Manual

µCROS SL

Part 1: Hardware

Version V1.10 EN - 2020/03

µCROS SL Manual V1.10 EN - 2020/03

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2.1 Symbols

The safety notices contained in this manual are identified with the danger symbol shown below:
The safety notices as shown below contain extremely important information. They should be read carefully and respected.

⚠	**Danger:** indicates an immediate danger with a high risk of loss of life or severe injury if not avoided.

⚠	**Warning:** indicates a possible danger with a moderate risk of loss of life or severe injury if not avoided.

⚠	**Attention:** indicates a low risk hazard which could result in minor or medium physical injuries or property damage if not avoided.

2.2 Notes

This manual explains the hardware of the µCROS SL data logger. It provides technical descriptions of the components, available interfaces, connectors and the electromechanical specifications of the µCROS SL data logger.

Support of certain functions of the hardware may depend on the particular firmware version in use. The functionality of the firmware is described in the firmware documentation.

⚠	**Danger:** Using the logger and display while operating a vehicle can distract the driver. Concentration on traffic should be the driver's top priority at all times.

⚠️ **Warning:**
Operating a data logger in transmission mode can interfere with the proper functioning of safety and control components, resulting in the cancellation of the respective vehicle operating permit. It is the sole responsibility of the installing party to supervise this. Moreover, it is that same party's obligation to instruct vehicle drivers on this matter, as well as to advise them on proper procedures.

⚠️ **Warning:**
Keep out of reach of children.

⚠️ **Warning:**
For use in restricted areas only.

⚠️ **Warning:**
For use by instructed and skilled personal only.

⚠️ **Warning:**
The minimum safe distance between human bodies and the antenna is 20 cm. When placing the antenna make sure that the distance between humans and the antenna never drops below that value.

2.2.1   WLAN

> ⚠ **Warning:**
> The frequencies between 5150MHz and 5350 MHz (Channels 32 - 68) of the 5GHz band are restricted to indoor use only in the following countries:
>
> | AT | BE | BG | CY | CZ | DE | DK |
> |----|----|----|----|----|----|----|
> | EE | ES | FI | FR | GR | HR | HU |
> | IE | IT | LT | LU | LV | MT | NL |
> | PL | PT | RO | SE | SI | SK | GB |
>
> Placement of the µCROS SL inside a vehicle is considered **outdoors** for the scope of this restriction as the necessary signal dampening for "indoors" cannot be garanteed. Even if both the µCROS SL and the access point are placed inside the same vehicle this is still considered outdoor use. So if you want to use these channels you have to make sure that the vehicle itself is within a closed garage, workshop or another building during the data transmissions.

2.3   User Information CFR § 15.105 (b)

NOTE: 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 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.

3   Hardware Description

3.1   Overview

The µCROS SL is a compact data logger for use cases which demand a maximum of four CAN and one 100MBit Ethernet channel. Two analog, two digital inputs are added as additional means to log voltages and status over time and a digital output capable of delivering up to 0.5 A may be used to trigger or power external circuitry. Two USB ports may be used to add storage or to unload data. A removable global navigation satellite systen (GNSS) antenna provides absolute position of the µCROS SL in time and space while MIMO WLAN and UMTS transmitters multiply the users options to access the logged data.

3.2   Properties

- Four CAN channels

- One 100MBit Ethernet connector

- Dual USB 2.0 ports.

- MIMO WLAN module

- GNSS receiver

- UMTS module

- Dual analog inputs

- Dual digital inputs

- Switchable power output for external electronics

- Removable combination antenna for MIMO WLAN, UMTS and GNSS.

3.3   Housing

The outer shell of the µCROS SL is a state of the art composite of highly conductive carbon fibers and a high performance polymer. It is robust and saves about 60% weight when compared to a aluminium housing of the same size. Latches allow for fast fastening and removal via cable ties or other means.

> ⚠️ **Attention:**
> The housing is an electric conductor and connected to UB-! Make sure the µCROS SL is kept isolated from conducting objects with a potential difference to UB-. Stray electric currents between the housing and the power line may damage the cabling, housing and/or the µCROS SL

3.4 Connections

3.4.1 Front
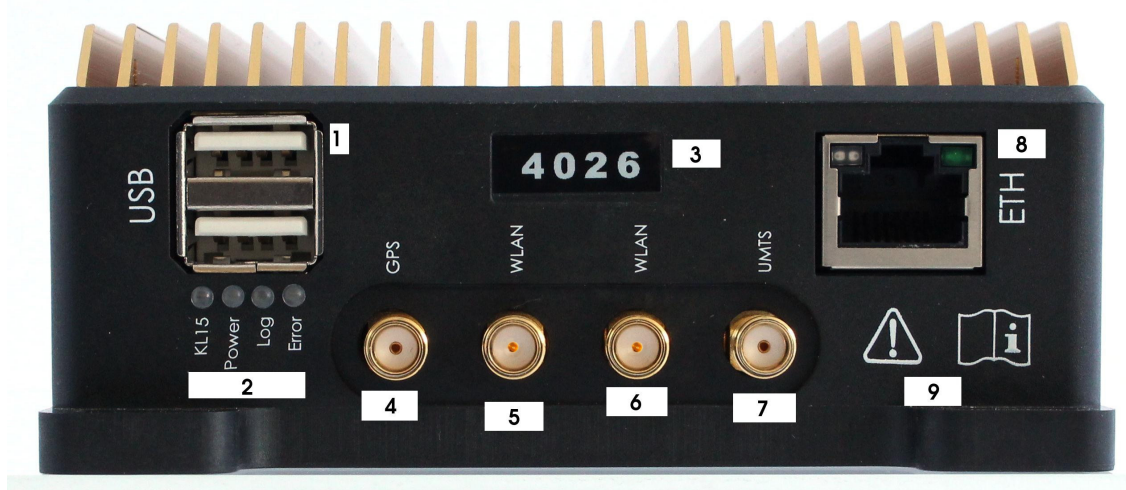
1. Twin USB 2.0 connector for data and configuration file transfer.

2. Status LEDs. The status displayed by the LEDs are described in section 5.8 on page 12.

3. Front serial number. This number is the reference for the software licenses.

4. GPS SMA connector for the global navigation satellite system (GNSS) antenna cable of the external combination antenna PN 113846.

5. WLAN R-SMA connector for one of the the WLAN antenna cables of the external combination antenna PN 113846.

6. WLAN R-SMA connector for one of the the WLAN antenna cables of the external combination antenna PN 113846.

7. UMTS SMA connector for the the UMTS antenna cable of the external combination antenna PN 113846.

8. RJ45 jack used to communicate with an external host computer for data download, configuration up- and download, firmware updates and the logger web server.

> ⚠️ **Warning:**
> The µCROS SL contains a DHCP server. Do not connect the µCROS SL to an existing network unless you know exactly what you are doing. If connected other systems might unexpectedly change their IP addresses.

> ⚠️ **Warning:**
> Use only the provided taoglas antenna PN 113846. The use of other antennas may void the certification of the µCROS SL

9. Symbols telling the user that he really should have read this manual first.

3.4.2   Back
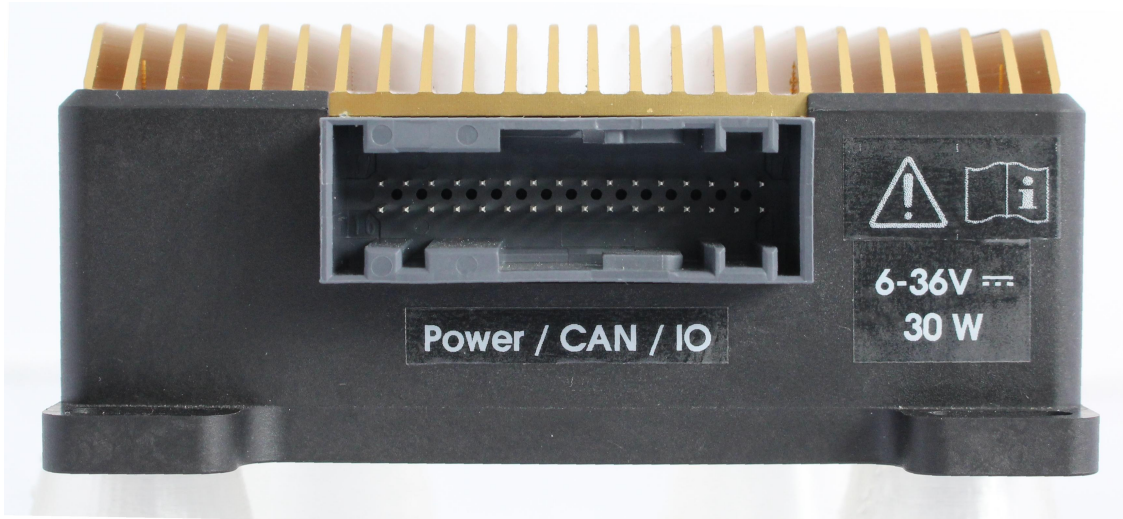
The single connector at the back side of the µCROS SL is the POWER/CAN/IO Connector. This connector bundles all the measurement signals and the power supply which usually are part of the test rig. This feature facilitates fast connect and disconnect of the µCROS SL from the device under test. The ordering code and the pinout of the connector are described in section 7.8.3 on page 30.

4   Definitions

Download: data transfer from the µCROS SL to a host.

Upload: data transfer from a host to the µCROS SL

Web Interface: A set of web pages which are served by the internal webserver of the µCROS SL at http://203.0.113.1:8080. These pages are the GUI interface for the µCROS SL settings.

5   Functional description

5.1   Analog Inputs

The analog inputs of the µCROS SL are semi-differential inputs with a input range of $\pm\,2\,V$ between Analog IN CHx GND and the negative power supply UB- and a range of 0 V to 40 V between Analog IN CHx + and Analog IN CHx GND. The Analog IN CHx GND pins are independent of each other so a differential voltage between each of the pins as well as UB- is acceptable as long as it stays within the $\pm\,2\,V$ limit. This design compensates potential differences between the the µCROS SLs UB- supply and the point of the analog measurement without compromising the accuracy of the measurement. If the increased accuracy isn't needed the Analog IN CHx GND pins may be connected to UB- at the POWER/CAN/IO connector.

5.2   CAN buses

The four CAN buses on the µCROS SL are fully functional CAN 2.0 Interfaces which may be used as data inputs to log and analyse CAN bus traffic and as CAN data outputs for traffic generated by the µCROS SL. For a complete specification see section 7.7.2 on page 27.

5.3   Configuration

The µCROS SL is configured via a file named config.cfg which is fed into the device either via an USB stick with the file in the root directory on shutdown or via the web interface (see 5.11 on page 13. If the µCROS SL is to be configured via a USB stick the config.cfg file several requirements have to be met:

- The file has to be stored in the root directory

- There has to be another file named datalog.key in the root directory

- If the configuration file contains a serial number the number has to correspond with the µCROS SL serial number

The config.cfg file is a human-readable ascii text file. The file format is documented in the *configuration file manual*.
If the configuration file contains syntax errors the whole configuration is rejected, the former configuration is restored and an error is written into the log file.

5.4   Data Transfer

The transfer of the acquired data may always be done via the web interface (see section 5.11 on page 13). Other possibilities include via WLAN, UMTS or automatic file transfer to a USB stick on shutdown, but the availability of those transfer modes depend on the configuration and installed hardware of the µCROS SL. These modes are described in the software manual.

5.5   Digital Inputs

The digital inputs of the µCROS SL are semi-differential inputs with a input range of $\pm 2\,V$ between Digital IN CHx GND and the negative power supply UB- and a range of $0\,V$ to $40\,V$ between Digital IN CHx + and Digital IN CHx GND. The digital inputs are provided with a hysteresis so that the transistion from off to on state happens when the input voltage rises above $2\,V$ while the transition from on to off state happens when the input drops below $1\,V$. The Digital IN CHx GND pins are independent of each other so a differential voltage between each of the pins as well as UB- is acceptable as long as it stays within the $\pm$ $2\,V$ limit. This design compensates potential differences between the the µCROS SLs UB-supply and the source of the digital signal for higher trigger point accuracy. If some offset is tolerable the Digital IN CHx GND pins may be connected to UB- at the POWER/CAN/IO connector.

5.6   Digital Output

The digital output is an open emitter / open source output which switches UB+ to the output pin.For a complete specification see section 7.7.4 on page 28.

5.7   Firmware Update

> ⚠️ **Attention:**
> Make sure to connect the µCROS SL to a stable power supply before you start the update process. Any power interruption during the update may render the µCROS SL unusable. If this happened the µCROS SL needs to be send back to the manufacturer.

The logger firmware update is done via the web interface. In order to update the firmware on an µCROS SL you need to connect to the web interface (see section 5.11 on page 13) and select the "Firmware" screen via the "Start" screen. Click on the "Upload new" button and select the file with the firmware update. Restart the logger with the restart button ↻ on the upper right corner of the browser window to start the update process.

5.8   LED indicators

Name	Color	Status	Function
Kl15	yellow	off	Low logic level on the KL15 pin of the Power/CAN/IO connector detected.
		on	High logic level on the KL15 pin of the Power/CAN/IO connector detected.
Power	green	off	The main CPU is unpowered.
	green	on	The main CPU is powered.
Log	yellow		This LED is used by the software to show a software operation status. Constant **on** usually means normal system operation.
Error	red		This LED is used by the software to show a software operation status. Constant **off** usually means normal system operation.

5.9   Power Supply

The µCROS SL is guaranteed to operate between 6 V and 36 V DC across the whole temperature range. The power is supplied via the UB+ and UB- lines of the POWER/CAN/IO connector. The pinout of the connector is shown in section 7.8.3 on page 30.

5.10   UMTS

Depending on the configuration the µCROS SL may be equipped with a 3G UMTS module for wireless data transfers. The µCROS SL is delivered without a SIM card so the card for the module has to be inserted before the UMTS module is fully operational (see section 7.1.4.2). The µCROS SL accepts Mini-SIM cards (also known as UICC or 2FF, size 25 mm × 15 mm). The UMTS module may be used to transfer the data collected by the µCROS SL to a host, to connect to the µCROS SL for supervisory purposes or the have the µCROS SL send SMS or e-mail messages either periodically or in case of user-defined events.

5.11 Web Interface

> ⚠️ **Warning:**
> The µCROS SL contains a DHCP server. Do not connect the µCROS SL to an existing network unless you know exactly what you are doing. If connected other systems might unexpectedly change their IP addresses.

The web interface is the main means of communication with the µCROS SL. Both firmware updates and configuration uploads are done via the web interface, and data transfers may be initiated by the interface as well.

To connect to the web interface the µCROS SL needs to be connected to an external computer via the RJ-45 ethernet port. The web interface of the µCROS SL may be reached via the IP 203.0.113.1 on port 8080. There are two main possibilities to access the web interface:

1. Set the hosts network interface to DHCP client so that the interface will get a valid address via the µCROS SL DHCP server.

2. Set the hosts network interface to an address which includes 203.0.113.1.

Wait a few seconds and type the address 203.0.113.1:8080 into a web browser on the host computer. If the µCROS SL has just been (re)started it will take some seconds until the web interface main screen is shown in the browser window:
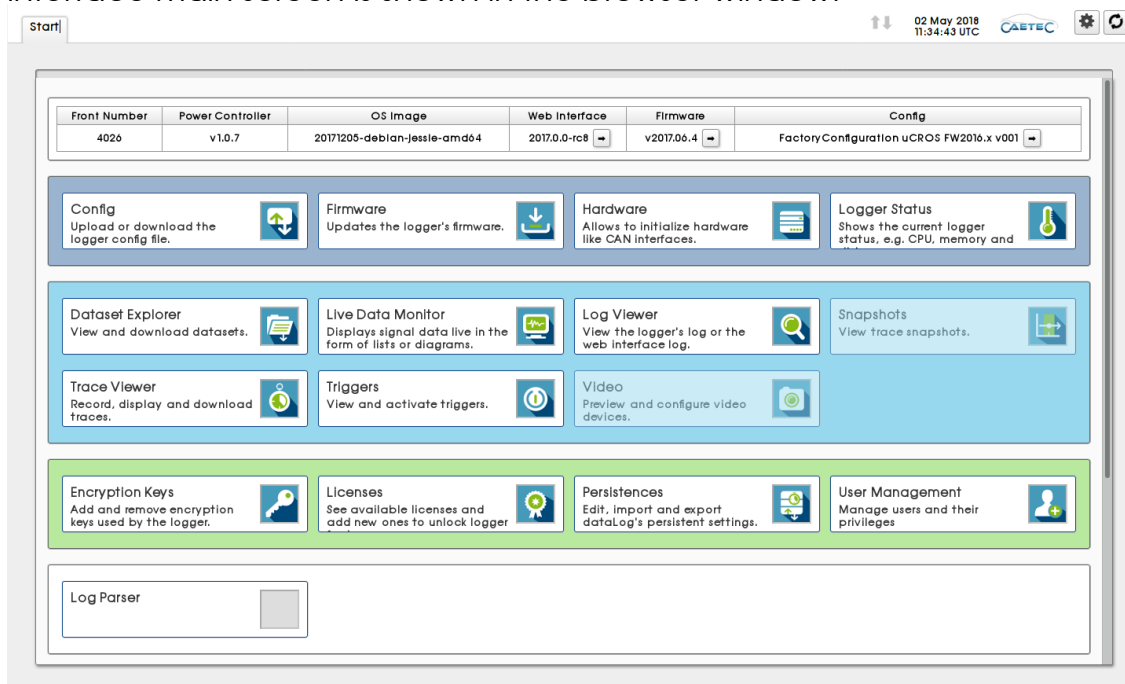
This hardware manual describes the header line and the first row of buttons of the web interface (Config, Firmware, Hardware and Logger status). The rest of the screen is described in detail in the web interface manual.

On the header line there is a list of recently used buttons for faster access (only "Start" is open in the picture), the network traffic indicator ⇅, the current logger time and date, the menu icon ⚙ and the restart button ↻.

5.11.1   Traffic Indicator

The traffic indicator shows wether there is any networt traffic between the µCROS SL and an external host. The indicator has four status:

⇅ No network traffic.

⇊ Network traffic from µCROS SL to host.

⇈ Network traffic from host to µCROS SL.

⇅ Network traffic in both directions.

5.11.2   Menu Icon

The menu icon contains a drop down menu with several logger settings

Change logger time   opens a new window where the logger time might be set either to the host computers UTC time or a time set via manual input. The last menu item cancels any change done after the last reboot and keeps the current logger timestamp.

General settings   opens a new window with user interface settings. The settings window allwo the user to change both font size and fiont weight as well as the general appearance ot the web interface ("theme"). Selecting "Use Usermanagement" enables the user management for the web interface which is described in the web interface manual. Selecting "Reopen apps ..." saves the opened sliders in the cookie so that they are re-opened as soon as any logger is connected to the host. The button "Remove all data ..." does exactly that.

Restart logger   restarts the logger.

Test fan   isn't used in the µCROS SL as it has no cooling fans.

About   opens a new slider with two subsliders. The left subslider displays the open source libraries used within the datalog firmware, The right subslider does the same for the web interface.

FAQs   opens a new slider with a list of frequently asked questions (and the respective answers)

5.11.3   Restart Button

This button forces a logger restart, which is needed for example to load a new configuration file.

5.11.4   Config

This button opens a register which lists the current logger configuration and manages up- and download of new configuration files

Download saves the current logger configuration to the host computer.

Upload new loads a new configuration file into the µCROS SL.

Edit includes advanced feature: manages subconfigurations in case the main configuration file specifies them. include file management is thoroughly described in the web interface manual.

5.11.5   Firmware

This button opens a register with the version numbers of both the logger firmware and the web interface. New versions of both the logger firmware andthe web interface may be installed with the "upload new" button.

5.11.6   Hardware

This button opens a register which lists the available logger interfaces with the internal channel numbers and firmware versions. The channel numbers of both interfaces can be changed in the "Settings" subregister.

> **Warning:**
> Do not change the channel numbers unless you are aware of the implications concerning the logger configuration.

5.11.7   Logger Status

This button opens a register which shows basic system status information. The subregister "Logger Status" shows CPU load, temperature, memory usage and used disk space. The subregister "CAN Bus Status" contains the bus load and error frame counters for the CAN buses and their settings.

5.12   WLAN

Depending on the configuration the µCROS SL may be equipped with a WLAN card for wireless data transfer. This module is designed to offload the collected data from the µCROS SL to an external host.
To enable wireless data transfers the access points need to be added to the configuration file either via the Phoenix GUI, the IPEmotion PlugIn CAETEC dataLog or manually (see also *configuration file manual*). Due to safety considerations the WLAN module is configured to work in a purely passive mode as default so the access points need to actively send beacons (hidden mode switched off) for the module to recognize and connect to them.[1]

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[1]If the module would actively try to connect to configured access points it would have to send data telegrams on all frequencies of all configured access points which may be illegal depending on the configured

> ⚠️ **Warning:**
> Make sure that the access points use allowable frequencies only. These differ from country to country especially for the 5GHz band so make sure the settings of the access point comply with local regulations.

While it is possible to switch the µCROS SL into a mode where it can connect to hidden access points by enabling the active search mode this is strongly discouraged as it might lead to illegal use of frequency bands once the system enters another country.

> ⚠️ **Warning:**
> The frequencies between 5150MHz and 5350 MHz (Channels 32 - 68) of the 5GHz band are restricted to indoor use only in the following countries:
>
> | AT | BE | BG | CY | CZ | DE | DK |
> |----|----|----|----|----|----|----|
> | EE | ES | FI | FR | GR | HR | HU |
> | IE | IT | LT | LU | LV | MT | NL |
> | PL | PT | RO | SE | SI | SK | GB |
>
> Placement of the µCROS SL inside a vehicle is considered **outdoors** for the scope of this restriction as the necessary signal dampening for "indoors" cannot be garanteed. Even if both the µCROS SL and the access point are placed inside the same vehicle this is still considered outdoor use. So if you want to use these channels you have to make sure that the vehicle itself is within a closed garage, workshop or another building during the data transmissions.

6   Commissioning

6.1   General Installation Recommendations

6.1.1   Environment

make sure the µCROS SL is used in an environment which doesn't exceed its thermal or mechanical design envelope as listed in Section 7.1.3 on page 21.

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access points and the current location of the µCROS SL. Hiding an access point is *not* a safety measure anyways as the SSID of the "hidden" AP is easily extractable by monitoring the traffic between the AP and other clients.

6.1.2   Potential equalization

The heat sink and the housing of the µCROS SL are connected to UB-.

> ⚠️ **Attention:**
> The housing is highly conductive! Make sure the µCROS SL is kept isolated from conducting objects with a potential difference to UB-. Stray electric currents between the housing and the power line may damage the cabling, housing and/or the µCROS SL.

6.2   Assembly/Mounting

> ⚠️ **Warning:**
> If the device is mounted inside a vehicle keep in mind that this is considered outdoor use as far as WLAN is concerned and that the 5GHz WLAN bands between 5150MHz and 5350 MHz (Channels 32 - 68) are restricted to indoor use only in the following countries:

AT	BE	BG	CY	CZ	DE	DK
EE	ES	FI	FR	GR	HR	HU
IE	IT	LT	LU	LV	MT	NL
PL	PT	RO	SE	SI	SK	GB

> If you want to use these channels you have to make sure that the vehicle itself is within a closed garage, workshop or another building during the data transmissions and make sure that transmissions are only enabled while inside the building. Even if both the µCROS SL and the access point are placed inside the same vehicle this is still considered outdoor use as the necessary signal dampening for "indoors" cannot be garanteed.

The µCROS SL has four slotted holes to facilitate mounting with M4 screws or cable straps. The position of the mounting holes are shown in the drilling template below:

Attention:
Maximum mounting torque 2 Nm. Use a washer M4 DIN125/ISO7089 between the screw head and the µCROS SL mounting hole. Use bolt adhesive instead of torque to secure the screws.

Attention:
Mount on even surfaces only. Mounting the µCROS SL on an uneven support may result in a warped or broken housing

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Attention:
The antenna of the µCROS SL has to be mounted so that a minimum distance between the antenna and human bodys of at least 20 cm (8 inch) is maintained.

6.3   Cabling

With the exception of the POWER/CAN/IO connector no special cables are needed: both the USB and the ETH jacks accept standard cables. For the POWER/CAN/IO connector please refer to 7.8.3 on page 30 for a compatibel connector and the pinout. Use at least 0,75 mm²/AWG 18 for the power supply via UB+ and UB- and 0,25 mm²/AWG24 for Digital Out + and Digital Out GND. The rest of the lines are low-current signal lines only. Both the GPS and the UMTS wireless jacks are female SMA jacks which accomodate SMA male connectors. The WLAN connectors are R-SMA female jacks for R-SMA male connectors.

⚠️	**Attention:** Check whether local regulations demand a minimum wire cross section for electrical wires.

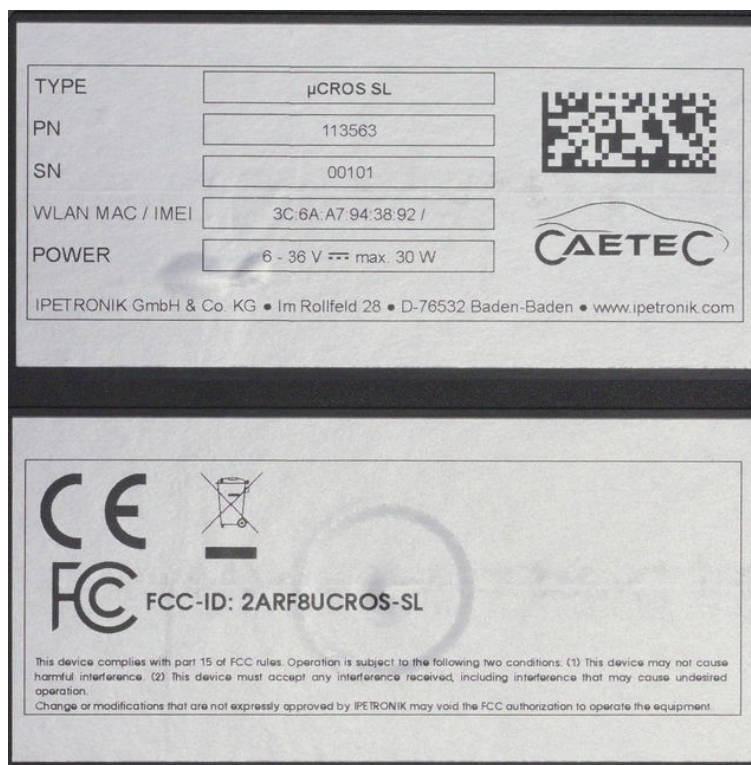| ⚠️	**Attention:** Wireless operation of the µCROS SL is certified with the special combination antenna PN 113846 only.

7   Technical Data

7.1   General Data

7.1.1   Markings on the µCROS SL

The markings found on the µCROS SL are described below:

7.1.1.1   Bottom labels:

Top label

TYPE	Depicts the name of the equipment: "µCROS SL ".
PN	Is the part number of this device. Please use the PN as reference for support and supplies.
SN	Is the unique serial number of this device.
WLAN MAC / IMEI	Lists the MAC of the build-in WLAN module and the IMEI of the build-in UMTS module
POWER	Lists the power requirements of the device

Bottom label

CE 0680	Label confirming CE conformity and notified body.
	Label confirming WEEE compliance.
FCC ID:...	Label confirming FCC conformity and depicting the FCC ID 2ARF8UCROS-SL.

7.1.1.2   Front:

⚠ 📖	Cautions the user to consult the manual for explanation and/or description of the feature

USB	Denotes a twin USB 2.0-compliant port
ETH	Denotes a gigabit Ethernet port
LEDs	
KI15	Indicates if the "Klemme 15" input is active.
Power	Indicates wether the µCROS SL is powered or off.
Log	Indicates that the µCROS SL logs data.
Error	Warns about an error condition.
GPS	SMA jack for the GNSS antenna cable of the antenna PN 113846.
WLAN	R-SMA jacks for the WLAN antenna cables of the antenna PN 113846.
UMTS	SMA jack for the UMTS antenna cable of the antenna PN 113846.

7.1.1.3   Back:

⚠️ 📖	Cautions the user to consult the manual for explanation and/or description of the feature
POWER/CAN/IO	main connector for power supply and signal input. For pinout refer to 7.8.3 on page 30.
6-36V ⎓ 30W	the allowed voltage range and the maximum power consumption of the device.

7.1.2   Standards

The µCROS SL meets the following standards:

EN 60 068-2-14:2009	Environment: temperature cycles
EN 60 068-2-27:2009	Environment: shock
EN 60 068-2-64:2008	Environment: vibration
EN 60 529:2014-09	Enclosures: degrees of protection
EN 62 311:2008-09	Human exposition to EM fields
EN 62 368-1:2014+AC2015	electrical safety
EN 300 328 v2.1.1	IEEE 802.11b/g/n
EN 301 489-01	EMC
EN 301 489-17 v3.2.0	EMC WLAN
EN 301 489-19 v2.1.0	GNSS / GPS / ROMES
EN 301 489-52 v1.1.0	UMTS
EN 301 511 v12.5.1	GSM
EN 301 893 v2.1.1	IEEE 802.11a/n 5GHz
EN 301 908-1 v11.1.1	UMTS
EN 303 413:2017-12	GNSS
FCC/ISED test 47 CFR Part 15B	unintentional emissions
FCC/ISED test 47 CFR Part 22/24	GSM
FCC/ISED test 47 CFR Part 22/24/27	WCDMA
FCC/ISED test 47 CFR Part 15.247	WLAN 2.4 GHz
FCC/ISED test 47 CFR Part 15.407	WLAN 5 GHz
ISO 16 750-3:2012-12	Road vehicle equipment: mechanical loads

7.1.3   Ambient Conditions

Operating temperature range	$-20\,^{0}C$ to $+75\,^{0}C$
Storage temperature range	$-40\,^{0}C$ to $95\,^{0}C$
Relativ humidity	0% to 90% non-condensing
Operating height	-500 to 5000 m above sea level
Protection rating EN 60529	IP 40
Acceleration	EN 60068-2-64:2008
Shock	EN 60068-2-27:2009

7.1.4   Maintenance

The µCROS SL is a complex system based on state-of-the-art miniaturized electronic components. The only customer-servicable part is the SIM card which may be replaced following the instructions in the next paragraphs. Any further service has to be done by a qualified service technician.

7.1.4.1   cleaning   The µCROS SL is *not* watertight. Clean with a damp towel and mild detergent only.

7.1.4.2   SIM Card Access
Tools needed: a TORX screwdriver T8.

> ⚠️ **Attention:**
> Make sure to take the necessary precautions against electrostatic discharges (ESD) before the µCROS SL is opened. Keep the µCROS SL on an antistatic mat during the process and keep yourself grounded by an antistatic wristlet or other means. The internals of the µCROS SL are sensitive to ESD.

Flip the µCROS SL onto its cooling fins and unscrew the four screws hidden in the recesses of the housing with a TORX screwdriver T8.

Flip the μCROS SL, hold the housing on the ESD mat and lift the POWER/CAN/IO connector until the PBC below the heat sink clears the housing on the side of the POWER/CAN/IO connector.

Then pull on the POWER/CAN/IO connector until the SMA connectors cleared the holes in the housing and lift the heat sink up until housing and heat sink/PCB assembly separate.
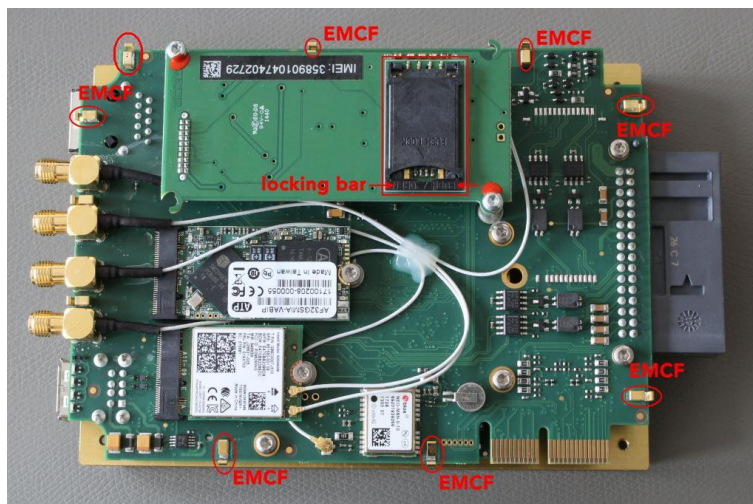
Put the housing aside for later reassembly and place the heat sink/PCB assembly with the PCB facing up on the ESD mat. The SIM card holder can be found on the UMTS daughterboard on top of the assembly. Open it by pushing the locking bar labeled "push to open".

> ⚠ **Attention:**
> Take care not to bend or break the EMC fingers (EMCFs) of the μCROS SL.
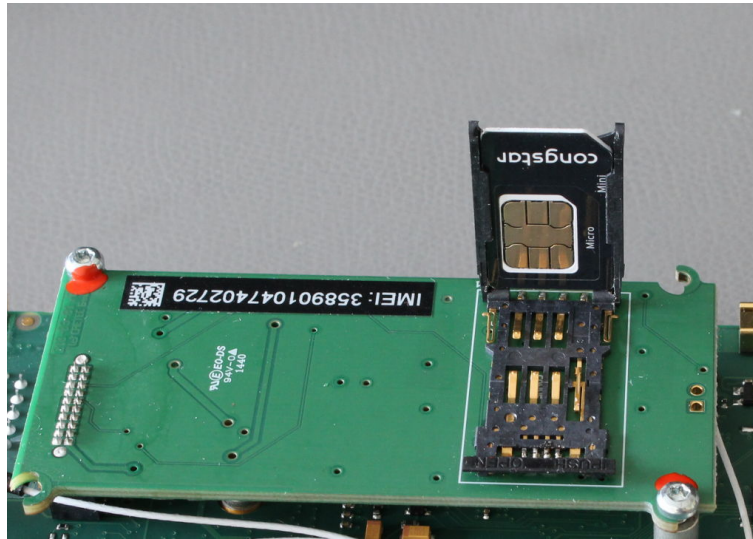
Insert the SIM card. Make sure the contacts face the contact springs of the card holder and the index corner is positioned correctly. Close the card holder again until the locking bar snaps into place.
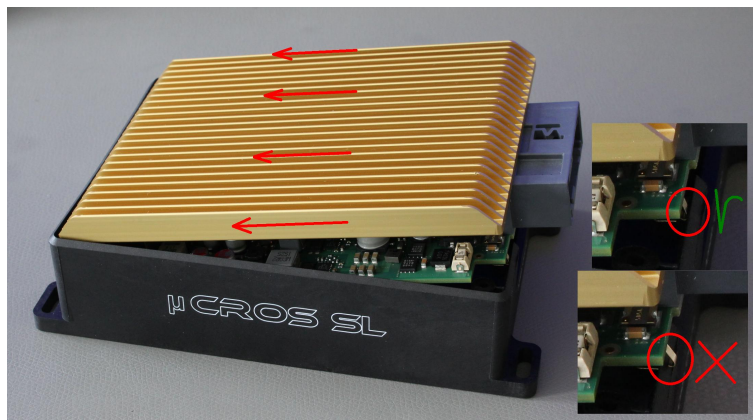
Place the housing of the µCROS SL on the ESD mat and slide the heat sink/PCB assembly into it until the leading edge of the heet sink contacts the housing. Be careful not to rip the small EMC fingers at the side of the PCB from their sockets and check that the EMC fingers on the side of the POWER/CAN/IO connector are *inside* the housing.
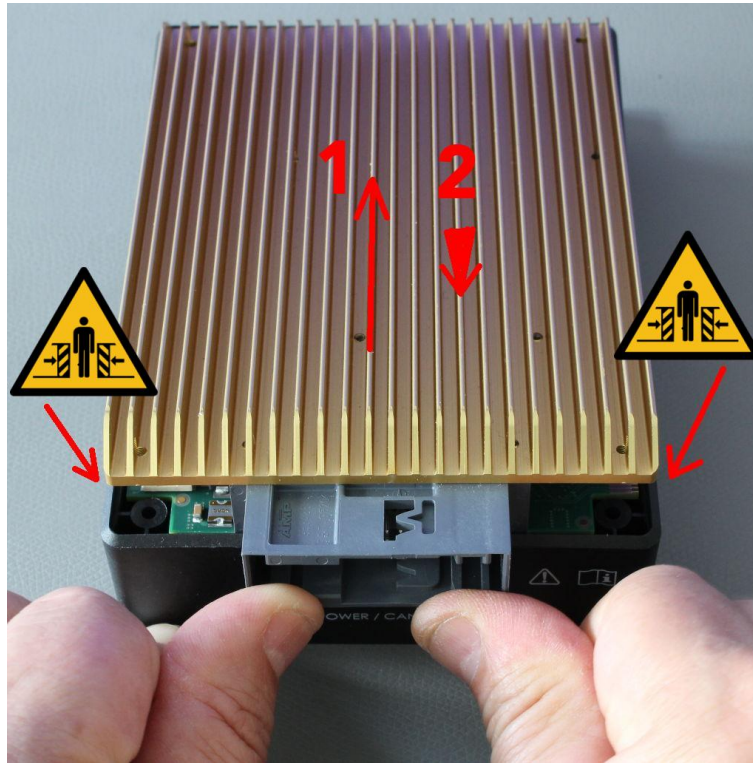
Retain the housing by placing your index fingers on the protituding tabs, put your thumbs on the POWER/CAN/IO connector and push towards the heat sink until the heat sink/PCB assembly drops into the housing. Some force will be needed to overcome the initial resistance.

> ⚠️ **Attention:**
> Make sure to keep your fingers away from the gap between the housing and the heat sink to avoid pinching your skin.

Flip the assembly and attach the screws. Use medium strength threadlocker (LOCTITE 243/248 or equivalent) to secure the screws in place. Tighten with 0.44 Nm torque.

7.1.4.3   BIOS battery replacement

7.2   RoHS Conformity

7.2.1   European Union

The EU Directive 2011/85/EU limits the use of certain hazardous materials for electric and electronic devices (RoHS directive).
IPETRONIK confirms that the product meets this directive applicable in the European Union.

7.3   CE marking

Hereby, IPETRONIK declares that the radio equipment type µCROS SL is in compliance with Directive 2014/53/EU. The complete CE Declaration of Conformity for the product is accessible at the following link: declaration of conformity.

7.4   End of Life Management

The European Union (EU) released the Directive for Waste Electrical and Elec- tronic Equipment - WEEE to ensure the setup of systems for collecting, treating and recycling electronic waste in all countries of the EU.
This ensures that the devices are recycled in a resource-friendly way that does not represent any risk to personal health and the environment.

The WEEE symbol on the product or its packaging identifies that the product may not be disposed of together with the remaining trash. The user is obligated to separately collect old devices and provide them to the WEEE return system for recycling.

The WEEE Directive applies to all IPETRONIK devices, but not to external cables or batteries. Additional information about the recycling program of IPETRONIK is available from the IPETRONIK service locations (see chapter 9 on page 31).

7.5   System Requirements

7.5.1   Hardware

Operation of the µCROS SL requires a DC power supply between 9 V[2] and 24 V which can source at least 30 W.

7.5.2   Software

The µCROS SL may be configured by any *datalog.cfg* file according to the Configuration specification manual. For ease of use a GUI tool named phoenix exists as well.

7.6   Mechanical Data

Dimensions		
length	17 cm	
width	11 cm	
height	5 cm	
Weight	0.5 kg	

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[2]The µCROS SL will run at 6.00 V between Uin + and Uin - , but a "6 V" power supply usually won't deliver 6 V at the µCROS SL connector due to voltage drops along the supply cables

7.7   Electrical Data

7.7.1   Analog Inputs

Input range	+0 V …+40 V
Resolution	10 bit (approx. 40 mV)
Sampling Rate	1 kHz
Cut-off frequency	approx. 50 Hz
Input resistance	1.2 MΩ 10 nF paralell

Attention:
The voltage difference between the ground pin of any analog channel and UB- must not exceed 2 V

7.7.2   CAN Bus Interfaces

The CAN bus inputs are fitted with CAN2.0 compatible ISO 11898-2 high speed transceivers. The transceivers provide a ESD protection of up to 16 kV HBM.

Maximum number of nodes	60
Supported bus speeds	62.5 …1000 kHz
Galvanic isolation	no
Common mode range	-7 V …12 V

Attention:
The reference ground for the CAN bus inputs is UB-. Potential differences in excess of the specified common mode range between UB- and the CAN inputs may impede measurements and even destroy the device

7.7.3   Digital Inputs

Fixed trigger point	+1.5 V typ;
	L -> H at U < 2.1 V,
	H -> L at U > 0.9 V guaranteed
Hysteresis	0.3 V typ; 0.1 V minimum
Sampling Rate	1 kHz
Cut-off frequency	approx. 50 Hz
Input resistance	1.2 MΩ 10 nF paralell

Attention:
The voltage difference between the ground pin of any digital channel and UB- must not exceed 2 V

7.7.4 Digital Output

Type	Voltage source
Output Voltage	positive supply voltage UB+
Maximum continuous current	200 mA
Internal resistance	approx. $6.5\,\Omega@25°C$; $< 9\,\Omega@75°C$

7.7.5 GNSS

Position data for the system is provided by an u-blox NEO-M8N module which uses the GPS satellite network to provide accurate position information.

7.7.6 LAN

The RJ45 port of the LAN interface supports a IEEE 802.3ab (aka. 1000BASE-T) gigabit ethernet over UTP cat.5 cabling and accepts standard patch cables with a IEC 60603-7 8P8C ("RJ45") connectors.

7.7.7 m.2 Slot

The m.2 slot of the µCROS SL contains the SSD drive for the firmware and data storage.

> ⚠ **Attention:**
> The µCROS SL needs an m.2 card complete with firmware and drivers installed in the slot to work properly. Installation or removal of the m.2 card may be done by qualified service personnel only. Do not attempt to replace the card without detailed instructions and a replacement card with preinstalled firmware.

The m.2 connector mounted in the µCROS SL is keyed for slot "B" and supports SATA 3 cards with a width of 22 mm and a length of 42 mm.

7.7.8 Supply

Supply Voltage	6 - 36 V DC
Power consumption	
Operation	30 W max. with USB and digital output
Standby	approx. 10 mW
Standby with WoC	approx. 120 mW
Standby with WoCnml	approx. 1 W

7.7.9 UMTS

UMTS functionality is provided by an u-blox LISA-U200 WCDMA and GPRS/EDGE module.

> **Attention:**
> The modul needs a SIM-card. Installation or removal of the SIM card may be done by qualified service personnel only. Refer to chapter 7.1.4.2 for SIM card access.

The module supports HSPA+ and GSM/EDGE data transmission with a HSDPA+ data transmission rate of up to 7.2 Mb/s. Actual data transmission rates may be limited by the installed firmware, drivers and/or national regulations.

7.7.10   USB

Compliance	USB 2.0
Max. current supplied	0.5 A

7.7.11   WLAN

WLAN functionality is provided by an intel Dual-Band Wireless-AC 8265 m.2 WLAN adapter. The adapter supports IEEE802.11 a/b/g/n/ac,802.11d, 802.11e, 802.11h, 802.11i, 802.11w, 802.11r, 802.11k and 802.11v. Actual support may be limited by the installed firmware, drivers and/or national regulations.
In the μCROS SL the modul is configured as passive client which needs a beacon from the access point (disable "hidden" mode) to choose the transmission band in the default settings. This may be overrridden by both enabling the active scan mode *and* choosing a location for the μCROS SL but this is discouraged as it might lead to illegal transmitter settings once the μCROS SL is moved to another country.

7.7.11.1   Transmitter power levels

2,4 GHz			
Channel	Modulation	TX power	Source: intel 56114-3.91 Table 6.5"WsP 2230 ETSI max TX power"
1-13	CCK	15 dB	
	OFDM	SISO: 15,5 dB	
		2x2 MIMO: 12,5 dB	

5 GHz		
Channel	TX power: countries	Source: output of "iw list" for the different country codes
36- 64	20 dBm (either SISO or sum of 2x2 MIMO): all	
100 - 144	22 dBm (either SISO or sum of 2x2 MIMO): all	

7.8   Connector Assignments

7.8.1   GPS Connector

The GPS connector is a standard SMA female connector. The Antenna cable of the included antenna PN 113846 labeled with "GPS" has to be connected to this output to enable reception of global position services.
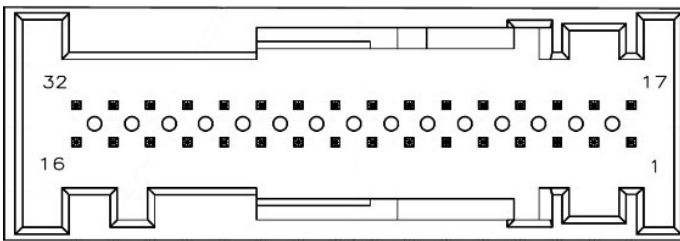
7.8.2   LAN

The LAN connector is a standard RJ45 socket wired according to EIA/TIA-568 standard ("ethernet-cable"):

1	DA+	5	DC-
2	DA-	6	DB-
3	DB+	7	DD+
4	DC+	8	DD-

7.8.3   POWER/CAN/IO Connector

The POWER/CAN/IO connector is a TE connectivity TE 953 486-1 (32W MQS right angle) connector. A matching connector is for example the TE connectivity part number TE 968 265-1.

Pin 1	Analog IN CH1 +	Pin 17	Analog IN CH1 GND
Pin 2	Analog IN CH2 +	Pin 18	Analog IN CH2 GND
Pin 3	Digital IN CH1 +	Pin 19	Digital IN CH1 GND
Pin 4	Digital IN CH2 +	Pin 20	Digital IN CH2 GND
Pin 5	CAN 1 H	Pin 21	CAN 1 L
Pin 6	CAN 2 H	Pin 22	CAN 2 L
Pin 7	CAN 3 H	Pin 23	CAN 3 L
Pin 8	CAN 4 H	Pin 24	CAN 4 L
Pin 9	Reserved	Pin 25	n.c.
Pin 10	Reserved	Pin 26	Reserved
Pin 11	Digital Out +	Pin 27	Reserved
Pin 12	Digital Out GND	Pin 28	UB +
Pin 13	n.c.	Pin 29	UB +
Pin 14	RUN_EXT	Pin 30	UB +
Pin 15	KL15	Pin 31	UB -
Pin 16	UB -	Pin 32	UB -
Minimum sum of cable size 0.75 mm^2/AWG18 for UB+ / UB- Minimum cable size is 0.25 mm^2/AWG24 for Digital Out + / Digital Out GND			

7.8.4   UMTS Connector

The UMTS connector is a standard SMA female connector. The Antenna cable of the included antenna PN 113846 labeled with "UMTS" has to be connected to this output to enable UMTS transmission of data.

7.8.5   USB Connector

The USB connectors are USB 2.0 Type A Jacks which mate with USB 2.0/30. Type plugs (Note: USB 3.0 functionality is not supported).

7.8.6   WLAN Connectors

The WLAN connectors are standard R-SMA female connectors. The Antenna cables of the included antenna PN 113846 labeled with "WLAN" have to be connected to these outputs to enable WLAN transmission of data.

8   Cables and Accessories

Order No	Description
666-500.015 (IPETRONIK) CTC-114439 (CAETEC)	µCROS SL Kabel CAN, PWR,DIG-ANL-IN 1,5m

9   Contact Adresses

9.1   Headquarters

IPETRONIK GmbH & Co. KG
Im Rollfeld 28
76532 Baden-Baden

Tel: +49 7221 9922 0
Fax: +49 7221 9922 100
WWW: https://www.ipetronik.com

9.2   Subsidiaries

9.2.1   Olching

IPETRONIK GmbH & Co. KG
NL Olching
Industriestr. 1
82140 Olching

Tel: +49 8145 501 360
Fax: +49 8142 501 369
WWW: https://www.caetec.de

For information about your local sales and service representative please contact IPETRONIK:
https://caetec.de/de/kontakt/
mailto:caetec@ipetronik.com