

# Hardware and Installation Manual

## BoX2 extreme

MAEN276  
2024-01



## Foreword

All BoX2 devices are developed to satisfy the demands of human-machine communication. Configuration is carried out on a PC using iX Developer software. The project can then be transferred and stored in the device itself. Various types of automation equipment such as PLCs, servos or drives can be connected to the device. In this manual, the term “the controller” refers to the connected equipment. This manual explains how to install the device. Please refer to the iX Developer reference manual for further information.

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# 1. Safety Precautions

Both the installer and users of the BoX2 device must read and understand this manual.

## 1.1. General

- Read the safety precautions carefully.
- Check the delivery for transportation damage. If damage is found, notify the supplier as soon as possible.
- Do not use the device in an environment with high explosive hazards.
- The supplier is not responsible for modified, altered, or reconstructed equipment.
- Use only parts and accessories manufactured according to specifications of the supplier.
- Read the installation and operating instructions carefully before installing, using, or repairing the device.
- Never allow fluids, metal filings or wiring debris to enter any openings in the device. This may cause fire or electrical shock.
- Only qualified personnel may operate the device.
- This is an OPEN-TYPE device and should therefore be installed in an enclosure to prevent unqualified personnel from operating it.
- The figures in this manual serve an illustrative purpose. Because of the many variables associated with any particular installation, the supplier cannot assume responsibility for actual use based on the figures.
- The supplier neither guarantees that the device is suitable for your particular application, nor assumes responsibility for your product design, installation or operation.

## 1.2. Hazardous Materials

Part description 零件描述	Toxic and hazardous materials or elements 有毒和有害的材料或元素					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
PCB and electronic components PCB 和电子元件	X	O	O	O	O	O

O: Indicates that this toxic or hazardous substance contained in all of the homogenous materials for this part is below the limit requirement in SJ/T 11363-2014.

O: 表示该有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2014 规定的限量要求以下

X: Indicates that this toxic or hazardous substance contained in at least one of the homogenous materials for this part is above the limit requirement in SJ/T 11363-2014.

X: 表明该有害物质至少在部件的某一均质材料中的含量超出 SJ/T 11363-2014 规定的限量要求。

## 1.3. Disposal Requirements Under WEEE Regulations

**For professional users in the European Union:** If you wish to discard electrical and electronic equipment (EEE), please contact your dealer or supplier for further information.

**For disposal in countries outside of the European Union:** If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal.

## 1.4. UL and cUL Installation

- All devices have to be supplied by a Class 2 power supply.



### WARNING

- Do not separate when energized.  
AVERTISSEMENT, NE PAS SEPARER SOUS TENSION.
- Do not open when an explosive atmosphere is present.  
NE PAS OUVRIR SI UNE ATMOSPHERE EXPLOSIVE EST PRÉSENT.
- Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire. This product contains a battery that is not user replaceable.  
LA BATTERIE PEUT EXPLOSER EN CAS DE MAUVAISE MANIPULATION. NE LA RECHARGEZ PAS, NE LA DÉMONTÉZ PAS ET NE LA JETÉZ PAS DANS LE FEU. CE PRODUIT CONTIENT UNE PILE QUI NE PEUT PAS ÊTRE REMPLACÉE PAR L'UTILISATEUR.
- Potential electrostatic charging hazard, see instructions. To avoid electrostatic charge build-up, it must not be rubbed or cleaned with solvents or a dry cloth when installed or used within a potentially explosive atmosphere.  
POTENTIEL ÉLECTROSTATIQUE RISQUE DE CHARGEMENT, VOIR INSTRUCTIONS.
- Explosion hazard! Substitution of components may impair suitability for Class I, Division 2.  
RISQUE D'EXPLOSION! LA SUBSTITUTION DE COMPOSANTS PEUT NUIRE À LA CONFORMITÉ DE CLASSE I, DIVISION 2.



### CAUTION

- Temperature code xT4 IEC/EN60079-0, IEC/EN60079-7, IEC/EN60079-15 and IEC/EN60079-31. Protection string Ex ec nC IIC T4Gc and Ex tc IIIC T82 °C Dc.  
CODES DE TEMPÉRATURE T4 IEC/EN60079-0, IEC/EN60079-7, IEC/EN60079-15 et IEC/EN60079-31. CHAÎNE DE PROTECTION Ex ec nC IIC T4Gc et Ex tc IIIC T82 °C Dc.

## 1.5. During Installation

- Install the device according to the accompanying installation instructions.
- Ground the device according to the accompanying installation instructions.
- Only qualified personnel may install the device.
- Separate the high voltage, signal, and supply cables.
- Make sure that the voltage and polarity of the power source is correct before connecting the device to the power outlet.
- Peripheral equipment must be appropriate for the application and location.
- Use only UL certified and approved M12 cables or M12 connector with cable gland. See section *Installation Process* for installation details. See step 3 in the process for UL approved M12 cables sets and M12 connector with cable gland.

## 1.6. During Use

- Keep the device clean.
- Emergency stop and other safety functions may not be controlled from the device.

## 1.7. Service and Maintenance

- Only qualified personnel should carry out repairs.
- The agreed warranty applies.
- Before carrying out any cleaning or maintenance operations, disconnect the equipment from the electrical supply.
- The battery must be replaced by an authorized Beijer Electronics service center.



### **WARNING**

On versions with Codesys runtime included, do not replace the battery before a backup of the Codesys retain variables and content has been made!

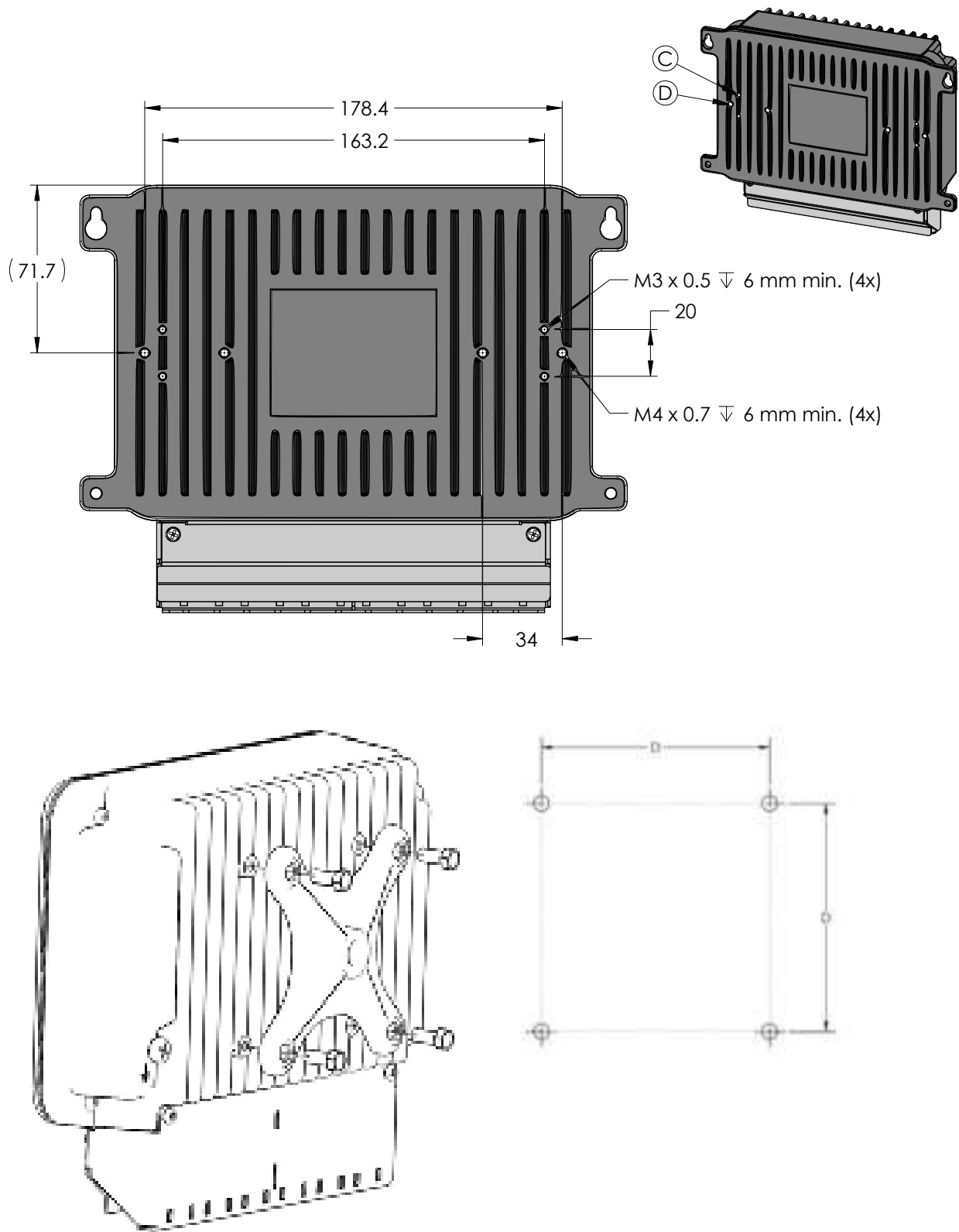
For more information contact our local support team or look in help online.

## 1.8. Dismantling and Scrapping

- Recycle the device and parts of it according to local regulations.
- The following components contain substances that might be hazardous to health and the environment: lithium battery and electrolytic capacitor.

## 2. Installation

### 2.1. Installation Process





The following is needed:

- A Phillips screwdriver for installation of the M12 protection bracket
- Four M5 × 0.8 screws conforming to the table above
- Installation tool for mounting screws

Do the following:

1. Unpack and check the delivery. If damage is found, notify the supplier.

**NOTE**

Place the BoX2 device on a stable surface during installation. Dropping the device or letting it fall may cause damage.

2. Attach UL certified and approved cables\connectors to the BoX2 device. Special precaution must be followed to ensure approved cable\connector sets are installed according to the environment and application where the device will be located. The unit is certified to be installed in the following hazardous environments:

- C1D2, Type 4X
- ATEX\IECEX Zone 2

**NOTE**

Please refer to the following tables for information on which connectors \ cables are to be used in each of these two environments.

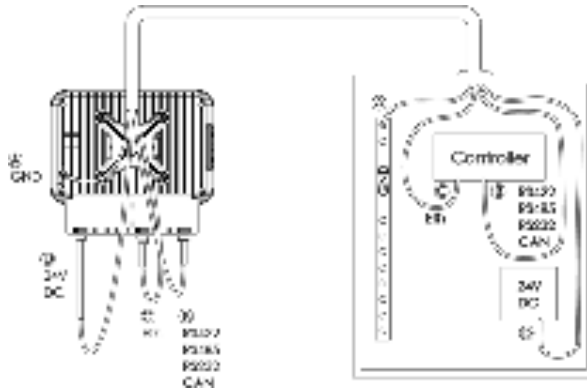
**NOTE**

For information, see table ATEX \ IECEX Zone 2 Environment (M12 cables sets) and Type 4X, C1D2 Environments (M12 connector with cable gland) below.

**NOTE**

M12 connector with cable gland torque: 3 Nm.

3. Drill the correct hole pattern in device outlined above or install unit on VESA compliant mounting bracket.



- Connect cable A to the terminal, using 14-20 AWG (2.08-0.52 mm<sup>2</sup>), 180-220 N-cm torque.



#### NOTE

Use minimum 85°C copper conductors only.

### ATEX \ IECEx Zone 2 Environment (M12 cables sets)

Manufacturer	Beijer Part Number	Manufacturer Model No.	Description
Binder	100-1025	77-3529-0000-50708-0300	M12 male 8p to blank 3 meter (COM)
	100-1151	77-3529-0000-50708-1000	M12 male 8p to blank 10 meter (COM)
Binder	100-1024	77-4529-0000-34704-0300	M12 male 4p to blank 3 meter (LAN)
	100-1152	77-4529-0000-34704-1000	M12 male 4p to blank 10 meter (LAN)
Binder	100-1023	77-3430-0000-50004-0300	M12 female 4p to blank 3 meter (power)
	100-1153	77-3430-0000-50004-1000	M12 female 4p to blank 10 meter (power)

### Type 4X, C1D2 Environments (M12 connector with cable gland)

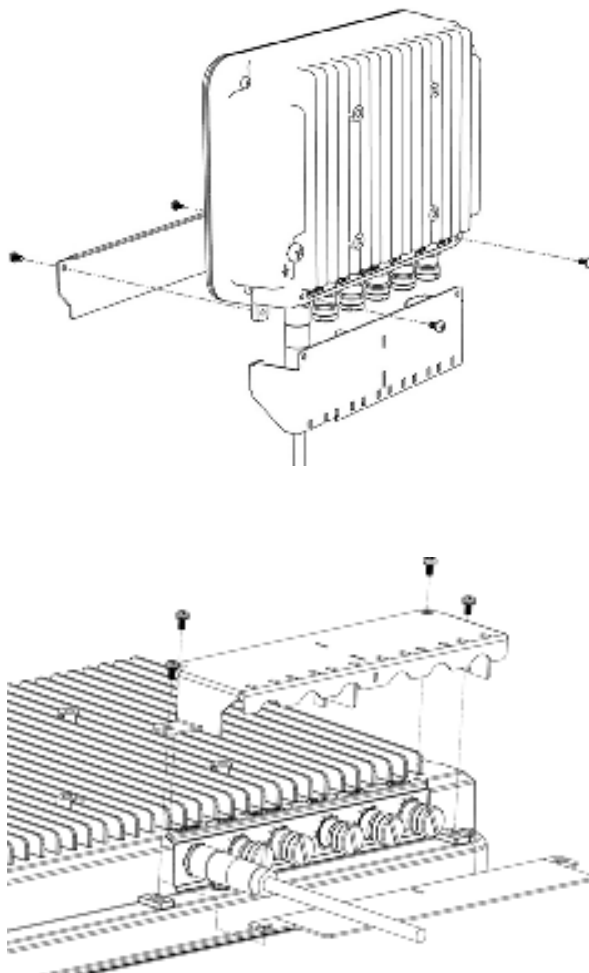
Manufacturer	Beijer Part Number	Manufacturer Model No.	Description	Cable Ratings
Binder	100-1148	99-1487-992-08	X2 extreme Connector, M12 SS 8p male 5.5 - 7.5 mm Gland (COM)	CMX cable rated 300V, 2 4AWG, 8 conductor, 5.5 - 7.5 mm OD, -30° C to 70° C PLTC cable rated 300V, 22AWG, 4 conductor, 5.5 mm - 7.5 mm OD, -30° C to 70° C

Manufacturer	Beijer Part Number	Manufacturer Model No.	Description	Cable Ratings
Binder	100-1149	99-3729-995-04	X2 extreme Connector, M12 SS 4p male 5.5 - 7.5 mm Gland (LAN)	
Binder	100-1150	99-1430-992-04	X2 extreme Connector, M12 SS 4p female 5.5 - 7.5 mm Gland (Power)	

### 2.1.1. Protective Connector Shield Installation Process

Do the following:

1. Install the protective connector shield as shown.

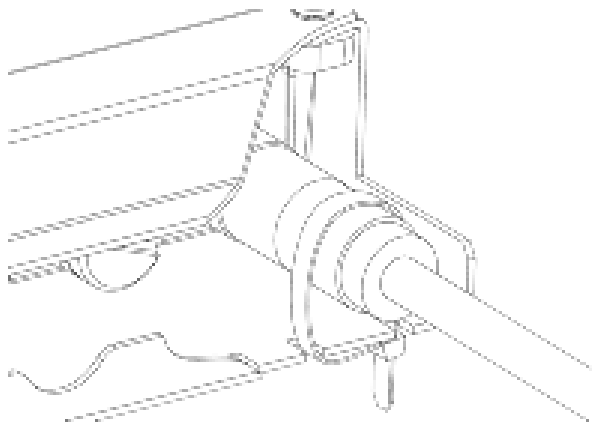




**NOTE**

Torque: 45 Ncm.

2. Secure the cables to the protective connector shield using the included cable ties



**NOTE**

The protective connector shield is required to be used on all applications.

### 2.1.2. Connections to the Controller

For information about the cables to be used when connecting the HMI panel to the controller, please refer to the help file for the driver in question.

### 2.1.3. Other Connections and Peripherals

Cables, peripheral equipment and accessories must be suitable for the application and its environment. For further details or recommendations, please refer to the supplier.

### 3. Technical Data

Parameter	BoX2 extreme
Front panel, W×H×D	234x183x62 mm
Sealing	IP66 (IP65 for IECEx\ATEX)
Frame material	Powder-coated aluminum
Weight	1.5 kg
CPU	i.MX 6Quad Quad ARM Cortex-A9 Core 1.0 GHz 1 MB L2 cache
Serial port COM A	M12 (8 pin, female) 1×RS-232 Rx/Txwith RTS(no CTS) 1×RS-422, or 1×RS -485 or 1×CAN 2.0B *Not supported for X2 control 7/10/15 web or X2 extreme 7/12/15 HP web.
Serial port COM B	M12 (8 pin, female) 1×RS-485 with isolated +5V/5mA out for bias resistor network, or 1×CAN 2.0B with termination *Not supported for X2 control 7/10/15 web or X2 extreme 7/12/15 HP web
Ethernet LAN A	M12 (4 Pin, female, D-coded according to EN/IEC 61076-2-101) 10/100 Mbit via RMII
Ethernet LAN B	M12 (4 Pin, female, D-coded according to EN/IEC 61076-2-101) 10/100 Mbit via RMII
USB	Supports up to USB 2.0 High Speed
External storage media	1 × SD card
Flash memory (application memory)	2 GB SSD (eMMC), 1.5 GB free for application
Memory RAM	2 GB (DDR3)
NVRAM	64 kB
LED	1 × Multi color
Real time clock	Yes
Battery	BR 2477A/GAN lithium battery, non replaceable
Power consumption at rated voltage	8 W
Fuse	Internal DC fuse, 4 AT, SMT
Power supply	+24 V DC (18-32 V DC)  CE: The power supply must conform with the requirements according to EN/IEC 60950 and EN/IEC 61558-2-4. UL and cUL: The power supply must conform with the requirements for class 2 power supplies.

Parameter	BoX2 extreme
Operating temperature	-30 °C to +70 °C
Storage temperature	-40 °C to +80 °C
Relative humidity in operation	5 - 95% non-condensation
Vibration	4g, according to IEC 60068-2-6, Test Fc
Mechanical shock	40g, half-sine, 6ms according to IEC60068-2-27
Approvals and certifications	CE/FCC/KCC Information is available on <a href="http://www.beijerelectronics.com">www.beijerelectronics.com</a>
UL approval	Information is available on <a href="http://www.beijerelectronics.com">www.beijerelectronics.com</a> and <a href="http://UL.com">UL.com</a>
Marine certificates	Information is available on <a href="http://www.beijerelectronics.com">www.beijerelectronics.com</a>

### 3.1. Compass Safe Distance

Variant	Condition	Standard Compass	Steering Compass
BoX2 extreme (SC)	Non-energized	10 cm	5 cm
	Non-energized after magnetization	15 cm	5 cm
	Energized and operating	10 cm	5 cm

## 4. Chemical Resistance

### 4.1. Metal Casing

The frame and casing material is powder-coated aluminum. This powder paint withstands exposure to the following chemicals without visible change:

Acetic acid 10%	Phosphoric acid 4%
Citric acid 10%	Phosphoric acid 10%
Diesel	Sea water
Distilled water	Sodium chloride 2%
Edible oil	Sodium chloride 20%
Fuel oil	Sulphuric acid 20%
Hydrogen peroxide 3%	Tap water

The powder paint shows limited resistance to the following chemicals at room temperature:

Butanol	Nitric acid 3%
Hydrochloric acid 5%	Nitric acid 10%
Isopropyl alcohol	Phosphoric acid 43%
Sodiumhypochlorite 10%	Turpentine



#### NOTE

If exposure to any of the above chemicals is demanded, it is recommended to first test the chemical in a hidden spot of the metal casing.

The powder paint shows little or no resistance to the following chemicals at room temperature:

Acetic acid, conc.	Methyl-ethyl ketone	Toluene
Acetone	Nitric acid 30%	Trichlorethylene
Ammonia 5%	Phenol	Xylene
Ammonia, conc.	Sodium hydroxide 5%	97 octane unleaded petrol
Ethyl acetate	Sodium hydroxide 30%	98 octane leaded petrol

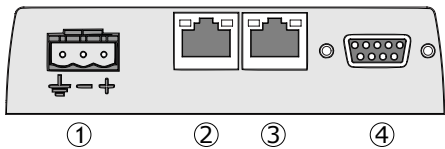
# 5. Device Drawings

## 5.1. Connectors




Pos	Connector	Description
1	Power supply	+24 V DC
2	COM B	Serial communication port
3	USB 1+ USB 2	USB Host 2.0, max output current 500 mA
4	LAN A	1 × 10/100 Base-T
5	LAN B	1 × 10/100 Base-T
6	COM A	Serial communication port

## 5.2. Connectors




Pos	Connector	Description
1	Power supply	+24 V DC (18-32 V DC)
2	LAN A	1×10/100 Base-T (shielded RJ45)
3	LAN B	1×10/100 Base-T (shielded RJ45)
4	COM	Serial communication port

### 5.2.1. Power Supply

Pin	Description	M12. 4 pin male
1	$V_{in+}$	
2	$V_{in-}$	
3	$V_{in-}$	
4	$V_{in+}$	




### 5.2.2. Communication Ports


COM B			
Pin	COM 3	CAN	M12, 8 pin female
1	RS-485 Tx+/Rx+	CAN-H	
2	TERM+	TERM+	
3	-	-	
4	-	-	
5	GND	GND	
6	RS-485 Tx- /Rx-	CAN-L	
7	TERM-	TERM-	
8	Vcc	Vcc	




#### NOTE

The connector supports galvanic isolated RS-485 or CAN.

USB		
Pin	USB 1/2	M12, 8 pin female
1	Vcc	
2	USB 2 D-	
3	USB 2 D+	
4	GND	
5	Vcc	
6	USB 1 D-	
7	USB 1 D+	
8	GND	

LAN A / LAN B			
Pin	LAN A	LAN B	M12, 4pin female
1		Tx+	
2		Rx+	
3		Tx-	
4		Rx-	

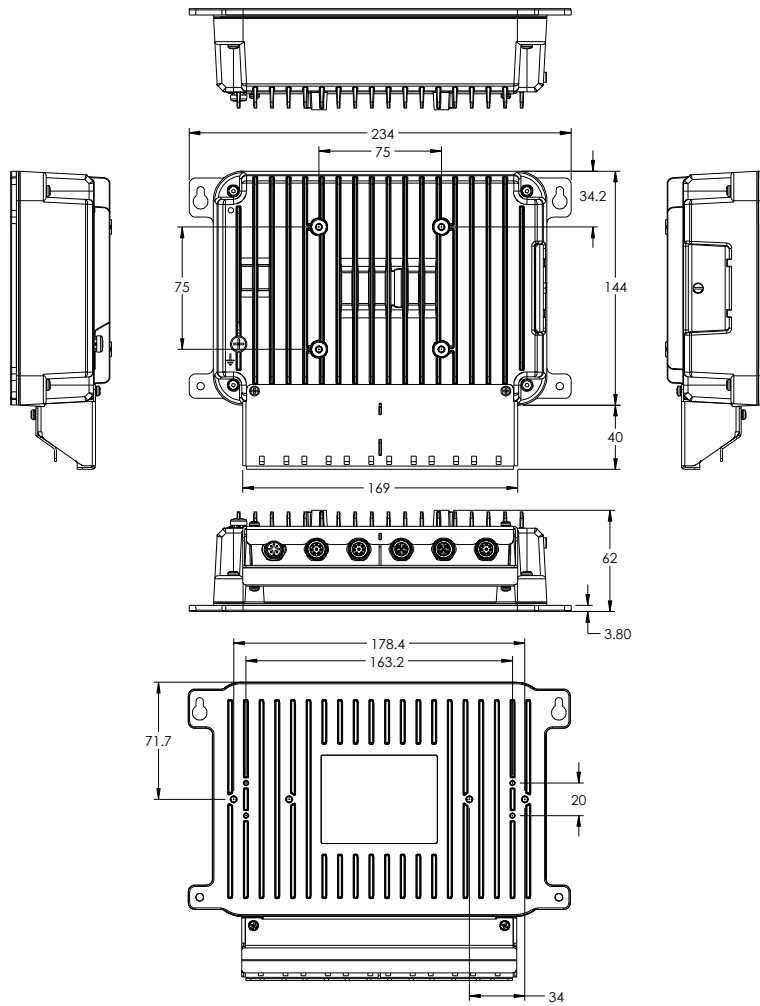
COM A				
Pin	COM 1	COM 2	COM 3	M12, 8 pin female
1	-	RS-422 Tx+ RS-485 Tx+/Rx+	CAN-H	
2	RS-232_RxD	-	-	
3	RS-232_TxD	-	-	
4	-	RS-422_Rx+	-	
5	GND	GND	-	
6	-	RS-422 Tx- RS-485 Tx-/Rx-	CAN-L	
7	RS-232_RTS	-	-	
8	-	RS-422 Rx-	-	



**NOTE**

The connector supports up to two independent serial communication channels and can be configured for RS-232, and RS-422 or RS-485 or CAN.

### 5.3. Device Outline



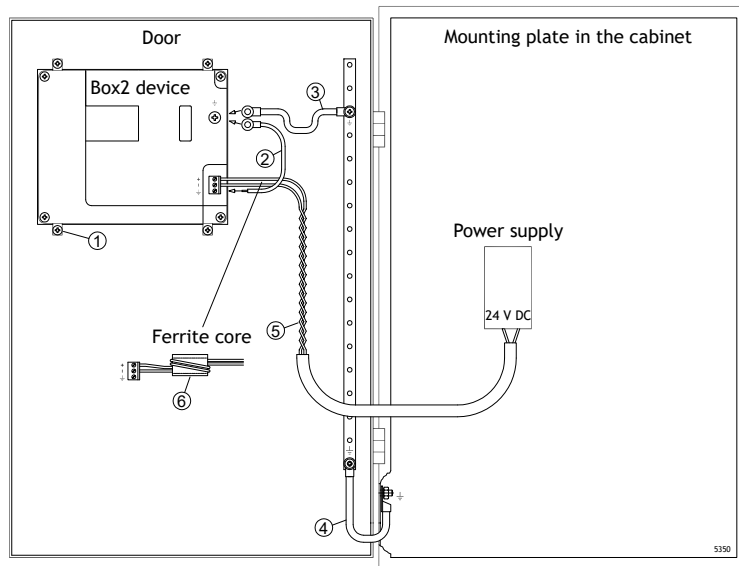
#### NOTE

A Step CAD file is available on the web site [www.beijerelectronics.com](http://www.beijerelectronics.com)

## 6. Additional Installation Tips

When experiencing communication problems in noisy environments or when operating close to temperature limits, the following recommendations are to be noticed.

### 6.1. Grounding the Device



The mounting clamps of the BoX2 device do not provide a secure grounding connection between the device and the device cabinet, see 1 in drawing above. To ground the device:

1. Connect a wire, that is sized correctly according to local electrical codes, between the quick-connect terminal connector on the device and the chassis of the device, see 2 in drawing above.
2. Connect a wire or grounding braid, that is sized correctly according to local electrical codes, between the chassis of the device and the closest grounding point on the door, see 3 in drawing above.
3. Connect a strong but short grounding braid between the door and the device cabinet, see 4 in drawing above.
4. Twist the cables onto the 24 V DC feed, see 5 in drawing above.
  - 2 turns around the ferrite core provide 4 times the suppression of 1 turn.
  - 3 turns around the ferrite core provide 9 times the suppression of 1 turn.



#### NOTE

The grounding wires should be short and the conductor should have a large area.

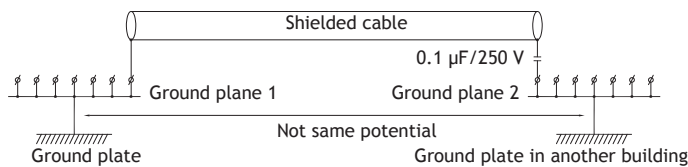
A long, thin grounding wire has a very high impedance (resistance) at high frequencies and does not guide disturbances to the ground.

Multi-wire conductors are better than single wire conductors with the same area.

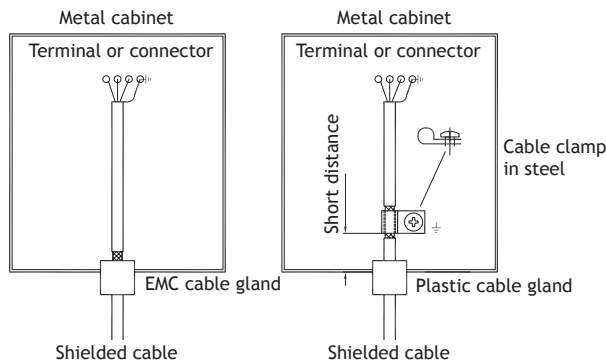
A braided conductor wire with the same area is even better. The best is a short, thick grounding braid.

## 6.2. To Achieve Better EMC Protection

- Initially, use the original cabling from Beijer Electronics primarily.
- Place the 24 V DC and communications cabling in one cable trunk/cable duct and 230/380 V AC in another. If the cables need to be crossed, cross them at 90° only. Avoid combining the cabling for stronger 24 V DC outputs with the communication cabling.
- Use shielded cables for RS-232 communication.
- Use twisted pair and shielded cabling for RS-422 and RS-485.
- Use the cabling intended for the bus type; Ethernet, Profibus, CC-Link, CAN, Device Net etc.
- Install and connect according to applicable specifications for the relevant bus standard.
- Use shielded cabling for Ethernet, preferably with foil and a braided shield.
- D-sub covers should be shielded, and the shield should be connected to the cover 360° where the cable enters.
- Connect the shield at both ends.



With longer distances, there is a risk that the ground potential may be different. In that case, the shield should only be connected at one end. A good alternative is to connect the other end of the shield to the ground via a 0.1 μF / 250 V film capacitor. Both ends are then connected to the ground in terms of HF, but only connected to the ground at one end in terms of LF, thus avoiding the 50/60 Hz grounding loops.

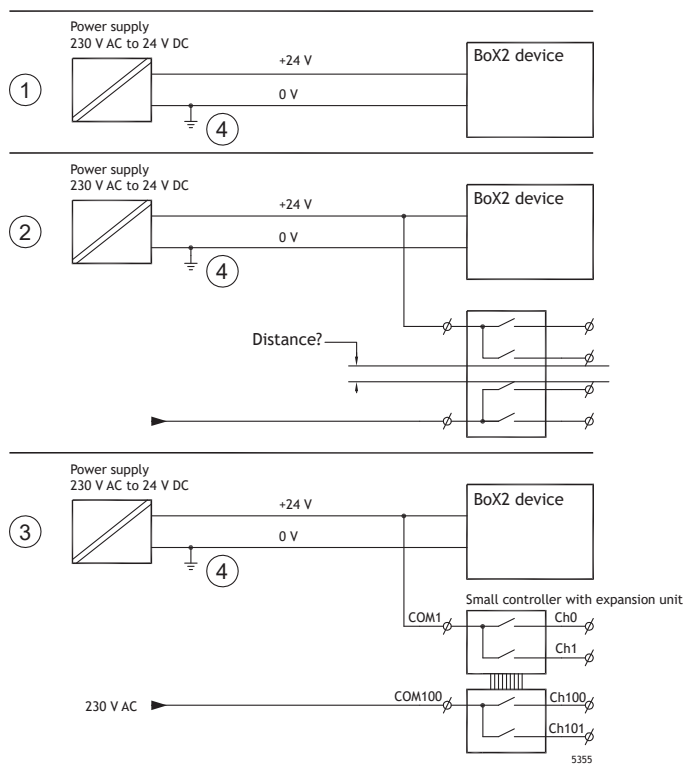


- Use an EMC cable gland or regular plastic cable gland, remove the outer jacket and connect the shield to the installation plate with a 360° metal cable clamp.
- Place the 24 V DC and communications cabling in one cable trunk/cable duct and 230/380 V AC in another. If the cables need to be crossed, cross them at 90° only. Avoid combining the cabling for stronger 24 V DC outputs with the communication cabling.

**NOTE**

Ferrite cores that are snapped onto the shielded cabling may remove minor disturbances. Large ferrite pieces that are snapped onto unshielded cabling and where the wires go 2-4 times around the cores are approximately 5-25 times more efficient.

## 6.3. Safety



If a power supply that meets safety standards is used and only powers the BoX2 device, there is no problem. See 1 in drawing above.

However, if a 24 V unit that also powers other units is used, there is reason to be cautious, see 2 in drawing above. The device does not have insulation that meets safety requirements in the event of a potential short circuit between 230 V AC and 24 V DC. It is assumed that the 24 V power supply is secure, for example, SELV according to EN 60950 (protection against electric shock) and UL 950.

**NOTE**

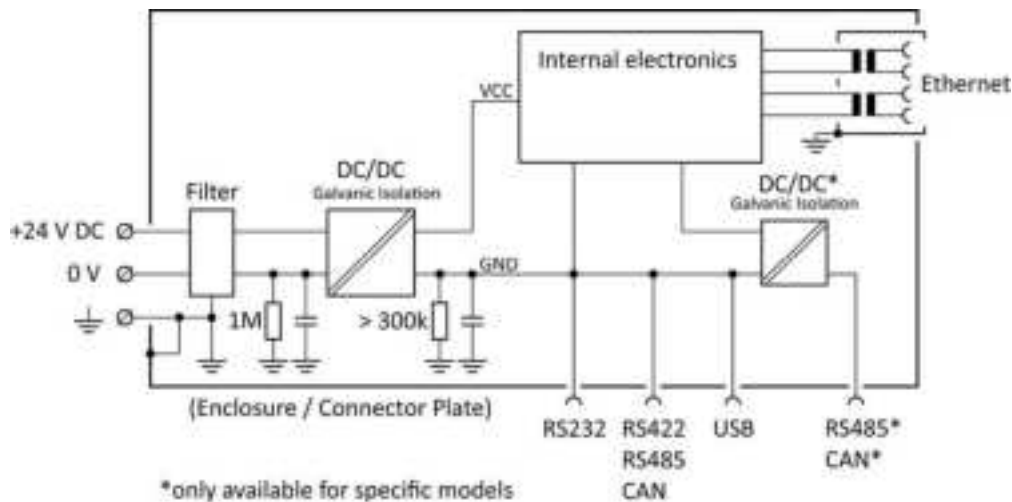
Here is an example that explains why a secure 24 V DC power supply can be ruined by mixing 24 V relay contacts with 230 V AC relay contacts in a smaller controller. Check that the clearances and creepage distances between 24 V DC and 230 V AC fulfill EN 60950 or UL 950. If not, input a separate 24 V unit into the device.

If there is a substantial distance between the relay contacts for 24 V DC and 230 V AC, it is OK to use the same 24 V devices for all feeds. See 3 in drawing above.

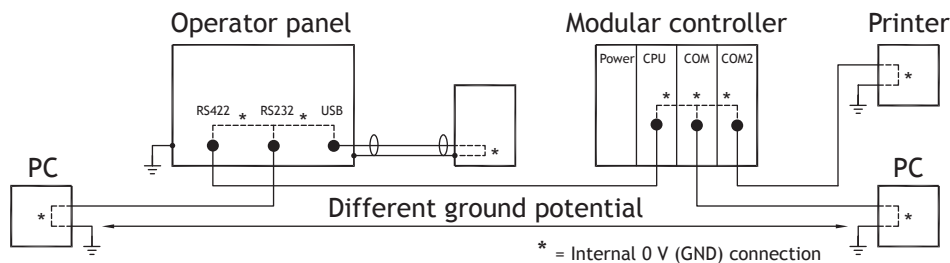
Connect 0 V on the 24 V power supply to the ground, see 4 in drawing above. This offers three advantages:

- Safety is increased. The 24 V power supply is not live in the event of a faulty connection or short circuit between 0 V (24 V) and 230 V phase.
- Transients on the 24 V feed are connected to the ground.
- No risk that the 24 V feed is at a high level in relationship to the ground. This is not unusual since there is high static electricity.

## 6.4. Galvanic Isolation



*The HMI panel has galvanic isolation against the 24 V DC power supply but no galvanic isolation between the communication ports for RS-232, RS-422, RS-485 and USB. Only the Ethernet connection has galvanic isolation.*



When a PC is connected to the HMI panel, the internal 0 V (GND) of the panel is connected to the protective ground via the PC.

A number of USB devices can have the shield connected together with the protective ground. Here, the 0 V (GND) of the HMI panel is connected to the protective ground when, for example, a USB memory stick, keyboard, or similar device is plugged in.

If a number of units are connected that have a 0 V and a ground connection, and these are connected to various grounding points, there is a substantial risk of problems. Grounding currents go through communication cables, the rear plate of the controller, internally in the HMI panel, and can cause errors.

Use external units to improve communication and achieve galvanic isolation. Westermo has good industry-standard insulators that are also insulated from the 24 V DC feed.

**NOTE**

It is very important to make sure that the 24 V feed in the external insulation unit is not connected to one of the communication outlets. If it does not have 100% insulation against the 24 V feed, disturbances and grounding currents from the 0 V on the 24 V side disrupt the communication.

Using this type of unit solves one problem but creates a larger problem! A substandard installation may work now, but problems may arise when other devices are connected.

## 6.5. Cable and Bus Termination RS-485

- If maximum transfer distance and maximum transfer speed is needed, shielded and twisted pair cable should be used. The mutual capacitance may not exceed 52.5 pF/m, and the cable area should be at least 0.25 mm<sup>2</sup> (AWG 24).
- 0 V, the reference voltage for communication should be included in the cabling. With two-way communication use two pairs; one pair for communication and one pair for 0 V.
- The shield must be grounded at one end. The other end is usually grounded, but with longer distances or when there is a difference in the ground potential, the shield should be connected to the ground via 0.1 µF / 250 V film capacitor to prevent ground current in the braided shield. Some manufacturers recommend that the shield be grounded at each node. Various manufacturers have different systems for bus termination.

Depending on the recipients' design, the bus wires may be on the same level or require pull-up or pull-down to ensure that no faulty signals are detected when the bus is in resting mode (all transmitters are disconnected).

## 6.6. CAN Interface

### 6.6.1. Cable Recommendations

- Use shielded, twisted pair cable to improve noise immunity and to reduce radiated emissions.  
Characteristic impedance: 120 Ohm (typical)  
Propagation delay: 5 ns/m  
Mutual capacitance: 40 pF/m (typical, wire to wire)
- Recommended cable cross section:  
Bus length 0-40 m: 0.25-0.34 mm<sup>2</sup> (AWG23,AWG22), 70 mOhm/m  
Bus length 40-300 m: 0.34-0.6 mm<sup>2</sup> (AWG22,AWG20), < 60 mOhm/m  
Bus length 300-600 m: 0.5-0.6 mm<sup>2</sup> (AWG20), < 40 mOhm/m  
Bus length 600-1000 m: 0.75-0.8 mm<sup>2</sup> (AWG18), < 26 mOhm/m
- GND should be included in the cabling to provide a reliable reference Ground for each CAN node (potential equalization). Use two wire pairs; one pair for communication and one pair for GND. Do not use the cable shield to connect GND.

### 6.6.2. Termination

- To achieve the best signal integrity, noise immunity and reliable bus performance, the CAN network must be terminated at its two most distant CAN nodes with 118Ohm... 130Ohm resistors. The recommended resistor value is 120 Ohm/1%/0.25W on each end.
- Place the termination resistor near the CAN bus connector (as close as possible).
- This product has no integrated termination resistors. They must be added externally.



### 6.6.3. Restrictions and Recommendations

- The maximum supported bit rate depends on bus load, bus topology, number of nodes, bus termination, propagation delay of each CAN node and the bus length.
- Do not connect more than 32 nodes to one CAN network without using a repeater.
- If the bus length exceeds about 200 m, it is recommended to use CAN nodes with built-in galvanic isolation.
- If the bus length exceeds 1000 m, a CAN bus repeater should be used.
- For additional information refer to the driver documentation for FreeCAN and Can Open in the iX Developer software.

## 6.7. USB Flash Drive

The USB port, or ports, are of 2.0 standard and support FAT16, FAT32 and exFAT file systems for USB flash drives (option, sold separately).

#### Size limitations for file systems:

- FAT16: up to 2 GB
- FAT32: up to 32 GB
- exFAT: up to 2 TB

