

# Kvaser Leaf Pro HS v2 User's Guide



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<http://www.kvaser.com>

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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.

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## 1 About this manual

This manual is intended for Kvaser Leaf Pro HS v2 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 Leaf Pro HS v2.

### 2.1 Welcome to Kvaser Leaf Pro HS v2



Figure 1: Kvaser Leaf Pro HS v2

Kvaser Leaf Pro HS v2 is a small, yet advanced, portable single channel CAN to USB real time interface that handles transmission and reception of standard and extended CAN messages on the CAN bus with a high time stamp precision. The Kvaser Leaf Pro HS v2 is compatible with applications that use Kvaser's CANlib.

This guide applies to Kvaser Leaf Pro HS v2 devices listed in Table 1 on Page 6.

Device	Product Number (EAN)
Kvaser Leaf Pro HS v2	73-30130-00843-4
Kvaser Leaf Pro HS v2 OBDII	73-30130-00849-6

Table 1: Kvaser Leaf Pro HS v2 devices and their product numbers.

Throughout this document, we use the name Kvaser Leaf Pro HS v2 to mean any one of the different Kvaser Leaf Pro HS v2 products listed in Table 1, unless otherwise noted.

## 2.2 Major features

- USB CAN interface with Kvaser *t* programmability.
- Supports CAN FD.
- Quick and easy plug-and-play installation.
- Supports both 11-bit (CAN 2.0A) and 29-bit (CAN 2.0B active) identifiers.
- Power is taken from the USB bus.
- 100% compatible with applications written for other Kvaser CAN hardware with Kvaser CANlib.
- High-speed CAN connection (compliant with ISO 11898-2), up to 1 Mbit/s.
- Fully compatible with J1939, CANopen, NMEA 2000<sup>®</sup> and DeviceNet.
- Kvaser MagiSync – automatic time synchronization (see Section 4.7, Kvaser MagiSync, on Page 17 for more details).
- Auto response buffers, to send messages on a defined event.
- Auto transmit buffers, to send messages on a defined interval.
- Simultaneous operation of multiple devices.

## 2.3 Interface

Kvaser Leaf Pro HS v2 provides a CAN bus interface through a standard USB interface.

## 2.4 The t programming language

The Kvaser t programming language is event oriented and modeled after C. It can be used to customize the behavior of the Kvaser Leaf Pro HS v2 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 Leaf Pro HS v2 can be used via CANlib on a PC. The addition of t programs running directly on the Kvaser Leaf Pro HS v2 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 <http://www.kvaser.com/download/>.

## 2.5 Restrictions in t functionality

The Kvaser Leaf Pro HS v2 is an interface and as such does not contain real-time clock (RTC), logger or SD card functionality. This means that the t functionality listed in Table 2 is not available on Kvaser Leaf Pro HS v2 as of version 3.2 of the t language compiler.

Group	Function name
Predefined File I/O Functions	fileOpen
	fileClose
	fileGets
	fileReadBlock
	filePuts
	fileWriteBlock
	fileSeek
	fileDelete
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 2: Functionality in the t language (v3.2) that is not supported by Kvaser Leaf Pro HS v2.

## 2.6 Additional software and documentation

The Kvaser CANlib SDK includes everything you need in order to develop software for the Kvaser CAN hardware. The SDK contains full documentation and many sample programs, written in C, C++, C#, Delphi, Python and Visual Basic. All Kvaser CAN interface hardware share a common software API. Programs written for one device type will run without modification on other device types.

The latest versions of documentation, software and drivers can be downloaded for free at <http://www.kvaser.com/download/>.



## 3 Kvaser Leaf Pro HS v2 hardware

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

### 3.1 Hardware installation

The Kvaser Leaf Pro HS v2 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 Leaf Pro HS v2 to communicate with the host computer, the correct version of the Kvaser driver and firmware must be installed. The firmware is downloaded and installed directly on the Kvaser Leaf Pro HS v2 and the driver is installed on the host computer. The latest version of the driver and firmware can be downloaded from <http://www.kvaser.com/download/>.

The driver is installed by running the file `kvaser_drivers_setup.exe`.

For information on how to upgrade the firmware, see Section 4.6, Updating the firmware, on Page 17.

### 3.2 USB connector

The Kvaser Leaf Pro HS v2 has a standard USB type "A" connector.



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 USB cable length is 5 m (~ 16 ft). If you need a longer cable,

you can use USB hubs or USB extension cables with a built-in hub. By chaining up to 5 hubs, you can achieve an effective cable length of up to 25 m (~ 82 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 CAN channels

The Kvaser Leaf Pro HS v2 has one CAN Hi-Speed channel in a CAN connector depending on the model. Either a 9-pin DSUB or a 16-pin OBDII connector is used. See Section 4.4, CAN connectors, on Page 15 for details about the pinout.



Figure 3: 9-pin DSUB CAN connector



Figure 4: OBDII CAN connector

### 3.4 Power supply

The Kvaser Leaf Pro HS v2 is powered from the USB port.

### 3.5 LED Indicators

The Kvaser Leaf Pro HS v2 has one power LED and one traffic LED for the CAN channel as shown in Figure 5 on Page 11. Their functions are described in Section 4.1, Definitions of LED states and colors, on Page 12.



Figure 5: LEDs on the Kvaser Leaf Pro HS v2.

### 3.6 Troubleshooting

Use “Kvaser Hardware” in the Control Panel to verify that the computer can communicate with the Kvaser Leaf Pro HS v2, if the firmware version shown is all zeroes, there are communication problems.

If the LEDs are not flashing or do not light up at all, check that power is supplied correctly.

## 4 Appendices

In this section you will find technical information about the Kvaser Leaf Pro HS v2 and its connectors.

### 4.1 Definitions of LED states and colors

A Kvaser device has two basic types of LEDs; Power and Traffic. These are dual colored as shown in Table 3. A device with multiple CAN channels has one Traffic LED for each CAN channel. When the device has more than one channel a space and digit is added on the label, CAN 1, CAN 2 etc. The red Traffic LEDs are also used to indicate errors by using all red Traffic LEDs simultaneously.

LED	Label	Color
Power	PWR	Green/Yellow
Traffic	CAN	Yellow/Red

Table 3: The different type of LEDs.

The following definitions is used to describe the state of an LED:

**Off** The LED is off and no light is emitted.

**Flash** The LED is lit up during a very short time. A single flash may be hard to see and a continuous set of flashes will look the same as On.

**Slow Blink** The LED is repeatedly turned On and Off. The On and Off phase is equal in time.

**Fast Blink** The LED is repeatedly turned On and Off but with a higher frequency than Slow Blink. The On and Off time is still equal.

**On** The LED is constantly emitting light.

**Slow Waver** This is a variant of Slow Blink but instead of being Off, a second color is On. This is only possible with a dual colored LED.

**Fast Waver** The LED is alternating between two colors as in Slow Waver but using a higher frequency.

**Running** This means that all LEDs are lit, one at the time, in sequence with every color available i.e. "Power green->Power yellow->Traffic 1 yellow->Traffic 1 red->..."

As an example, "Slow Waver (Green/Yellow)" means that the LED is slowly blinking by alternating between green and yellow.

### 4.1.1 Interface mode

The device is in Interface mode when it is connected to the PC via USB. If the Power LED is showing a steady green light, the device is in Interface mode and working correctly. When connected to the computer for the first time, the Power LED will blink slowly in yellow until the driver is installed and it has received a USB configuration. If the Power LED is showing yellow in the Interface mode for an extended period something is wrong, see Table 4 on Page 13.



The power should never be removed when firmware update is in progress.

Power LED	Traffic LED	Description
Slow Blink (Yellow)	All off (-)	Waiting for USB configuration
Slow Waver (Green/Yellow)	Slow Waver (Yellow/Red)	Firmware configuration error <sup>1</sup>
Slow Waver (Green/Yellow)	All Slow Blink (Yellow)	Power problem <sup>2</sup>

Table 4: Yellow Power LED shows problems in Interface mode.

Traffic LED	Description
Off (-)	Idle, no CAN traffic
Flash (Yellow)	CAN message received or sent
Flash (Red)	Error frame received
All Fast Blink (Yellow)	Firmware update is in progress
Fast Blink (Red)	CAN channel is error passive
On (Red) <sup>3</sup>	CAN overrun

Table 5: Traffic LED shows CAN bus status in Interface mode .

### 4.1.2 Status of scripts

There are by default no LED indications showing the state of a t program. Instead, the developer of a script can override any of the existing LEDs and create notifications as needed when the t program is running, including program exceptions.

<sup>1</sup>This should not normally happen. If it does, please contact Kvaser support.

<sup>2</sup>This indicates low power supply, such as using an unpowered USB hub.

<sup>3</sup>The red Traffic LED indicating overrun will stay on until the device goes bus off.

## 4.2 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 <http://www.kvaser.com/download/> for more information.

The “on start” event will be triggered in the Kvaser Leaf Pro HS v2 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.

### 4.3 Technical data

In Table 6 on Page 15 you will find the Kvaser Leaf Pro HS v2's technical specifications.

CAN Channels	1
CAN Transceivers	MCP2561FD (Compliant with ISO 11898-2)
CAN Controller	Kvaser CAN IP in FPGA
Galvanic isolation	Yes
CAN Bit Rate	40 kbit/s to 1 Mbit/s
CAN FD Bit Rate	Up to 8 Mbit/s (with proper physical layer)
Time stamp resolution	1 $\mu$ s
Max message rate	20000 msg/s per channel
Error Frame Detection	Yes
Error Frame Generation	Yes
Silent mode	Yes
Kvaser MagiSync	Yes
PC interface	USB Hi-Speed
Power consumption	max 195 mA
Hardware configuration	Done by software (Plug & Play).
Software requirements	Windows Vista or later. (For other operating systems, contact Kvaser support.)
Dimensions	35 x 165 x 17 mm for body incl. strain relief
Weight	120 g (DSUB), 130 g (OBDII)
Operating temperature	-40 °C to +85 °C
Storage temperature	-40 °C to +85 °C
Relative humidity	0% to 85% (non-condensing.)

Table 6: Technical Specifications.

### 4.4 CAN connectors

Kvaser Leaf Pro HS v2 devices that use the 9-pin D-SUB connector (see Figure 6) have the pinning described in Table 7 on Page 16.

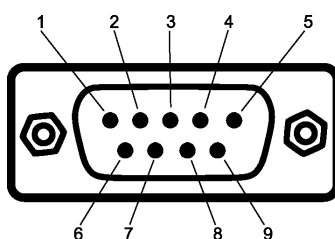


Figure 6: The D-SUB 9 connector pin numbers

D-SUB pin number	Function
1	Not connected
2	CAN_L
3	GND
4	Not connected
5	Shield
6	Not connected.
7	CAN_H
8	Not connected.
9	Not connected.

Table 7: Configuration of the 9-pin DSUB

Kvaser Leaf Pro HS v2 devices that use the 16-pin OBDII plug (see Figure 7) have the pinning described in Table 8.

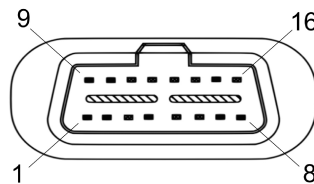


Figure 7: OBDII Connector

OBDII pin number	Function
4	GND
6	CAN_H
14	CAN_L
16	Not connected.

Table 8: OBDII pin configuration (showing only connected pins)

## 4.5 CAN bus termination

Every CAN bus must be terminated with a 120 Ohm resistor at each end of the bus. The Kvaser Leaf Pro HS v2 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.**

## 4.6 Updating the firmware

For the Kvaser Leaf Pro HS v2 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 <http://www.kvaser.com/download/>.

Connect the Kvaser Leaf Pro HS v2 to your PC 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 Hardware" which can be found in the Control Panel. Select "Kvaser Leaf Pro HS v2" 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.

## 4.7 Kvaser MagiSync

Time synchronization is needed to achieve accurate and precise time stamping between several PC-to-bus interfaces connected to one PC. Since each PC-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.

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 8 on Page 18 and Figure 9 on Page 18.

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 Leafs synchronized. The easiest way to verify the setup is to look under the Synchronization tab in "Kvaser Hardware" in your computer's control 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.

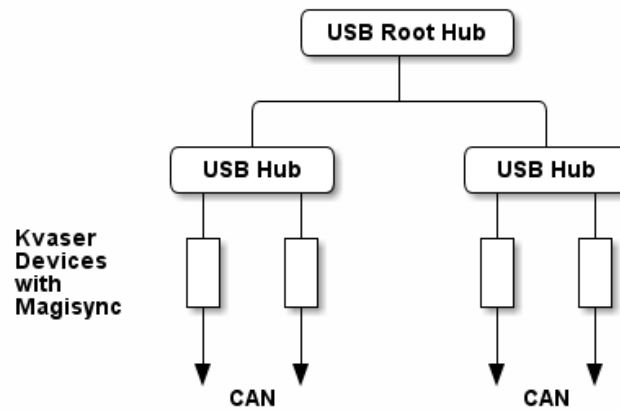


Figure 8: An example setup where all devices are synchronized via MagiSync.

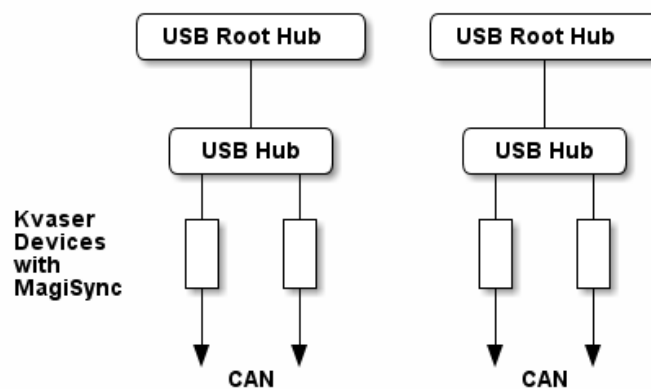


Figure 9: Not all devices are synchronized via MagiSync in this setup.

## 5 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:  
<http://www.kvaser.com/en/kvaser/recycling-policy.html>

## 6 Legal acknowledgements

### 6.1 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.

## 6.2 EC Regulatory Compliance

The product(s); 73-30130-00843-4, 73-30130-00849-6, is in conformity with the essential requirements of the following regulations and directives:

- DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 (WEEE)
- REGULATION (EC) No. 1907/2006 (REACH), Annex XIV (the 'Candidate list') and Annex XVII ('Restriction of Substances')

The products listed above also complies with DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 (RoHS) and is in conformity with the following standards and/or other normative documents:

Standard	Description
EN 50 581 (2012)	Assessment with respect to restriction of hazardous substances

Table 9: Standards and normative documents for RoHS 2011

The products listed above also complies with DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 December 2004 (EMC-directive) and is in conformity with the following standards and/or other normative documents:

Standard	Description
EN 55 022 (2010)	Class B, radiated. IT equipment, commercial emission
EN 55 024 (2010)	IT equipment, commercial immunity

Table 10: Standards and normative documents for EMC 2004

**NOTE:** 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/her own expense.

## 6.3 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.

## 7 Document Revision History

Version history for document UG\_98178\_leaf\_pro\_hs\_v2:

Revision	Date	Changes
1.0	2015-08-10	Initial version