

PEAK-MiniDiag NMEA 2000

User Manual



Relevant Product

Product Name	Part Number
PEAK-MiniDiag NMEA 2000	MPEH-001011

Imprint

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Contents

Imprint	2
Relevant Product	2
Contents	3
1 Introduction	5
1.1 Specifications	6
1.2 Prerequisites for Operation	7
1.3 Scope of Supply	7
2 Commissioning	8
2.1 Connecting to the CAN Bus	8
2.2 Inserting Batteries (optional)	10
2.3 Turning on/off	11
2.4 User Interface	12
2.5 Operation	13
3 Device Functions	14
3.1 System Info	16
3.2 Bus Power	19
3.3 Shield Voltage	21
3.4 Common Mode Voltage	22
3.5 Net Min/Max	23
3.6 Net Voltages	24
3.7 Net Differential Voltages	25
3.8 Termination	26
3.9 Bit Rate	28
3.10 Bus Load	33
3.11 Bus Traffic	35
3.12 Bus Errors	36
4 Firmware Upload	37
4.1 System Requirements	37
4.2 Firmware Transfer	38

5 Technical Specifications	41
Appendix A CE Certificate	44
Appendix B UKCA Certificate	45
Appendix C Dimension Drawing	46
Appendix D Signal Level of a NMEA 2000 Bus	47
Appendix E Thresholds	48
Appendix F Disposal	50

1 Introduction

The PEAK-MiniDiag NMEA 2000 is a portable, affordable handheld device for diagnosing NMEA 2000 networks. Users can validate networks, detect flaws, and aid device installation with its wide range of measuring functions, including voltage measurements, CAN termination, and bus load.

Multiple values like the current, the minimum, and maximum measurements are displayed on a single screen, giving an instant insight in the network's performance. The color-coded measurement indication ensures effortless reading and easy interpretation. With this, NMEA 2000 diagnostic is accessible for everyone, for experienced technicians as well as novices.

The PEAK-MiniDiag NMEA 2000 has an increased ingress protection due to its casing and membrane keypad. The device can be powered via the NMEA 2000 network supply or three replaceable batteries.

The standard NMEA 2000 from the National Marine Electronics Association specifies a manufacturer-independent communication via CAN between devices like sensors and displays on boats and ships.

1.1 Specifications

- High-speed CAN connection (ISO 11898-2)
- CAN bus connection via D-Sub, 9-pin
- NMEA 2000 connection via the supplied adapter cable D-Sub, 9-pin to Micro-C circular connector, 5-pin
- Preset to the NMEA 2000 default bit rate of 250 kbit/s
- No influence on the CAN bus due to permanent listen-only mode
- OLED display with 128 x 128 pixel resolution
- Power supply via the 12-Volt NMEA 2000 network supply or with exchangeable batteries (3 x Micro AAA with 1.2 V or 1.5 V)
- Maximum current consumption 25 mA, LEN 1
- Operation via membrane keypad with four keys
- Plastic casing with increased Ingress Protection IP42
- Dimensions: 122 x 69 x 44 mm
- Operating temperature range from -10 to +50 °C (14 to 122 °F)

Measuring functions

- Measurement of the NMEA 2000 bus supply voltage
- Measurement of Shield voltage offset against ground
- Measurement of the common mode voltage
- Measurement of minimum and maximum voltage values for NET-High and NET-Low
- Measurement of dominant and recessive levels for NET-High and NET-Low and determination of their differential voltage
- Measurement of differential voltages of the dominant and recessive levels
- Measurement of the CAN termination
- Detection of bit rates via exact bit timing measurements
- Measurement of the bus load with display in diagram

- Measurement of the bus load and CAN messages per second of all or single devices
- Indication of errors per second and the total number of occurred errors

1.2 Prerequisites for Operation

- Adapter cable for NMEA 2000 connection and power supply
- Optional: 3 x AAA batteries for operating

1.3 Scope of Supply

- PEAK-MiniDiag NMEA 2000 delivered in shockproof plastic box
- Adapter cable for NMEA 2000 connection and power supply
- Batteries (4 x 1.5 V Micro AAA)
- Manual in PDF format
- Printed quick start guide

2 Commissioning

For operating the PEAK-MiniDiag NMEA 2000, go through the sections in this chapter one after the other.

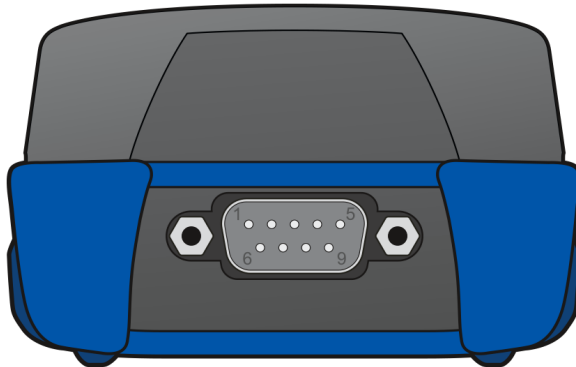


Attention: Protect the OLED display from longer exposure to direct sunlight, otherwise the display may be damaged.

2.1 Connecting to the CAN Bus

The PEAK-MiniDiag NMEA 2000 has a 9-pin D-Sub socket on the back of the device for the connection to the NMEA 2000 bus as well as for the primary power supply. Both are realized via the supplied NMEA 2000 connection cable.

In addition, the PEAK-MiniDiag NMEA 2000 can be equipped with three micro AAA batteries. With the help of the batteries, the PEAK-MiniDiag NMEA 2000 can acquire the data of the NMEA 2000 bus at the moment of switch-on. When supplied by the NMEA 2000 bus, the batteries are not used any further afterwards. Inserting the batteries is explained in section 2.2 *Inserting Batteries (optional)*.



D-Sub connector of the PEAK-MiniDiag NMEA 2000 at the rear of the housing

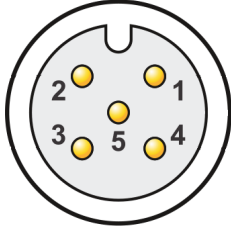


NMEA 2000 connection cable

Pin assignment D-Sub

Pin	Assignment	D-Sub Connector
1	Not connected	A diagram of a 9-pin D-sub connector. The pins are arranged in two rows. The top row has pins 1, 2, 3, 4, and 5. The bottom row has pins 6, 7, 8, and 9. The pins are represented by yellow dots on a grey background.
2	NET-Low / CAN-Low	
3	NET-C / GND	
4	Not connected	
5	Not connected	
6	Shield	
7	NET-High / CAN-High	
8	Not connected	
9	NET-S / V _{Bat} +12 V	

Pin assignment Micro-C

Pin	Assignment	Micro-C Connector
1	Shield	
2	NET-S / V _{Bat} +12 V	
3	NET-C / GND	
4	NET-High / CAN-High	
5	NET-Low / CAN-Low	

2.2 Inserting Batteries (optional)

The PEAK-MiniDiag NMEA 2000 can additionally be operated with non-rechargeable or with rechargeable batteries. The battery type is selected in the options under `System Info`. For more information, see section 3.1.1 *Available Options*.



Note: Rechargeable batteries must be charged with a charger. The PEAK-MiniDiag NMEA 2000 does not charge batteries.



Insert batteries:

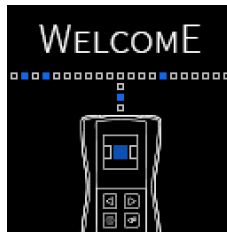
1. Remove the two Phillips screws on the case underside.
2. Remove the battery cover.
3. Insert the batteries.
Note: Make sure that the polarity is correct (+/-).
4. Put back the cover.
5. Tighten the two Phillips screws.

The PEAK-MiniDiag NMEA 2000 is now ready for operation. If the PEAK-MiniDiag NMEA 2000 is connected to the NMEA 2000 bus supply, the batteries


are not used. However, in case of a poor bus supply, the device automatically switches to the battery supply.

2.3 Turning on/off

The PEAK-MiniDiag NMEA 2000 is turned on and off by pressing the Enter key . Press the Enter key  once to turn on the PEAK-MiniDiag NMEA 2000.



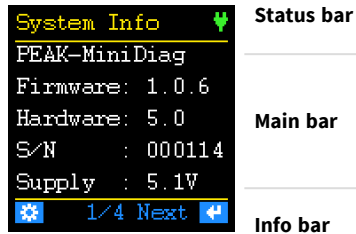
Start screen after turning on

To turn off the PEAK-MiniDiag NMEA 2000, press and hold the Enter key  for three seconds.

2.4 User Interface




The display consists of three fixed areas:

- Status bar (top)
- Main bar (middle)
- Info bar (bottom)



Display structure

Status Bar

In the status bar, the currently selected function is displayed. As soon as the gear wheel  appears next to the name of the function, you are in the options of the respective function. On the right, a symbol indicating the current supply is displayed. For the NMEA 2000 bus supply this is  and  for battery supply.

Main Bar





In the main bar, depending on the function, various information such as instructions and measurement results are displayed.

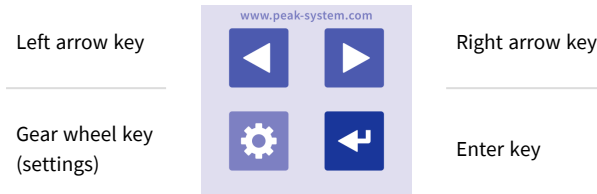
Info Bar

In the info bar, actions that can be performed, selected settings, or both are displayed.

In the options, the bar is divided into **ESC**  and **OK** . With **OK** the settings are accepted. With **ESC** the previous settings are not changed.

2.5 Operation

The PEAK-MiniDiag NMEA 2000 is operated via four keys. Navigation and selection are done using the arrow keys  . The gear wheel key  opens the options of the currently displayed function. The Enter key  executes actions or confirms changed settings.



Key assignment of the PEAK-MiniDiag NMEA 2000

3 Device Functions

This chapter covers the device functions of the PEAK-MiniDiag NMEA 2000. The following subchapters describe the 12 functions.

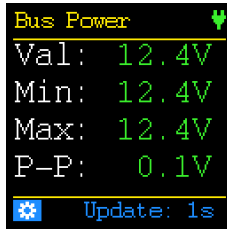
The navigation is carried out using the arrow keys ◀ ▶. In the following table, all functions are listed in order to the right ▶:



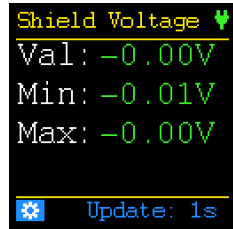
Note: For functions that include an evaluation, the displayed measurements are color-coded:
 OK = green, Warning = yellow, Error = red



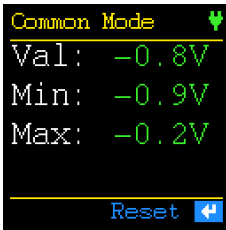
Indication of firmware and hardware version, serial number, and supply



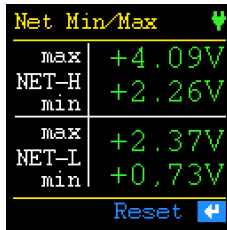
Check of the NMEA 2000 bus supply voltage



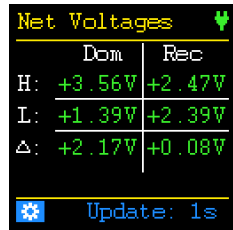
Measurement of Shield voltage offset against ground



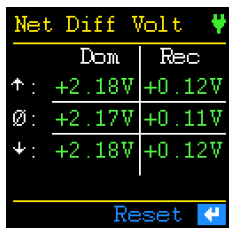
Measurement of common mode voltage



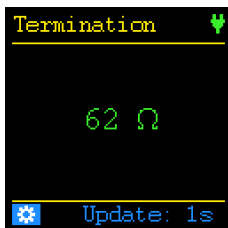
Measurement of minimum and maximum voltages for NET-High and NET-Low



Measurement of dominant and recessive voltage levels



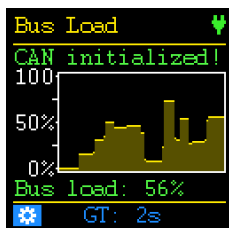
Measurement of differential voltages of the dominant and recessive levels



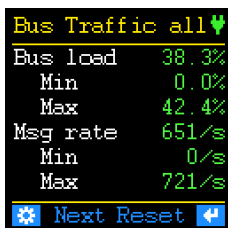
Measurement of the CAN termination



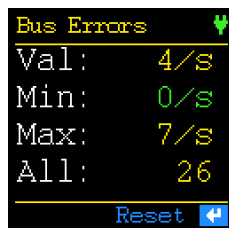
Automatic detection or manual configuration of the bit rate



Measurement of the bus load with display in diagram



Measurement of bus load and messages per sec of all or single devices







Indication of occurred errors



Attention! Do not apply voltages out of the measuring range in order to avoid damage to devices and persons.

3.1 System Info

With the `System Info` function, information about the installed `Firmware`, the `Hardware version`, the serial number (`S/N`), and information about the power supply (`Supply` or `Battery`) are displayed. Further information and the status of the calibration can be reached by pressing the `Enter` key  (`Next`).

```
System Info   
PEAK-MiniDiag  
Firmware: 1.0.6  
Hardware: 5.0  
S/N      : 000114  
Supply   : 5.1V  
 1/4 Next 
```

PEAK-MiniDiag NMEA 2000 system information

3.1.1 Available Options

The following options are available via the gear wheel key 

Shutdown time

A time from 2 to 30 minutes can be set after which the PEAK-MiniDiag NMEA 2000 shuts down. The time-controlled turn off is deactivated with the setting `never`.


Supply type

The used battery type is set:

- `rechargeable` for rechargeable batteries
- `non-recharge` for non-rechargeable batteries

The setting affects the display of the battery icon in the status bar.


Call bootloader



The bootloader can be activated in order to perform a firmware update with the help of the PEAK-Flash software. The bootloader is loaded by selecting the option `yes` and confirming with the Enter key . If no firmware update is performed within a period of 45 seconds, the PEAK-MiniDiag NMEA 2000 turns off.



Note: : A detailed step-by-step guide for the firmware update with PEAK-Flash can be found in chapter 4 *Firmware Upload*.


3.1.2 Power Supply via NMEA 2000 Connection Cable

The power supply via the NMEA 2000 connection cable is shown in the status bar with the power plug symbol . The label in the display changes to `Supply` and shows the applied voltage value.

```
System Info   
PEAK-MiniDiag  
Firmware: 1.0.6  
Hardware: 5.0  
S/N      : 000114  
Supply   : 5.1V  
 1/4 Next 
```

Voltage value

3.1.3 Battery Voltage Display

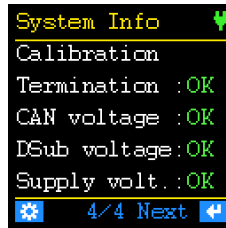
If the device is supplied by batteries, the battery icon  is indicated in the status bar, with color coding for the battery condition. The label in the menu changes from `Supply` to `Battery` and the voltage displayed, is the actual measured battery voltage.

The color codes are as follows:

Battery Symbol	Non-recharge	Rechargeable
Green	> 3.9 V	> 3.7 V
Yellow	> 3.3 V	> 3.15 V
Red	> 3.0 V	> 2.7 V
Red flashing	< 3.0 V	< 2.7 V

3.1.4 Calibration Status

The measurement functions calibrated before delivery are displayed under `Calibration`. The status has to be OK everywhere.



Overview of the calibration status



Important note: If NOK is displayed, contact our support for recalibration of the device function(s) via E-mail:

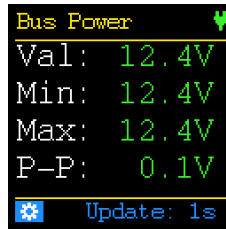
support@peak-system.com

3.2 Bus Power

The `Bus Power` function continuously checks the supply voltage applied via the NMEA 2000 bus. The measuring range is from -40 to +40 volts.


The following measurements are displayed:

Measurement	Description
Val	Current voltage value
Min	Minimum voltage measured since the device function was opened
Max	Maximum voltage measured since the device function was opened
P-P	Ripple voltage (periodic voltage superposition)




Screen Bus Power


Measurement	Measurement Range	Status
Bus power voltage	+10 V to +15.75 V	OK
	+9 V to +10 V	Warning
	< +9 V or > +15.75 V	Error
Ripple voltage (P-P)	< +2 V	OK
	+2 V to +5 V	Warning
	> +5 V	Error

All values are reset by the Enter key  (Reset), when the PEAK-MiniDiag NMEA 2000 is switched off, or when the function is exited.

3.2.1 Available Options

The following option is available via the gear wheel key :

Update time

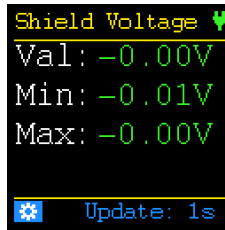
A time from 1 to 15 seconds can be set in which the measurement should be repeated. Alternatively, the values at the setting `manual` can be updated by pressing the Enter key  (Update).

3.3 Shield Voltage

The PEAK-MiniDiag NMEA 2000 measures the current (*Val*), minimum (*Min*), and maximum (*Max*) DC shield voltage between the shield and the ground.


The NMEA 2000 specification requires that the Shield and NET-C (GND) are connected together to the power supply. The shielding of the D-Sub connector is connected with high-impedance to ground (pin 3). The voltage between shield and GND is measured via pin 6 and the supply via pin 9. The shield measuring range is -5 to +3 volts. The shield measurement is only possible if the bus voltage is at least 7 volts.

NMEA 2000 buses that comply with the NMEA specification ideally have a shield voltage between 0 V and -2.5 V.



Screen Shield Voltage

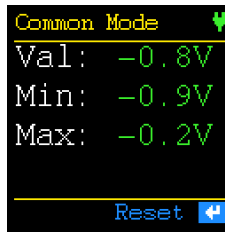
Measurement	Measurement Range	Status
Shield Voltage	-2 V to +0.3 V	OK
	-2.5 V to -2 V or +0.3 V to +1 V	Warning
	< -2.5 V or > +1 V	Error

All values are reset by the Enter key  (*Reset*), when the PEAK-MiniDiag NMEA 2000 is switched off, or when the function is exited. No options are available for this function.

3.4 Common Mode Voltage


The PEAK-MiniDiag NMEA 2000 measures the current, minimum, and maximum common mode voltage (CMV) for your network. The CMV is a shift of the signal voltages of NET-High and NET-Low without a change of their differential voltage.

The common mode voltage should be within the voltage range of -2.5 V to 2.5 V. If this value deviates, disturbances may occur on the NMEA 2000 bus and the message flow may be impaired. A possible cause may be a defective CAN transceiver in one of the connected devices. Furthermore, an excessive common mode voltage can cause the signal voltages to exceed the capabilities of the installed transceivers, which ultimately leads to communication errors.




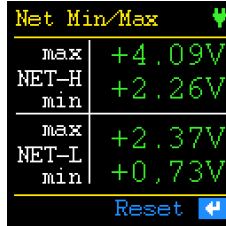
Screen Common Mode

Measurement	Measurement Range	Status
Common Mode Voltage	-2.5 V to +2.5 V	OK
	-5.5 V to -2.5 V or +2.5 V to +5.5 V	Warning
	< -2.5 V or > +5.5 V	Error

All values are reset by the Enter key  (Reset), when the PEAK-MiniDiag NMEA 2000 is switched off, or when the function is exited. No options are available for this function.

3.5 Net Min/Max

With the Net Min/Max function, the minimum and maximum voltages at NET-H and NET-L are measured. The values can be reset via the Enter key  (Reset). The measuring range is within -7 to +10 volts. No options are available for this function.



Measurement of minimum and maximum voltages of NET-High and NET-Low

Measurement	Measurement Range	Status
NET-High	-2 V to +8.5 V	OK
	+8.5 V to +9.5 V or -3 V to -2 V	Warning
	> +9.5 V or < -3 V	Error
NET-Low	-3 V to +7 V	OK
	+7 V to +8.5 V or -4.5 V to -3 V	Warning
	> +8.5 V or < -4.5 V	Error

3.6 Net Voltages


At the `Net Voltages` function, the voltages of the dominant (`Dom`) and recessive (`Rec`) levels within a CAN frame at NET-High (`H`) and NET-Low (`L`) are measured as well as their differential voltage (`Δ`). The measuring range is within -7 to +10 volts.

Net Voltages	
	Dom Rec
H:	+3.56V +2.47V
L:	+1.39V +2.39V
Δ:	+2.17V +0.08V
Update: 1s	


Measurement of dominant and recessive levels of NET-High and NET-Low as well as their differential voltage

Measurement	Measurement Range	Status
Recessive NET-Low	-2 V to +7 V	OK
Recessive NET-High	-3 V to -2 V or +7 V to +8.5 V	Warning
	< -3 V or > +8.5 V	Error
Recessive Differential	-0.18 V to +0.08 V	OK
	< -0.18 V or > +0.08 V	Error
Dominant NET-Low	-3.5 V to +6.25 V	OK
	-4.3 V to -3.5 V or +6.25 V to +7.75 V	Warning
	< -4.5 V or > +7.75 V	Error
Dominant NET-High	-1.25 V to +8.5 V	OK
	-2.25 V to -1.25 V or +8.5 V to +10 V	Warning
	< -2.25 V or > +10 V	Error
Dominant Differential	+1.45 V to +2.75 V	OK
	+1.2 V to +1.45 V or +2.75 V to +3 V	Warning
	< +1.2 V or > +3 V	Error

3.6.1 Available Options

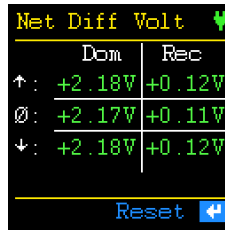
The following option is available via the gear wheel key :



Update time

A time from 1 to 15 seconds can be set in which the measurement should be repeated. Alternatively, the values at the setting `manual` can be updated by pressing the Enter key  (Update).

3.7 Net Differential Voltages

The `Net Diff Volt` function determines the minimum (\downarrow), mean (\emptyset) and maximum (\uparrow) values of the differential voltages of the dominant (Dom) and recessive (Rec) levels.



Net Diff Volt 		
	Dom	Rec
\uparrow :	+2.18V	+0.12V
\emptyset :	+2.17V	+0.11V
\downarrow :	+2.18V	+0.12V
Reset 		

Minimum, mean, and maximum values of the differential voltages of the dominant and recessive level

Measurement	Measurement Range	Status
Recessive Differential	-0.18 V to +0.08 V	OK
	< -0.18 V or > +0.08 V	Error
Dominant Differential	+1.45 V to +2.75 V	OK
	+1.2 V to +1.45 V or +2.75 V to +3 V	Warning
	< +1.2 V or > +3 V	Error

The minimum (↓) and maximum (↑) values are saved. The mean value (∅) is continuously updated. The values can be reset via the Enter key ↵ (Reset). No options are available for this function.

3.8 Termination

With the Termination function, the termination of the CAN bus is displayed. The CAN traffic is not affected. The resistance R is displayed in Ohm Ω. The measurement can be performed automatically or manually with the Enter key ↵.



Measurement of correct termination

Measurement	Measurement Range	Status
Termination	44 Ω to 67 Ω	OK
	40 Ω to 44 Ω or 67 Ω to 128 Ω	Warning
	< 40 Ω or > 128 Ω	Error

3.8.1 Available Options

The following option is available via the gear wheel key ⚙:

Update time

A time from 1 to 15 seconds can be set in which the measurement should be repeated. Alternatively, the values at the setting manual can be updated by pressing the Enter key ↵ (Update).

3.8.2 Evaluation of the Measurement


A NMEA 2000 bus has to be terminated at both ends with 120 Ω each between the CAN lines NET-Low and NET-High. The two resistors connected in parallel result in a total resistance of 60 Ω. The following table describes possible reasons for the respective measurement result:

Measurement Result	Meaning
~ 60 Ω	The termination on the NMEA 2000 bus is technically ok. Make sure that the termination resistors are present at the bus ends and not, for example, at the taps in the middle of the bus.
~ 120 Ω	Only one termination resistor is available. Install another 120 ohm resistor.
< 45 Ω	Too many termination resistors are present on the NMEA 2000 bus. This can occur, for example, if both a separate termination resistor and a NET node with internal termination are present at one bus end.
--- Ω	The measurement was not successful.
missing	No or a too large termination resistor (> 1.2 kΩ) is present on the NMEA 2000 bus. Set up a correct termination.
shorted	Short circuit (< 10 Ω)! Check whether the PEAK-MiniDiag NMEA 2000 has been properly connected and terminated.
Jumping value	Check whether the PEAK-MiniDiag NMEA 2000 has been connected correctly. For example, the NET lines NET-High and NET-Low may have been reversed.



Note: A correct termination is important to avoid signal reflections at the cable ends and to guarantee a correct function of the CAN transceivers at the NMEA 2000 bus.

3.9 Bit Rate

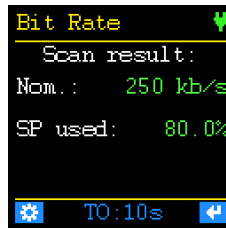
The PEAK-MiniDiag NMEA 2000 is preconfigured at delivery with the NMEA 2000 default bit rate of 250 kbit/s and with a sample point of 80%. If the bit rate of the NMEA 2000 network is unknown, the `Bit Rate` function can be used to automatically determine the bit rate and associated sample point by using bit timing measurements. The automatic detection is started with the Enter key .



Automatic detection or manual configuration of the bit rate

The capture of the required sample data can take more time at low bus load and cannot be interrupted. The `Scan Timeout (TO)` option can be used to set a maximum measurement time. Alternatively, a manual configuration can be done.

If, for example, the measurement of the bit rate of a NMEA 2000 bus was successful, the nominal bit rate (`Nom.`) and the sample point (`SP used`) required for further measurements are displayed. The result or configuration is saved.



Measurement results NMEA 2000

If the `Bit Rate` function is left and called up again later, the values may appear color coded:

Status	Meaning
green	Bit rate verified. CAN frames are received without errors.
gray	Bit rate cannot be verified. No CAN frames or errors are received. No active connection to a CAN bus.
yellow	CAN frames are received with errors.
red	Error rate too high. Check if the configured bit rate of the PEAK-MiniDiag NMEA 2000 matches the bit rate of the network.

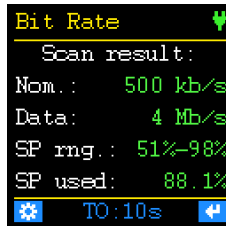


Tip: If the measurement of the bit rate remains unsuccessful, check the termination under `Termination` and the voltage values on the NET lines under `Net Voltages`.

3.9.1 CAN FD Support

The PEAK-MiniDiag NMEA 2000 supports the CAN FD standard (CAN with Flexible Data rate) which is **not used** by NMEA 2000.


CAN FD is primarily characterized by higher bandwidth for data transfer. The maximum of 64 data bytes per CAN FD frame instead of 8 can be transmitted with an additional, higher data bit rate. The automatic detection of the bit rate is done with the CAN FD ISO protocol and is therefore capable of detecting the data bit rate if CAN FD traffic occurs on the bus.




Measurement results CAN FD

If the measurement was successful, the data bit rate (`Data`) and the sample point range (`SP rng.`) are listed in addition to the nominal bit rate (`Nom.`) and the sample point (`SP used`). The detection range of the function is from 10 kbit/s to 8 Mbit/s.

3.9.2 Available Options

The following options are available via the gear wheel key :

Bit Rate

The automatic detection or the manual configuration of the bit rate can be selected. The setting `auto-detect` is set by default. You can use the arrow keys to change to `user-defined` and confirm this setting with the Enter key , the configuration can be entered manually.

Scan timeout (TO)


A time from 1 to 20 seconds can be set in which the PEAK-MiniDiag NMEA 2000 waits for incoming CAN messages. The option appears after confirming the setting `auto-detect`. The selected time is displayed in the function `Bit Rate` in the info bar under the abbreviation `TO`.

3.9.3 Status Messages

The PEAK-MiniDiag NMEA 2000 outputs the following status messages during or after an unsuccessful measurement of the bit rate:

Status Message	Meaning
Capturing data. 10 to 50 frames required.	Device is measuring and data is still being collected. 10 to 50 CAN frames are required by the PEAK-MiniDiag NMEA 2000 to determine the bit rate. The message is an indication of little CAN traffic on the CAN bus.
No CAN activity detected. No bit rate scan possible.	The device cannot detect any CAN traffic. Make sure that the PEAK-MiniDiag NMEA 2000 is properly connected and the bus is terminated.
Not enough CAN frames detected. Please increase the scan time or CAN frame rate.	The PEAK-MiniDiag NMEA 2000 has received too few CAN frames. Select the maximum measurement time of 20 seconds using the Scan timeout setting. If the search for the bit rate continues to fail, increase the number of CAN frames on the bus or configure the bit rate manually.
Calculation of bit rate is not possible.	Causes for this status message can be too many error frames, different bit rates, or disturbances such as voltage peaks on the CAN bus.

3.9.4 Manual Configuration

The manual configuration is started after confirmation of the setting user-defined with the Enter key . Therefore, the following CAN and CAN FD options are queried one after the other:

CAN Options

Nominal BR: The nominal bit rate for CAN frames from 10 kbit/s up to 1 Mbit/s has to be set.



Note: The default bit rate for NMEA 2000 networks is 250 kbit/s.

Nominal SP: The sample point for the nominal bit rate from 50 to 99.9 percent has to be set.

Enable CAN FD: CAN FD is enabled with `yes`. This is followed by CAN FD options. If `no` is selected, the configuration is completed.



Note: CAN FD is not used for NMEA 2000 networks.

CAN FD Options

Enable Data BR: A data bit rate for CAN FD frames is enabled with `yes`. In addition, the following options appear: `Data BR` and `Data SP`. With `no`, the set nominal bit rate is also used for the data part of CAN FD frames.

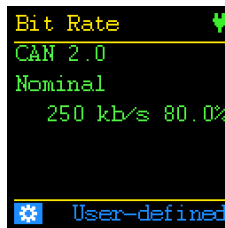
CAN FD ISO mode: The protocol CAN FD ISO (`on`) or CAN FD non-ISO (`off`) has to be set.



Note: CAN FD ISO corresponds to the in 2015 standardized CAN FD standard ISO 11899-1:2015. CAN FD non-ISO was the first protocol from Bosch and was implemented for a short time by some chip manufacturers.

Data BR: The data bit rate for CAN FD frames from 66.6 kbit/s up to 10 Mbit/s has to be set.

Data SP: The sample point for the data bit rate from 50 to 99.9 percent has to be set.



Screen after manual configuration for NMEA 2000 network

3.10 Bus Load

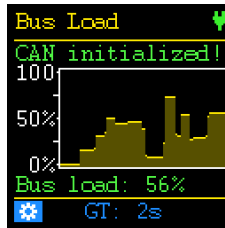
With the `Bus Load` function, the bus load on the NMEA 2000 bus is represented by percentage value(s) and a progression chart. The bus load progress is represented by a graph whose speed is influenced by the set measurement time (`GT`). The function adapts depending on whether the CAN controller is initialized (`CAN initialized!`) or not (`Not initialized!`). The following subchapters describe the two measurements.



Note: An exact bus load measurement is only possible if the bit rate has been configured correctly before. If this has failed, the bus load measurement can provide further indications for a diagnosis without initializing the CAN controller.

3.10.1 Initialized CAN Controller

The CAN controller is initialized (`CAN initialized!`) when a bit rate has been set by using the `Bit Rate` function. Then the `Bus Load` function calculates the percentage bus load (`Bus load:`) from the ratio of the set measurement time (`GT`) and the measured total time of the CAN frames on the NMEA 2000 bus.

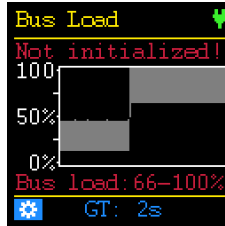


Bus load measurement with existing connection to an active NMEA 2000 bus

All values are reset when the PEAK-MiniDiag NMEA 2000 is switched off or when the function is exited.

3.10.2 Non-Initialized CAN Controller

If the CAN controller has not been initialized (Not initialized!), a value range for the bus load is displayed in the Bus Load function. Within this range lies the exact bus load value. This is made possible by measuring the duration of the dominant states on the NMEA 2000 bus. The number of recessive states of the CAN frames has to be estimated. The calculated total time of the CAN frames within the set measuring time (GT) results in the percentage value range after Bus load: and in the graph.




Bus load measurement with non-initialized CAN controller

The measurement without an initialized CAN controller can provide further indications for a diagnosis. If the percentage value is greater 0, the NMEA 2000 bus is active (dominant). If the percentage value equals 0, the NMEA 2000 bus is in idle state (recessive) or not in operation.

All values are reset when the PEAK-MiniDiag NMEA 2000 is switched off or when the function is exited.

3.10.3 Available Options


The following option is available via the gear wheel key :

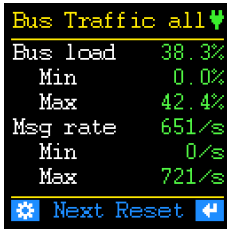
Gating time (GT)

A time span from 0.5 to 15 seconds for measuring the bus load is set.

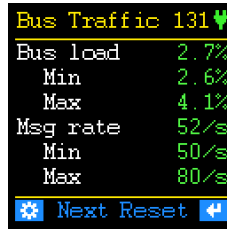
3.11 Bus Traffic

The `Bus Traffic` function displays the total bus load in percent and the CAN messages per second for all or single devices. The measured values can only be displayed completely after the bit rate has been successfully determined. Then the current `Bus load` as well as the minimum (`Min`) and maximum (`Max`) bus load since the start of the measurement are displayed. The message rate (`Msg rate`) and the minimum (`Min`) and maximum (`Max`) message rate since the start of the measurement are also displayed.

The gear wheel key  (`Next`) displays the values for each detected device on the NMEA 2000 bus. Instead of `all`, the Network Node Address of the device is then indicated on the top right next to the supply icon.




Bus Traffic for all devices



Bus Traffic for the single device 131

Measurement	Measurement Range	Status
Bus Traffic (% bandwidth)	0 to 79	OK
	80 to 89	Warning
	≥ 90	Error

All values are reset by the Enter key  (`Reset`), when the PEAK-MiniDiag NMEA 2000 is switched off, or when the function is exited.

3.12 Bus Errors

The `Bus Errors` function displays errors per second occurring during data transmission on the NMEA 2000 bus in real time. Besides the current value (`Val`), the function shows the minimum (`Min`) and maximum (`Max`) error rate as well as the total number of occurred errors (`All`) since the beginning of the recording. From an error rate of more than 10/s, the reason should be determined to avoid impairment of the NMEA 2000 bus.

```
Bus Errors  ⬇
Val:      4/s
Min:      0/s
Max:      7/s
All:      26
Reset  ⬅
```

Screen Bus Errors

Measurement	Measurement Range	Status
Bus Errors (errors/second)	0	OK
	1 to 15	Warning
	> 15	Error
Bus Errors All	0	OK
	> 0	Warning

All values are reset by the Enter key `↵` (`Reset`), when the PEAK-MiniDiag NMEA 2000 is switched off, or when the function is exited. No options are available for this function.

4 Firmware Upload

A new firmware version can be transferred to the PEAK-MiniDiag NMEA 2000. The firmware is uploaded via a CAN bus using the Windows software PEAK-Flash.



Note: A firmware upload to the PEAK-MiniDiag NMEA 2000 should only be performed with battery supply and a direct connection from a computer to the PEAK-MiniDiag NMEA 2000.

The PEAK-MiniDiag NMEA 2000 disables the listen-only mode for the required bootloader operation mode and can thus generate interfering CAN communication on the NMEA 2000 bus. In addition, the current consumption rises.

4.1 System Requirements

- CAN interface of the PCAN series for the computer, for example PCAN-USB
- CAN cabling between the CAN interface and the PEAK-MiniDiag NMEA 2000 with correct termination at both ends of the CAN bus with 120 Ohm each
- Operating system Windows 11 (x64/ARM64), 10 (x86/x64)

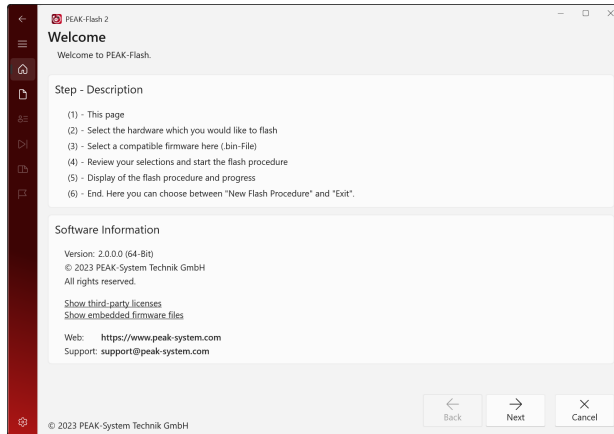
4.2 Firmware Transfer

You can download the PEAK-Flash software via the following link:




<https://www.peak-system.com/quick/DL-Software-E>

1. Open the zip file and extract it to your local storage medium.
2. Run the `PEAK-Flash.exe`.

The main window of PEAK-Flash appears.

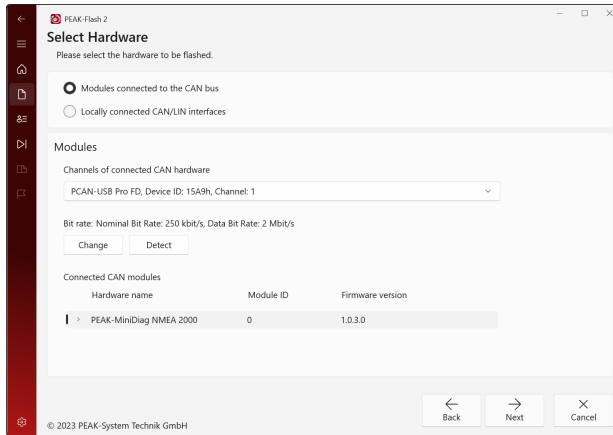


Tip: You can click on the *Show embedded firmware files* link. In the list you can then see which firmware version is currently available.

3. Set the PEAK-MiniDiag NMEA 2000 to bootloader mode. If the device is switched off, hold down the arrow keys   and the Enter key  until the Bootloader appears.

Alternatively, the bootloader can be started in the `System Info` function via the `Call bootloader` option set to `yes`.

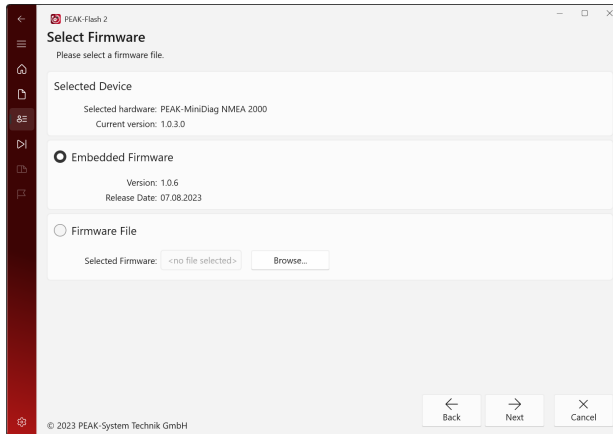
- Click the button *Next*.
The *Select Hardware* window appears.




- Click on the *Modules connected to the CAN bus* radio button.
- In the drop-down menu *Channels of connected CAN hardware*, select a CAN interface connected to the computer.
- In the drop-down menu *Bit rate*, select the nominal bit rate 250 kbit/s.
- Click on *Detect*.
In the list, the PEAK-MiniDiag NMEA 2000 appears with the firmware version. If not, check whether a proper connection to the CAN bus with the corresponding nominal bit rate exists and whether the CAN bootloader is active on the PEAK-MiniDiag NMEA 2000.

9. Click *Next*.

The *Select Firmware* window appears.



10. Select the *Embedded Firmware* radio button.
11. Click *Next*.
12. Click *Start* to transfer the new firmware to the PEAK-MiniDiag NMEA 2000. The *Flashing* dialog appears.
13. After the process is complete, click *Next*.
14. You can exit the program.
15. When the bootloader is finished, the PEAK-MiniDiag NMEA 2000 must be restarted via the Enter key .

Check under the function *System Info* whether the current version is displayed next to *Firmware*. You can now use the PEAK-MiniDiag NMEA 2000 with the new firmware.

5 Technical Specifications

Supply

Current consumption	
Regular operation:	max. 25 mA at 12 V; LEN 1
Bootloader operation:	max. 100 mA
Voltage supply	7 V to 24 V (NMEA 2000 connecting cable) or 3 x Micro AAA with 1.2 or 1.5 Volt, replaceable
Operating time with batteries	approx. 10 h

D-Sub Connector

Function	CAN and supply connector
Number of pins	9-pole

CAN

Specification	CAN FD ISO 11898-1:2015, CAN FD non-ISO, CAN 2.0 A/B
Physical transmission	ISO 11898-2 (High-speed CAN)
CAN bit rates	10 kbit/s to 1 Mbit/s
CAN FD bit rates	66.6 kbit/s to 10 Mbit/s
Transceiver	MCP2558FD
Listen-only mode	Active while regular operation. Not active when performing a firmware update.

Measurement Function	Measurement Range	Accuracy
Bit timing measurement to detect the bit rate	10 kbit/s to 8 Mbit/s	-/-
Voltage at pin 9	-40 to +40 V	±1 %
Voltages at pins 2 and 7 (NET-Low and NET-High)	-7 to +10 V	±1 %
Termination	10 Ω to 1 kΩ	±1 % ±3 Ω

Screen

Display type	OLED (RGB) Attention! Protect the OLED display from longer exposure to direct sunlight!
Resolution	128 x 128 pixel

Dimensions

Size	121.9 x 69 x 42.4 mm (W x H x D)
Weight (with batteries)	164 g
Weight (without batteries)	130 g

Environment

Operating temperature	With supplied batteries: -10 to +50 °C (14 to 122 °F) Without supplied batteries: -20 to +70 °C (-4 to +158 °F)
Temperature for storage and transport	-30 to +80 °C (-22 to +176 °F) (without batteries)
Relative humidity	15 to 90 %, not condensing
Ingress protection (DIN EN 60529)	IP42

Conformity

RoHS 2	EU Directive 2011/65/EU (RoHS 2) + 2015/863/EU DIN EN IEC 63000:2019-05
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EMC	EU Directive 2014/30/EU DIN EN 61326-1:2013-07
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Appendix A CE Certificate

EU Declaration of Conformity



This declaration applies to the following product:

Product name: **PEAK-MiniDiag NMEA 2000**
Item number(s): **MPEH-001011**
Manufacturer: PEAK-System Technik GmbH
Otto-Röhm-Straße 69
64293 Darmstadt
Germany



We declare under our sole responsibility that the mentioned product is in conformity with the following directives and the affiliated harmonized standards:

EU Directive 2011/65/EU (RoHS 2) + 2015/863/EU (amended list of restricted substances)

DIN EN IEC 63000:2019-05

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016);
German version of EN IEC 63000:2018

EU Directive 2014/30/EU (Electromagnetic Compatibility)

DIN EN 61326-1:2022-11

Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2020);
German version of EN IEC 61326-1:2021

Darmstadt, 18 August 2023

A handwritten signature in black ink, appearing to read "Uwe Wilhelm".

Uwe Wilhelm, Managing Director

Appendix B UKCA Certificate

UK Declaration of Conformity



This declaration applies to the following product:

Product name: **PEAK-MiniDiag NMEA 2000**

Item number(s): **MPEH-001011**

Manufacturer:

PEAK-System Technik GmbH
Otto-Röhm-Straße 69
64293 Darmstadt
Germany

UK authorized representative:

Control Technologies UK Ltd
Unit 1, Stoke Mill,
Mill Road, Sharnbrook,
Bedfordshire, MK44 1NN, UK



We declare under our sole responsibility that the mentioned product is in conformity with the following UK legislations and the affiliated harmonized standards:

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

DIN EN IEC 63000:2019-05

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016);
German version of EN IEC 63000:2018

Electromagnetic Compatibility Regulations 2016

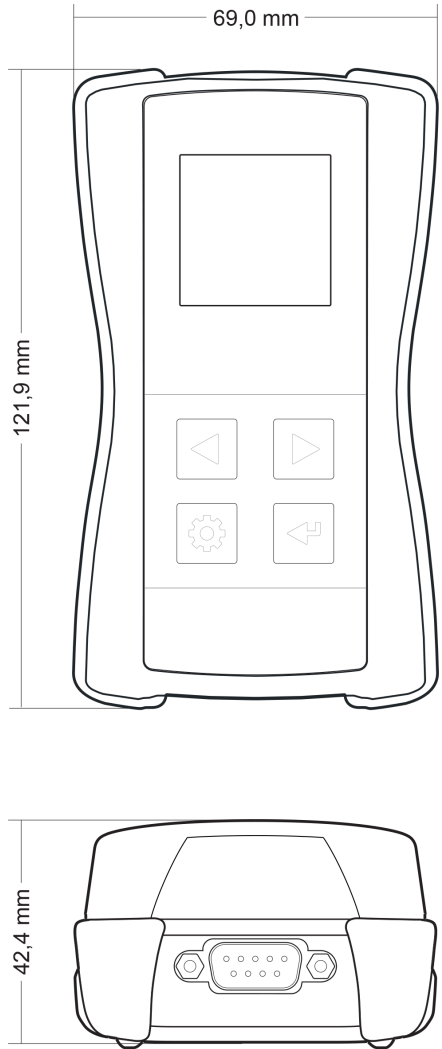
DIN EN 61326-1:2022-11

Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2020);
German version of EN IEC 61326-1:2021

Darmstadt, 18 August 2023

Uwe Wilhelm, Managing Director

Appendix C Dimension Drawing



Appendix D Signal Level of a NMEA 2000 Bus

The PEAK-MiniDiag NMEA 2000 provides two device functions for checking the NET lines NET-High and NET-Low. This appendix provides a brief explanation of the interpretation of the measurement results.

Basically, a distinction is made between the recessive (passive) and the dominant (active) state for the signal level of a NMEA 2000 bus. In the recessive state, the voltages of the two lines NET-High and NET-Low are approximately 2.5 volts.

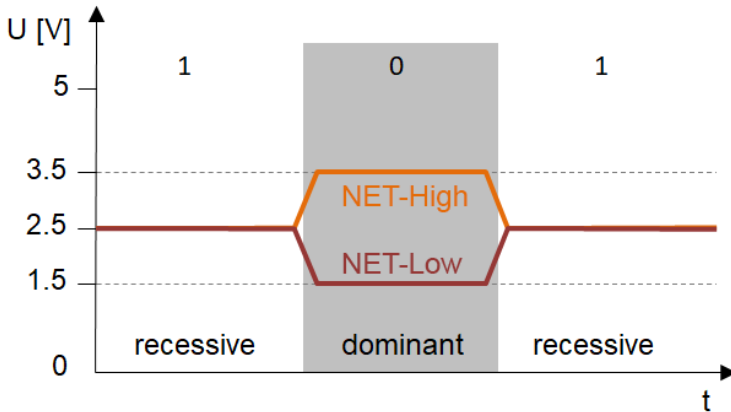


Diagram of the recessive and dominant signal levels on the NMEA 2000 bus

When the recessive changes to the dominant state, NET-High rises and NET-Low falls by 1 volt each. The voltage difference between NET-High and NET-Low is 0 volt in the recessive state and 2 volts in the dominant state.

Appendix E Thresholds

Measurement	Measurement Range	Status
NET-High	-2 V to +8.5 V	OK
	+8.5 V to +9.5 V or -3 V to -2 V	Warning
	> +9.5 V or < -3 V	Error
NET-Low	-3 V to +7 V	OK
	+7 V to +8.5 V or -4.5 V to -3 V	Warning
	> +8.5 V or < -4.5 V	Error
Recessive NET-Low	-2 V to +7 V	OK
Recessive NET-High	-3 V to -2 V or +7 V to +8.5 V	Warning
	< -3 V or > +8.5 V	Error
Recessive Differential	-0.18 V to +0.08 V	OK
	< -0.18 V or > +0.08 V	Error
Dominant NET-Low	-3.5 V to +6.25 V	OK
	-4.3 V to -3.5 V or +6.25 V to +7.75 V	Warning
	< -4.5 V or > +7.75 V	Error
Dominant NET-High	-1.25 V to +8.5 V	OK
	-2.25 V to -1.25 V or +8.5 V to +10 V	Warning
	< -2.25 V or > +10 V	Error
Dominant Differential	+1.45 V to +2.75 V	OK
	+1.2 V to +1.45 V or +2.75 V to +3 V	Warning
	< +1.2 V or > +3 V	Error

Measurement	Measurement Range	Status
Common Mode Voltage	-2.5 V to +2.5 V	OK
	-5.5 V to -2.5 V or +2.5 V to +5.5 V	Warning
	< -2.5 V or > +5.5 V	Error
Bus Power Voltage	+10 V to +15.75 V	OK
	+9 V to +10 V	Warning
	< +9 V or > +15.75 V	Error
Bus Power Voltage (P-P)	< +2 V	OK
	+2 V to +5 V	Warning
	> +5 V	Error
Shield Voltage	-2 V to +0.3 V	OK
	-2.5 V to -2 V or +0.3 V to +1 V	Warning
	< -2.5 V or > +1 V	Error
Bus Errors (errors/second)	0	OK
	1 to 15	Warning
	> 15	Error
Bus Errors All	0	OK
	> 0	Warning
	0 to 79	OK
Bus Traffic (% bandwidth)	80 to 89	Warning
	≥ 90	Error
Termination (Ω)	44 Ω to 67 Ω	OK
	40 Ω to 44 Ω or 67 Ω to 128 Ω	Warning
	< 40 Ω or > 128 Ω	Error

Appendix F Disposal

The PEAK-MiniDiag NMEA 2000 and the batteries it contains must not be disposed of with household waste. Remove the batteries from the PEAK-MiniDiag NMEA 2000 and dispose of the batteries and the PEAK-MiniDiag NMEA 2000 separately and properly, according to local guidelines.

The PEAK-MiniDiag NMEA 2000 contains the following batteries/rechargeable batteries:

- 3 x Micro AAA with 1.5 Volt not-rechargeable batteries or
- 3 x Micro AAA with 1.2 Volt rechargeable batteries