

**Technion Display Control
Unit TDC130
Technical manual**

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1 Overview

This document specifies Technion Display Control Unit (TDC130) electrical and mechanical details and gives brief functional overview of the display controller.

2 Abbreviations and terminology

CAN	Controller Area Network
TBD	To Be Defined
USB	Universal Serial Bus
EMC	Electromagnetic compatibility
I/O	Input / Output
SW	Software
System SW	Software preprogrammed to device by Technion Oy
Application SW	Software customized by/for customer - a TeGUI program
TeGUI	User interface configuration tool

3 General

TDC130 is a general purpose display unit for mobile vehicles. Mobile vehicles consist of but not limited to following utility, forest, construction, mining, load and container handling machinery. The TDC130 is intended for mounting inside the cabin.

3.1 Limited Responsibility

This Product is designed and intended to be used for machine / equipment controlling purposes. Technion Ltd or any of its subsidiaries shall not assume any responsibility for this Product being fit for any specific application, unless Technion has so expressly stated in writing.

Technion Ltd or any of its subsidiaries requires that applicable machine / equipment safety guidelines, requirements, directives, machine / equipment warning labelling and rules are adhered to in the country/market where the product is used.

WARNING. The Product including the System software and libraries can fail in operation causing serious damage.

Technion Ltd or any of its subsidiaries recommends that for each machine / equipment type in which the Product is used a separate professional safety analysis be performed. The machine / equipment builder and system integrator shall analyze all aspects of the Product and the operation conditions and the applications. The machine / equipment builder is alone responsible for making the final selection of components and systems integrated into its product. The machine/equipment builder is alone responsible for any and all consequences that may occur. Technion Ltd or any of its subsidiaries does not have responsibility for any consequences, be it direct or indirect, caused by failures or malfunctions. Furthermore, Technion Ltd or any of its subsidiaries does not have any responsibility for accidents caused by incorrectly mounted or maintained machinery/equipment and it does not assume any liability for Technion Ltd or any of its subsidiaries components which have been incorrectly applied or the system having been programmed in a manner which jeopardizes safety.

The specifics and features of the Product should always be appropriately documented in the machine and equipment owner/user manuals in a way that the machine and equipment operator has the data to enable him to operate the machine / equipment correctly and in a safe manner.

Technion Ltd or any of its subsidiaries shall not be liable for loss of production, loss of profit, loss of use or any other consequential damages, punitive damages and/ or indirect losses, irrespective of the cause thereof. In case claims based on product liability are brought against Technion Ltd or any of its subsidiaries for which Technion Ltd or any of its subsidiaries may be liable, Technion Ltd or any of its subsidiaries liability is limited to the coverage covered under normal product liability insurances. The equipment/machinery builder shall compensate Technion Ltd or any of its subsidiaries to the extent Technion Ltd or any of its subsidiaries might be liable to pay damages as a result of claims based on product liability.

Technion Ltd or any of its subsidiaries reserves the right to alter the contents of this Technical Manual as well as the right to improve its products without further notice.

4 Product data

4.1 Mechanics

Material(s): Aluminum, stainless steel and polycarbonates
 Protection Class: IP67 front side, IP65 backside (M12 connectors) / IP40 (plug-in connectors)
 Weight: 350 g
 Dimensions: 118 x 91 x 27 mm (excluding connectors)
 Mounting: Panel mount
 Connectors: Straight mount, located at back side of the casing

Mechanical drawing is presented in Chapter 9.

4.2 Electrical connection

Module has three connectors. Connector types and usage is presented in Table 1. Connector orientation and location is presented in mechanical drawing (see Chapter 9).

Table 1- TDC130 connectors

Ref	Pins	Module connector	Contact plating	Mating connector	Usage
CAN1	5	M12 socket, A-coded	Gold		Power input, CAN1
CAN2	5	M12 socket, A-coded	Gold		Isolated CAN2
USB	5	Mini USB, type B (M12)	Gold	Phoenix Contact: 1420168	USB
<i>Alternative connector option</i>					
X1	16	Phoenix contact: 1843363	Tin	Phoenix Contact: 1847262 Phoenix Contact: 1863149	Power input, CAN1, CAN2, USB

4.3 Marking

Product is marked with the Technion part number and serial number.

4.4 Order options

TDC130 product family has several product variants. This documents covers following products.

Table 2- TDC130 product options

Order code	
TDC130-001	TDC130 FULL, plug-in connector
TDC130-002	TDC130 FULL, M12 connectors
TDC130-003	TDC130 BASIC, plug-in connectors
TDC130-004	TDC130 BASIC, M12 connectors
TDC130-005	TDC130 ECO, plug-in connector
TDC130-006	TDC130 ECO, M12 connector



Table 2- TDC130 product features

Feature / Product	TDC130 ECO TDC130-005 / TDC130-006	TDC130 BASIC TDC130-003 / TDC130-004	TDC130 FULL TDC130-001 / TDC130-002
3.2" QVGA Display	X	X	X
4-button membrane keypad	X	X	X
Two Bi-color LEDs	X	X	X
CAN 2.0B (CAN1)	X	X	X
CAN 2.0B Electrically isolated (CAN2)			X
USB		X	X
Buzzer			X
RTC		X	X
Data Flash 16MB		X	X
<i>Connector options</i>			
CAN1 M12	X	X	X
CAN2 M12			X
USB M12		X	X
16-pin plug-in connector	X ⁽¹⁾	X ⁽¹⁾	X ⁽¹⁾

¹⁾ Alternative connector for M12 connectors

5 Electrical data

5.1 System block diagram

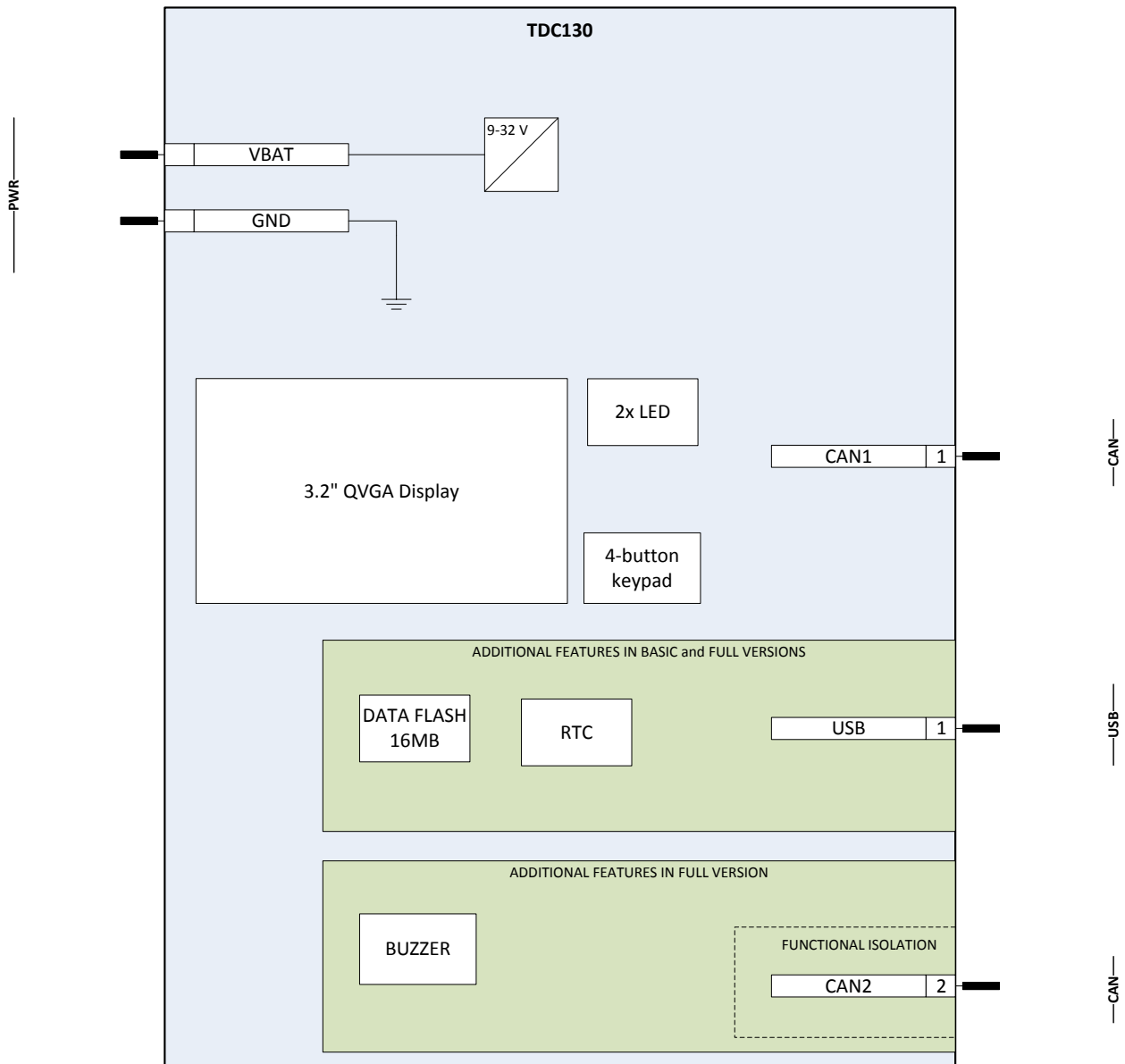


Figure 1 - TDC130 I/O block diagram

5.2 System properties

TDC130 has 32-bit CPU architecture that is capable to handle simple display operations. TDC130 application software is developed using TeGUI editor.

Table 2 – TDC130 memories

Memory	Size
RAM (total)	64 KiB
Program Flash (total)	512 KiB
Data Flash	16 MiB

Table 3 – TDC130 Module start-up time

Parameter	Time (typical)	Notes
Start-up time from power-up to application software start	3800 ms	TeGUI application

TDC130 CPU has integrated watch-dog that monitors program execution. If watch-dog is not refreshed for 4 seconds module is re-started.

5.3 Power supply

TDC130 module can operate either in 12V or 24V electrical system.

Table 4 – TDC130 power supply

Item	Min	Nom	Max	Unit	Notes
Supply voltage	9	24	32	V	
Overvoltage			36	V	Controller operates normally during overvoltage (32 V – 36 V). Maximum overvoltage 1 duration that module withstands is 60 minutes. ¹
Reverse voltage	-28			V	
Under voltage shutdown		6,2		V	
Supply current: module/logic		0,10		A	

5.3.1 Power supply input

Supply voltage must be within in the module operating range. Power input is protected against polarity reversal with internal diode.

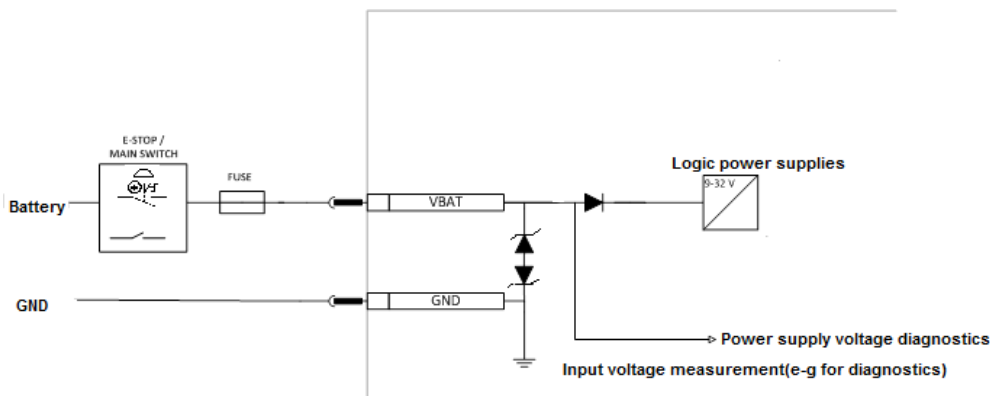


Figure 2 – VBAT power input topology

Module VBAT power input voltage (i.e. system/battery voltage) can be measured in application level.

Table 5 – VBAT input diagnostics

Item	Min	Nom	Max	Unit	Notes
VBAT voltage measurement range	0		48	V	
Measurement accuracy % FS			±5	%FS	

Table 6 – Power input signals

Signal	Type	Description
VBAT	IN	Power supply input
GND	-	Ground for power supply

¹ Some I/O functions do not tolerate overvoltage during short circuit to battery conditions. See detailed I/O specifications.

6 General functionality

All I/O functions (every connector pin) have short circuit protected against ground (GND). All I/O pins except USB are protected against short circuit to system supply voltage (max 32V).

TDC130 product family has several product variants. Available functionality depends on product variant. Product variant description is presented in chapter 4.4.

6.1 User Interface definition

6.1.1 Display unit

Table 7 – Display parameters

Item	Min	Nom	Max	Unit	Notes
Type		TFT, transmissive, 16-bit color			
Resolution		320x240		pixels	
Diagonal size		3.2		inch	active area 64.8 mm x 48.6 mm
Contrast ratio		500			
Brightness		175		cd/m ²	
Viewing angle		55		degrees	in all directions



Figure 3 – 3,2” QVGA TFT display

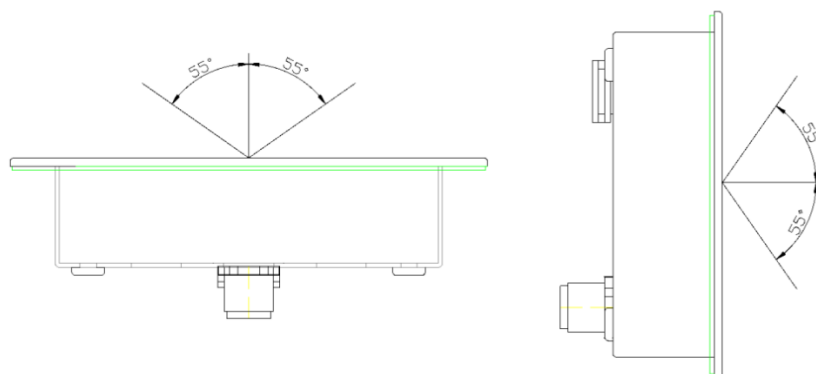
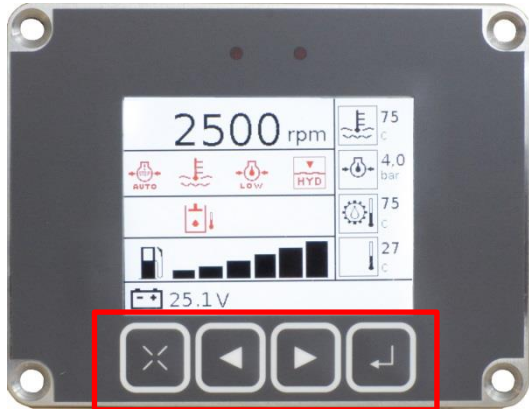


Figure 3 – Display viewing angle

6.1.2 Keyboard

4-button membrane keypad. Key functionalities are freely programmable in TeGUI.

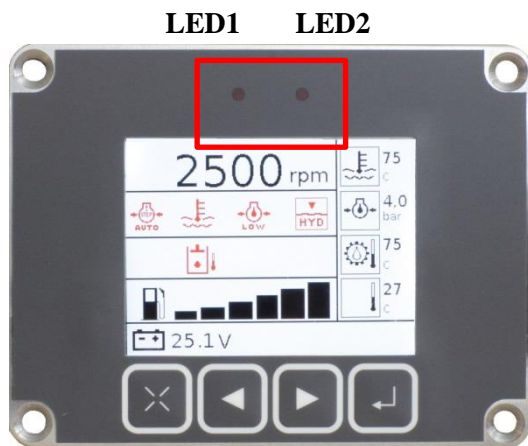


6.1.3 LEDs

Led functions: Freely programmable in TeGUI

Number of LEDs : 2

Bi-color LEDs: Red /Green



6.1.4 RTC

TDC130 has real-time clock with internal power back-up capacitor.

Table 8 – RTC parameters

Item	Min	Nom	Max	Unit	Notes
Accuracy		10		s/day	T _{amb} -25...+60°C
Operation time without VBAT power		14		days	

6.2 Communication definition

6.2.1 CAN1

Module has CAN 2.0 A/B communication interface. CAN physical layer is according to ISO 11898-2.

Table 9 – CAN1 Electrical specification

Parameter	Value	Description
Physical layer	ISO 11898-2	High speed CAN
Termination resistor	no internal termination	
Communication speed	40 kbps – 1 Mbps	
Common mode voltage	-25 V ... +25 V	
Short circuit protection	-28 V ... +36 V	
CAN_H / CAN_L leakage current	5 μ A	Max leakage current during power-off, $U_{CAN_H/CAN_L} < 5$ V
Protection	Short circuit to GND Short circuit to VBAT (32V)	

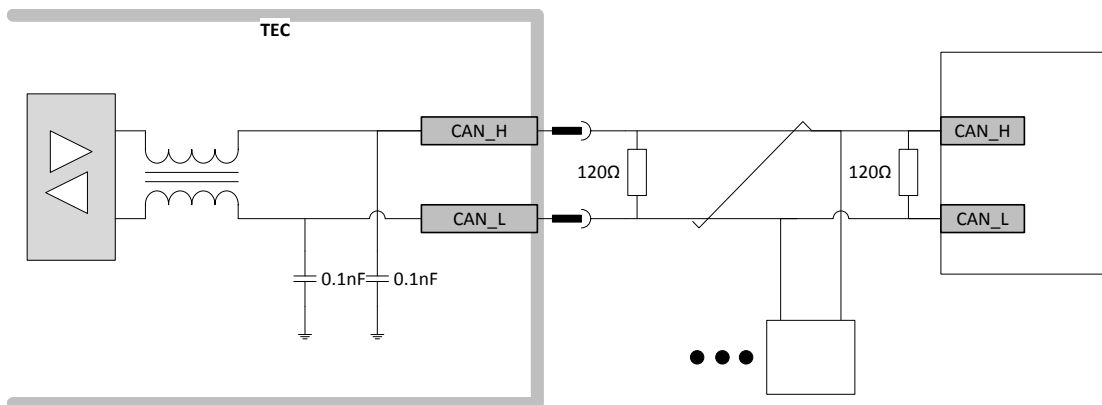


Figure 4 - CAN1 usage

Table 10 – CAN1 interface signals

Signal	Dir	Description
CAN_H	In / Out	CAN transmit / receive high
CAN_L	In / Out	CAN transmit / receive low
CAN_SHDL		Optional CAN shield. Connected directly to module enclosure

6.2.2 CAN2 (with functional isolation)

Module has one CAN 2.0 A/B communication interfaces with galvanic isolation (functional insulation). Isolation category is functional. Functional isolation does not provide protection to the user. Functional isolation is required to interface work properly in environments with high ground potential differences or where ground loops needs to be avoided. CAN_GND signal is needed balance the common mode voltage between (isolated) CAN nodes. CAN_GND has the same functional isolation from TDC130 GND as the CAN_L and CAN_H signals. CAN physical layer is according to ISO 11898-2.

Table 11 – CAN2 Electrical specification

Parameter	Value	Description
Physical layer	ISO 11898-2	High speed CAN
Termination resistor	no internal termination	
Communication speed	40 kbps – 1 Mbps	
Common mode voltage	-25 V ... +25 V	
Short circuit protection	-28 V ... +36 V	
CAN_H / CAN_L leakage current	5µA	Max leakage current during power-off, $U_{CAN_H/CAN_L} < 5\text{ V}$
Electical isolation	60 V	Functional isolation
Protection	Short circuit to GND Short circuit to VBAT (32V)	

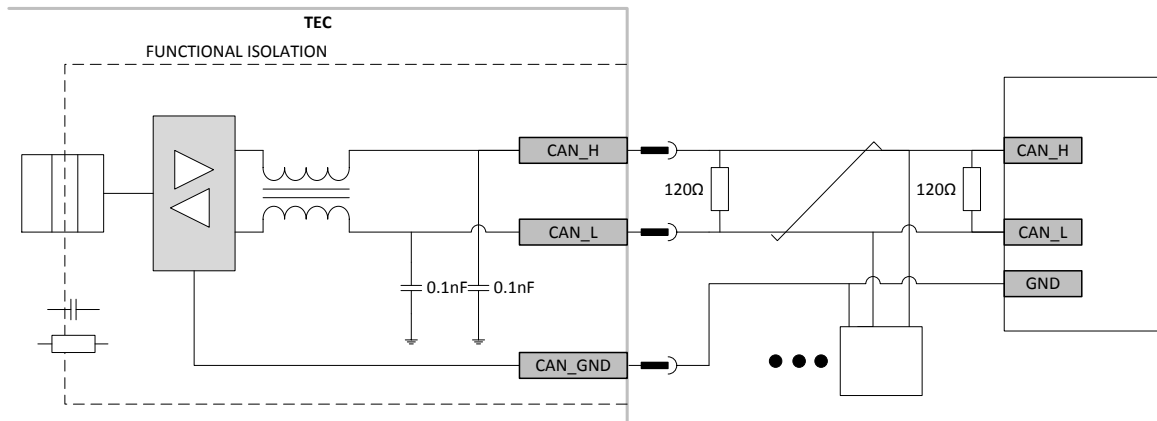


Figure 5 – CAN2 usage

Table 12 – CAN2 interface signals

Signal	Dir	Description
CAN_H	In / Out	CAN transmit / receive high (isolated)
CAN_L	In / Out	CAN transmit / receive low (isolated)
CAN_SHDL		Optional CAN shield. Connected directly to module enclosure
CAN_GND		CAN ground reference (isolated)

6.2.3 USB

Module has one USB 2.0 Full speed Host communication interface. USB interface is host type and it supports USB mass storage device class. USB flash drives (memory sticks) can be connected to interface. Intended usage is software update for the TDC130 or other devices connected to TDC130 CAN bus.

Table 13 – USB Electrical specification

Parameter		Value	Description
Physical layer		USB 2.0	
Type		Host	
Supported device classes		USB Mass storage	USB flash drive is supported
Communication speed		Full speed 12 Mbit/s	
USB_PWR (V _{BUS})		5V, max 500 mA	
Maximum USB cable length		0.5 m	
Protection		Short circuit to GND	Interface doesn't withstand short-circuit to VBAT or USB_PWR (TDC130 will be damaged permanently).

7 Environmental specification

7.1 General

Electrical and environmental requirements are based on standard ISO 16750.

7.2 Ambient temperature

The ECU is to be designed to operate inside the cabin. The function of the ECU will not deteriorate in an unacceptable manner, throughout the environmental extremes, for normal life time of the product.

Table 14 – TDC-130 ambient temperature

Item	Min	Nom	Max	Unit	Notes
Operating temperature	-25	-	60	°C	
Storage temperature	-40	-	75	°C	

7.3 Functional safety

TDC130 is not a safety component according to the machine directive 2006/42/EC. TDC130 is not SIL classified.

7.4 Display window cleaning

Do not use abrasive or highly alkaline cleaners, never scrape the sheet with squeegees, razor blades or other sharp instruments. Do not clean window in hot sun or at elevated temperatures. Afterwards, a warm final wash should be made, using a mild soap solution and ending with a thorough rinsing with cold water. Window cleaning can use a microfiber cloth.

8 Connector pin mapping

8.1 Connector locations



Figure 3 - Connector locations: M12 connectors.



Figure 4 - Connector location: Plug-In connector.

8.2 Connector pin map

8.2.1 CAN1

Table 15 – Connector CAN1 pinout

Connector CAN1 – M12 A coded				
Pin	Dir	Function(s)	Notes	
CAN1	1		CAN1_SHDL	CAN interface 1 shield (connected to module enclosure)
CAN1	2	PWR	VBAT	Power supply input
CAN1	3	GND	GND	Power supply ground
CAN1	4	I/O	CAN1_H	CAN interface 1 dominant high line
CAN1	5	I/O	CAN1_L	CAN interface 1 dominant low line

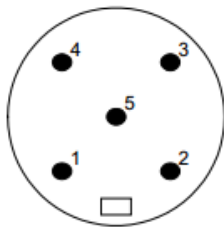


Figure 5 - CAN1 connector pin numbering

8.2.2 CAN2

Table 16 – Connector CAN2 pinout

Connector CAN2 – M12 A coded				
Pin	Dir	Function(s)	Notes	
CAN2	1		CAN2_SHDL	CAN interface 1 shield (connected to module enclosure)
CAN2	2			
CAN2	3	I/O	CAN2_GND	Ground reference for CAN2 (isolated)
CAN2	4	I/O	CAN2_H	CAN interface 2 dominant high line (isolated)
CAN2	5	I/O	CAN2_L	CAN interface 2 dominant low line (isolated)

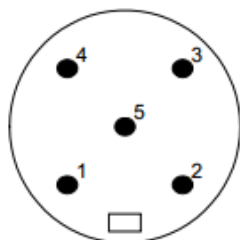


Figure 6 - CAN2 connector pin numbering

8.2.3 USB

Table 17 – Connector mini USB pinout

Connector USB – mini USB type B				
Pin	Dir	Function(s)	Notes	
USB	1	O	USB_+5V	USB power supply +5V, 500mA
USB	2	I/O	USB_D-	USB Data -
USB	3	I/O	USB_D+	USB Data +
USB	4			
USB	5		USB_GND	USB ground



Figure 7 - Mini USB type B connector pin numbering

8.2.4 PLUG-IN CONNECTOR X1

Table 18 – Connector X1 pinout

Connector USB – mini USB type B				
Pin	Dir	Function(s)	Notes	
X1	1	I/O	CAN2_GND	Ground reference for CAN2 (isolated)
X1	2	I/O	CAN2_L	CAN interface 2 dominant low line (isolated)
X1	3	I/O	CAN2_H	CAN interface 2 dominant high line (isolated)
X1	4		CAN2_SHDL	CAN interface 1 shield (connected to module enclosure)
X1	5			
X1	6	PWR	VBAT	Power supply input
X1	7	GND	GND	Power supply ground
X1	8	I/O	CAN1_L	CAN interface 1 dominant low line
X1	9	I/O	CAN1_H	CAN interface 1 dominant high line
X1	10		CAN1_SHDL	CAN interface 1 shield (connected to module enclosure)
X1	11	O	USB +5V	USB power supply +5V, 500mA
X1	12		USB_GND	USB ground
X1	13	I/O	USB_D-	USB Data -
X1	14	I/O	USB_D+	USB Data +
X1	15		USB_SHDL	USB cable shield
X1	16			

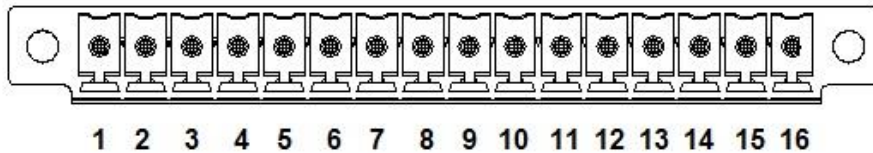


Figure 8 - X1 connector pin numbering

9 Mechanical drawings

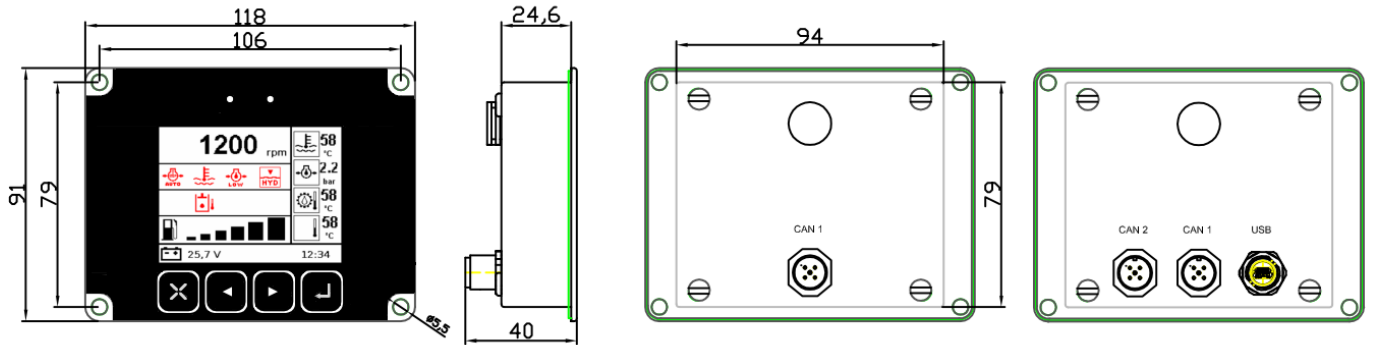


Figure 9 - TDC130 mechanical drawing M12 connectors

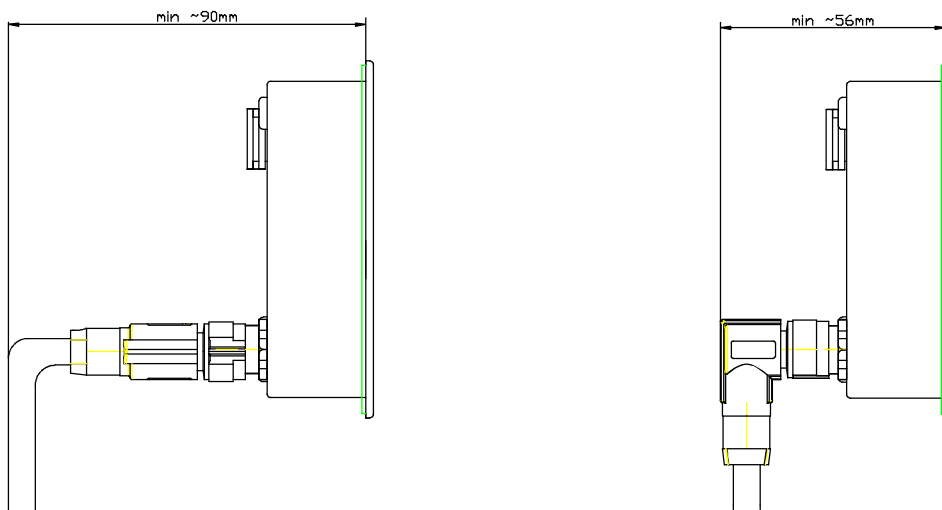


Figure 10 - TDC130 mechanical drawing M12 connectors – minimum required space for mating connector

Cable assembly must be fixed to rigid point at maximum distance 150 mm from TDC130.

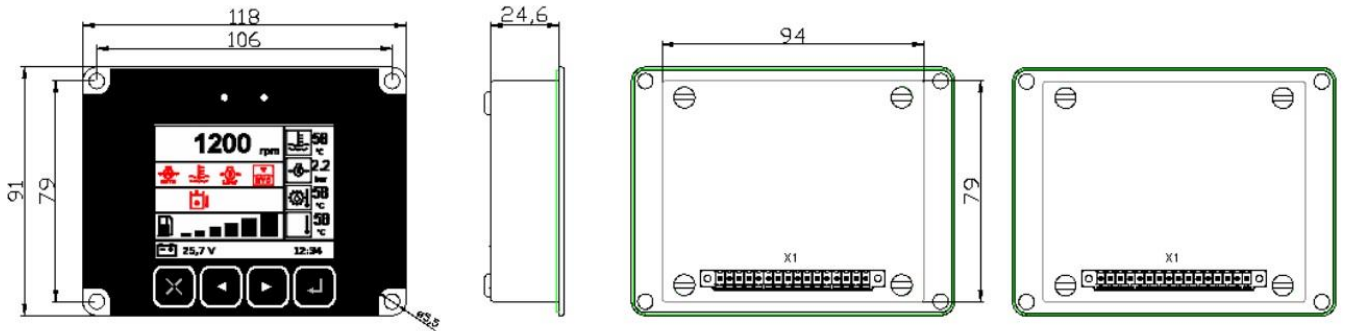


Figure 11 - TDC130 mechanical drawing plug-in connector

X1 Phoenix contact MC 1,5/16-STF-3,5 - 1847262

X1 Phoenix contact MCVW 1,5/16-STF-3,5 - 1863149

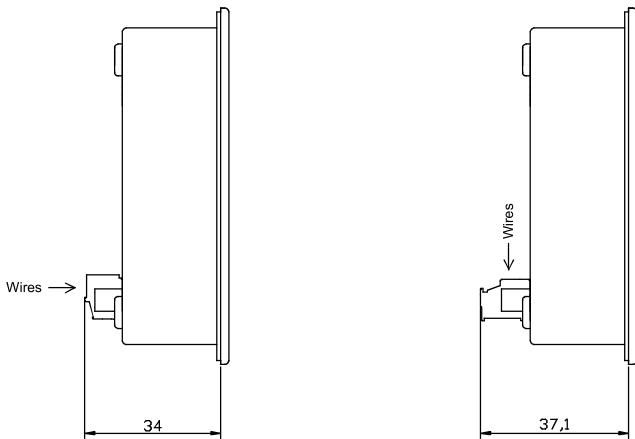


Figure 12 - TDC130 mechanical drawing plug-in connector – minimum required space for mating connector

Cable assembly must be fixed to rigid point at maximum distance 150 mm from TDC130.

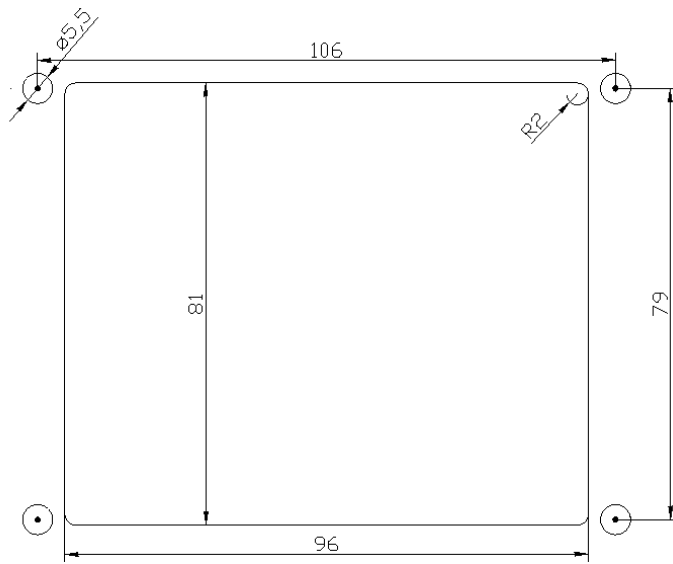


Figure 13 - Panel cut drawing



10 Reference documents

Item	Document name	Description	Rev.



11 Version History

Version	Date	Description	Author	Approval
1.0	16.3.2015	Initial version		
1.1	15.3.2016	Ch 6.1.4 RTC operation time updated Ch 6.2.1 & 6.2.2 CAN Minimum communication speed updated Ch 6.2.3 USB physical layer and USB_PWR specification updated Ch 8.2.3 & 8.2.4 USB pinout updated (ID removed)		