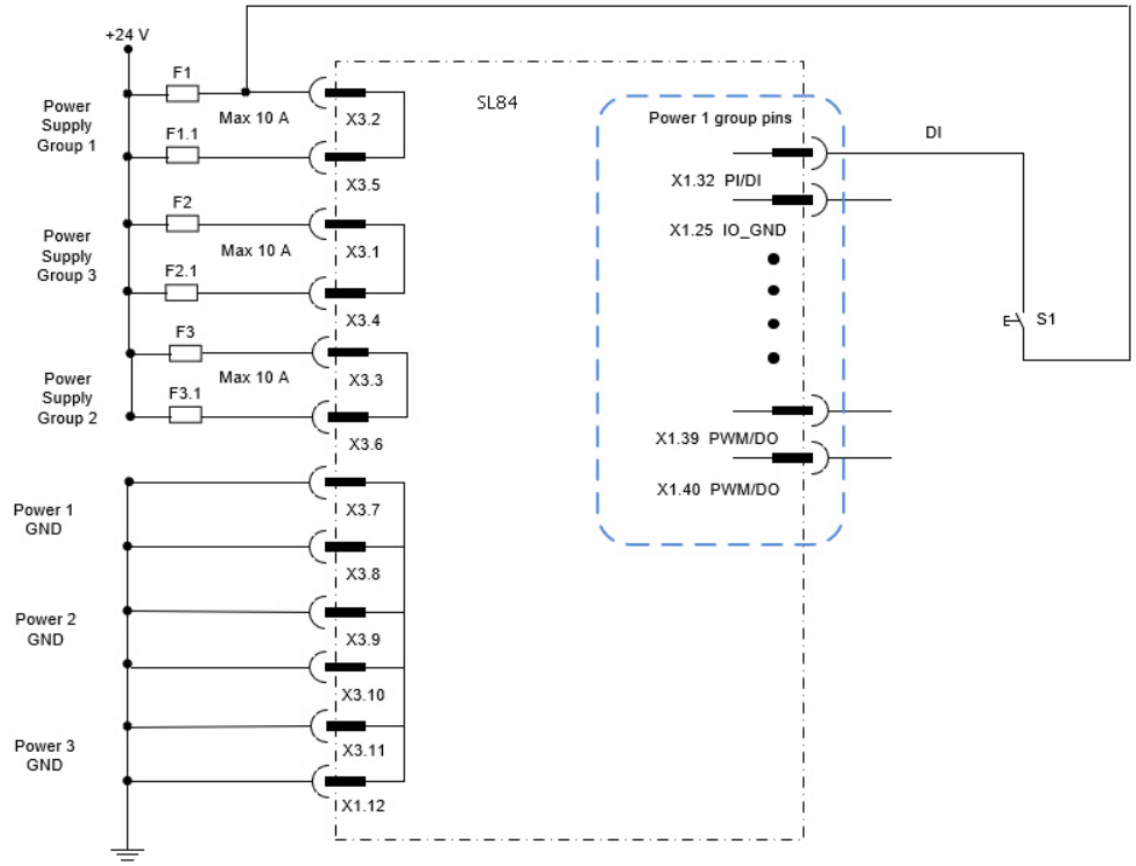
To ensure correct measurement, reserve separate GND pin(s) for AI pin(s) and don't use it/them for any other purposes. See the cabling example below.

- The cabling for encoders etc. is in many cases supplied together with them
- In many cases, very simple basic cable may be used, e.g. automobile R2 cable (0,5 or 1,0) by NK Cables
- Dimensions of the cable should be appropriate for MCP contacts (so that crimping is possible)
  - Refer to LEAVYSEAL table (in section *Accessories and Ordering Codes*) for dimensions
  - Take extra care for protecting the cables against physical wear and damage
- Only one wire can be connected to one LEAVYSEAL connector pin. However, if more than one wire has to be connected to one connector pin, it has to be connected by branch wiring
- Some voltage inputs use relatively low voltages
  - Consider using shielded cables for these encoders etc. especially for longer distances to increase safety
- Using shielded cable is recommended also in joystick connections

The following figure describes closed loop wiring:



Do not connect the closed circuit loop as shown in the following figure:



- sensors and encoders must be wired according to the closed-loop principle, i.e. the power for the sensors and encoders is supplied by the control unit they are connected to. This way, it is possible to avoid harmful potential differences, so the MOSFET driven output power switching operates properly.

The unit has several GND pins which allows for point to point topology to be used when wiring auxilary devices and sensors.

Refer to section *Power Supply* for accurate pin allocation of connectors.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

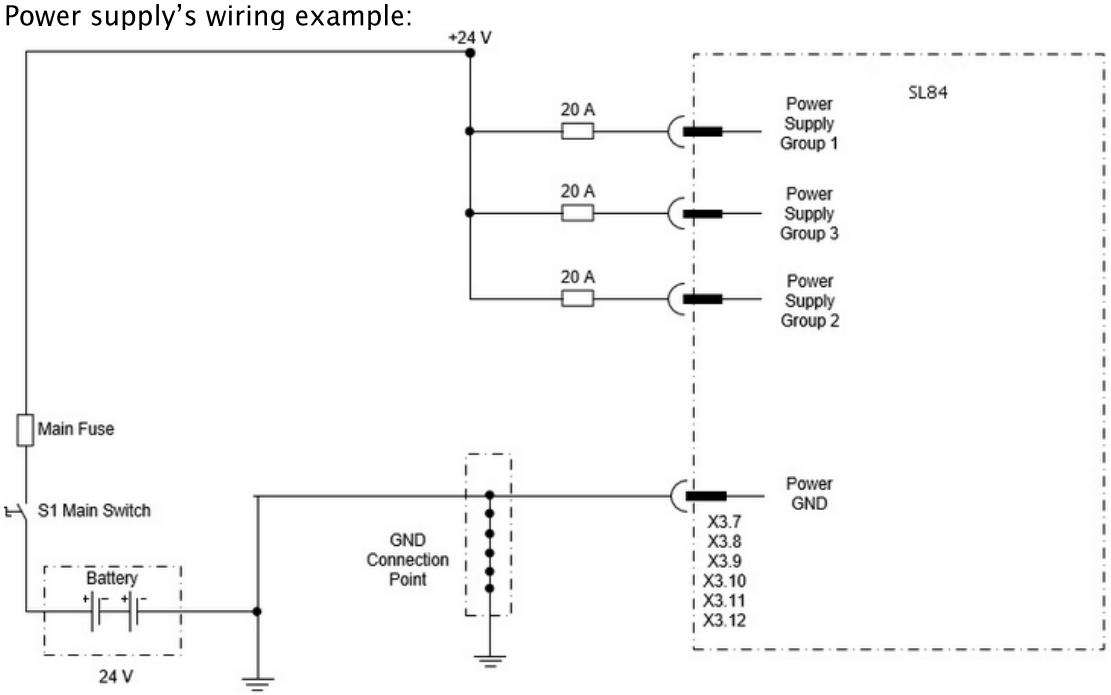
8.4.4 Power Supply Cabling

The maximum continuous current per power supply pin is 20 A. However, it must be taken into consideration that the maximum overall continuous current of the controller is 60 A.

The power for sensors, encoders and other equipment should be supplied from the same unit that the equipment is connected to, to ensure the best performance of the system. No external power (or ground) connections are allowed.

- The nominal operating voltage for Epec control units is 12 and 24 VDC. The full operating range is 8,5 – 33 VDC
- See section *Power Supply* for accurate pin allocation of the connectors when using the Epec SL84 Safety Control Unit
- Single point grounding should be used for power supply for all the control units

Power supply's wiring example:



8.4.4.1 Emergency Stop

In all European Community countries, the emergency stop should be implemented in accordance with standard EN ISO 13850, which complies to the EC Machinery directive 2006/42/EC. In other countries, the emergency stop should be implemented according to local standards and/or to local legislation.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.5 Welding

Welding causes some high current flows and voltage peaks in the machine. It should be noted that the electronics of the control system may be damaged if the welding current can get through the control unit itself. So, when welding, it should be taken care to prevent high currents from going through the control units or through the CAN bus.

Carefully follow the following instructions.

Disconnect all the connectors from the control units before welding.

Generally, even if the control system power is disconnected, welding should be done carefully and by following appropriate safety measures. Welding grounding should be connected close to the welding point to avoid long distance high current flow through machine frame.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.6 Accessories and Ordering Codes

Picture	Product name	Epec ordering code	Epec data sheet code	TE Connectivity ordering code
	Epec 4610 Breakout box Includes: • 2 connector pliers • 5 black banana plug connector cables • 5 red banana plug connector cables • 1 LEAVYSEAL cable, 46 pin/46 pin (A code), 500mm • 1 LEAVYSEAL cable, 46 pin/46 pin (B code), 500mm	E3004610	MAN000708	
	21 pin LEAVYSEAL plug with 2m leads	E30902497	MAN000709	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

	46 pin LEAVYSEAL plug with 2m leads (A code)	E30902498	MAN000709	
	46 pin LEAVYSEAL plug with 2m leads (B code)	E30902499	MAN000709	
	LEAVYSEAL cable, 46 pin/46 pin (A code), 500mm	E30902504	MAN000709	
	LEAVYSEAL cable, 46 pin/ 46 pin (B code), 500mm	E30902505	MAN000709	

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

	AMP MCP 1.5K contact (for 46 pin LEAVYSEAL) Wire size: 0.5 – 1.0 mm^2 Loose Piece (100 pcs)	KX0517		1241381
	AMP MCP 1.5K contact (for 46 pin LEAVYSEAL) Wire size: 0.5 – 1.0 mm^2 Strip Form (100 pcs)	KX0498		1241380
	AMP MCP 2.8 contact (for 21 pin LEAVYSEAL) Wire size: 1.0 – 2.5 mm^2 Loose Piece (100 pcs)	KX0518		968876
	AMP MCP 2.8 contact (for 21 pin LEAVYSEAL) Strip Form (100 pcs)	KX0497		968857

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

	Wire Seal 1.5K (for 46 pin LEAVYSEAL) Color: Grey Insulation Diameter: 1.4 – 1.9 mm (500 pcs)	KX0500		963530-1
	Wire Seal 2.8 (for 21 pin LEAVYSEAL) Color: White Insulation Diameter:2.2 – 3.0 mm (500 pcs)	KX0499		828905-1
	Cavity Plug (for 46 pin LEAVYSEAL) Color: Natural (500 pcs)	KX0519		1394132-1
	Cavity Plug (for 21 pin LEAVYSEAL) Color: Green (500 pcs)	KX0520		828922-2
	Connector Cover LEAVYSEAL 46 pin Color: Black (A code)	KX0495		2112233-1

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

	Cavity Block LEAVYSEAL 46 pin Color: Black (A code)	KX0491		3-2112231-1
	Cavity Block LEAVYSEAL 46 pin Color: Grey (B code)	KX0492		3-2112231-2
	Connector Cover LEAVYSEAL 21 pin Color: Black	KX0496		1394050-2
	Cavity Block LEAVYSEAL 21 pin Color: Black (A code)	KX0494		1-2208686-1

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.6.1 LEAVYSEAL Tools

Tools are specific to the contact style. To create a proper crimp and achieve the highest performance specifications, contacts must be crimped with the recommended tooling.

Picture	Product name	Epec ordering code	Epec data sheet code	TE Connectivity ordering code
	Contact Extraction Tool Set	E0000040	MAN000710	1-1579008-7 (21 pin Extraction tool) 1-1579007-1 (46 pin Extraction tool)
	LEAVYSEAL Handtool frame (21 pin/ 46 pin)	E0000041	MAN000711	539635-1
	LEAVYSEAL 21 pin Die set MCP2.8	E0000042	MAN000711	539725-2

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

	LEAVYSEAL 46 pin Die set 2 MCP1.5K (Wire insulation diameter 2,2 – 2,4 mm)	E0000043	MAN000711	5-1579001-3
	LEAVYSEAL 46 pin Die set 1 MCP1.5K (Wire insulation diameter 1,1 – 1,4 mm)	E0000044	MAN000711	4-1579016-0

All applied cables should be properly shielded, bundled, and grounded.

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.6.2 LEAVYSEAL Contacts

Stamped and Formed Receptacles with Single Wire Sealing System – AMP MCP.

TE Ordering Codes:

	Receptacle Part Numbers				Insulation Diameter (mm)			
Size	**Strip Form**	**Package Quantity**	**Loose Piece**	**Package Quantity**	**Wire Size (mm^2)**	**FLK**	**FLR**	**Finish**
1.5K	1564324	4500	1564325	500	0.22 – 0.35	–	1.1 – 1.4	CuNiSi, selective silver plated (–3)
	1241380*	4500	1241381*	500	0.5 – 1.0	–	1.4 – 2.1	CuNiSi, selective silver plated (–3)
	1418884	4500	1418885	500	>1.0 – 1.5	–	2.2 – 2.4	CuNiSi, selective silver plated (–3)

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

2.8	968855	3500	968896	500	0.35	-	1.2 -1.4	CuNiSi, selective silver plated (1-xxx-3)
	968855	3500	968875	500	0.5 -1.0	-	1.4 - 2.1	CuNiSi, selective silver plated (1-xxx-3)
	968857*	4000	968876*	500	>1.0 -2.5	-	2.2 - 3.0	CuNiSi, selective silver plated (1-xxx-3)

*Also available from Epec

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.6.3 Wire Seals

Wire seals are required for connectors without an integrated rear seal to maintain an environmental seal.

TE Ordering Codes:

Contact Size	Insulation Diameter (mm)	Color	Part Number	Package Quantity
1.5K	0.9 – 1.2	Green	1718705-1	10 000
	1.2 – 1.6	Red	964971-1	
		Blue	1394133-1	
	1.4 – 1.9	Grey	963530-1*	
	1.9 – 2.1	Yellow	964972-1	
	1.9 – 2.4	Orange	2112323-1	
2.8	1.2 – 2.1	Blue	828904-1	1000
			828904-2	10 000
	2.2 – 3.0	White	828905-1*	

*Also available from Epec

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

8.6.4 Sealing Plugs

Open cavities provide pathways for contaminates to enter the connectors. To maintain seal integrity, any unused cavity must be filled with the appropriate size sealing plug.

TE Ordering Codes:

Contact Size	Cavity Size (mm)	Color	Part Number	Package Quantity
1.5K	3.6	White	963531-1	10 000
		Natural	1394132-1*	
2.8	5.6	Natural	828922-1	
		Green	828922-2*	

*Also available from Epec

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

9 GLOSSARY

A

API: Application Programming Interface

B

Boot loader: Boot loader is a software that is needed to load and run the device system. Epec boot loader cannot be updated by the customer.

C

CAN: Controller Area Network

CANopen: Communication protocol and device profile specification for embedded systems used in automation by CAN in automation (CiA) http://www.can-cia.org/

CODESYS: Controller Development System

CPU: Central Processing Unit

E

ECC: Error-correcting code memory

F

Firmware: Firmware is the device software programmed into memory contained in the hardware. Epec firmware can be updated by the customer, Epec firmware does not include boot loader.

G

GFG: Glass-Film-Glass. A touchscreen panel with a robust glass surface designed for harsh environmental conditions.

GPS: Global Positioning System

H

HMI: Human Machine Interface

I

IP class: Ingress Protection Rating, protection class. Classifies the degree of protection provided against the intrusion dust, water etc in mechanical casings and with electrical enclosures. It is published by the International Electrotechnical Commission (IEC).

J

J1939: SAE J1939 protocol Vehicle bus standard used for communication and diagnostics

L

LCD: Liquid-Crystal Display. A display that uses liquid crystals' light modulating properties

LED: Light-Emitting Diode. A semiconductor light source used for example in lamps and displays.

M

MB: Megabyte

N

NBR: Nitrile Rubber

O

OVP: Overvoltage Protection

P

PCAP: Projected Capacitive Touch

PCB: Printed Circuit Board

PLC: Programmable Logic Controller

PLCopen: PLCopen is a global standard for industrial control programming. IEC61131

PWM: Pulse-Width Modulation

R

RTC: Real-Time Clock

RTR: Remote Transmission Request

S

SIM: Subscriber Identity Module. An integrated circuit that stores securely the international mobile subscriber identity (IMSI) and the related key. They are used for identifying and authenticating subscribers on mobile telephony devices

T

TFT: Thin-Film-Transistor display. A display that uses thin-film transistor technology to improve image qualities such as addressability and contrast.

U

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi

USB: Universal Serial Bus. An industry standard developed to standardize the connection of computer peripherals.

UTC: Coordinated Universal Time

UVP: Undervoltage Protection

W

WVGA: Wide Video Graphics Array. A display resolution with the same 480 pixel height as VGA but wider, such as 800×480 (5:3).

Epec Oy
Tiedekatu 6
FIN-60320 Seinäjoki

Postal address
PL/P.O.Box 194
FIN-60101 Seinäjoki, Finland

Phone
+358-(0)20-7608 111

Internet
www.epec.fi