

Kvaser U100S-X3 User's Guide



Copyright 2020-2024 Kvaser AB, Mölndal, Sweden
<https://www.kvaser.com>

Printed Sunday 18th February, 2024

We believe that the information contained herein was accurate in all respects at the time of printing. Kvaser AB cannot, however, assume any responsibility for errors or omissions in this text. Also note that the information in this document is subject to change without notice and should not be construed as a commitment by Kvaser AB.

(This page is intentionally left blank.)

Contents

1	About this manual	4
2	Introduction	5
2.1	Welcome to Kvaser U100S-X3	5
2.2	Major features of Kvaser U100S-X3	6
3	Kvaser U100S-X3 hardware	7
3.1	Hardware installation	7
3.2	USB connection	7
3.3	Kvaser MagiSync	8
3.4	CAN connection	9
3.5	CAN bus termination	10
3.6	Power supply	10
3.7	LED Indicators	11
3.8	Interface mode	12
3.9	The t programming language	13
3.10	Restrictions in t functionality	14
3.11	Updating the firmware	16
3.12	Start and stop of t programs	16
3.13	Technical data	17
4	Troubleshooting	18
5	Safety Instructions	19
5.1	Intended Use	19
5.2	Usage Warning	19
6	Disposal and Recycling Information	20
7	Legal Acknowledgements	21
7.1	EU Regulatory Compliance	21
7.2	FCC Regulatory Compliance	22
7.3	Patents, Copyrights and Trademarks	23
8	Document Revision History	24

1 About this manual

This manual is intended for Kvaser U100S-X3 users. This document contains a description of the hardware's properties and general instructions for connecting the device to a computer.

2 Introduction

This section will describe the functions and features of the Kvaser U100S-X3.

2.1 Welcome to Kvaser U100S-X3



Figure 1: Kvaser U100S-X3

Kvaser U100S-X3 is a small, yet powerful, CAN to USB interface. It provides real-time transmission and reception of standard and extended CAN messages on the bus with a high timestamp precision, and is compatible with applications that use Kvaser's CANlib.

This guide applies to Kvaser U100S-X3 devices using at least firmware and driver versions listed in Table 1. For minimum compatible firmware and driver versions of Kvaser U100S-X3 see Table 7 on Page 16.

Device	Product Number	Firmware	Driver (Windows/Linux)
Kvaser U100S-X3	73-30130-01274-5	v3.25	v5.36 (kcany/mhydra)

Table 1: Firmware and driver versions needed to support all functionality present in this guide.

2.2 Major features of Kvaser U100S-X3

- USB CAN interface with Kvaser *t* programmability.
- Powered through the USB connector.
- Supports CAN FD, up to 8 Mbit/s (with correct physical layer implementation).
- Supports both 11-bit (CAN 2.0A) and 29-bit (CAN 2.0B active) identifiers.
- Supports silent mode for analysis tools – listen to the bus without interfering.
- Lightweight robust housing made of glass fibre reinforced polyamide overmolded with TPE.
- Intuitive LED UI.
- Reinforced galvanic isolation. Tested according to EN 60335-1:2012 paragraph 13 with 5000 VAC rms applied for 60 seconds.
- Industrial grade temperature range, -40°C to $+85^{\circ}\text{C}$.
- 20 000 msg/s, each timestamped with a resolution of 1 μs .
- Kvaser MagiSync – automatic time synchronization (see Section 3.3, Kvaser MagiSync, on Page 8 for more details).
- Fully compatible with applications written for other Kvaser CAN hardware with Kvaser CANlib.
- Support for SocketCAN.
- Fully compatible with J1939, CANopen, NMEA 2000[®] and DeviceNet.
- IP67 rated housing.

3 Kvaser U100S-X3 hardware

In this section you can read more about the CAN channels, power supply and LED indicators.

3.1 Hardware installation

The Kvaser U100S-X3 may be inserted in any free USB socket on the host computer. You do not need to switch the power off before inserting or removing the device. For the Kvaser U100S-X3 to communicate with the host computer, a compatible version of the Kvaser driver and firmware must be installed.

The driver is installed by running the file `kvaser_drivers_setup.exe`. For instructions on how to update the firmware, see Section 3.11, Updating the firmware, on Page 16. The latest version of the driver and firmware can be downloaded from www.kvaser.com/download.

The firmware is downloaded and installed directly on the Kvaser U100S-X3 and the driver is installed on the host computer. After the driver has been installed on the host computer, the firmware may then be downloaded and installed on the Kvaser U100S-X3.

3.2 USB connection

The USB connector for the Kvaser U100S-X3 is a standard USB type "A" connector (see Figure 2).



Figure 2: A standard USB type "A" connector.

Connect the device to your computer using any high quality USB 2.0 certified cable. The maximum total USB cable length is 5 m (~ 16 ft).



As USB cables become longer they are more sensitive to EMI, because they make a longer antenna that can pick up more noise. These issues can be mitigated by using higher quality cables with better shielding. Thicker cables tend to be better than thin ones, and braided shielding tends to be more reliable than only foil. Furthermore, longer cables may introduce signal degradation and timing issues that, if necessary, can be mitigated using shorter cable segments combined with hubs that amplify the signal and handle delays on a per-cable basis.

3.3 Kvaser MagiSync

Time synchronization is needed to achieve accurate and precise time stamping between several host computer-to-bus interfaces connected to one host computer. Since each host computer-to-bus interface uses its on-board clock to set the time stamps.

Kvaser MagiSync is an innovative way to synchronize several different Kvaser USB interfaces. You do not need external cables - you get instant synchronisation when you connect the MagiSync enabled Kvaser USB device.

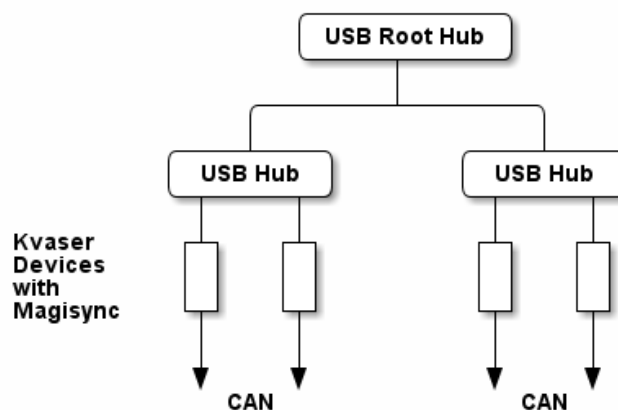


Figure 3: An example setup where all devices are synchronized via MagiSync.

For this to work the Kvaser USB interfaces must reside on the same USB root hub. If they do not they will not be synchronized, see Figure 3 and Figure 4 on Page 9.

Usually, a computer has a USB controller with one root hub in a computer. If you use that one, you do not need an external USB hub to get your Kvaser Devices synchronized. The easiest way to verify the setup is to view Synchronized Hardware in the Device Tree of "Kvaser Device Guide" in your computer's control

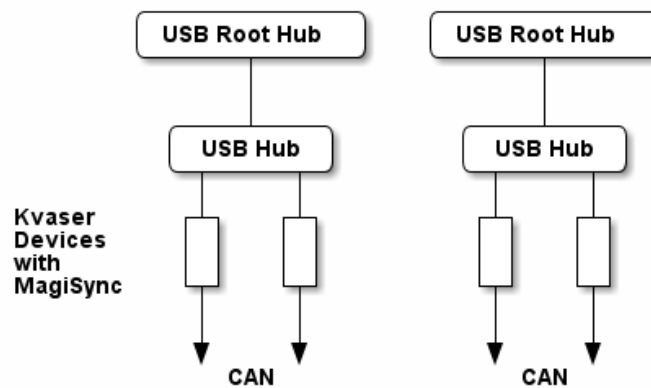


Figure 4: Not all devices are synchronized via MagiSync in this setup.

panel. If all your hardware is placed in one Kvaser MagiSync Group, then you are ready to go.

When connected correctly, all units are synchronized achieving a high precision virtual clock accurate to the microsecond.

3.4 CAN connection

The Kvaser U100S-X3 has one CAN channel.

The CAN connector for the Kvaser U100S-X3 is the 16-pin OBDII Type B plug which has the pinning described in Table 2.



Figure 5: OBDII Type B CAN connector.

OBDII pin number	Function
4	GND
6	CAN_H
14	CAN_L

Table 2: OBDII pin configuration (showing only connected pins).

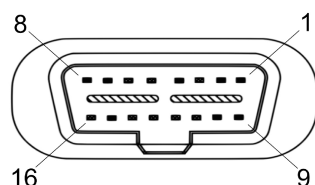


Figure 6: OBDII CAN connector pinout.

3.5 CAN bus termination

Every CAN bus must be terminated with a 120 Ohm resistor at each end of the bus. The Kvaser U100S-X3 does not contain any CAN bus termination, because their inclusion could cause severe disturbance in a system which is already correctly terminated.

For laboratory or testing use, the exact value of the termination resistors is not always critical. Sometimes a single terminator is sufficient. For production, proper termination is essential. If you see error frames on the bus, you should check the termination.



To save yourself a lot of trouble, always terminate the CAN bus properly.

3.6 Power supply

The Kvaser U100S-X3 is powered through the USB connector. Make sure the USB power source can supply enough current (500 mA). If using a USB hub, choose an externally powered one to be safe.

3.7 LED Indicators

A Kvaser U100S-X3 device has two traffic LED bars where part of each LED bar is also used as a status area. The TX LED Bar has a status area towards the USB end of the bar, and the RX LED bar has a status area towards the CAN end of the bar. This is shown in Figure 7.

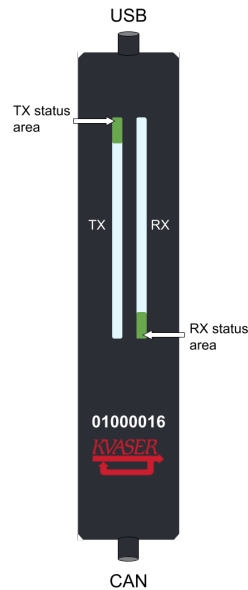


Figure 7: The TX and RX LED bars on the Kvaser U100S-X3 include status areas.

Different colors are used for different types of information and different blink patterns define the current state, see Table 3 and Table 4 on Page 12.

Color	Information type
Yellow	Traffic
Green	Status
Red	Error
White	Alert
Blue	System

Table 3: Different types of information.

State	Definition
Off	The indicator is off and no light is emitted.
Slow Blink	The indicator is repeatedly turned on and off. The on and off phases are equal in time.
Fast Blink	The indicator is repeatedly turned on and off but with a higher frequency than Slow Blink. The on and off times are still equal.
On	The indicator is constantly emitting light.
Dynamic	The indicator is moving and/or increasing/decreasing in size.

Table 4: Definitions of the indicator states.

3.8 Interface mode

The device is in interface mode when connected to a computer via USB. If the status area is presenting a steady white light, the device is in interface mode, working correctly and ready to be used. When connected to a computer for the first time, the status area will Fast Blink with blue light until the Kvaser Drivers are installed and the device has automatically received a USB configuration. The status area will change from white to green when going bus on. Table 5 summarises the information shown in interface mode.

Description	Status area	LED bar
Power is on	On (White)	-
Waiting for USB configuration	Fast Blink (Blue)	-
CAN channel is bus on	On (Green)	-
CAN channel traffic	On (Yellow)	Dynamic (Yellow)
Error frame	-	Dynamic (Red)
CAN channel is error passive	Fast Blink (Red)	-
CAN overrun	On (Red)	-
Firmware update	Slow Blink (Blue)	-
Locate hardware	Slow Blink (White)	Slow Blink (White)

Table 5: LED indications in interface mode.

The Kvaser U100S-X3 has one TX LED Bar and one RX LED Bar. Each LED Bar has a status area, the TX LED Bar has a status area towards the USB end of the bar, and the RX LED bar has a status area towards the CAN end of the bar. This is shown in Figure 7 on Page 11.

The TX LED bar lit area grows from the USB end of the LED bar towards the CAN end of the bar as CAN TX traffic is increased. Likewise, the RX LED bar lit area grows from the CAN end of the LED bar towards the USB end of the bar as the message rate of the received traffic is increased, see Figure 8 on Page 13. In this example the unit is transmitting data, which shows a yellow TX status area. No CAN traffic is received and thus the RX status area is green.

The combined area lit by the TX LED bar and the RX LED bar is proportional to the current bus load, e.g. Figure 8 on Page 13 shows only transmitting CAN messages



Figure 8: The TX LED bar lights up from the USB side to the CAN side of the unit, while the RX LED bar lights up from the CAN side to the USB side of the unit.

at 50% bus load. Figure 9 on Page 13 shows two different bus load conditions. The image on the left shows the unit transmitting and receiving data corresponding to 50% bus load in each direction for a total of 100% bus load. The image on the right shows the unit transmitting data corresponding to 100% bus load.



Figure 9: The yellow-lit area of the LED bars is proportional to the bus load. Both images indicate a bus load of 100%.

3.9 The t programming language

The Kvaser t programming language is event oriented and modelled after C. It can be used to customize the behavior of the Kvaser U100S-X3 and other Kvaser t capable devices.

A t program is invoked via hooks, which are entry points that are executed at the occurrence of certain events. These events can be, for example, the arrival of specific CAN messages or a timer expiration.

Like any Kvaser CAN interface, the Kvaser U100S-X3 can be used via CANlib on a host computer. The addition of t programs running directly on the Kvaser U100S-X3 makes it possible to react much quicker to CAN bus events (for example to speed up file transfer protocols or to simulate missing hardware).

For more information, see the Kvaser t Programming Language guide that can be downloaded at www.kvaser.com/download.

3.10 Restrictions in t functionality

The Kvaser U100S-X3 is a dedicated CAN interface, and as such does not contain real-time clock (RTC), logger or SD card functionality, neither does the Kvaser U100S-X3 include dedicated I/O pins. This means that the t functionality listed in Table 6 on Page 15 is not available on Kvaser U100S-X3 (the table shows version 3.10 of the t language compiler).

Group	Function name
Hooks	on IoEvent
Predefined I/O Functions	kvIoGetNumberOfPins
	kvIoPinGetInfo
	kvIoPinSetInfo
	kvIoConfirmConfig
	kvIoPinSetDigital
	kvIoPinGetDigital
	kvIoPinGetOutputDigital
	kvIoPinSetRelay
	kvIoPinGetOutputRelay
	kvIoPinSetAnalog
	kvIoPinGetAnalog
	kvIoPinGetOutputAnalog
	Predefined File I/O Functions
fileClose	
fileGets	
fileReadBlock	
filePuts	
fileWriteBlock	
fileSeek	
Predefined XML Functions	xmlOpen
	xmlClose
	xmlGet
Predefined t Program Related Functions	scriptLoad
Predefined Logger Related Functions	filterDropMessage
	loggerStatus
	loggerStart
	loggerStop
Other Predefined Functions	timeGetDate

Table 6: Functionality in the t language (v3.10) that is not supported by Kvaser U100S-X3.

3.11 Updating the firmware

For the Kvaser U100S-X3 to communicate with the host computer, compatible versions of the Kvaser CANlib (including driver) and firmware must be installed.

The latest versions of firmware and drivers can be downloaded for free at www.kvaser.com/download.

Connect the Kvaser U100S-X3 to your host computer with the USB cable and start the update.exe application. A window opens showing the Firmware Update Instructions; read and follow those carefully.

To check the current firmware version, open “Kvaser Device Guide” which can be found in the Control Panel. Select “Kvaser U100S-X3” in the tree view to the left, and click on the channel. The firmware revision information now appears in the right half of the window.

The absolute minimum firmware and driver versions needed in order to use Kvaser U100S-X3 are listed in Table 7.

Device	Min. Firmware Version	Min. Driver Version
Kvaser U100S-X3	v3.25	v5.33

Table 7: Minimum compatible driver and firmware versions of Kvaser U100S-X3.

3.12 Start and stop of t programs

All events that a t program will react to are specified using various event hooks. In effect, these are functions which are called when the specific events occur. Among other events, the program can react to starting and stopping itself which this section describes. Read the Kvaser t Programming Language guide that can be downloaded at www.kvaser.com/download for more information.

The “on start” event will be triggered in the Kvaser U100S-X3 when any of the following occurs:

- When a t program is started using the CANlib API (`kvScriptStart()`).
- When a t program is started from another t program.

The “on stop” event will be triggered for running t programs during the corresponding cases:

- When a t program is stopped using the CANlib API (`kvScriptStop()`).
- When a t program is stopped from another t program.

3.13 Technical data

In Table 8 below you will find the technical specifications of Kvaser U100S-X3.

CAN Channels	1
CAN Connector	16-pin OBDII Type B plug
CAN Transceivers	ADM3055E (Compliant with ISO 11898-2)
CAN Controller	Built into the processor.
Galvanic isolation	Yes, reinforced. Tested according to EN 60335-1:2012 paragraph 13 with 5000 VAC rms applied for 60 seconds.
CAN Bit Rate	10 kbit/s to 1 Mbit/s
CAN FD Bit Rate	Up to 8 Mbit/s (with correct physical layer implementation).
Time stamp resolution	1 μ s
Max message rate	20 000 msg/s per channel
Error Frame Detection	Yes
Error Frame Generation	Yes
Silent mode	Yes
Kvaser MagiSync	Yes
Kvaser <i>t</i> programming	Yes
Kvaser CANtegrity	No
Host interface	USB 2.0, standard USB type "A" connector
Host OS	Windows (7 or later), Linux
Power consumption	Typical 250 mA
Dimensions	38 x 128 x 26 mm for body
Cable length	USB 1.0 m, CAN 0.3 m
Weight	185 g including connectors
Operating temperature	-40 °C to +85 °C
Storage temperature	-40 °C to +85 °C
Relative humidity	0 % to 85 % (non-condensing)
IP Rating Housing	IP67
IP Rating CAN connector	IP40 Mated
IP Rating USB connector	IP40 Mated

Table 8: Technical Specifications

4 Troubleshooting

Use “Kvaser Device Guide” in the Control Panel to verify that the computer can communicate with the Kvaser U100S-X3. If the firmware version shown is all zeros, there are communication problems. If the LED Bar or the status indication is not flashing or does not light up at all, check the power supply.

5 Safety Instructions

5.1 Intended Use

Kvaser interfaces are used to connect computer systems to CAN buses. The Kvaser U100S-X3 is intended for connection to a computer via the USB port.

5.2 Usage Warning



WARNING FOR ALL USERS

WARNING! - YOUR USE OF THIS DEVICE MUST BE DONE WITH CAUTION AND A FULL UNDERSTANDING OF THE RISKS!

THIS WARNING IS PRESENTED TO INFORM YOU THAT THE OPERATION OF THIS DEVICE MAY BE DANGEROUS. YOUR ACTIONS CAN INFLUENCE THE BEHAVIOR OF A CAN-BASED DISTRIBUTED EMBEDDED SYSTEM, AND DEPENDING ON THE APPLICATION, THE CONSEQUENCES OF YOUR IMPROPER ACTIONS COULD CAUSE SERIOUS OPERATIONAL MALFUNCTION, LOSS OF INFORMATION, DAMAGE TO EQUIPMENT, AND PHYSICAL INJURY TO YOURSELF AND OTHERS. A POTENTIALLY HAZARDOUS OPERATING CONDITION IS PRESENT WHEN THE FOLLOWING TWO CONDITIONS ARE CONCURRENTLY TRUE: THE PRODUCT IS PHYSICALLY INTERCONNECTED TO A REAL DISTRIBUTED EMBEDDED SYSTEM; AND THE FUNCTIONS AND OPERATIONS OF THE REAL DISTRIBUTED EMBEDDED SYSTEM ARE CONTROLLABLE OR INFLUENCED BY THE USE OF THE CAN NETWORK. A POTENTIALLY HAZARDOUS OPERATING CONDITION MAY RESULT FROM THE ACTIVITY OR NON-ACTIVITY OF SOME DISTRIBUTED EMBEDDED SYSTEM FUNCTIONS AND OPERATIONS, WHICH MAY RESULT IN SERIOUS PHYSICAL HARM OR DEATH OR CAUSE DAMAGE TO EQUIPMENT, DEVICES, OR THE SURROUNDING ENVIRONMENT.

WITH THIS DEVICE, YOU MAY POTENTIALLY:

- CAUSE A CHANGE IN THE OPERATION OF THE SYSTEM, MODULE, DEVICE, CIRCUIT, OR OUTPUT.
- TURN ON OR ACTIVATE A MODULE, DEVICE, CIRCUIT, OUTPUT, OR FUNCTION.
- TURN OFF OR DEACTIVATE A MODULE, DEVICE, CIRCUIT, OUTPUT, OR FUNCTION.
- INHIBIT, TURN OFF, OR DEACTIVATE NORMAL OPERATION.
- MODIFY THE BEHAVIOR OF A DISTRIBUTED PRODUCT.
- ACTIVATE AN UNINTENDED OPERATION.
- PLACE THE SYSTEM, MODULE, DEVICE, CIRCUIT, OR OUTPUT INTO AN UNINTENDED MODE.

ONLY THOSE PERSONS WHO:

(A) ARE PROPERLY TRAINED AND QUALIFIED WITH RESPECT TO THE USE OF THE DEVICE,

(B) UNDERSTAND THE WARNINGS ABOVE, AND

(C) UNDERSTAND HOW THIS DEVICE INTERACTS WITH AND IMPACTS THE FUNCTION AND SAFETY OF OTHER PRODUCTS IN A DISTRIBUTED SYSTEM AND THE APPLICATION FOR WHICH THIS DEVICE WILL BE APPLIED, MAY USE THE DEVICE.

PLEASE NOTE THAT YOU CAN INTEGRATE THIS PRODUCT AS A SUBSYSTEM INTO HIGHER-LEVEL SYSTEMS. IN CASE YOU DO SO, KVASER AB HEREBY DECLARES THAT KVASER AB'S WARRANTY SHALL BE LIMITED TO THE CORRECTION OF DEFECTS, AND KVASER AB HEREBY EXPRESSLY DISCLAIMS ANY LIABILITY OVER AND ABOVE THE REFUNDING OF THE PRICE PAID FOR THIS DEVICE, SINCE KVASER AB DOES NOT HAVE ANY INFLUENCE ON THE IMPLEMENTATIONS OF THE HIGHER-LEVEL SYSTEM, WHICH MAY BE DEFECTIVE.

6 Disposal and Recycling Information



When this product reaches its end of life, please dispose of it according to your local environmental laws and guidelines.

For information about Kvaser's recycling programs, visit:
<https://www.kvaser.com/en/kvaser/recycling-policy.html>

7 Legal Acknowledgements

7.1 EU Regulatory Compliance



EU Declaration of Conformity (DoC)

We

Company Name:	Kvaser AB	City:	Mölnadal
Postal address:	Aminogatan 25	Telephone number:	+46 31 886344
Postcode:	431 53	E-mail address:	sales@kvaser.com

declare that the DoC is issued under our sole responsibility and belongs to the following product:

Product: Kvaser U100S-X3

Object of the declaration (identification of apparatus allowing traceability):

Product: Kvaser U100S-X3

Type: 73-30130-01274-5

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Electromagnetic Compatibility (EMC) Directive 2014/30/EU (Art. 6)

RoHS recast Directive 2011/65/EU (Art. 4.1)

The following harmonised standards and technical specifications have been applied
(title, date of standard/specification):

EN 55032 (2015 + A11:2020) EN 55035 (2017 + A11:2020)

EN IEC 63000 (2018)


Signed for and on behalf of:

Mölnadal

2022-04-01

Place of issue

Date of issue


Claes Haglund, Supply Chain and Quality Director

7.2 FCC Regulatory Compliance



Federal Communications Commission (FCC) Compliance Information Statement

IDENTIFICATION OBJECT:

Product: Kvaser U100S-X3

Type: 73-30130-01274-5

APPLICABLE COMPLIANCE STATEMENTS:

CFR Title 47 Part 15 §15.107, §15.109

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

RESPONSIBLE PARTY (IN USA) NAME:

Kvaser Inc.

23881 Via Fabricante, Suite 503

Mission Viejo, CA 92691

Internet contact: support@kvaser.com

7.3 Patents, Copyrights and Trademarks

All trademarks are the property of their respective owner. Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Adobe, the Adobe logo, and Reader are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

MagiSync is a trademark of Kvaser AB.

DeviceNet is a trademark of Open DeviceNet Vendor Association, Inc.

NMEA 2000 is the registered trademark of the National Marine Electronics Association, Inc.

For information about Kvaser related CAN patents, see www.kvaser.com/patent.

8 Document Revision History

Version history for document UG_98242_U100S-X3:

Revision	Date	Changes
1.0	2021-09-07	Initial version
1.1	2022-01-24	Added connector types to Technical Data section, updated EU Declaration of Conformity.
1.2	2022-04-01	Minor textual changes, updated EU Declaration of Conformity.
1.3	2023-06-16	Updated text about galvanic isolation.