

# Cybrotech CAN/IEX-2 BUS wiring

TN-013  
rev. 4



cybroTECH

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## Safety information

This manual contains notices to which you should pay attention to ensure personnel safety, as well as to protect the controller and the connected equipment. These notices are highlighted in the manual by a warning triangle:



**Warning**

which indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.



**Caution**

which indicates that minor to medium personal injury or property damage can result if proper precautions are not taken.

### **Warning**

This product can only function correctly if it is transported, stored, set up and installed correctly, and operated and maintained as recommended. Failure to comply with applicable codes and standards can result in damage to equipment or serious injury to personnel.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary geographically and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation comply with the latest revision of these codes.

We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation or operation.

# 1 Introduction

This document presents rules and guidelines for correct wiring of Cybrotech IEX-2 networks.

Following these guidelines will ensure that networked devices will work as specified and to customer satisfaction.

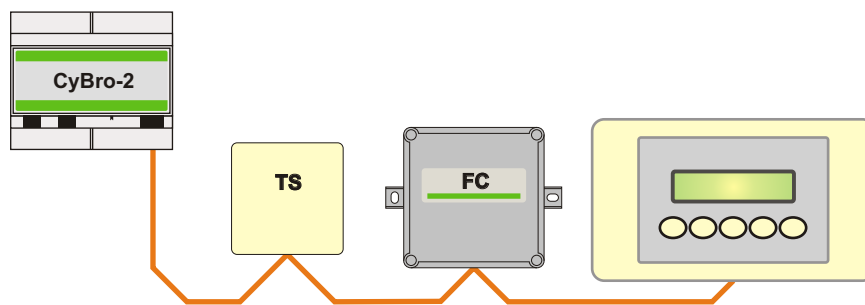
In this document IEX-2 will be used when describing a network of devices using this protocol, also Cybrotech's cable recommended for connection of devices uses the same name.

# 2 IEX-2 network overview

Cybrotech systems use two levels of networking. Both types of networks must be established over separate cabling.

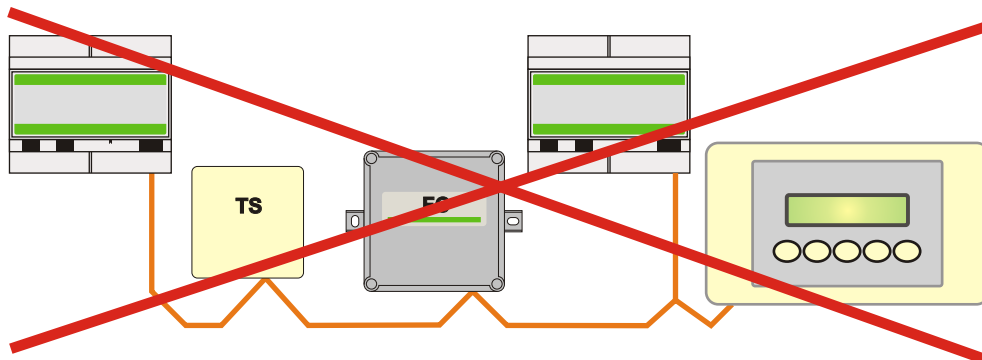
The low-level named is named **IEX-2**. IEX-2 is a proprietary protocol based on CAN 2.0B protocol and CAN physical level. Figure 1 shows an examples of IEX-2 network. Expansion modules (BIO-24R, AIC-12, FC, etc.) are connected over IEX-2 cable to a PLC controller (CYBRO-2, RC).

PLC controllers can be programmed with application that can use any or all of the I/O points of all the expansion modules connected.



**Figure 1:** Examples of low-level IEX-2 network.

In each individual IEX-2 network **ONLY** one PLC controller is allowed!



**Figure 2:** Only one controller allowed in each IEX-2 network.

### 3 General wiring guidelines

Follow all applicable electrical codes when wiring CyBro-2 series. Install and operate all equipment according to national and local standards.

All wirings should be performed by qualified personnel.

#### Warning

Control devices may fail in an unsafe condition, resulting in unexpected operation of controlled equipment.

Such unexpected action could result in death or serious personal injury, and/or equipment damage.

Install emergency stop switch, electromechanical overrides, or other redundant safeguards that are independent of the programmable controller.

#### Warning

Connect a power supply that meets the voltage rating, shown on the front panel.

A CyBro-2 may fail in an unsafe manner or present an electrical shock hazard to personnel if high voltage is applied to terminals intended for 24V= circuit connections.

Such a failure or shock could result in death or serious personal injury, and/or equipment damage.

Always supply 24V= circuits from a source that provides safe electrical separation from 120/230V~ power.

Provide a circuit breaker rated 10A/Type B that removes power from power supply and all the connected expansions. The circuit breaker or separate disconnect switch should be near the controller.

#### Warning

Never touch the terminals while the power is on. There is a risk of an electric shock, which could result in death or serious personal injury.

Separate AC wiring and high-energy DC wiring from low-energy signal wiring.

Equip inductive loads with suppression circuits.

Use 0.5-1.5 mm (22-14 AWG) size wires.

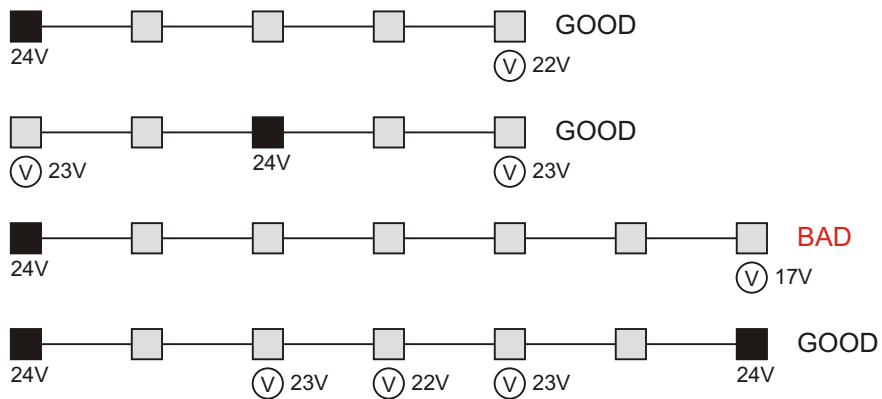
Use 85°C rated wires if there are no external heat sources nearby.

### 3.1 Power supply consideration

Wire resistance cause voltage drop on power supply lines. It depends of line length, wire diameter and supply current (determined by number and type of connected modules).

Each module should have at least minimum supply voltage of 18V DC. If that is not the case, additional power supply modules should be added. Power supply should have enough power for all connected modules.

#### Examples



## 4 Wiring IEX-2 network

There are two types of mounting possible:

- Installation box
- Distributed installation

### 4.1 Installation box

In this type expansion modules are mounted on a DIN rail (35mm) in close proximity of the controller, typically in the same cabinet.

For this kind of installation CAD-Px cables with RJ9-RJ9 connectors are used for connection of all devices.

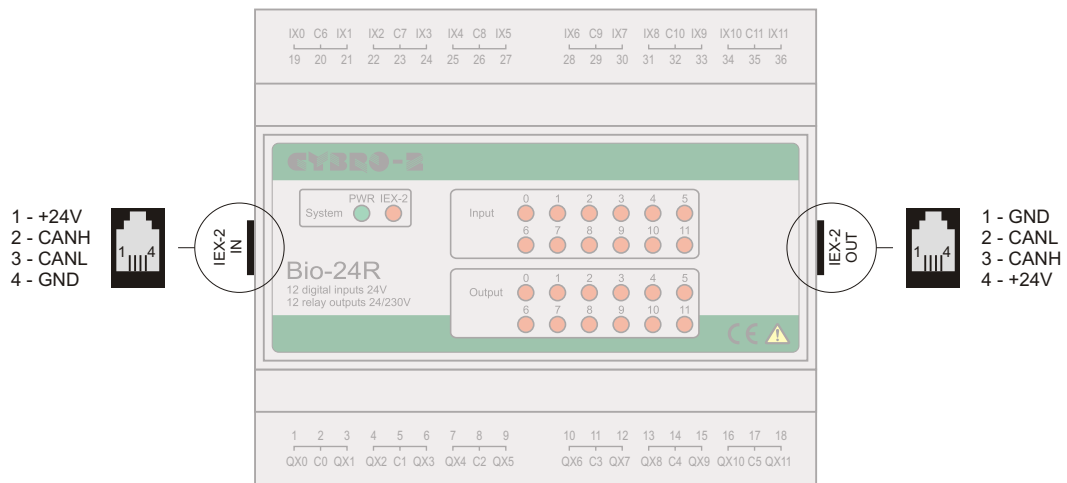
#### 4.1.1 Connecting

Each DIN mountable expansion module has an input and output IEX-2 ports (Figure 3). For this reason, it is important to correctly mount each device on the rail.

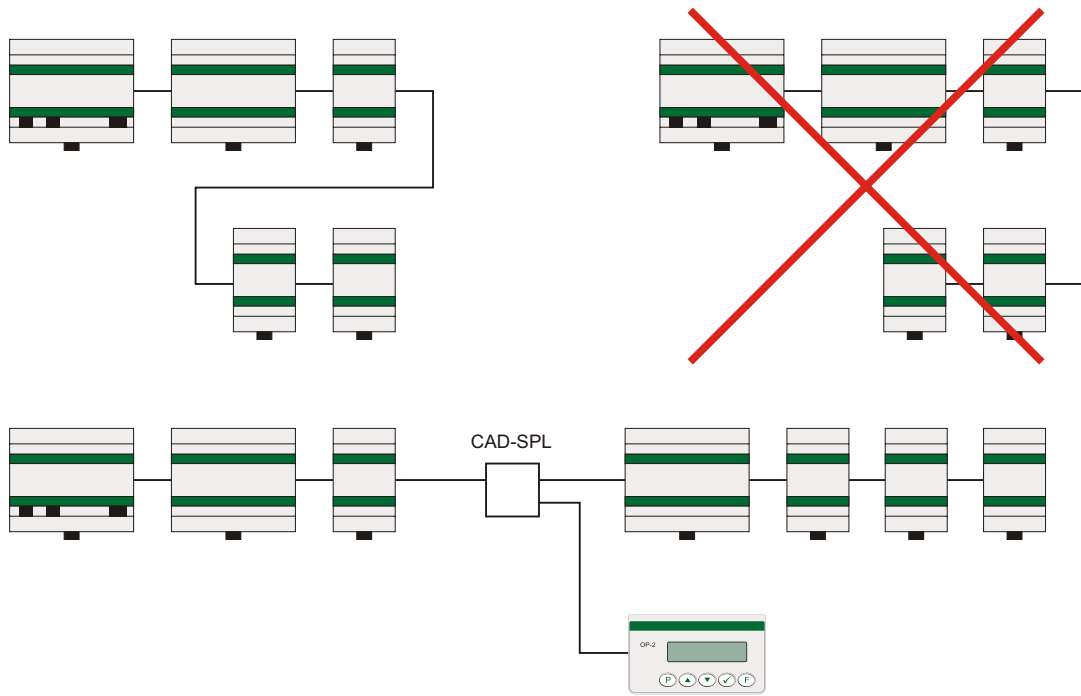
Since PLC has IEX-2 OUT (on the right side) it is good practice to place it left-most on the rail. Each module follows the placing on the rail to the right.

Connect IEX-2 OUT port from one device to IEX-2 IN port of the next device.

See figure 4 on the next page for some connecting examples.



**Figure 3: IEX-2 input and output ports.**



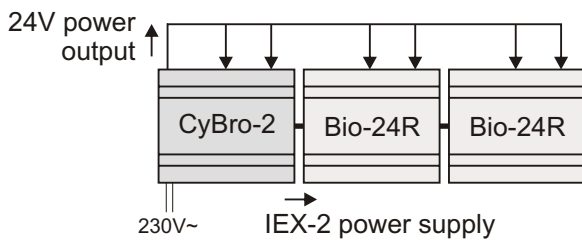
**Figure 4:** Network examples.

#### 4.1.2 Limitations

Number of connected IEX-2 modules is limited by the available power supply but can not be greater than 32 devices in one IEX-2 network.

Bus length:      max. 25m (500kbps, terminated)  
                      max. 100m (100kbps)

1) Small systems - number of IEX-2 modules limited by CyBro-2 internal power supply



Max. total power output of CyBro-2-230 internal 24VDC power supply:

- 320mA (at 85..260V AC)
- 500mA (at 230..240VAC)

IEX-2 power supply:

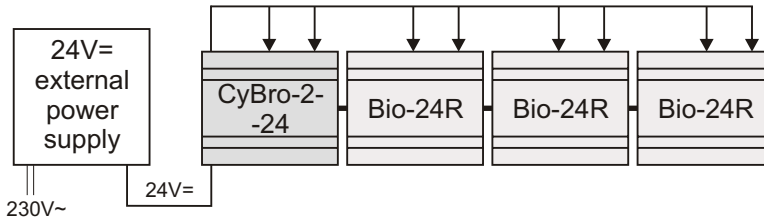
Bio-24R:	160mA
AiR-12:	50mA
OP-2:	40mA

24V power output:

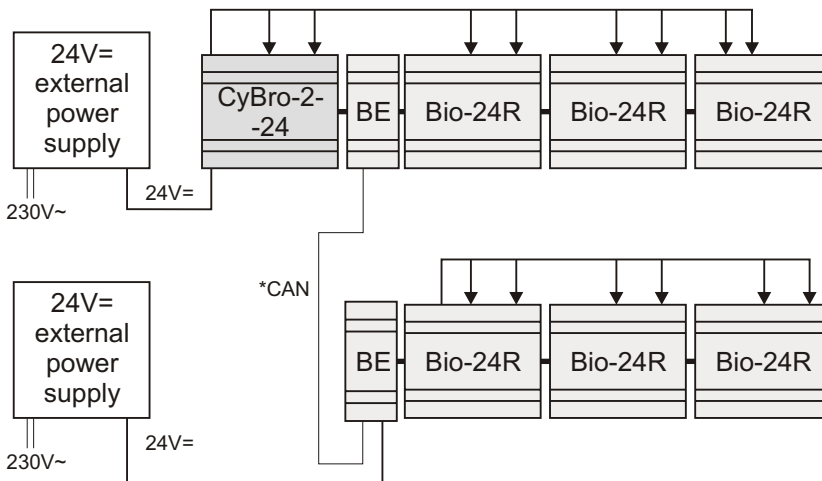
CyBro-2 inputs: 10x7mA=70mA max  
Bio-24 inputs: 12x7mA=84mA max

Total consumption: 404mA

2) Large systems - number of IEX-2 modules limited by external power supply



**NOTE:** Maximum current that can run through a DIN-mounted expansion module is limited to 2A. If more current is needed, additional IEX-2 modules may be connected using bus extender (BE).



\*Only communication lines (CANH, CANL) are connected between bus expanders.

### 4.1.3 Cable specification

Several IEX-2 connection cables of different lengths are available for purchase from Cybrotech:

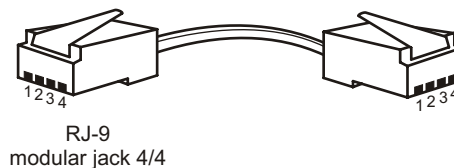
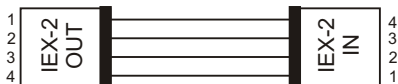
- CAD-P0 (minimum length)
- CAD-P1 (l=1m)
- CAD-P2 (l=2m)
- CAD-P3 (l=3m)



For custom cable the use of standard 4 wire telephone cable is recommended. At each end a RJ-9 connector must be crimped. See correct diagram below.

Flat telephone cable AWG 26-4

- 4 standard bare copper wires (0.129mm<sup>2</sup>, 133Ω/km)



## 4.2 Distributed installation

Unlike installation type discussed in chapter 4.1 expansion modules here are placed in different section of the building. For that reason the wiring of this system differs greatly.

In the following chapters wiring rules will be presented for correct establishing of IEX-2 network using two types of cables recommended for use in Cybrotech systems:

- IEX-2 Network cable Orange (Order code: **CAD-TP2X2**)

Also possible is to use standard EIB cable. See appendix for more details.

### 4.2.1 Cabling topology and cable termination

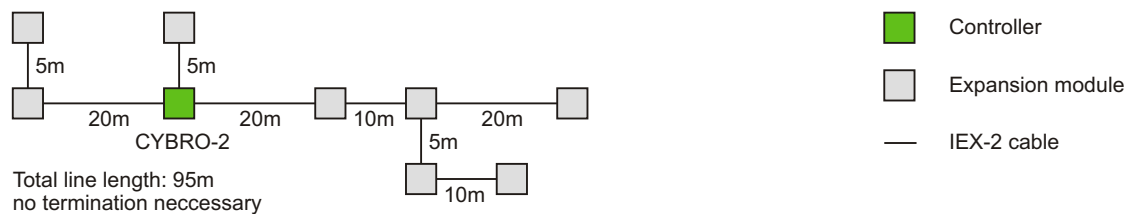
When designing network two critical features should be carefully considered:

1. Line length and network topology may affect network speed. Using default baudrate of 100kpbs, up to 100m may be considered safe. Longer lines should be properly terminated, and topology is restricted.
2. Wire resistance cause voltage drop on power supply lines. It depends of line length, wire diameter and supply current (determined by number and type of connected modules).

Each module should have at least minimum supply voltage of 18V DC.

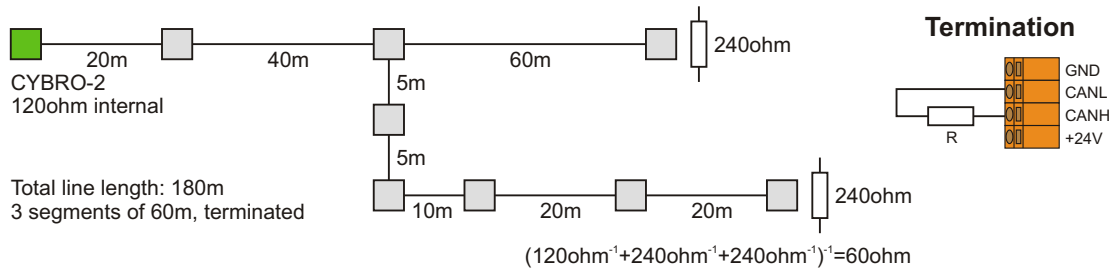
To ensure proper operation of IEX-2 network the following topology and cable termination rules presented are to be followed:

#### 1) Total IEX-2 bus length <100m



No termination resistors are necessary. Network topology is free, number of branches is not limited.

## 2) 100m < Total IEX-2 bus length < 200m



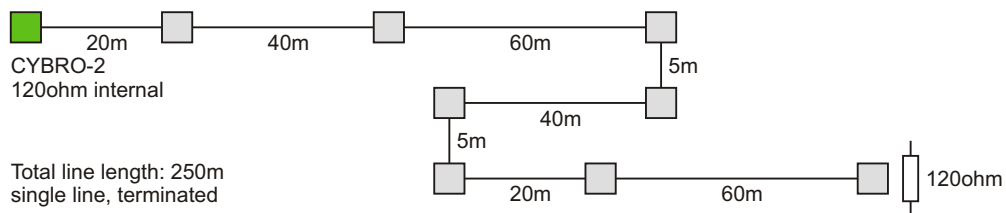
Termination required. No more than four branches are allowed. Each segment longer than 20m should be terminated. Termination resistors are calculated so that total resistance is 60ohm.

## 3) 200m < Total IEX-2 bus length < 300m

Line should be connected strictly in line, without branches. Both ends should be terminated with 120ohm terminated resistors (one of them is internal RC termination resistor).

Maximum allowed line length is 300m.

Room controller has internal termination resistor, which can't be turned off. External termination resistors should be connected to CANL and CANH lines.



Termination required. No more than four branches are allowed. Each segment longer than 20m should be terminated. Termination resistors are calculated so that total resistance is 60ohm.

### 4.2.2 Cable specification

#### IEX-2 Network cable Orange

- 4 fine wire strands of plain copper wire
- 2 communication wires (2 x 0.25mm<sup>2</sup>)
- 2 power wires (2 x 0.75mm<sup>2</sup>, 24Ω/km)

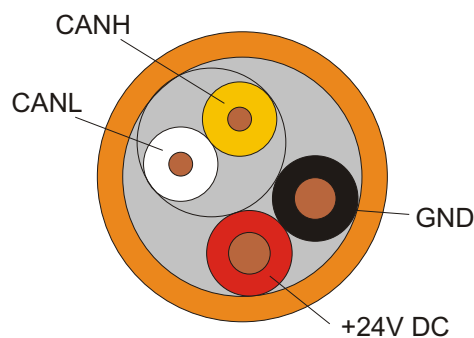


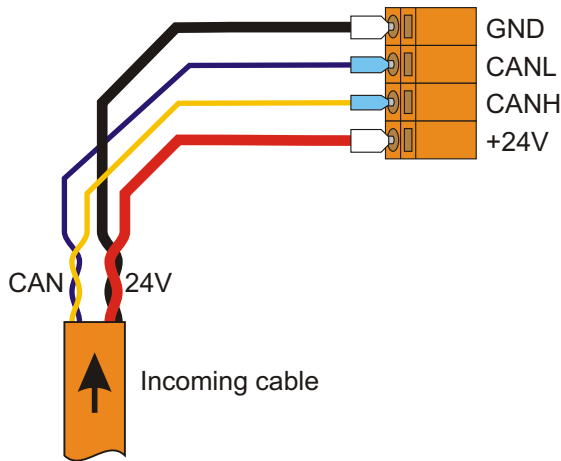
Figure 5: IEX-2 Cable Orange cross section.

### 4.2.3 Cable connections

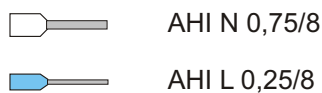
Special care must be taken when connecting IEX-2 bus to expansion devices to ensure working network. For this reason the use of conductor end sleeves is recommended. The following diagrams show the different end sleeves that must be used based on the cable used and whether connection is continuing or ended.

#### IEX-2 Network cable Orange

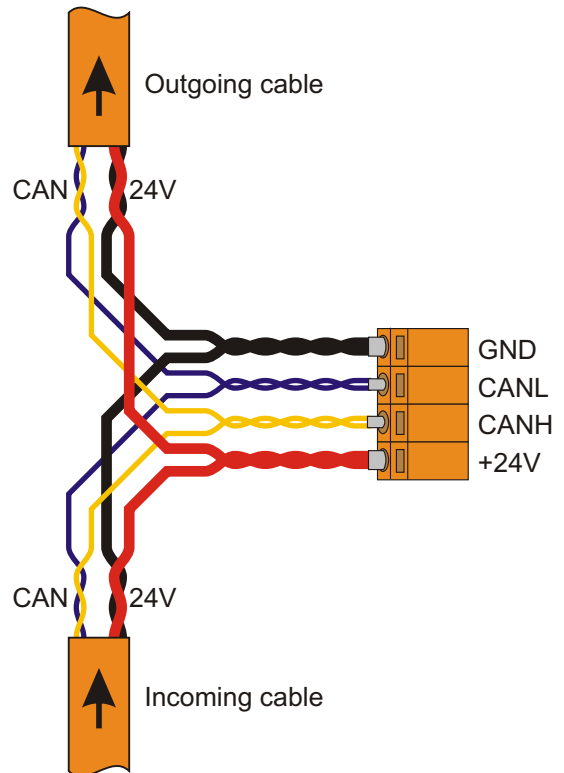
End connection



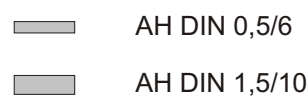
Insulated conductor end sleeves



Continuing connection



Non-insulated conductor end sleeves



For end connection isolated or uninsulated conductor end sleeves can be used. For continuing connection only uninsulated sleeves can be used.

Use appropriate crimping pliers when pressing end sleeves.

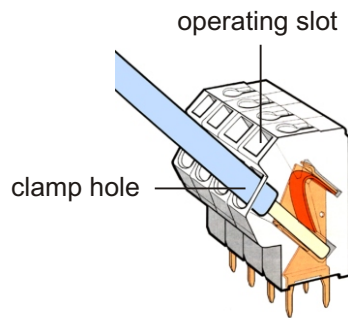


To reduce electromagnetic susceptibility, communication lines (CANH and CANL) should be twisted together, and also power lines (+24V and GND) should be twisted together.

#### 4.2.4 Push-wire handling

To ensure specified network functionality, good cable insertion must be performed at each device connected to the network.

All expansion devices use push-wire clamps for connection of IEX-2 bus. To not damage clamps use of special screwdriver is recommended (Order code: CAD-SCREW).



##### Solid wire insertion

1. Push wire in the clamp hole

##### Stranded wire insertion

1. Push screwdriver in the operating slot
2. Insert wire in the clamp hole

##### Solid/stranded wire removal

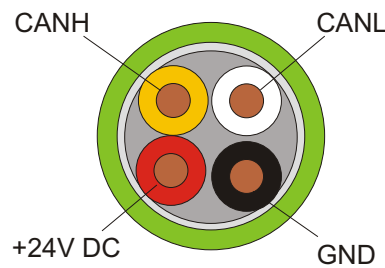
1. Push screwdriver in the operating slot
2. Remove wire

## 5 Appendix

### EIB BUS cable

Instead of original IEX-2 cable use of EIB cable (J-Y(ST)Y 2x2x0,8mm according to DIN VDE 0815) is also possible. Due to different cross-section of wires special care must be taken when designing topology to make sure that all devices are sufficiently powered (see chapter 3.1).

Maximum cable length is reduced by approximately 1/3 in comparison to allowed length of CAD-TP2X2 specified in chapter 4.2.1.



**Figure 6:** IEX-2 Cable Green cross section.

Cable is composed of solid wires and therefore does not requires the use of end sleeves but it is still recommended to use sleeves when connecting incoming and outgoing line to a clamp. If not extra care must be taken to make sure that wires are firmly hold by the clamp.

