Ixxat®
BY HMS NETWORKS

USB-to-CAN FD

Compact | Embedded | Automotive | PCIe Mini

USER MANUAL

4.01.0350.20000 1.6 en-US ENGLISH

HMS Connecting Devices™

Important User Information

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The data, examples and illustrations found in this document are included for illustrative purposes and are only intended to help improve understanding of the functionality and handling of the product. In view of the wide range of possible applications of the product, and because of the many variables and requirements associated with any particular implementation, HMS Networks cannot assume responsibility or liability for actual use based on the data, examples or illustrations included in this document nor for any damages incurred during installation of the product. Those responsible for the use of the product must acquire sufficient knowledge in order to ensure that the product is used correctly in their specific application and that the application meets all performance and safety requirements including any applicable laws, regulations, codes and standards. Further, HMS Networks will under no circumstances assume liability or responsibility for any problems that may arise as a result from the use of undocumented features or functional side effects found outside the documented scope of the product. The effects caused by any direct or indirect use of such aspects of the product are undefined and may include e.g. compatibility issues and stability issues.

Table of Contents

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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, CAN FD, LIN and the applicable standards. Only ESD trained staff is authorized to install the interface. The contents of the manual must be made available to any person authorized to use or operate the product.

1.2 Related Documents

Document	Author
Installation Guide *VCI Driver*	HMS

1.3 Document History

Version	Date	Description
1.0	January 2017	First release
1.1	February 2017	Minor corrections, added FCC compliance statement and info about USB specification and extension cable
1.2	April 2018	Added trademark information, changes in chapter LIN interface
1.3	August 2018	Added information about resistor in LIN mode, target audience and intended use
1.4	June 2019	Layout changes
1.5	December 2019	Added PCIe Mini variant and support for ECI driver
1.6	December 2021	Added UKCA conformity information, adjusted CAN FD bit rates

1.4 Trademark Information

1.5 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

Risk of interference to radio and television if used in office or home environment! The product is a class B device.

Use exclusively included accessories or HMS accessories that are intended for use with the device. Use exclusively shielded cables.

Make sure that the shield of the interface is connected with the device plug and the plug on the other side.

2.1 General Safety Instructions

- Protect product from moisture and humidity.
- Protect product from too high or too low temperature (see *Technical Data, p. 19*).
- 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.

2.2 Intended Use

The interfaces are used to connect computer systems to CAN, CAN-FD and LIN networks. USB-to-CAN^{FD} Embedded and PCIe Mini are intended for installation in computer systems with closed housing. The USB-to-CAN^{FD} Compact and Automotive are intended for the connection to a computer via the USB interface.

3 Scope of Delivery

Included in the scope of delivery:

- USB-to-CAN^{FD} interface
- only variant automotive: 2 x RJ45 to D-Sub 9 adapter cable
- only variant embedded: slot bracket and internal USB cable
- only variant PCIe Mini: JST open-style cable for CAN and LIN
- CD with VCI driver, programming examples, canAnalyser and software design guide
- *VCI Driver* Installation Guide
- *USB-to-CAN^{FD}* User Manual

The following equipment can be ordered separately:

- CAN bus termination
- RJ45 to D-Sub 9 adapter cable
- ECI driver for Linux

4 Product Description

The USB-to-CAN^{FD} is an active USB interface which enables the user to monitor and control up to two ISO CAN FD or non-ISO CAN FD or CAN High Speed channels and a LIN channel, depending on the variant.

4.1 USB-to-CAN^{FD} Compact/Embedded

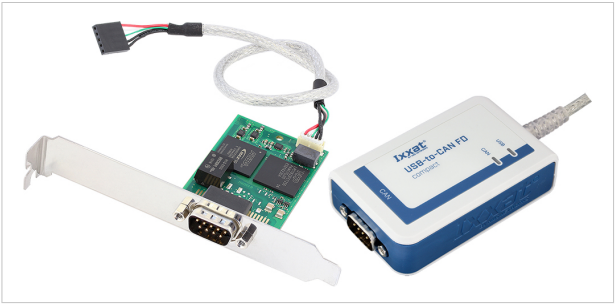


Fig. 1 USB-to-CAN^{FD} embedded and compact (D-Sub 9)

- USB 2.0 Hi-Speed (480 MBit/s)
- 1 x CAN FD interface with three operation modes:
  - ISO CAN FD according ISO 11898-1: 2015
  - non-ISO CAN FD
  - CAN high-speed according ISO 11898-2: 2016
- galvanic CAN bus isolation
- fieldbus connection:
  - compact: D-Sub 9 or RJ45
  - embedded: D-Sub 9
- variant embedded: slot bracket and internal USB cable

4.2 USB-to-CAN^{FD} Automotive

Fig. 2 USB-to-CAN^{FD} automotive

- USB 2.0 Hi-Speed (480 MBit/s)
- 2 x CAN FD interface with three operation modes:
  - ISO CAN FD according ISO 11898-1: 2015
  - non-ISO CAN FD
  - CAN high-speed according ISO 11898-2: 2016

  Operation mode can be set for each port individually.
- 1 x LIN interface V1.3 and V2.0/2.1, Master/Slave mode and LIN frame format switchable via software
- galvanic fieldbus isolation (all fieldbus channels are on the same potential)
- fieldbus connection: 2 x RJ45
- 2 x RJ45 to D-Sub 9 adapter cable

4.3 USB-to-CAN^{FD} PCIe Mini

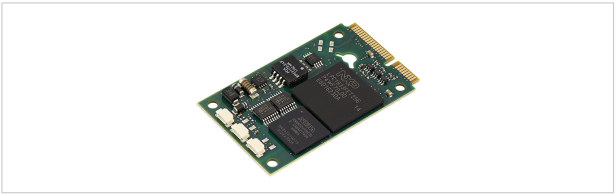


Fig. 3 USB-to-CAN^{FD} PCIe Mini

- USB 2.0 Hi-Speed (480 MBit/s) via PCIe Mini (if supported by computer in use)
- galvanic CAN bus isolation
- CAN FD interface with three operation modes:
  - ISO CAN FD according ISO 11898-1: 2015
  - non-ISO CAN FD
  - CAN high-speed according ISO 11898-2: 2016

  Operation mode can be set for each port individually.
- LIN interface V1.3 and V2.0/2.1, Master/Slave mode and LIN frame format switchable via software

The USB-to-CAN^{FD} PCIe Mini is available in two variants:

- 2 x CAN FD interface and 1 x LIN interface
- 1 x CAN FD interface

5 Installation

5.1 Installing the Software

> **!** For the operation of the interface a driver is needed.
> The USB-to-CAN^{FD} is only supported by VCI V4 or newer.

Windows

► Install the VCI driver (see Installation Guide *VCI Driver*).

Linux and Real-Time Operating Systems

► Observe information about supported operating systems and interfaces on www.ixxat.com.

5.2 Installing the Hardware

5.2.1 Connecting USB

> **!** Connection disturbance possible if extension cable or longer cable is used!
>
> HMS recommends connecting the interface directly with the included cable or via an active USB hub to the computer according to the USB specification.

> **!** Insufficient power supply!
>
> Connect the interface directly to the computer or to self-powered hubs to ensure sufficient power supply.

The shield of the USB cable is connected to ground using a 100 nF capacitor. The shield of the CAN connector is connected to CAN ground via a 1 MΩ resistor and a 10 nF capacitor. The shields of the CAN connectors of the variant *automotive* are connected directly together.

USB-to-CAN^{FD} Compact/Automotive

Connector:

- USB cable with plug type A
- Assignment corresponds to USB 2.0 standard.

► Make sure that the VCI driver is installed.

► Plug the USB connector in the USB port of the computer.

→ Windows automatically finds and installs the hardware.

→ USB LED is green.

> **i** *USB interface supports hot plug!*
>
> *It is possible to plug or unplug the device during operation.*

USB-to-CAN^{FD} Embedded

> **!** Risk of ESD damages caused by improper handling!
>
> Use ESD protective measures to avoid equipment damage.

> **!** Damage of the equipment because of reverse polarity or wrong type of power supply!
>
> Make sure that the power supply is correctly connected and of recommend type.

Connector:

- USB cable with 5 pin female connector
- Assignment corresponds to PC standard for internal USB devices.

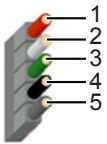


Fig. 4 Standard wire assignments 1x5 header connector female

1	Red: +5 V/voltage +/VCC
2	White: D-/data-/USB-
3	Green: D+/data+/USB+
4	Black: GND/voltage-/ground
5	Black: S-GND/over current/shielding

- ► Make sure that the driver is installed.
- ► Turn off the computer.
- ► Pull the power cord.
- ► Open the computer case according to the instructions of the computer manufacturer.
- ► Mount the slot bracket with embedded board in suitable slot.
- ► Plug the small plug of the USB cable in the USB connector of the embedded board.
- ► Plug the USB connector in the suitable connector on the computer main board.
- ► Close the computer case.

  → Hardware installation is complete.

USB-to-CAN^{FD} PCIe Mini

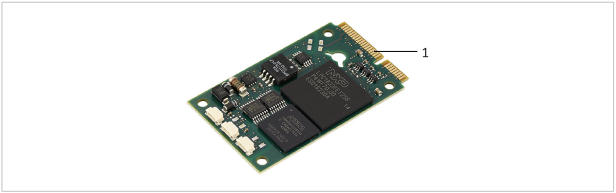


Fig. 5 PCIe connector

- Make sure that the computer in use supports USB via PCIe Mini.
- Make sure that the driver is installed.
- Turn off the computer.
- Pull the power cord.
- Open the computer case according to the instructions of the computer manufacturer.
- Determine the corresponding slot.
- Plug the PCIe connector (**1**) in the corresponding slot, without using force.
- Make sure that the interface is securely held in the computer.
- Close the computer case.

  → Hardware installation is complete.

5.2.2 Connecting the CAN Fieldbus

The assignment of the fieldbus connectors (D-Sub 9 and RJ45) is in accordance to CiA 303-1.

The shield of the CAN connector is connected to CAN ground via a 1 MΩ resistor and a 10 nF capacitor. The shields of the CAN connectors of the variant *automotive* are connected directly together.

For best noise immunity connect shields of the CAN cables directly to the device ground.

USB-to-CAN^{FD} Compact/Embedded

Pin Allocation		
	Pin No.	
Signal	**RJ45**	**D-Sub 9**
CAN high	1	7
CAN low	2	2
CAN GND	3, 7	3, 6

USB-to-CAN^{FD} Automotive

Pin Allocation			
	RJ45, Pin No.		Adapter cable
Signal	**CAN 1**	**CAN 2/LIN**	**D-Sub 9, Pin No.**
CAN high	1	1	7
CAN low	2	2	2
CAN GND	3, 7	3, 7	3, 6
LIN	-	6	5
$VBAT_{LIN}$	-	8	9

USB-to-CAN^{FD} PCIe Mini

The CAN connector type is SM03B-SURS-TF by JST. The counterpart is 03SUR-32S by JST. A pre-assembled open-style cable for each CAN and LIN connector is included.

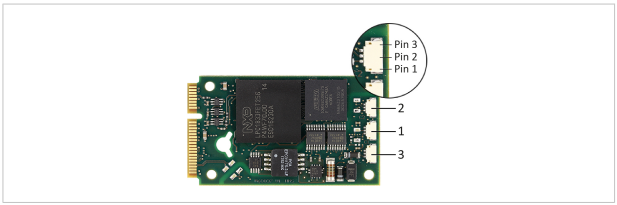


Fig. 6 Connectors

1	CAN 1
2	CAN 2 (only supported in variant with 2 x CAN FD and LIN)
3	LIN (only supported in variant with 2 x CAN FD and LIN)

Pin Allocation PCIe Mini CAN FD Interface 1/2		
Signal	**Pin No.**	**Color**
CAN high	1	Red
CAN low	2	Yellow
CAN GND	3	Black

Pin Allocation PCIe Mini LIN Interface 3		
Signal	**Pin No.**	**Color**
$VBAT_{LIN}$	1	Red
LIN	2	Yellow
LIN GND	3	Black

Connecting the Fieldbus

- If necessary install bus termination (see *CAN Bus Termination, p. 18*).
- Observe the pin allocation.
- Connect the CAN fieldbus connector to the CAN fieldbus.
- Start canAnalyser on the computer.
- In canAnalyser adjust the USB-to-CAN^{FD} properties according to fieldbus characteristics:

> **!** Devices which only support CAN 2.0 (CAN high-speed) destroy CAN FD telegrams!
>
> Only use CAN FD format in networks purely using CAN FD devices or with CAN 2.0 devices unplugged or switched to standby.

  - To activate CAN FD, activate the checkbox **Use CAN FD format**.
  - To use ISO CAN FD frames, activate the checkbox **Use ISO conform frame**.
  - To use non-ISO CAN FD frames, deactivate the checkbox **Use ISO conform frame**.

> **!** ISO CAN FD frames and non-ISO CAN FD frames are incompatible!
>
> Use either ISO CAN FD or non-ISO CAN FD in the fieldbus network.

– Select predefined CAN FD bitrate in drop-down list **Bitrate**.

With a predefined CAN FD bitrate the CAN FD standard bit timing and the CAN FD fast bit timing are specified and bit rate switching is enabled.

- Define the CAN messages to be transmitted in the transmit window of the canAnalyser.
- To transmit CAN messages with flexible data rate, activate the boxes **FDF** and **Fast**.
- Start canAnalyser communication.
  - → Received CAN messages are shown in the receive window of the canAnalyser.
  - → CAN LED is green flashing with each CAN message.

5.2.3 Connecting the LIN Fieldbus

LIN functionality is only available on USB-to-CAN^{FD} automotive variant and USB-to-CAN^{FD} PCIe Mini variant with LIN interface.

Power consumption is limited by a 1 kΩ resistor.

The LIN interface can receive and transmit LIN frames according to LIN specification V1.3 and V2.0/2.1. The LIN interface can be configured as LIN master.

A 1 kΩ pull-up resistor is automatically activated in LIN Master mode and automatically deactivated in LIN Slave mode. External pull-up resistors are not necessary.

- To use the LIN interface connect a voltage of 12 V DC (voltage range see *Technical Data, p. 19*) to pin $VBAT_{LIN}$ (see *Pin Allocation , p. 13* or *Pin Allocation PCIe Mini LIN Interface 3, p. 14*).

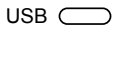
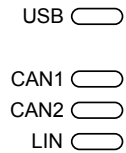
To ensure successful transmission of LIN messages:

- Connect the external voltage before LIN messages are transmitted.
- Make sure, that the external voltage is not switched off and on during operating in LIN mode.

6 Operation

The implemented LEDs vary dependent on the variant of the USB-to-CAN^{FD}. The PCIe Mini has no LEDs.

LED Arrays of the Different Variants

Compact	Automotive
	

6.1 USB LED

The USB LED reflects the status of the USB communication.

LED state	Description	Comments
Off	No communication	Device not initialized, check power supply. Device not connected to USB port.
Green	Communication possible	Device is ready for use.
Red flashing	State changes between *power saving* and *active*	Changing power state.

6.2 CAN LED

The CAN LEDs reflect the status of the CAN communication (CAN 1 and CAN 2).

LED state	Description	Comments
Off	No communication	No communication, device not connected to CAN
Green flashing	Communication present	LED is triggered with each message.
Red flashing	Controller in error state	Controller is in state error warning or state error passive, communication is possible.
Red	Bus off	Controller is in state bus off, no communication possible.

6.3 LIN LED

LIN functionality is exclusively available on USB-to-CAN^{FD} automotive.

LED state	Description	Comments
Off	No communication	No communication on LIN bus or device not connected to LIN bus.
Green flashing	Communication present	LED is triggered with each message.
Red flashing	Communication with errors	On transmission or reception of a LIN message an error was detected.

7 Additional Components

7.1 CAN Bus Termination

In the interface is no bus termination resistor for the CAN bus integrated. HMS Industrial Networks offers a bus termination resistor as a feed through connector.

Fig. 7 CAN bus termination resistor

- For ordering information see www.ixxat.com.

7.2 Adapter Cable

HMS Industrial Networks offers a RJ45 to D-Sub 9 adapter cable.

Fig. 8 Adapter cable

- For ordering information see www.ixxat.com.

8 Technical Data

8.1 Compact/Embedded/Automotive

USB interface	USB 2.0, Hi-Speed (480 MBit/s)
Microcontroller/RAM/ Flash	32 Bit/192 kByte/512 kByte
CAN controller/clock frequency	IFI CAN_FD IP/80 MHz
CAN bit rates	10 kbit/s to 1 Mbit/s
CAN FD bit rates	Arbitration rate: up to 1000 kbit/s, data rate: up to 8000 kbit/s (verified by testing) User defined bit rates are possible. Depending on the operating conditions (cable length, settings made, remote stations, etc.) the maximum data might not be reached or exceeded.
CAN bus termination	None
LIN bit rates	Max. 20 kbit/s
$VBAT_{LIN}$	8 to 18 V DC, 12 V DC typical
Dimensions	80 x 50 x 22 mm
CPU clock	180 MHz
Weight	Approx. 100 g
Power supply	Via USB, 5 V DC/300 mA
Galvanic isolation	800 V DC/500 V AC for 1 min
Operating temperature	-20 to +70 °C
Storage temperature	-40 to +80 °C
Relative humidity	10 to 95 %, non condensing
Housing material (compact/automotive)	ABS plastic
Protection class (compact/automotive)	IP40

8.2 PCIe Mini

USB interface	USB 2.0, Hi-Speed (480 MBit/s) via PCIe Mini connector
Form factor	F2: Full Mini with bottom-side keep outs According to PCI Express Mini Card Electromechanical Specification, Revision 1.2
CAN/LIN connector type	SM03B-SURS-TF by JST (counterpart is 03SUR-32S by JST) Pre-assembled open-style cable for each CAN and LIN connector is included.
Microcontroller/RAM/ Flash	32 Bit/192 kByte/512 kByte
CAN bit rates	10 kbit/s to 1 Mbit/s
CAN FD bit rates	Arbitration rate: up to 1000 kbit/s, data rate: up to 8000 kbit/s (verified by testing) User defined bit rates are possible. Depending on the operating conditions (cable length, settings made, remote stations, etc.) the maximum data might not be reached or exceeded.
CAN controller/clock frequency	IFI CAN_FD IP/80 MHz
CAN/CAN FD transceiver	Texas Instruments TCAN334G
LIN bitrates	Max. 20 kbit/s
LIN transceiver	Microchip MCP2003B
$VBAT_{LIN}$	8–36 V DC, typ. 12 V DC
CPU clock	72 MHz
Dimensions	50.95 x 30 mm
Power supply	Via PCIe Mini, 3.3 V DC/300 mA
Operating temperature	-20 to +70 °C
Storage temperature	-40 to +80 °C
Relative humidity	10 to 95 %, non condensing
Galvanic isolation	500 V AC for 1 minute between CAN bus and internal logic

9 Troubleshooting

USB LED is off after installation.	
No communication	► Make sure that the device is correctly connected to the USB port. ► Check the power supply. ► Make sure that device and driver are correctly initialized. ► Make sure that the correct driver version is installed (VCI V4 or higher).
USB LED is red.	
No appropriate USB driver is installed.	► Check if the correct VCI driver version is installed.
Device is not working.	
Adapter cable is not according to specification.	► Use an adapter cable according to the specification.
USB extension cable is used.	► Remove the USB extension cable. ► According to the USB specification connect the interface directly or via an active USB hub to the computer.
Device is not initialized.	► Initialize the device with canAnalyser (see *Connecting the CAN Fieldbus, p. 12*).
Device is attached via non-self powered USB hub.	► Only use USB 2.0 hi-speed hubs with separate power supply.

10 Cleaning

- ► Disconnect the device from the power supply.
- ► Remove dirt with a soft, chemical untreated, dry cloth.

11 Support/Return Hardware

11.1 Support

- To contact support, go to www.ixxat.com/technical-support/contact-technical-support.
- Scroll down and click button **mysupport.hms.se** to register a support case.

11.2 Return Hardware

- On www.ixxat.com/support/product-returns click button **Portal** to access the support portal.
- In the support portal select **Submit Product Return (RMA)**.
- Read the information and click **Create RMA Case**.
- Register a support account and sign in.
- Fill in the form for warranty claims and repair.
- 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.

12 Disposal

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

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 EMC Compliance (UKCA)

The product is in compliance with the Electromagnetic Compatibility Regulations 2016. The Declaration of Conformity is available at www.ixxat.com

A.3 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	USB-to-CAN^{FD}
Model	Compact/Automotive/Embedded/PCIe Mini
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 B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and the receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

Changes and Modifications not expressly approved by the manufacturer or registrant of this equipment can void your authority to operate this equipment under FCC rules.

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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