

CAN Repeater

CAN-CR200, CAN-CR220, CAN-CR210/FO

USER MANUAL

4.01.0067.20000 3.4 en-US ENGLISH



Important User Information

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1 User Guide

Please read the manual carefully. Make sure you fully understand the manual before using the product.

1.1 Target Audience

This manual addresses trained personnel who are familiar with CAN and the applicable standards. The contents of the manual must be made available to any person authorized to use or operate the product.

1.2 Document History

Version	Date	Description
3.0	September 2017	Edited and released in new design
3.1	December 2017	Added technical information about CAN-CR210/FO
3.2	April 2019	Minor corrections
3.3	May 2019	Corrections CAN bit rate
3.4	July 2020	Added FO connector type to technical data, minor corrections

1.3 Trademark Information

Ixxat® is a registered trademark of HMS Industrial Networks. All other trademarks mentioned in this document are the property of their respective holders.

1.4 Conventions

Instructions and results are structured as follows:

- ▶ instruction 1
- ▶ instruction 2
 - result 1
 - result 2

Lists are structured as follows:

- item 1
- item 2

Bold typeface indicates interactive parts such as connectors and switches on the hardware, or menus and buttons in a graphical user interface.

```
This font is used to indicate program code and other
kinds of data input/output such as configuration scripts.
```

This is a cross-reference within this document: [Conventions, p. 4](#)

This is an external link (URL): www.hms-networks.com

Safety advice is structured as follows:



Cause of the hazard!



Consequences of not taking remediate action.

How to avoid the hazard.

Safety signs and signalwords are used dependent on the level of the hazard.



This is additional information which may facilitate installation and/or operation.



This instruction must be followed to avoid a risk of reduced functionality and/or damage to the equipment, or to avoid a network security risk.



Caution

This instruction must be followed to avoid a risk of personal injury.



WARNING

This instruction must be followed to avoid a risk of death or serious injury.

2 Safety Instructions

2.1 Information on EMC



Risk of interference to radio and television if used in office or home environment!

Make sure, that DIN rail is connected to ground.

Use exclusively included accessories. Use exclusively shielded cables.

Make sure, that the shield of CAN cable is connected with the D-Sub 9 and the plug on the other side.

If necessary, enlarge distance between source of interference (e.g. motors, frequency inverter) or drain of interference and device to avoid interference.

2.2 General Safety Instructions

- ▶ Protect product from moisture and humidity.
- ▶ Protect product from too high or too low temperature (see [Technical Data, p. 16](#)).
- ▶ Protect product from fire.
- ▶ Do not paint the product.
- ▶ Do not modify or disassemble the product. Service must be carried out by HMS Industrial Networks.
- ▶ Store products in dry and dust-free place.

2.3 Intended Use

The devices are used to establish a physical coupling of two or more segments of a CAN bus system. It is possible to implement tree or star topologies, as well as long drop lines. With a galvanically isolated repeater network segments can be electrically decoupled.

The devices cannot be used to extend a CAN system because in terms of signal the repeater corresponds to a line with delay time.

3 Scope of Delivery

Included in scope of delivery:

- CAN Repeater
- User Manual *CAN Repeater*
- 1 x power connector (mounted)

4 Product Description

CAN-CR200

- 2 x CAN interfaces according to ISO 11898-2, galvanically isolated
- additional CAN interface via DIN rail bus
- star topology possible by connecting several CAN-CR200 via DIN rail bus

CAN-CR210/FO

- 1 x CAN interface according to ISO 11898-2, galvanically isolated
- 1 x CAN interface with FO modules (ST or SMA connectors)
- compatible with multi mode fiber optic cables (only glass fiber optic cables)
- additional CAN interface via DIN rail bus
- star topology possible by connecting several CAN-CR210/FO via DIN rail bus

CAN-CR220

- 2 x CAN interfaces according to ISO 11898-2, galvanically isolated

5 Configuration

5.1 Opening the Housing

To operate the CAN repeater no software installation is required. The CAN repeater is configured via DIP switches. To set the DIP switches the housing must be opened.



Fig. 1 Opening the housing

- ▶ Use a screwdriver or similar tool to press the package locks (1) down.
→ Housing is unlocked.
- ▶ Pull the front part with the board out of the housing.
- ▶ Make sure, that the foil remains under the board.

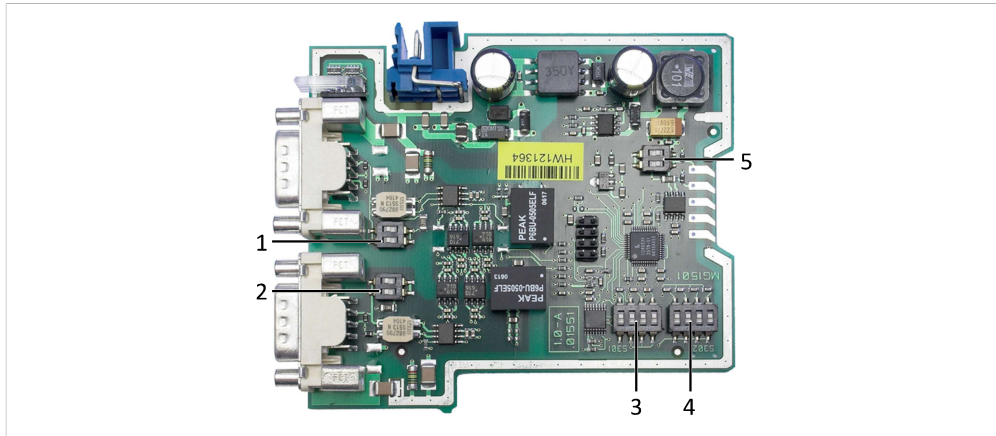


Fig. 2 DIP switches CAN-CR200

1	CAN 2 (CAN-CR200, CAN-CR220)
2	CAN 1
3	S301
4	S302
5	CAN 3 (CAN-CR200, CAN-CR210/FO)



The DIP switches of CAN-CR210/FO and CAN-CR220 are approximately at the same positions.

5.2 Configuring the Bus Termination Resistors



To avoid transmission issues, ensure correct bus termination!

Observe the following when configuring the bus termination resistors:

- ▶ Activate the bus termination resistors of every CAN circuit that is not connected.
- ▶ If one or two CAN repeater are used, activate the bus termination resistor of each CAN 3 circuit.
- ▶ If several CAN repeaters are used in a line, activate the bus termination resistors of CAN 3 of the first and the last CAN repeater in the network.
- ▶ Make sure, that the termination resistor value of the total network is about 60 Ohm (120 Ohm at both ends of the network).

The bus termination resistor for each CAN circuit can be activated and deactivated with the corresponding DIP switch.

- ▶ To activate the bus termination resistor, set both positions of the corresponding DIP switch to ON.
- ▶ To deactivate the bus termination resistor, set both positions of the corresponding DIP switch to OFF.

Default Configuration

CAN 1	CAN 2	CAN 3
OFF (deactivated)	OFF (deactivated)	ON (activated)

5.3 Configuring the Bit Rate

This setting is necessary, to allow the internal logic to detect dominant-lock states (dominant level on CAN bus exceeds the maximum allowed duration).

- ▶ Configure the bit rate of the CAN network with DIP switch **S301 (3)**.
- ▶ Only use one of the following valid combinations, to avoid malfunction of the CAN repeater.

Valid Bit Rate Combinations

S301-1	S301-2	S301-3	S301-4	Comment
ON	OFF	OFF	OFF	Bit rate between 5 kbit/s and 100 kbit/s
OFF	ON	OFF	OFF	Bit rate between 100 kbit/s and 500 kbit/s
OFF	OFF	ON	OFF	Bit rate equal or above 500 kbit/s (default)

5.4 Configuring the Lock Time

The CAN transceiver transmits data and receives these transmitted data again after a certain delay, the so-called loop delay. For example, if the transceiver transmits a dominant bit and after that a recessive bit, the transceiver only sees the recessive bit in its receive output after the loop delay. The size of the loop delay depends on several factors, like for example the number of CAN nodes in the network. The higher the capacity load is, the higher is the loop delay. To avoid bit errors caused by this delay, the configured lock time must be higher than the loop delay.

- ▶ Observe, that the setting depends on the bit rate and the capacitive load of the network (the higher the capacity load, the higher the value).
- ▶ Configure the lock time with DIP switch **S302 (4)**.
- ▶ Observe the following reference values:
 - for networks with less than 32 nodes the minimum lock time is about 300 ns
 - for networks between 32 and 64 nodes the minimum lock time is about 500 ns
 - for networks with more than 64 nodes the minimum lock time is about 1 μ s and with this setting the bit rate is limited to maximal 500 kbit/s

Valid Lock Time Combinations

S302-1	S302-2	S302-3	S302-4	Lock time in ns (tolerance ± 10 %)
OFF	OFF	OFF	OFF	100
OFF	OFF	OFF	ON	300 (default)
OFF	OFF	ON	OFF	500
OFF	OFF	ON	ON	800
OFF	ON	OFF	OFF	1000
OFF	ON	OFF	ON	1300
OFF	ON	ON	OFF	1500
OFF	ON	ON	ON	1800
ON	OFF	OFF	OFF	2000
ON	OFF	OFF	ON	2300
ON	OFF	ON	OFF	2500
ON	OFF	ON	ON	2800
ON	ON	OFF	OFF	3000
ON	ON	OFF	ON	3300
ON	ON	ON	OFF	3500
ON	ON	ON	ON	3800

6 Installation

6.1 Mounting the Device

Before mounting the device, make sure the following settings are configured:

- bus termination (see [Configuring the Bus Termination Resistors, p. 8](#))
- bit rate (see [Configuring the Bit Rate, p. 8](#))
- lock time (see [Configuring the Lock Time, p. 9](#))

6.1.1 Mounting a Single Device

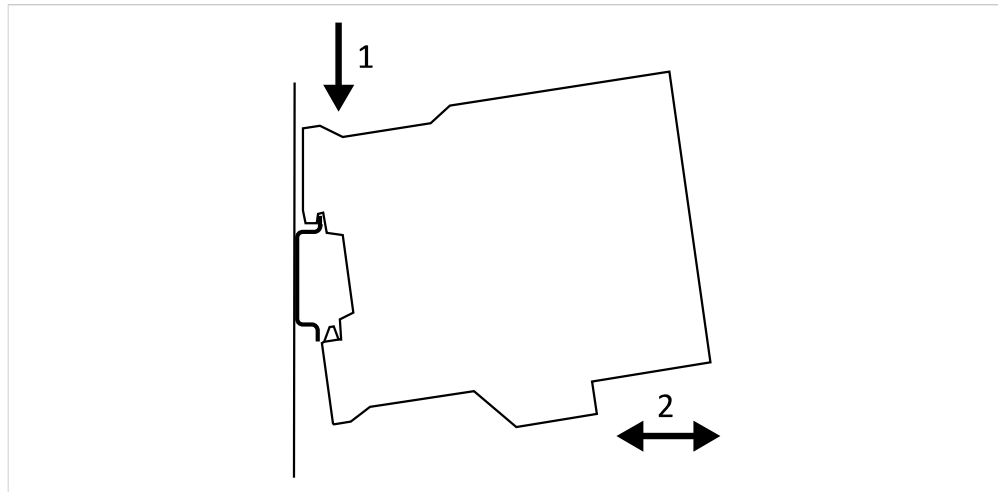


Fig. 3 Mounting on DIN rail

- ▶ Make sure, that the device is not connected to power supply.
- ▶ Hook the device onto the upper lip of the rail and push downwards (1).
- ▶ Push the device towards the rail until it snaps into place (2).

6.1.2 Connecting Several Devices



Allocation of the DIN rail bus extension is HMS specific!
Other than HMS devices may be damaged.
Connect only HMS devices to the HMS TBUS plug.

CAN-CR200 and CAN-CR210/FO support a DIN rail bus extension. With this the device can be connected to other CAN-CR200 devices or CAN-CR210/FO devices. It is possible to realize a star topology with up to 240 CAN connections.

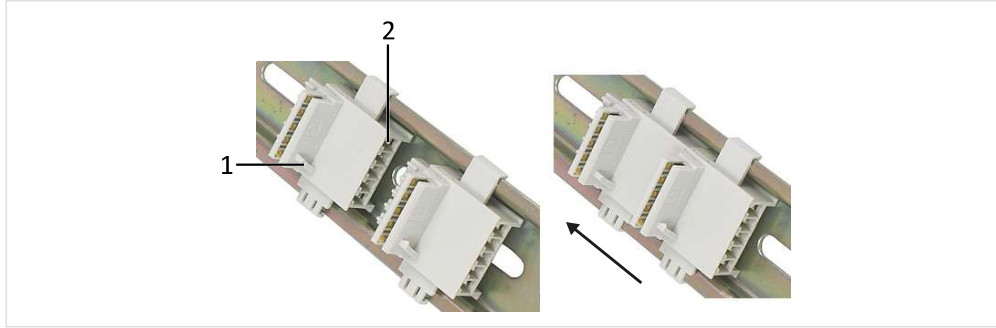


Fig. 4 Mounting the TBUS

1	Guide bar
2	Pin 1

Pin Allocation TBUS	
Pin no.	Signal
1	CAN high
2	CAN low
3	GND
4	—
5	—

- ▶ Make sure, that the device is not connected to power supply.
- ▶ Observe the guide bar (1) and mount the TBUS plug on the DIN rail according to the desired device installation position (in Fig. 4 the power connector of the CAN Repeater is above).
- ▶ To connect two TBUS plugs, mount the plugs on the DIN rail and move the plugs together on the DIN rail.
- ▶ Mount the TBUS connector (3) of the device on the TBUS plug.
- ▶ Make sure, that the guide bar of the TBUS plug (1) mates into the guide bar slot (4) on the device.



Fig. 5 TBUS connector

3	TBUS connector
4	Guide bar slot

6.2 Connectors

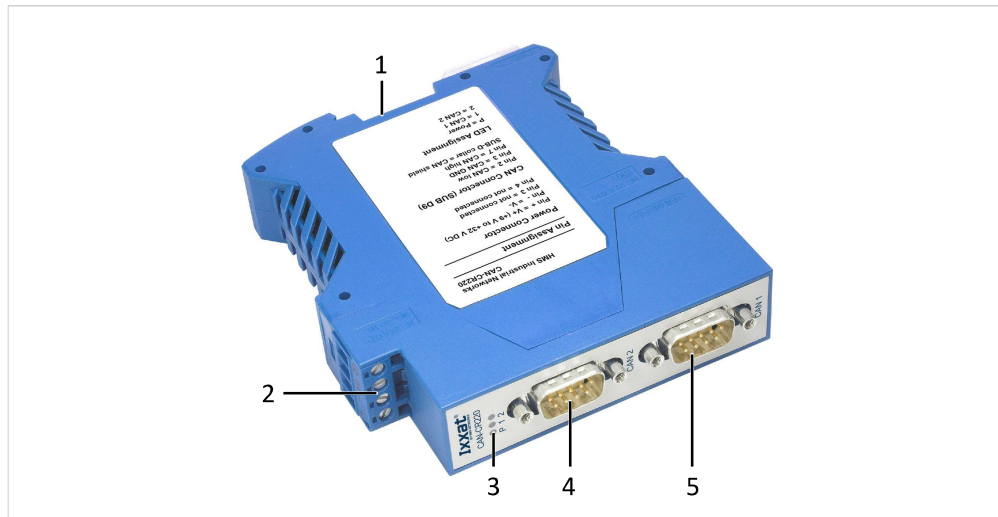


Fig. 6 Connectors

1	CAN 3
2	Power
3	LED array
4	CAN 2
5	CAN 1

6.2.1 Power Connector

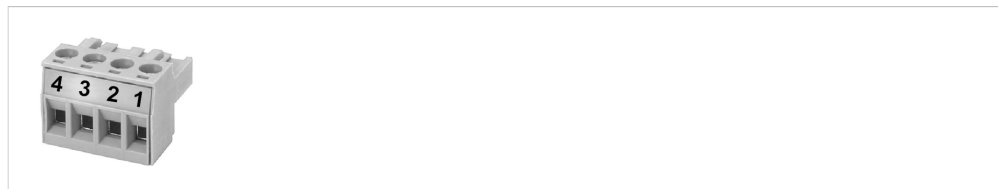


Fig. 7 Power connector

Pin no.	Signal
1 (+)	+9 V to +32 V DC
2 (-)	0 V
3	—
4	—

- ▶ Make sure, that the cross-sectional area of the cable is between 0.2 mm² and 2.5 mm².
- ▶ To remove the connector use a screwdriver or similar tool.
- ▶ Connect the cables.
- ▶ Plug the connector into the housing.

6.2.2 CAN Connector (D-Sub 9)

Pin no.	Signal
1	—
2	CAN low
3	CAN GND
4	—
5	—
6	—
7	CAN high
8	—
9	—

CAN Shield and CAN GND are connected via a 1 MΩ resistor and a 10 nF capacitor. CAN1 Shield and CAN2 Shield are not connected. The ground of the device is connected to the DIN rail via a RC element (1 MΩ resistor and a 10 nF capacitor). CAN Shield is connected to the PE via a 4.7 nF (CR220) respectively a 10 nF (CR200 and CR210/FO) capacitor.

Because of the higher galvanic isolation the circuit of CAN-CR220 differs from the circuit of CAN-CR200 and CAN-CR210/FO.

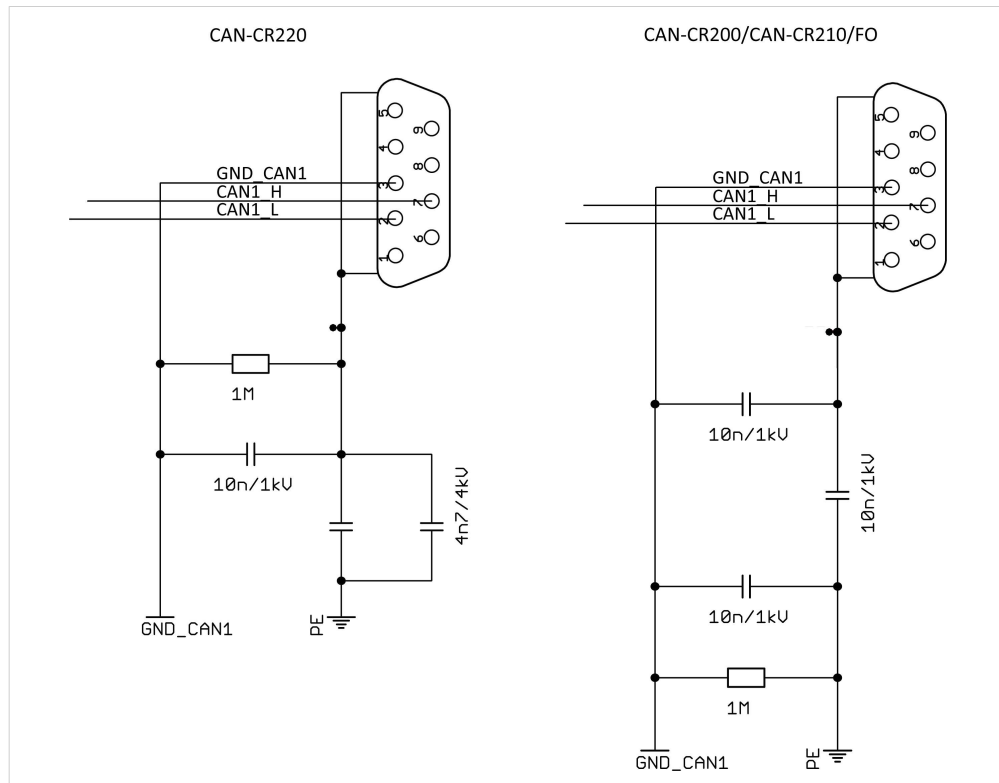


Fig. 8 Circuit diagram



For best noise immunity, ground the shields of the CAN cables.

7 Operation

7.1 LEDs

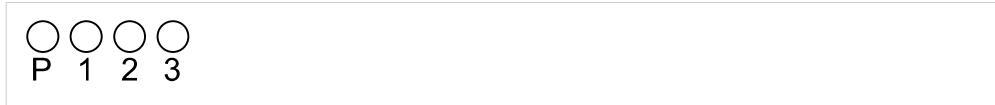


Fig. 9 LED array



CAN-CR220 has only LED P and CAN LED 1 and 2.

7.1.1 Power LED

Power LED **P** indicates the status of the power supply.

LED state	Description	Comments
Off	No power	Device not connected to power supply, or fuses of device or internal power supply damaged
Green	Power ok	Device fully functional
Red	Device is reset	After power-up the device is set into reset, LEDs are red during reset (normal duration: about 200 ms). Or power supply is damaged, internal voltage is below necessary level.

7.1.2 CAN LEDs

CAN LEDs **1**, **2** and **3** indicate the status of the CAN connection.

LED state	Description	Comments
Off	No CAN communication	No CAN communication, device not connected to CAN
Green or green flashing	CAN communication	LED is triggered when a dominant bit is transmitted to the respective CAN port.
Red flashing	CAN communication, but errors	Each CAN circuit transmits and reads back the transmitted bits. An error occurs, if the repeater transmits a dominant bit, but measures a recessive bit.
Red	Dominant-lock	External device applies a permanent dominant level to the CAN.

8 Additional Components

8.1 CAN Bus Termination Resistor

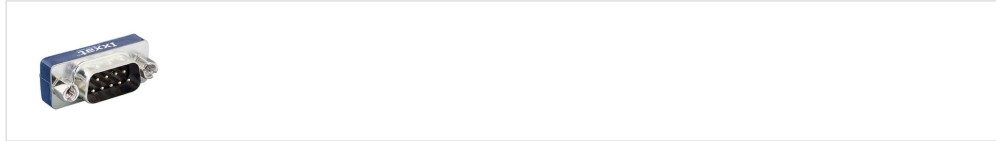


Fig. 10 CAN bus termination resistor

HMS Industrial Networks offers a bus termination resistor as a feed through connector.

8.2 TBUS Plug

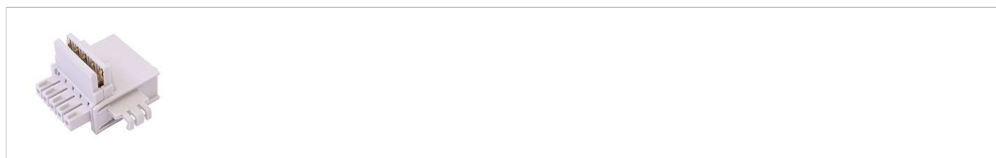


Fig. 11 TBUS

HMS Industrial Networks offers a TBUS plug to connect with other HMS devices supporting the DIN rail bus (e.g. CAN-CR200, CAN-CR210/FO).

8.3 Glass Fiber Cable

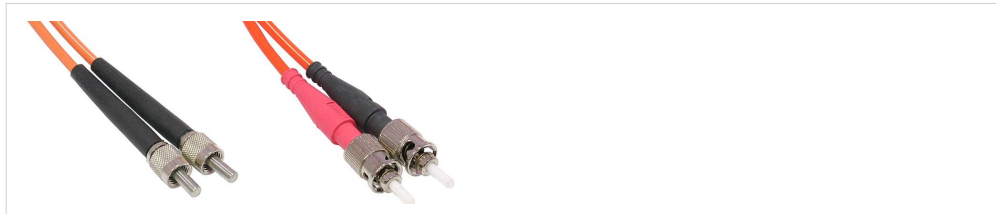


Fig. 12 Glass fiber cables FSMA and ST

HMS Industrial Networks offers cable assemblies (FSMA, ST) in various lengths to connect two CAN-CR210/FO.

9 Technical Data

Weight	Approx. 300 g
Operating temperature	-20 °C to +70 °C
Storage temperature	-40 °C to + 85 °C
Power supply	+9 V to +32 V DC
Housing material	Polyamid
CAN transceiver	Texas Instruments SN65HVD251
Max. number of bus nodes	120
CAN bus termination resistor	120 Ohm switchable via DIP switch
CAN bit rate	1 Mbit/s
Protection class	IP30
Relative humidity	10 to 95 %, non-condensing

CAN-CR200	
Dimensions	22.5 x 100 x 118 mm
Current consumption at 24 V	Typ. 41 mA, max. 100 mA
Galvanic isolation	1 kV DC/1 sec, 500 V AC/1 min CAN 1, CAN 2 and backbone bus galvanically isolated against each other
CAN propagation delay (typical)	Typ. 200 ns (40 m bus length)

CAN-CR220	
Dimensions	22.5 x 100 x 118 mm
Current consumption at 24 V	Typ. 41 mA, max. 100 mA
Galvanic isolation	CAN 1, CAN 2 and power supply galvanically isolated against each other 1.01.0067.44400: 2 kV AC/1 min, 3.5 kV AC/1 sec, 3.2 kV DC/1 min, 4 kV DC/1 sec 1.01.0067.44300: 3.75 kV AC/1 min, 4 kV AC/1 sec, 4 kV DC/1 min, 4 kV DC/1 sec
CAN propagation delay (typical)	Typ. 175 ns (35 m bus length)

CAN-CR210/FO	
Dimensions	22.5 x 100 x 120 mm
Current consumption at 24 V	Typ. 62 mA, max. 100 mA
Galvanic isolation	1 kV DC/1 sec, CAN 1 500 V AC/1 min
CAN propagation delay (typical)	Typ. 300 ns (60 m bus length) between wire connection of a FO Repeater through the fiber optic cable to the wire connection of a second FO Repeater (not including the signal delay time of the fiber optics: approx. 5 ns/m)
FO transmitter	Broadcom HFBR 1404Z, 820 nm
FO receiver	Broadcom HFBR 2402Z, 820 nm
FO connector	F-SMA or ST connector
FO line	Multi mode fiber optic cables (only glass); Recommended: 50/125 µm, 62.5/125 µm, also compatible with: 100/140 µm, 200 µm (consider max. line length)
Maximal line length between two FO repeaters	50/125 µm: 1500 m 62.5/125 µm: 2000 m

10 Support/Return Hardware

10.1 Support

- ▶ For problems or support with the product request support at www.ixxat.com/support.
- ▶ If required use support phone contacts on www.ixxat.com.

10.2 Return Hardware

- ▶ Fill in the form for warranty claims and repair on www.ixxat.com/support/product-returns.
- ▶ Print out the Product Return Number (PRN resp. RMA).
- ▶ Pack product in a physically- and ESD-safe way, use original packaging if possible.
- ▶ Enclose PRN number.
- ▶ Observe further notes on www.ixxat.com.
- ▶ Return hardware.

11 Disposal

- ▶ Dispose of product according to national laws and regulations.
- ▶ Observe further notes about disposal of products on www.ixxat.com.

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A Regulatory Compliance

A.1 EMC Compliance (CE)



The product is in compliance with the Electromagnetic Compatibility Directive. More information and the Declaration of Conformity is found at www.ixxat.com.

A.2 FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Product name	CAN Repeater
Model	CAN-CR200/CAN-CR220/CAN-CR210/FO
Responsible party	HMS Industrial Networks Inc
Address	35 E. Wacker Dr, Suite 1700 Chicago , IL 60601
Phone	+1 312 829 0601



Any changes or modifications not expressly approved by HMS Industrial Networks could void the user's authority to operate the equipment.



This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

A.3 RoHs Directive

The product is in compliance with the RoHs Directive 2002/95/EC (Restriction of the use of certain hazardous substances in electrical and electronic equipment).

A.4 Disposal and recycling



You must dispose of this product properly according to local laws and regulations. Because this product contains electronic components, it must be disposed of separately from household waste. When this product reaches its end of life, contact local authorities to learn about disposal and recycling options, or simply drop it off at your local HMS office or return it to HMS.

For more information, see www.hms-networks.com.

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