Epec Mini Display Module

Data Sheet

Document: 2029A00.doc
Updated: 1.11.2005

DOCUMENT VERSION HISTORY

Date	Notes
17.3.2005	First released version
1.11.2005	Updated chapter “1.2 About Manufacturer”

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose of This Document

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

1.2 About Manufacturer

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

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

1.3 Epec CAN Module Family

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

2 MINI DISPLAY MODULE GENERAL DESCRIPTION

The Mini Display Module is part of the Epec CAN Module Family. The display module is equipped with some input and output pins such as PWM outputs for proportional controls and feedback input for better accuracy of proportional controls. Versatile analog inputs can be used for example for joystick connection. In addition, the display module has some digital inputs and outputs for digital controlling. There are digital inputs which can be used as analog inputs and counterwise by the means of user application program. The display module is used in CAN bus based control systems as a multifunction controller with different kinds of sensors and actuators. It can be used also as an independent controller due to the digital and analog I/O capabilities. Furthermore, it is possible to connect control buttons to the display module. The display module has also a serial interface available.

The Mini Display Module can be used in some lighter control applications in which some I/Os and visual information are both required at the same time. The I/O capabilities are moderate compared to the original Mini PLC Module as the LCD display requires some capacity too. The display module can be nicely used e.g. controlling secondary joystick functions and visually presenting the engine speed and other parameters on the graphical LCD. In addition, there are possibilities to include some buttons, switches and on/off sensors.

Features

- User programmable CAN interface
- RS232 interface
- 8-bit processor with 20 MHz clock frequency
- 2,4” black and white graphic LCD panel, 128 x 64
- Operating voltage 10…30 VDC
- Nominal operating voltage 24 VDC
- Programming environment C or PLCopen with CoDeSys 2.3 or higher
- User application size up to 56 kilobytes (C) or 24 kilobytes (PLCopen)
- Overload protection for outputs
- Gold plated, locked and sealed connectors:
  8-pin AMPSEAL for module connection
  23-pin AMPSEAL for I/O
- Small outline dimensions: 147,5 x 63 x 53 mm
- Weight 0.5 kg

Applications

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

2.1 Programming with C

Memory allocation table, when programming Mini Display Module with C:

Description	***Memory size***	***Notes***
Application code	56 kB	If graphics library is used, it uses 20 kB of code capacity
RAM	256 B	Internal
RAM	2 kB	Integrated external
EEPROM	2 kB	

The display module is programmed by using the CAN bus connection between PC workstation and the module.

2.2 Programming with PLCopen

Mini Display Module can also be programmed with PLCopen (according to IEC 11313-3), using CoDeSys 2.3 or higher as a programming tool.

Memory allocation table:

Description	***Memory size***	***Notes***
Application code	24 kB	
Global data	464 B	
Flag memory	128 B	
EEPROM	2 kB	
Reserved for fonts, bitmaps and graphics library	20 kB	Graphics library uses part of the memory capacity

For more detailed information about programming, see the distinct Mini Display Module Programming Manual (document PM2029).

2.3 Programming Interface

The display module is programmed by using the CAN bus connection between PC workstation and the module.

3 INPUT / OUTPUT SPECIFICATIONS

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

3.1 Configurable I/Os

	DI	**PI**	**AI**	**PWM**	**DO**	**FB**
Amount	***Digital Input***	***Pulse Input***	***Analog Input***	***Pulse Width Modulation Capability***	***Digital Output (source)***	***Feedback***
2	X					
2	X	X				
6	X		X			
2				X	X	
1						X
13	*Total I/O amount*					

The usage of each I/O pin is determined by the application.

3.2 Digital Input

Pins X1.13 and X1.14 are ground referenced inputs (***DI***).

A pin without ***PI*** features is associated only a bit variable in the ***IX*** area in PLCopen programming environment. The application program will see there a logical zero when the pin is grounded or left open and logical one when the pin is connected to a positive voltage source.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
R_I	Input Resistance	V_I Greater than 4.3V (Note 1)	9.0	11	kΩ
		Referenced to 1.3V; V_I Less than 4.3V (Note 1)	6.2	7.6	kΩ
V_{IH}	Input High Voltage		4.8	30	V
V_{IL}	Input Low Voltage		-0.5	4.2	V
f_I	Input Frequency	t_C=10ms (Note 2, 3, 4, 5)		12	Hz
		Variable t_C (Note 2, 3, 5)		$1/8t_C$	
C_I	Input Capacitance		9	11	nF

Note 1: With input voltages below 4.3V it seems like the internal input resistance was connected to a 1.3V voltage source.

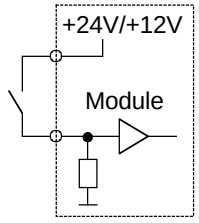
Note 2: t_C denotes software cycle time.

Note 3: Violating this rating may lead to system not recognizing all input state transitions.

Note 4: These parameters depend on software cycle time.

Note 5: Applies to inputs used as normal digital input. Violating this rating may lead to application program not noticing all input state transitions.

Connection Principle



3.3 Digital Input / Pulse Input

Pins X1.11 and X1.12 are ground referenced inputs (***DI***) including pulse counting (***PI***) feature.

The application program is provided with number of the pulses seen in the input in addition to the normal input state.

There are two variables associated with each pin of this type in PLCopen programming environment. The first is a bit variable in the ***IX*** area just in the same way as with the pins without the ***PI*** features. The second is a word variable in the ***IW*** memory area which hold the number of pulses.

Pulse counting, if needed, must be enabled explicitly by the application program (see programming manual PM2029).

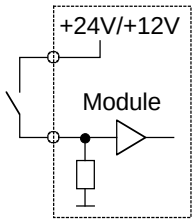
The counting of pulses competes with the application program and other processes for the CPU time. This makes it rather hard to estimate the actual maximum frequency of the pulses that the module is able to reliably count. The maximum frequencies given in the table below are such frequencies which makes the module to freeze in practice if all inputs are connected to their maximum frequency. It means that to be able to reach the maximum frequencies, there is no room for application program or any other processes like CAN traffic. So, the practical limits are lower but the maximum values of the table still give the basis for the estimation.

Inputs of this type are also suitable for quadrature sensor position counting. Any of these inputs can be logically paired with another similar input. The result is a two channel pulse counter which is capable of detecting the direction of the movement of the sensor. The pairing is done in the application software.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
R_I	Input Resistance	V_I Greater than 4.3V (Note 1)	9.0	11	kΩ
		Referenced to 1.3V; V_I Less than 4.3V (Note 1)	6.2	7.6	kΩ
V_{IH}	Input High Voltage		4.8	30	V
V_{IL}	Input Low Voltage		-0.5	4.2	V
f_I	Input Frequency (pulse counting)	(Note 2, 5)		2.5	kHz
	Input Frequency (normal input)	t_C=10ms (Note 2, 3, 4, 6)		12	Hz
		Variable t_C (Note 2, 4, 6)		$1/8t_C$	
t_I	Input Pulse Width	Note 2, 5	50		µs
		t_C=10ms (Note 2, 3, 4, 6)	40		ms
		Variable t_C (Note 2, 4, 6)	$4t_C$		
C_I	Input Capacitance		0.8	1.2	nF

Connection Principle



Note 1: With input voltages below 4.3V it seems like the internal input resistance was connected to a 1.3V voltage source

Note 2: Violating this rating may lead to system not recognizing all input state transitions

Note 3: These parameters depend on software cycle time

Note 4: t_C denotes software cycle time

Note 5: Applies to inputs used for pulse counting. Violating this rating may lead to incorrect measurement or counting

Note 6: Applies to inputs used as normal digital input. Violating this rating may lead to application program not noticing all input state transitions

3.4 Digital Input / Analog Input

The module has some supply voltage outputs for convenient excitation of input sensors. 12 volt outputs can be used to excitate for example potentiometers and temperature sensors respectively.

3.4.1 Pin X1.5

Pin X1.5 is used to measure analog signals. This pin can be used as a high impedance voltage input for signals from 0 to 23 volts.

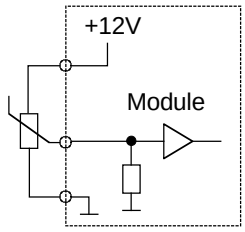
Word variable ***IW8*** is associated with this pin from where the software can read the actual signal magnitude at the pin.

In carefully selected applications this pin can also be used as digital input. Generally, it is not recommended. In voltage mode configuration it, being high impedance and having low threshold voltage, is quite sensitive to interference signals. Bit ***IX0.3*** is associated with this pin to support the DI functionality.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
V_I	Input Voltage	Analog measuring range	0.0	23	V
V_{IH}	Input High Voltage		19	30	V
V_{IL}	Input Low Voltage		-0.5	8	V
R_I	Input Resistance		90	94	kΩ
TIRE	Total Input Referred Error			1.15	V
p_I	Time Constant of Input Low Pass Filter		3.1	4.7	ms

Connection Principle



3.4.2 Pin X1.17

Pin X1.17 is used to measure analog signals. This pin can be used as low impedance current input for signals from 0 to 25 milliamperes.

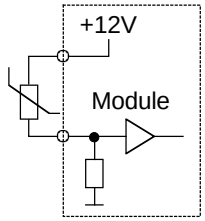
NOTE: It is recommended, that voltages exceeding 15 volts are not connected to this pin.

Word variable ***IW11*** is associated with this pin from where the software can read the actual signal magnitude at the pin. Bit ***IX0.13*** is associated with this input to support the DI functionality.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
I_I	Input Current	Analog measuring range	0.0	25	mA
V_I	Input Voltage		-0.5	15	V
I_{IH}	Input High Current		20	30	mA
I_{IL}	Input Low Current		0	9	mA
R_I	Input Resistance		98	102	Ω
TIRE	Total Input Referred Error			0.125	V
				1.25	mA
p_I	Time Constant of Input Low Pass Filter		4.0	5.4	µs

Connection Principle



3.4.3 Pins X1.20 and X1.21

Pins X1.20 and X1.21 are used to measure analog signals. They can be used as a high impedance voltage inputs for signals from 0 to 2.5 volts.

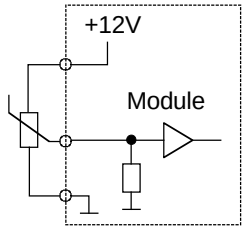
There is a word variable in ***IW*** area (see IEC map) associated with each pin from where the software can read the actual signal magnitude at the pin.

In carefully selected applications these pins can also be used as digital inputs. Generally, it is not recommended. In voltage mode configuration they, being high impedance and having low threshold voltage, are quite sensitive to interference signals. There are bits in ***IX*** area (see IEC map) associated with these inputs to support the DI functionality.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
V_I	Input Voltage	Analog measuring range	0.0	2.5	V
V_{IH}	Input High Voltage		2.0	30	V
V_{IL}	Input Low Voltage		-0.5	0.9	V
R_I	Input Resistance		81	83	kΩ
TIRE	Total Input Referred Error			0.125	V
p_I	Time Constant of Input Low Pass Filter		3.1	4.7	ms

Connection Principle



3.4.4 Pins X1.22 and X1.23

Pins X1.22 and X1.23 are used to measure analog signals. They can be used as a high impedance voltage inputs for signals from 0 to 2.5 volts. Pins of this kind can be used as e.g. joystick connection (see connection principle).

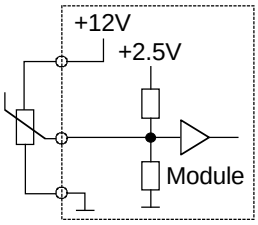
There is a word variable in ***IW*** area (see IEC map) associated with each pin from where the software can read the actual signal magnitude at the pin.

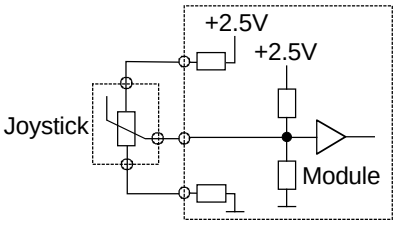
In carefully selected applications these pins can also be used as digital inputs. Generally, it is not recommended. In voltage mode configuration they, being high impedance and having low threshold voltage, are quite sensitive to interference signals. There are bits in ***IX*** area (see IEC map) associated with these inputs to support the DI functionality.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
V_I	Input Voltage	Analog measuring range	0.0	2.5	V
V_{IH}	Input High Voltage		2.0	30	V
V_{IL}	Input Low Voltage		-0.5	0.9	V
R_I	Input Resistance	Referred to 2.5V	37	45	kΩ
TIRE	Total Input Referred Error			0.125	V
p_I	Time Constant of Input Low Pass Filter		3.1	4.7	ms

Connection Principles





3.5 PWM Output / Digital Output

Pins X1.3 and X1.4 are current sourcing outputs. In other words, these pins connect the load to the positive supply voltage.

These outputs are also capable to generate pulse width modulated (PWM) output signals. This feature is useful when driving proportionally controlled loads e.g. proportional hydraulic valves.

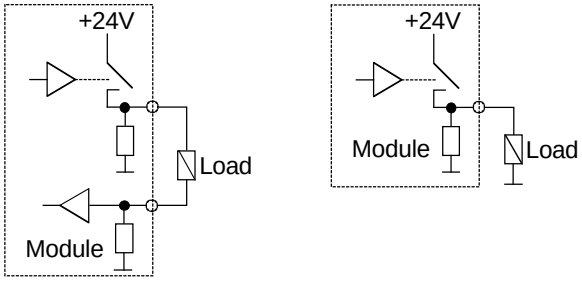
The PWM frequency is set to 100Hz. PWM frequencies cannot be configured under software control.

There are two bit and one byte variables associated with these pins in the PLCopen programming environment. The first bit variable is one of the ***QX*** output bits for controlling the pin as an output. The second is the ***MX63.X*** bits for controlling the pin as a PWM output. The byte variable is one of the ***QB*** output bytes for setting the pulse width of the pin.

Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
R_O	Output Resistance	Output On		0.2	Ω
I_O	Output Current	Output On		3	A
f_{PWM}	PWM Frequency	100Hz			
	PWM Resolution		256		
R_I	Input Resistance	Output Off	2.8	7.5	KΩ

Connection Principles



3.6 Feedback

Pin X1.2 has a small shunt resistor connected to ground. The shunt resistor is used to measure the current flowing through the load. Nothing prevents using this pin to measure currents from other sources as well.

Word variable ***IW7*** is associated with this pin from where the software can read the actual current flowing into the pin.

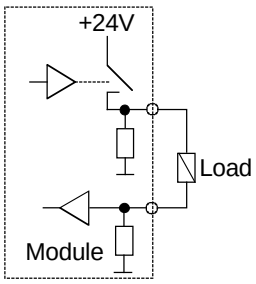
Electrical Characteristics

Symbol	*Parameter*	*Conditions*	*Min*	*Max*	*Units*
R_I	Input Resistance		0.21	0.23	Ω
I_I	Input Current	Analog measuring range (Note 1)	0.0	1.1	A
		Note 2		1.7	A
TIRE	Total Input Referred Error			55	mA

Note 1: If the max value is exceeded, the module fails to start.

Note 2: Exceeding the max value might cause damage to input.

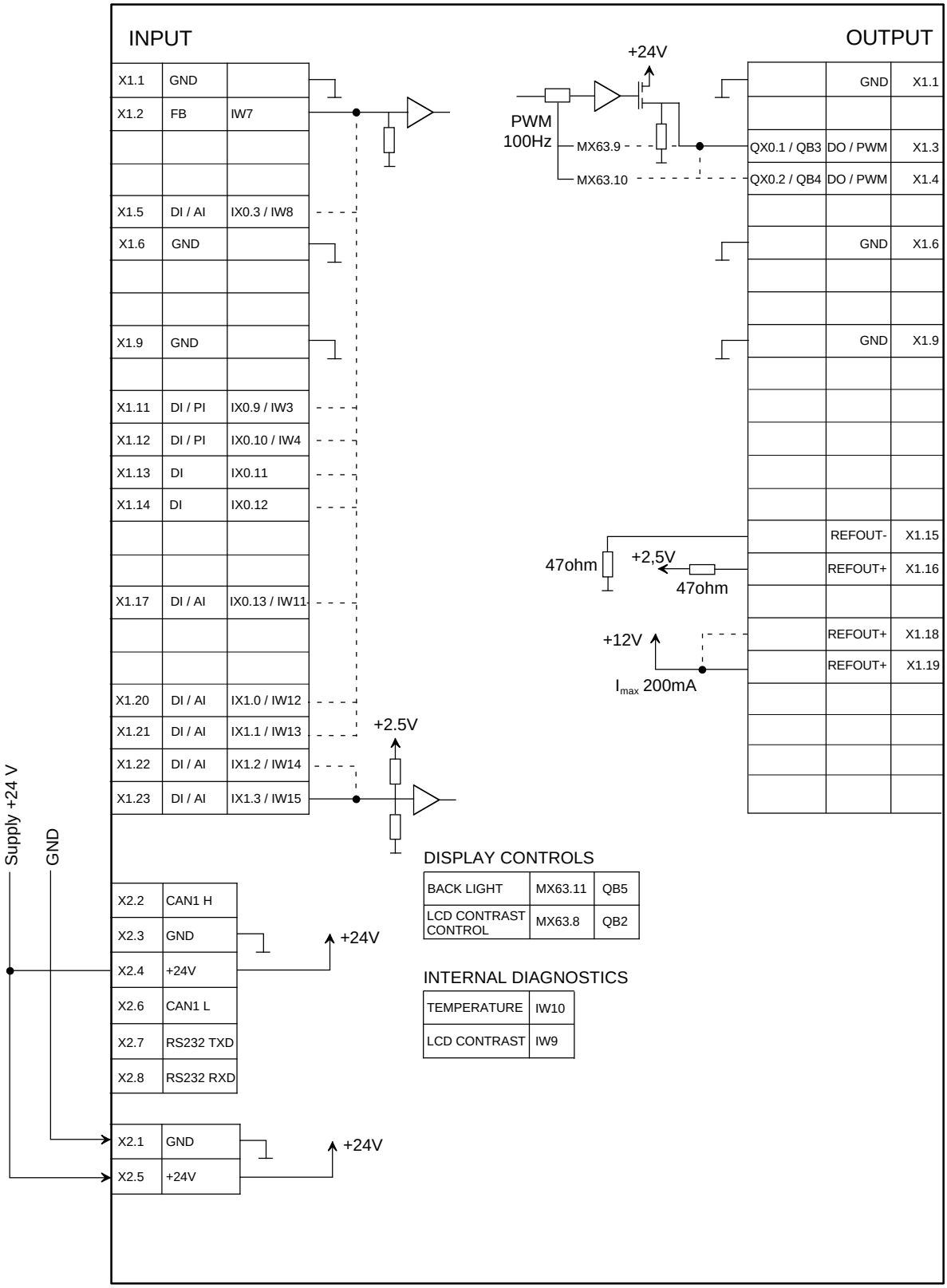
Connection Principle



3.7 Reserved Pins

Pins XM1.7, XM1.8 and XM1.10 are reserved for future use.

3.8 I/O / IEC Map



AI = ANALOG INPUT DO = DIGITAL OUTPUT FB = FEEDBACK NOTE! All addresses expressed as Word addresses
DI = DIGITAL INPUT PWM = PULSE WIDTH MODULATIVE OUTPUT
PI = PULSE INPUT n.c. = not connected

3.9 Connectors

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

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

3.10 AMPSEAL Cable Dimensions

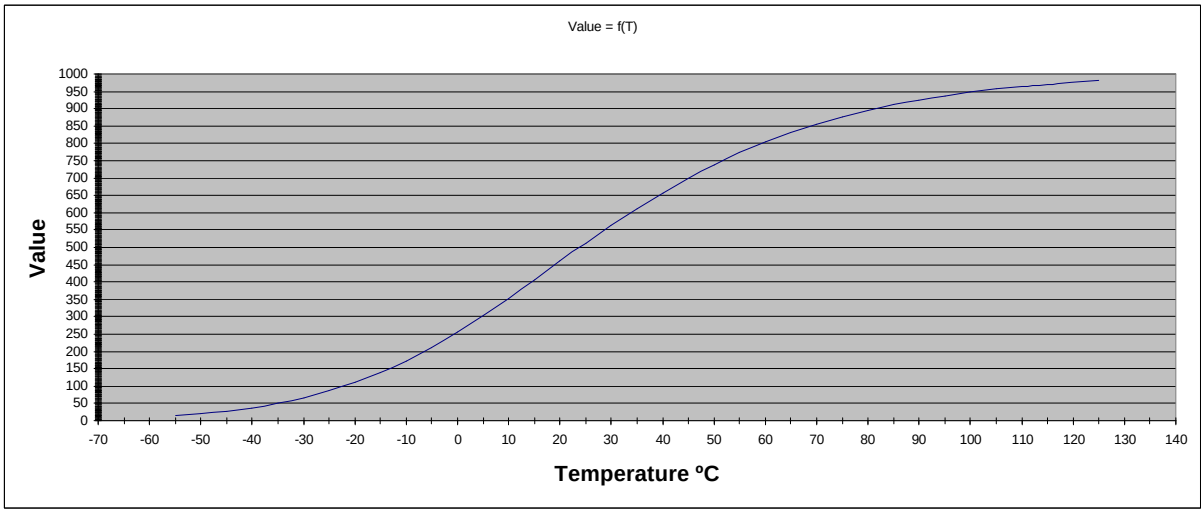
Size		***Insulation diameter range***	***Strip length ±0,4***	***Wire crimp height***	***Wire crimp width (nom)***	***Insulation crimp height max.***	***Insulation crimp width ±0,1***
mm^2	***AWG***						
0.5	20	1.7	5.1	1.17 ± 0.08	2.03	3.2	3.1
0.8	18	to	5.1	1.27 ± 0.05	2.03	3.2	3.1
1.4	16	2.7	5.1	1.40 ± 0.05	2.03	3.2	3.1
Typical hand crimping tools			AMP Procrimper 58440-1 (408-9592) AMP Procrimper 58529-1 (408-9999)				

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

4 INTERNAL CONTROLS AND DIAGNOSTICS

4.1 Temperature

Module temperature is associated with word variable ***IW10***. Variable returns a value which correlates to temperature according to following diagram:



4.2 LCD Contrast Control

LCD contrast control is associated with bit ***MX63.8***. When bit is set to "1", the contrast can be adjusted through byte variable ***QB2***.

LCD contrast value can be read through word variable ***IW9***.

4.3 Back Light Control

Back light control is associated with bit ***MX63.11***. When bit is set to "1", the back light brightness can be adjusted through byte variable ***QB5***.

5 POWER SUPPLY

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

5.1 Power Supply Pins

Designation	***Connector / pin number***	***Potential***
Supply voltage (V_{SUPPLY})	X2.4 X2.5	+24 VDC (+10…30 VDC)
Ground	X2.1 X2.3	GND

5.2 Overvoltage

- Max. 30 VDC (Stresses above this value may cause permanent damage to the module.)
- The module can handle only short period transients of greater voltages than 30V. The complete protection can be achieved with a Hub Module (EPEC 2021). The Hub Module is designed to protect the system against power line transients.

5.3 Power Consumption

- Approximately 2 W (+24 VDC, no external load)
- Supply Voltage (V_{SUPPLY}) maximum continuous current 5 A (with full external load)

5.4 Power Supply for Joysticks

Designation	***Connector / pin number***	***Potential***
Connection for joystick	X1.16 X1.15	2,5 VDC (47R) GND (47R)

NOTE! *Due to low signal level (2,5VDC), it is strongly recommended to use shielded cable in joystick connection.*

5.5 Power Supply for External Devices

Designation	***Connector / pin number***	***Potential***	
Power supply for external devices	X1.18 X1.19	12 VDC 12 VDC	(I max total 200mA)

5.6 Closed Loops Wiring

Epec strongly recommends using closed loops for connecting all sensors, actuators etc. devices to I/O modules. Closed loops wiring with the display module can be achieved by connecting the GND wire from the sensor, actuator etc. device into one of the GND pins in connectors X1 (grey AMP23) or X2 (black AMP8).

6 BUS CONNECTIONS

6.1 Bus Connection Pins

Designation	***Connector / pin number***
CAN High-Speed	X2.2 (CAN H) X2.6 (CAN L)
RS232	X2.7 (TXD) X2.8 (RXD)
Ground	X2.3 (GND)

6.2 CAN Interface

- ISO 11898 physical interface
- Supports CAN 2.0B protocol
- Used as main system interface
- Used as programming interface
- There is no internal terminal resistor in Mini Display Module. For detailed information concerning the use of terminal resistors, see the General Mounting and Cabling Instructions for Epec Modules

6.3 RS232 Interface

- RS232 physical interface

7 ENVIRONMENTAL CHARACTERS

- Operating temperature -10°C … +45°C
- Storage temperature -25°C … +60°C

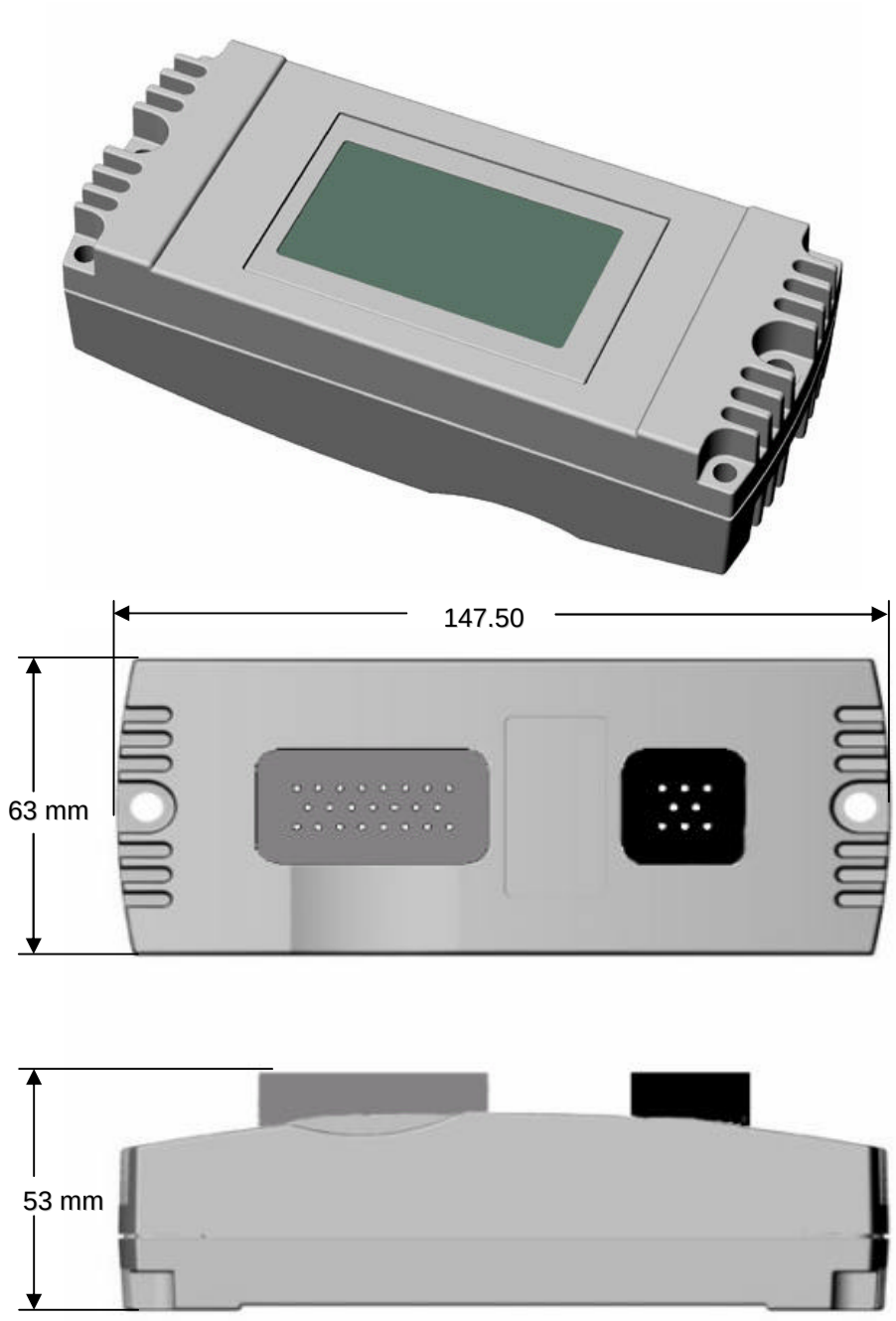
7.1 Protection

- Protection classification IP65 (classification according to IEC 60529)
- Protection for plugs depends on cable processing
- All cables, connectors and tools must be of correct type and sufficiently high quality. Also the environmental suitability of equipment should be checked (protection for moisture, mechanical stability, power durability, coupling resistance, etc.)
- Additional module cover for wires and connectors is also available (E10801109)

8 HOUSING

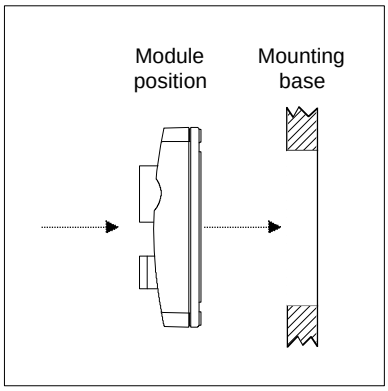
- Closed light cast aluminium housing
- Powder-painted, yellow surface passivation
- Puncture hole fastening

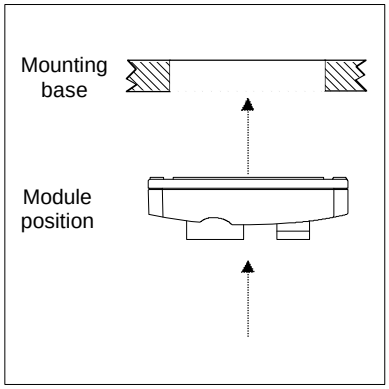
8.1 Unit Dimensions



8.2 Mounting

- 2 pieces of M6 screws to DIN 912
- Mini Display Module can be mounted for example on a panel.
- Recommended mounting position horizontal or vertical to allow water etc. flowing away from connectors:





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

9 ADDITIONAL DOCUMENTS

Document name	***Document description***
MountingInstructions	General mounting and cabling instructions for Epec modules
PM2029	Programming manual for Mini Display Module