G CAR 6282

Manual (Original documentation)

GOPEL electronics
Enjoy Testing

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1 Introduction

1.1 Notes on this document

This document applies only to the device type **G CAR 6282** . Any handling of the device requires the exact knowledge and observance of this manual. The operational safety and the function of the device can only be guaranteed if both the general safety and accident prevention regulations of the legislator and the safety instructions in the manual are observed.

The manual is part of the product. Please make sure that all persons who operate the device have read and understood the manual. Keep the manual in a safe place so that it can be used whenever needed.

This guide highlights some important comments as follows:

Symbol	Description
	**Warning** that indicates risk situations and dangers. Disregard can lead to life-threatening situations.
	**Information** that indicates certain aspects or is important for a particular topic or goal.
	**Tip** that gives useful hints or recommendations.

Table 1.1 Symbols

1.2 Intended Use

The **G CAR 6282** is a programmable, intelligent multibus controller with various communication interfaces for automotive and general control technology. Typical applications are:

- Communication with various bus users via CAN/ CAN FD, LIN/ K-Line, FlexRay or Automotive Ethernet for data acquisition and signal control
- Residual bus simulation and test of complex control units
- Application of transport and diagnostic protocols, network management, XCP, SecOC etc. directly on the hardware
- Flashing of control units

If you use the device for any purpose for which it is not intended, the **GOEPEL electronics GmbH** can not be held liable for resulting damage.

The device is intended for indoor use only and to be used only at an ambient temperature of 0 ° C - +45 ° C. It must not be exposed to extreme temperatures, temperature fluctuations, heating and cooling systems, direct sunlight, high levels of dust, vibration and impact, extreme humidity or moisture.

The device is only to be used in a technically perfect condition as well as in accordance with its intended use, in a safety-conscious and hazard-conscious manner, observing the operating instructions! In particular, faults that may affect safety must be rectified immediately!

1.3 EMC Protection Measures

The **G CAR 6282** Multibus Controller complies with the Electromagnetic Compatibility Directive (2014/30/EU).

In order to comply with the electromagnetic compatibility, the system may only be operated in the delivered condition. Mechanical and electrical changes of any kind are not allowed. Use only suitable shielded signal and control cables.

If the product is installed and operated in a system with other equipment, accessories and components, the system as a whole and all its equipment, accessories and components must conform to the EMC directives and standards. The system integrator is responsible for compliance with the EMC Directive 2014/30/EU and national EMC laws for installed systems, system accessories and system components that have not been supplied or tested and approved by **GOEPEL electronics** as manufacturer of the equipment.

1.4 EU Declaration of Conformity

The EU Declaration of Conformity can be found in the appendix to this documentation.

1.5 General Safety Regulations

To avoid personal injury and / or property damage, follow these general safety instructions.

Risk of accident due to electric shock or fire

- In addition to the operating instructions, observe the legal requirements and regulations for accident prevention and environmental protection of the countries in which you operate the system.
- Do not make any changes to the system without the written consent of the manufacturer.
- Never operate damaged devices or components.
- Keep liquids away from the unit and do not place any containers with liquid on the unit.

Danger of tripping or falling due to improperly laid cables

- Lay cables so that nobody can step on them or trip over them.
- Never try to stretch cables to enable a connection. The cables must always have enough clearance.

Damage caused by improper use or failure to observe the safety instructions and warnings is not covered by the warranty. For consequential damages no liability is assumed by **GOEPEL electronics**!

1.6 Liability and Warranty Exclusion

The **G CAR 6282** has not been developed, tested or intended for use in safety-related applications. Do not use the device for safety-related systems or vehicle subsystems. The use of such a device within motor vehicles to control the main vehicle functions can be dangerous and lead to malfunction of motor vehicles.

In no event shall **GOEPEL electronics** be responsible for any direct, indirect, incidental, special, exemplary, or consequential damages (including but not limited to the purchase of replacement goods or services, loss of use, loss of data or profit, breakdowns, injury, or potential death) in any way in the case of improper use of the **G CAR 6282** Multibus Controllers.

1.7 Supplied Accessories

As accessories to **G CAR 6282** Multibus Controller you get:

- **Series 62** Multibus Controller as a **G CAR 6282** Stand-alone-Box
- CD with driver, software and manual
- RJ45 ethernet cable
- Power supply

2 Commissioning

2.1 Hardware Installation

Please make sure that **all** hardware installation work is done while the system is off! The power supply should be disconnected.

The hardware installation of the stand-alone box **G CAR 6282** is limited to the connection of the power supply and the connection to the control computer. The **G CAR 6282** Multibus Controller starts automatically when the power supply is switched on.

Please use the included LAN cable to connect the stand-alone box **G CAR 6282** to the ethernet interface of the PC. Other cables may not be suitable!

2.2 Driver Installation

The **G CAR 6282** Multibus Controller can be operated under Windows 7, 8 and 10 as well as under Linux.

2.2.1 USB

To set up the USB drivers on your system, the **GUSB** driver setup must be run. To do this, start the setup program ***G-USB-Setup-*.exe*** on the supplied product CD and follow the instructions.

2.2.2 G-API

The **G-API** (Goepel electronics Application Programming Interface) is a software interface. It supports various hardware products from **GOEPEL electronics** and gives the user the opportunity to integrate them into their own applications. The enclosed CD contains the setup for installing the **G-API** , which will guide you through the Hardware Wizard. For more information about **G-API** , its installation and about the **HardwareExplorer** , see the **G-API Quickstart Guide** .

2.2.3 Ethernet

When using the ethernet interface, no driver installation is required to communicate with the control computer. The device can be addressed directly via the IP address. However, to address the device, you will need a network adapter that has a valid IP address and subnet mask. Otherwise the PC / Laptop will not be able to communicate with the **G CAR 6282** Multibus Controller in the network.

For this setup, open the "Properties" dialog of the corresponding network adapter and select "Internet Protocol Version 4 (TCP / IPv4)".

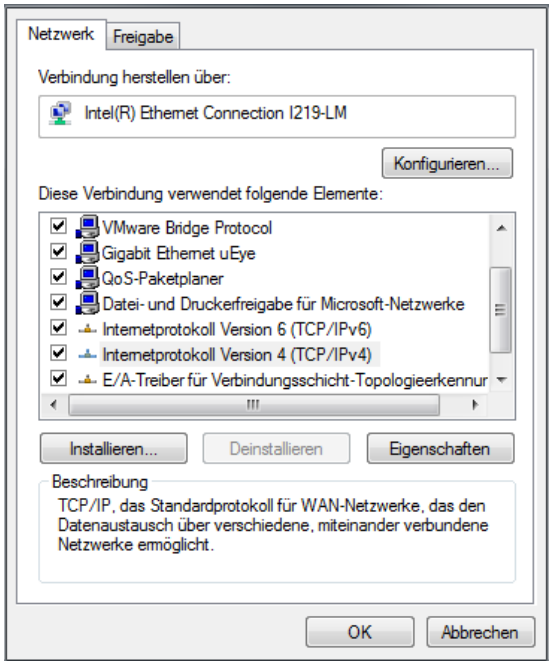

Figure 2.1 Properties of the network adapter

Put a tick next to "Use the following IP address" and set the IP address and subnet mask according to the following rules:

- The IP-Address of the **G CAR 6282** Multibus Controller must be different from that of the network adapter.
- The subnet mask must be set to a value such that both IP addresses (**G CAR 6282** Multibus Controller and network adapter) are located in the same subnet.

Example:
The default IP address of the **G CAR 6282** Multibus Controllers is 192.168.1.62 (Port 5134). For example, if you set your network device to IP address 192.168.1.1 and the subnet mask to 255.255.255.0, then both devices are now on the same subnet 192.168.1.xyz.

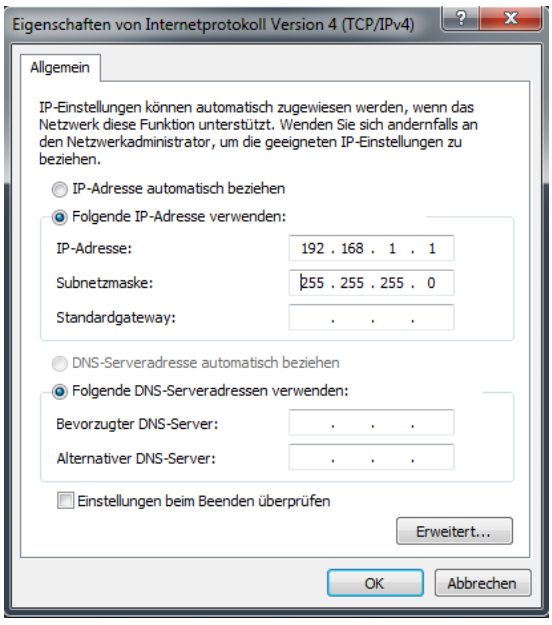

Figure 2.2 Example IP address of the network adapter

After the network adapter has been set up correctly, the **G CAR 6282** Multibus Controller can be addressed directly after its hardware installation via its IP address. The IP address of the **G CAR 6282** Multibus Controllers can be changed by means of the **HardwareExplorers** , whereby the entered IP address only becomes effective after a successful restart.

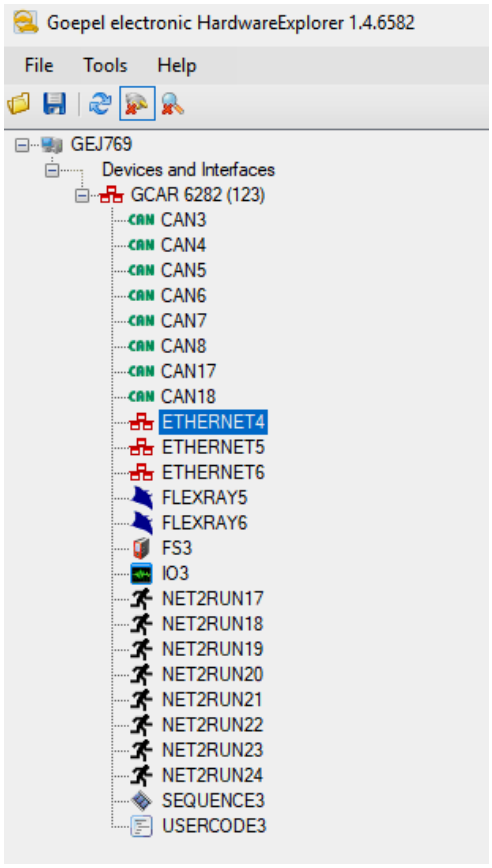

Figure 2.3 HardwareExplorer with **G CAR 6282** Multibus Controller

A second way to change the IP address is to use the **G-API** command `G_Common_Ethernet_IpAddress_Set`. The new IP address is effective after a restart.

It is necessary to change the static IP address if you want to operate several **Series 62** Multibus Controllers or other **GOEPEL electronics** devices (such as **basicCAN 61xx**) in the same network. In this case, always connect only the device whose IP address is to be changed and change it. Make a note of the new IP addresses and the associated serial numbers if you need this information again later. If all devices have different IP addresses, they can be operated together on the same network.

2.3 Firmware Update

Please make sure to use the correct firmware variant when updating the firmware. The installation of the wrong firmware variant could lead to a loss of functionality and thus cause malfunctions of your application. (In such a case, reinstalling the correct firmware variant can restore the functionality.)

To update the firmware, do the following:

- Download the latest firmware update file from genesis.goepel.com
- Open the **GOEPEL electronics HardwareExplorer**
- Right-click on the selected device (for example G CAR 6282) and select "Flash Firmware"
- Select the appropriate update file in the selection window and confirm with "OK"

- Confirm after successful flashing with "OK"

2.4 Change of the Transceiver

If it is necessary to replace a transceiver, observe the general rules for avoiding electrostatic charge. A correctly positioned plugging in the transceiver must be realized.

Please make sure that **alle** hardware installation work is done while the system is off! The power supply should be disconnected.

To change your transceiver, follow these steps:

1. Loosen the four screws on the underside of the device and carefully remove the bottom plate. You now have direct access to the transceiver slots.
2. Then pull the appropriate transceiver away from the motherboard without tilting it.
3. Plug the new transceiver into the connector on the motherboard. When plugging in the transceivers, please pay attention to their position and orientation. The Automotive Ethernet transceivers can only be plugged into the slots TRX17 and TRX18. There are two connectors per slot required for communication with the Automotive Ethernet transceivers.
4. Place the bottom plate back on the bottom of the unit and press firmly. Finally secure the bottom plate with the four screws.

Figure 2.4 Change of the transceiver

3 Technical Description

3.1 Product Description

The **G CAR 6282** Multibus Controller is an industrial test system from **GOEPEL electronics** with a wide range of applications and high flexibility. This test system has been specially adapted to the needs and transmission standards in the vehicle sector.

The following features make the **G CAR 6282** Multibus Controller an extremely versatile automotive test system:

- Xilinx MPSoC with Quad-Core ARM Cortex A53 Processor
- 4 GByte DDR4 RAM and 8 GByte eMMC
- Gigabit Ethernet interface for control and data exchange with the PC
- Independent, freely configurable bus interfaces for the technical adaptation of the system to the test environment
- Universal analog and digital I/O and SENT interfaces for triggering or status output, as well as for interaction with test objects
- Support of transport and diagnostic protocols, network management, XCP, SecOC etc. directly on the hardware
- State visualization by LEDs
- Possibility of high-performance flashing of control units
- Real-time clock for time synchronization

3.2 Overview of G CAR 6282 Multibus Controller

The **G CAR 6282** Multibus Controller was developed as a stand-alone device for independent use outside of complex test systems. To operate this device, an external power supply of 12..30 VDC is required. For this purpose, an external 12V DC power adapter is included in the delivery, which is connected to the host side of the device.

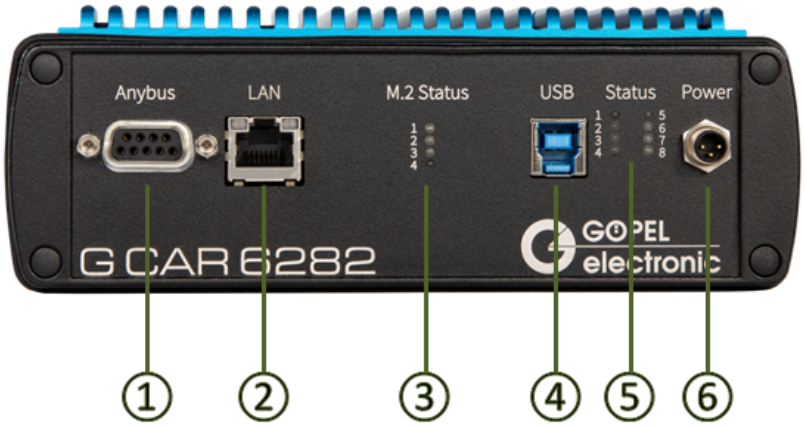

Figure 3.1 Host Side

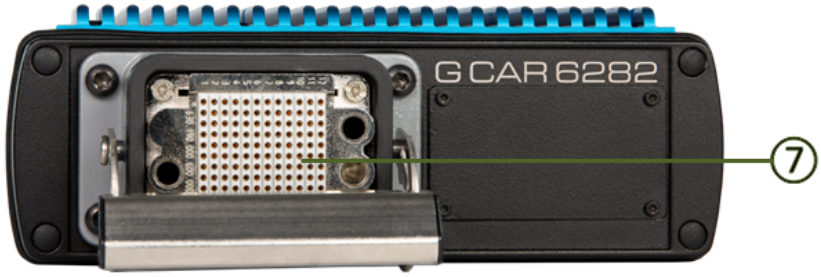

Figure 3.2 DUT Side

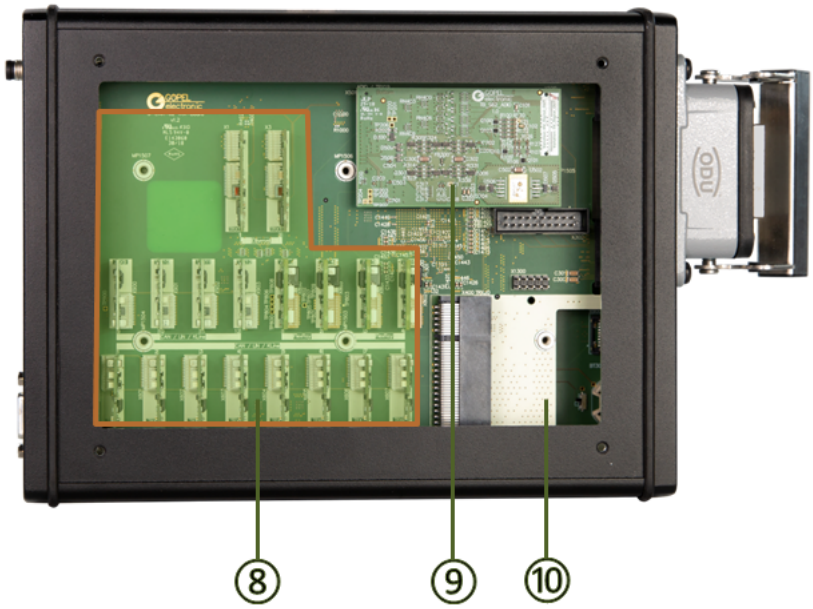

Figure 3.3 Transceiver

Position	Description
1	Socket "Anybus" (reserved)
2	Socket "LAN"
3	M.2 Status LEDs
4	Socket "USB"
5	Status LEDs
6	Socket "Power Supply"
7	Socket "ODU"
8	Steckplätze "Onboard Interfaces"
9	Steckplatz "Multi I/O Expansion Board"
10	Extension Board "Automotive Ethernet"

Table 3.1 Components of the **G CAR 6282**

3.3 Technical Specifications

3.3.1 General Specifications

Property	Value	Unit	Comment
Processor	Zynq UltraScale+ MPSOC		
RAM	4	GByte	DDR4
Flash eMMC	8	GByte	
Operating temperature	0 .. +50	°C	
Protection class	IP 40		
Dimensions	280 x 170 x 65	mm^3	L x B x H
Weight	2000	g	

Table 3.2 General specifications

3.3.2 General Electrical Specifications

The following table shows the general electrical characteristics of the **G CAR 6282** Multibus Controller. The electrical characteristics of the individual bus interfaces are listed in the respective chapters. The standardized Ethernet interface is not described additionally in this document.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
U_{SS}	Supply voltage	12	12	30	V	
I_{SS}	Supply current	0.8	1.2	2	A	
P_{SS}	Power consumption	10	15	24	W	

Table 3.3 General electrical specifications

3.4 Design and Function

The **G CAR 6282** Controller has been developed as a highly flexible multibus controller platform. It offers up to 19 serial bus interfaces and another 48 digital and analog I/O interfaces. The bus interfaces can be configured in numerous variants. Each bus interface has a transceiver slot assigned to it, with the respectively inserted transceiver determining the type of interface of the associated node. If e.g. a CAN transceiver is plugged into slot TXR5, this node forms the interface CAN5 (ID 5). If instead a LIN transceiver inserts, this node forms the interface LIN5 (ID 64). The software addresses the interfaces according to the ID (ID 5 and ID 64 in this example).

The number of Automotive Ethernet interfaces (maximum two onboard) can be increased by three additional nodes via an expansion board.

The base board of the **Series 62** Multibus Controllers offers four digital outputs. Plugging in a Multi-IO Module adds 16 digital inputs, 12 digital outputs, as well as 8 analog inputs and 8 analog outputs. From the digital inputs and outputs, two can be reconfigured to SENT Rx and four to SENT Tx.

On the DUT side of the controller board, there is a ODU Connector through which the connections of all bus interfaces as well as inputs and outputs are routed.

The host side of the device is equipped with the connectors for Ethernet, USB and Power Supply. In addition, you will find eight status LEDs that indicate the operating status of the controller board and four additional LEDs for the M.2 status. The **G CAR 6282** also has an Anybus expansion module whose DSUB-9 connector is also on the host side.

3.4.1 Block Diagram

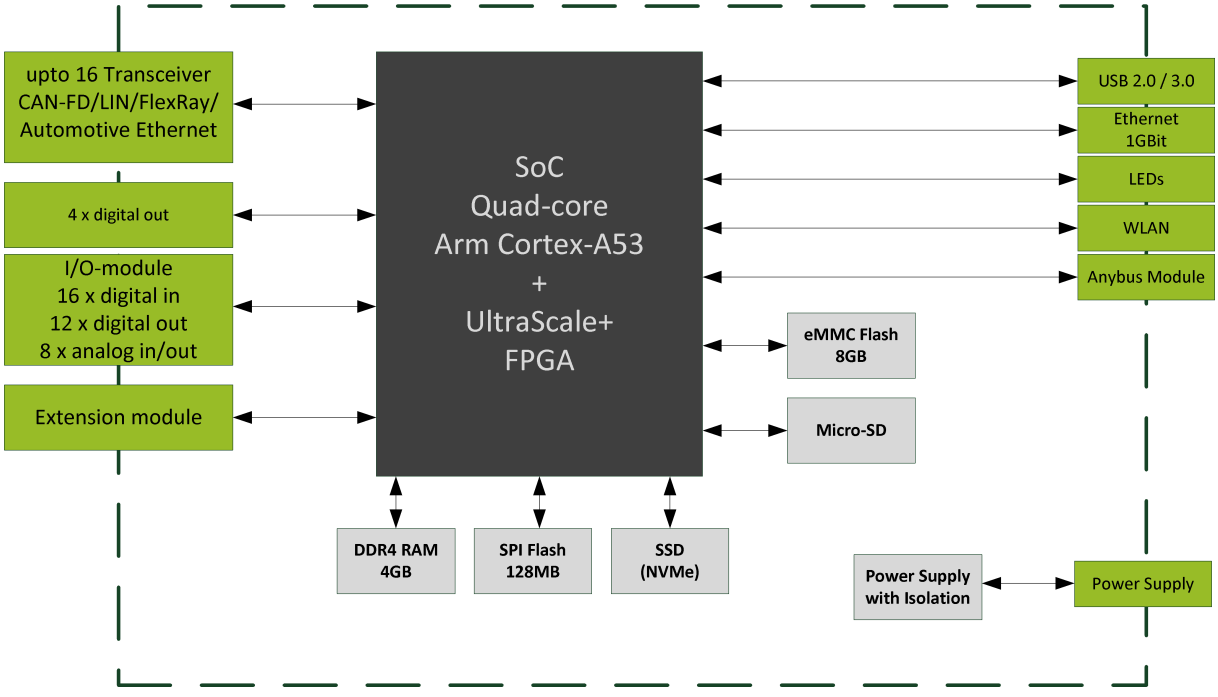

Figure 3.4 Block diagram of the **G CAR 6282** Multibus Controller

3.4.2 Pin Assignment

A **ODU** connector is provided for connecting the communication interfaces (see next page). The table is designed so that the table rows and columns correspond exactly to the pin matrix of the ODU.

	A	B	C	D	E	F	G	H	I	K
12	Analog_OUT7	Analog_OUT8	Analog_IN1	Analog_IN2	Analog_IN3	Analog_IN4	Analog_IN5	Analog_IN6	Analog_IN7	Analog_IN8
11	UBAT_TRV_9-12	UBAT_TRV_1-8	UBAT_ADIO	GND_A_OUT	Analog_OUT1	Analog_OUT2	Analog_OUT3	Analog_OUT4	Analog_OUT5	Analog_OUT6
10	GND	SYNC_CLK_OUT	SYNC	SYNC_CLK_IN	GND	GND	GND	GND	GND	GND_A_IN
9	TRV_Slot17_P	TRV_Slot17_N	TRV_Slot18_P	TRV_Slot18_N	ExtC_0_P	ExtC_0_N	ExtC_1_P	ExtC_1_N	ExtC_2_P	ExtC_2_N
8	reserved_0	reserved_1	reserved_2	reserved_3	reserved_4	reserved_5	reserved_6	reserved_7	reserved_8	reserved_9
7	TRV_Slot12_H	TRV_Slot12_L	TRV_Slot13_H	TRV_Slot13_L	TRV_Slot14_H	TRV_Slot14_L	TRV_Slot15_H	TRV_Slot15_L	TRV_Slot16_H	TRV_Slot16_L
6	TRV_Slot7_H	TRV_Slot7_L	TRV_Slot8_H	TRV_Slot8_L	TRV_Slot9_H	TRV_Slot9_L	TRV_Slot10_H	TRV_Slot10_L	TRV_Slot11_H	TRV_Slot11_L
5	GND	GND	GND	reserved	TRV_Slot4_H	TRV_Slot4_L	TRV_Slot5_H	TRV_Slot5_L	TRV_Slot6_H	TRV_Slot6_L
4	Digital_IN14	Digital_IN15	Digital_IN16	GND	TRV_Slot1_H	TRV_Slot1_L	TRV_Slot2_H	TRV_Slot2_L	TRV_Slot3_H	TRV_Slot3_L
3	Digital_IN4	Digital_IN5	Digital_IN6	Digital_IN7	Digital_IN8	Digital_IN9	Digital_IN10	Digital_IN11	Digital_IN12	Digital_IN13
2	Digital_OUT11	Digital_OUT12	Digital_OUT13	Digital_OUT14	Digital_OUT15	Digital_OUT16	GND	Digital_IN1	Digital_IN2	Digital_IN3
1	Digital_OUT1	Digital_OUT2	Digital_OUT3	Digital_OUT4	Digital_OUT5	Digital_OUT6	Digital_OUT7	Digital_OUT8	Digital_OUT9	Digital_OUT10

TIP Always short the ground signals GND, GND_A_IN and GND_A_OUT close to the DUT.

Table 3.4 Pin assignment matrix of the ODU connector

Some pins of the connector are labeled **"TRV_Slot**"** . Here the signals of the Automotive Bus interfaces are led out. Depending on which transceiver or which bus interface is placed on the corresponding slot, the communication signals are placed on the corresponding TRV_Slot pins.

3.4.3 LAN/ Ethernet

The board has an RJ45 Ethernet socket for configuring and controlling the **G CAR 6282** Multibus Controller using a PC. The 1GBit Ethernet interface is either used to control the controller or can serve as a debug interface as well as for transferring large amounts of data (e.g., monitor data). An RJ45 Ethernet cable is already included.

3.4.4 LEDs/ Status Indication

The eight light-emitting diodes arranged between the USB and the voltage socket provide information about the current operating status of the **G CAR 6282** Multibus Controller. LED 1 to LED 4 can assume a green or red color state. These LEDs can be configured by the user (green) or additionally indicate errors when they occur on the device (light up permanently red). A brief flash of the LEDs while starting the instrument is normal. The display states of the status LEDs 1-4 are explained in the following table:

LED	Function GREEN	Function RED
1	User LED 1	Power Management System Error
2	User LED 2	FPGA 2 not loaded
3	User LED 3	Processing System Error
4	User LED 4	reserved

Table 3.5 Display states of the status LEDs 1-4

The display states of the status LEDs 5-8 indicate general status information and are explained in the following table:

LED5	LED6	LED7	LED8	Comment
constantly ON				Controller is not running (Error)
blinking alternately				Bootloader software is running
	blinking			Firmware is running
ON (shortly)				Execution of a firmware command for onboard interfaces
			ON	Ethernet connection established

Table 3.6 Display states of the status LEDs 5-8

In addition, the **G CAR 6282** Multibus Controller has four LEDs for displaying the M.2 status. The display states of the M.2 status LEDs are explained in the following table:

LED	Function
1	WIFI activity LED1
2	WIFI activity LED2
3	Extension Board active
4	reserved

Table 3.7 Display states of the M.2 status LEDs

3.4.5 Power Supply

An external supply is required to operate the **G CAR 6282** Multibus Controller. This includes an external 12VDC power adapter included in the delivery, which is connected to the host side of the device. The secondary side ground of the power supply is on earth. The power adapter has the following specifications:

Property	Value	Unit	Comment
Model	BET-0600		
Cable length	1.5	m	
AC Input voltage	90 .. 264	V	
DC Output voltage	12	V	
DC Output current	5000	mA	
Operating temperatur	-20 .. +60	°C	
Power	60	W	
Ripple	120	mV	Peak to peak
Weight	300	g	
Type of input connector	IEC socket		

Table 3.8 Specifications of the power adapter

The device-side connector is a 3-pin M8 socket from
PHOENIX CONTACT (Item No. 1456035; plug side: 1681172).

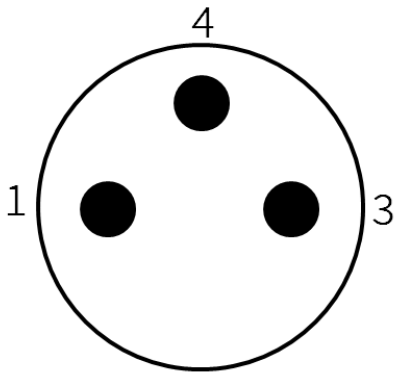

Figure 3.5 Schematic drawing of the socket of the power supply

The following table shows the pin assignment of the connector:

Pin	Signal
Housing	GND_SHELL
1	V_ISO_IN
3	GND_ISO_IN
4	GND_SHELL

Table 3.9 Pin assignment of the power supply

When delivered, **GND_SHELL** and **GND_ISO** are not connected. Between the two signals is only a 100nF / 250V ceramic capacitor. Please place the signal **GND_SHELL** on the test objects ground or earth.

3.4.6 Galvanic Isolation

Overvoltages can damage expensive test equipment or lead to unsafe test results. The potential separation protects against overvoltages and can suppress dangerous surges. It also prevents ground loops responsible for data errors due to ground potential differences.

On the **G CAR 6282** Multibus Controller, the host system is electrically isolated from the interfaces that go to the DUT. This includes the CAN/ CAN FD, LIN/ K-Line, Automotive Ethernet and FlexRay communication interfaces as well as the digital and analog inputs and outputs.

When using the galvanically isolated interfaces, please make sure to connect the separated ground (isolated, see Pin assignment matrix of the ODU connector) of the **G CAR 6282** power supply to the DUT ground.

3.5 Onboard Interfaces

The **G CAR 6282** Multibus Controller offers the possibility to use a total of 19 Automotive Bus interfaces. Transceivers are available for each bus (CAN/ CAN FD, LIN/ K-Line, FlexRay and Automotive Ethernet), which can be replaced with little effort in accordance with your test requirements (see Change of the Transceiver). Furthermore onboard four digital out signals are supported. Each transceiver type is coded and uniquely identifiable. Detailed information about the interfaces and how they are supported can be found on the following pages in the corresponding chapters.

Due to the large number of possible variants, how the various bus interfaces can be connected to the transceiver slots some variants were defined in order to be able to handle these on the firmware side. The **G CAR 6282** Multibus Controller can be equipped with these variants. On the software side the transceiver slots all have a unique assignment via which the interfaces are addressed. The interface options supported by the firmware variants can be found in the following table:

	Variant 1		Variant 2	
Slot	**Bus Interface**	**Software Interface**	**Bus Interface**	**Software Interface**
1	CAN_1	ID 1	CAN_1	ID 1
2	CAN_2	ID 2	CAN_2	ID 2
3	CAN_3	ID 3	CAN_3	ID 3
4	CAN_4	ID 4	CAN_4	ID 4
5	CAN_5	ID 5	LIN_5	ID 64
6	CAN_6	ID 6	LIN_6	ID 65
7	CAN_7	ID 7	LIN_7	ID 66
8	CAN_8	ID 8	LIN_8	ID 67
9	LIN_9	ID 68	LIN_9	ID 68
10	LIN_10	ID 69	LIN_10	ID 69
11	LIN_11	ID 70	LIN_11	ID 70
12	LIN_12	ID 71	LIN_12	ID 71
13	CAN_13	ID 13	LIN_13	ID 72
14	CAN_14	ID 14	LIN_14	ID 73
15	CAN_15	ID 15	LIN_15	ID 74
16	CAN_16	ID 16	LIN_16	ID 75
17	Ethernet_2	ID 41	Ethernet_2	ID 41
18	Ethernet_3	ID 42	Ethernet_3	ID 42
Host	Ethernet_1	ID 40	Ethernet_1	ID 40

Table 3.10 Interface options of the firmware variants

Please contact our sales or technical support if you have any questions about the firmware variants.

3.5.1 CAN/ CAN FD

The **G CAR 6282** Multibus Controller supports a total of twelve CAN/ CAN FD interfaces.

For CAN and CAN FD the same transceiver is used:

- TJA1044GT

The following specifications apply to the transceiver:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
C	Transfer rate			5	MBit/s	
$UBAT_{int}$	Internal battery voltage		12		V	switchable
$UBAT_{ext}$	External battery voltage			27	V	only slots 1-12
R_{CAN}	Termination resistance		120		Ω	switchable

Table 3.11 Electrical characteristics for CAN/ CAN FD

The CAN interface is generally supplied with an **internal 12V voltage** ($UBAT_{int}$). If other voltage levels are used, the internal voltage can be switched off individually by software with the **G-API** command `G_Can_Node_InternalVBat_Disable`. In this case, the external voltage ($UBAT_{ext}$) must be fed via the predefined pins on the front connector. With `G_Can_Node_InternalVBat_Enable` the internal supply is switched on again.

The battery voltage UBAT of the transceiver slots 13-16 cannot be switched externally.

The **120Ω bus terminating resistor** of the transceiver can be deactivated by software with the **G-API** command `G_Can_Node_BusTermination_Disable`. With `G_Can_Node_BusTermination_Enable` the bus termination resistor is reactivated.

3.5.2 LIN/ K-Line

The **G CAR 6282** Multibus Controller supports a total of four LIN/ K-Line interfaces.

Please note that only the high multibus pin "TRV_Slot*_H" of the ODU connector is required for LIN/ K-Line.

For LIN the following transceiver is used:

- TJA1020

The following specifications apply to the transceiver:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
	Transfer rate			19.2	kBit/s	
$UBAT_{int}$	Internal battery voltage		12		V	switchable
$UBAT_{ext}$	External battery voltage		12	27	V	only slots 1-12
R_{LIN}	Pull up resistance	1	30		kΩ	switchable for Master (1k)/ Slave (30k)

Table 3.12 Electrical characteristics for LIN

The LIN interface is generally supplied with an **internal 12V voltage** ($UBAT_{int}$). If other voltage levels are used, the internal voltage of all LIN interfaces can be controlled by software with the **G-API** command `G_Lin_Node_InternalVBat_Disable`. In this case, the external voltage ($UBAT_{ext}$) must be fed via the predefined pins on the front connector. With `G_Lin_Node_InternalVBat_Enable` the internal supply is switched on again.

The battery voltage UBAT of the transceiver slots 13-16 cannot be switched externally.

The **1kΩ pull up resistor** corresponds to the LIN Master Bus termination and can be activated by software with the **G-API** Kommando `G_Lin_PullUpResistor_Enable`. With `G_Lin_PullUpResistor_Disable`the slave mode is activated. When deactivated (slave mode), the internal terminating resistor of the LIN transceiver becomes active (30kΩ).

For K-Line the following transceiver is used:

- L9637D

The following specifications apply to the transceiver:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
	Transfer rate			9.6	kBit/s	
$UBAT_{int}$	Internal battery voltage		12		V	switchable
$UBAT_{ext}$	External battery voltage		12	27	V	only slots 1-12

Table 3.13 Electrical characteristics for K-Line

3.5.3 FlexRay

The **G CAR 6282** Multibus Controller supports a total of two FlexRay interfaces. Since a FlexRay transceiver can map either the A or B channel, two slots are required per interface. For the total of two possible FlexRay interfaces, a total of 4 slots are occupied. The FlexRay controller is fixed in the FPGA.

For FlexRay the following transceiver is used:

- TJA1081BTS

The following specifications apply to the transceiver:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
	Transfer rate	2.5		10	MBit/s	per channel
$UBAT_{int}$	Internal battery voltage		12		V	switchable
$UBAT_{ext}$	External battery voltage	5	12	48	V	only slots 1-12
R_{FR}	Termination resistance		100		Ω	switchable

Table 3.14 Electrical characteristics for FlexRay

The FlexRay interface is generally supplied with an **internal 12V voltage** ($UBAT_{int}$). If other voltage levels are used, the internal voltage can be switched off individually by software with the **G-API** command `G_FleyRay_Node_InternalVBat_Disable`. In this case, the external voltage ($UBAT_{ext}$) must be fed via the predefined pins on the front connector. With `G_FlexRay_Node_InternalVBat_Enable` the internal supply is switched on again.

The battery voltage UBAT of the transceiver slots 13-16 cannot be switched externally.

The **100Ω bus terminating resistor** of the transceiver can be deactivated by software with the **G-API** command `G_FlexRay_Node_BusTermination_Disable`. With `G_FlexRay_Node_BusTermination_Enable` the bus termination resistor is reactivated.

When configured with two FlexRay interfaces both modules can be used together to start a FlexRay cluster. In this case one node forms the leading cold starter and the other the following cold starter. If the controller under

test itself is a cold start node, an interface alone can start the cluster. In this case, the second interface can be used to independently operate a second FlexRay cluster.

3.5.4 Automotive Ethernet

The **G CAR 6282** Multibus Controller supports a total of two Automotive Ethernet interfaces **onboard** . The two possible Automotive Ethernet transceivers can only be plugged into the slots TRX17 and TRX18. By attaching an additional Automotive Ethernet extension board with three interfaces, a total of five Automotive Ethernet interfaces are available. The coupling with a test device is capacitive.

For Automotive Ethernet the following transceiver is used:

- 88Q2112 (100/ 1000MBit/s)

To use the Automotive Ethernet interfaces an Ethernet activation is necessary. This can be obtained through the **GOEPEL electronics** sales team.

3.5.5 Digital Out

The specifications of the four onboard Digital Out interfaces are described in chapter Multi I/O Extension Board.

3.6 Multi I/O Extension Board

The **G CAR 6282** Multibus Controller supports a total of four Digital Out interfaces **onboard** . These are firmly installed on the board. By attaching an IO extension board, a total of 48 I/O interfaces are available (including the four **onboard** Digital Out interfaces). The following table shows an overview of the interfaces of the I/O extension board:

Interface	Amount	Comment
Digital In	max. 16	Total max. 16 Digital In/ SENT Rx
SENT Rx	max. 2	Total max. 16 Digital In/ SENT Rx
Digital Out	max. 12	Total max. 12 Digital Out/ SENT Tx
SENT Tx	max. 4	Total max. 12 Digital Out/ SENT Tx
Analog In	max. 8	
Analog Out	max. 8	

Table 3.15 Overview I/O interfaces of the extension board

The I/O extension board is also available as a **High Voltage** version up to 36V. The digital outputs 1-4 and 13-16 still have an output voltage of 5V. The digital outputs 5-12 have an output voltage of up to 36V and must be supplied via UBAT_ADIO (see Pin assignment matrix of the ODU connector). The DAC must also be powered via UBAT_ADIO.

The following specifications apply to the interfaces:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
Digital Inputs (extension board)						
U_{IH}	High-level input voltage	4		24	V	
U_{IL}	Low-level input voltage			1.5	V	
Digital Outputs (onboard and extension board)						
U_{OH}	High-level output voltage		5		V	at I_{OUT}=50µA
U_{OL}	Low-level output voltage			0.1	V	at I_{OUT}=50µA
I_{OUT}	Output current		48		mA	

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
Digital Outputs of High Voltage version (extension board)						
U_{OH}	High-level output voltage	U_{BAT} -0,2		36	V	
U_{OL}	Low-level output voltage			0.2	V	
I_{OUT}	Output current		250		mA	
Analog Inputs (extension board)						
U_{INL}	Low Voltage input voltage	0		5	V	
U_{INH}	High Voltage input voltage	0		11	V	
	Sample Rate			1	MSPS	
Analog Outputs (extension board)						
U_{OUTL}	Low Voltage output voltage	0		10	V	
U_{OUT}	High Voltage output voltage	0		25	V	

Table 3.16 Electrical characteristics for Multi I/O

3.6.1 SENT

Optionally, up to two SENT inputs and four SENT outputs according to the SAE J2716 standard are available. The Datalink Layer of the SENT Transmitter is implemented as programmable FPGA logic. The digital inputs (for SENT Rx) or outputs (for SENT Tx) of the base board serve as a physical layer. This means that two of the 16 digital inputs can be routed to SENT Rx. As an equivalent, four of the total of 16 digital outputs can be reconfigured to SENT Tx.

The commands for controlling the SENT functionality can be found in the **G-API** documentation in section **IO-Function** .

The SENT Interfaces are a license option for each device. An upgrade of already delivered devices is done via an activation code.

The SENT interfaces belong to the I/O interface. Therefore, they do not appear as separate interfaces in **GOEPEL electronics HardwareExplorer** .

4 Software

The following options are available for integrating the **G CAR 6282** Multibus Controller into your own applications:

- Create your own applications by programming with G-API
- Create your own applications by programming with LabVIEW
- Creating your own onboard programs through UserCode programming

4.1 Programming via G-API

The **G-API** (GOEPEL-API) is the C-based user interface for **GOEPEL electronics** hardware under Windows. It provides a comprehensive, hardware-independent instruction set for CAN, CAN FD, LIN, K-Line, MOST, FlexRay, Ethernet, LVDS, SENT, analog and digital I/O, and diagnostic services. No matter if a PXIe/ PCIe, USB or Ethernet device is used - the commands are the same. The hardware abstraction associated with the **G-API** allows the test application parallel access to the hardware. This allows an application to access multiple hardware interfaces. On the other hand, several applications can access the same hardware interface in parallel. Another feature of the **G-API** is asynchronous hardware access. This means: No execution restrictions for waiting firmware commands. The command acknowledgment is delivered via a callback mechanism.

With the **HardwareExplorer** , **GOEPEL electronics** provides a hardware configuration and management tool that gives users a convenient way to manage their hardware configurations and access logical names to each hardware interface (see Ethernet). Using logical names eliminates the need to recompile the application when switching to another interface or controller board: The interfaces can be easily reassigned in the **HardwareExplorer** .

Please use the **G-API** documentation for more information. This documentation and the installation software can be found in the **G-API** folder of the supplied "Product Information" CD

4.2 Programming via LabVIEW

The supplied CD contains a VI collection that can be used to access the **G CAR 6282** Multibus Controller under LabVIEW. The LabVIEW VIs use the functions of the **G-API** .

4.3 UserCode Programming

The **G CAR 6282** Multibus Controller can execute user programs directly on the internal processor. This requires an activation of the UserCode run-time module. The UserCode Run-Time module is optionally offered for controller boards of the **Series 62** (and other **GOEPEL electronics** hardware) and requires one license per board. Executing programs directly on the processor significantly improves real-time performance and relieves the PCI bus of the host computer. For this purpose, **GOEPEL electronics** has ported the existing **G-API** for Windows to the QNX Neutrino real-time operating system and extended it with additional onboard functionalities. The QNX Neutrino real-time operating system is based on a microkernel architecture, which is characterized by a clean separation of kernel and application. This makes it possible to execute user programs in their own virtual memory, which guarantees secure program execution and improves stability. For a smooth porting of existing program source codes, the UserCode onboard **G-API** uses an image of the familiar Windows **G-API** commands. In addition, additional functions provide access to event handling, timer tasks, as well as the FLASH file systems and other operating system resources, as well as to the standard C libraries. In UserCode programming, note that the processor uses a little-endian byte order. For easier porting, endian conversion macros are included with the **Net2Run IDE** development system. With the **Net2Run IDE** development system, **GOEPEL electronics** offers a complete set of development tools for creating UserCode programs and directly executing them on **Series 62** controller boards. The **Net2Run IDE** development system is based on Eclipse IDE and includes the QNX Neutrino Command Line Tools (CLT), including compiler, linker and debugger.

UserCode programs can be downloaded and debugged directly from the **Net2Run IDE** via an Ethernet connection.

4.4 Additional Software Interfaces

4.4.1 File System

The software interface "FS" (File System) allows, among others, to create, copy, delete, run, and finding files on the hardware. It thus provides unified access to the onboard file system.

4.4.2 Sequence

The software interface "Sequence" enables the recording and playback of firmware commands as a command sequence, in short "Sequence". A sequence can also be stored permanently under any name on the device. By specifying the name, this sequence can be reloaded and played. The automatic loading of a sequence after switching on the device allows e.g. starting a CAN command sequence to configure a display (if the sequence contains the necessary commands).

4.4.3 Net2Run

The software interface "Net2Run" is used to create, configure and execute a residual bus simulation. Several bus interfaces for CAN, CAN FD, LIN, FlexRay and Ethernet can be simulated simultaneously and coherently. The Net2Run interface supports the loading and execution of so-called residual bus simulation files (***.rbs***). These are preconfigured command sequences that contain a static residual bus simulation. These files are created using the Net2Run Configurator tool.

Net2Run is divided into several software modules and relies heavily on **AUTOSAR** . There are the software modules

- COM
- PDU Router
- CAN Interface
- LIN Interface
- FlexRay Interface
- PDU Multiplexer
- CAN-NM
- FlexRay-NM

Thus, routing of PDUs from e.g. CAN1 on CAN2, CAN1 on LIN3 or FlexRay2 on CAN4 is possible (PDU-Gateway). The routing of individual signals can be realized by a COM signal gateway. Several Net2Run interfaces exist so that several independent residual bus simulations can run on one card (for example one residual bus simulation on CAN1, CAN2, CAN3, etc.).

4.4.4 UserCode

The software interface "UserCode" allows the execution of self-created on-board programs (see UserCode Programming). Message FIFOs exist for communication between on-board programs and the host. A message FIFO can be created, written and read by any side (on-board program or host). Each FIFO can be read and written from both sides. For consistency, it is recommended to have a separate FIFO for each direction. One side only writes while the other reads only from a FIFO.

4.5 Reset the Device

The **Series 62** Multibus Controller starts automatically when the power is turned on.

During operation, a software reset of the device may be performed via the API to reset the configurations to their default values. Each interface can be initialized individually or all interfaces together. To initialize an interface, the command `G_Common_InitInterface` can be used. With `G_Common_SoftwareReset` all interfaces are reset. The reset is also possible with the **HardwareExplorer** . To do this, right-click on the desired device (for resetting all interfaces) in the **HardwareExplorer** or on a single interface and select "Reset".

5 Service and Support

5.1 Spare Parts and Accessories

Item No.	Designation

Table 5.1 Overview spare parts and accessories

Additional options for the **Series 62** Multibus Controller	
DIAG KW2000 TP1.6	Keyword 2000 on TP1.6 onboard CAN diagnostic software
DIAG KW2000 TP2.0	Keyword 2000 on TP2.0 onboard CAN diagnostic software
DIAG KW2000 ISO-TP	Keyword 2000 on CAN-ISO-TP onboard CAN diagnostic software
DIAG UDS ISO-TP	UDS on CAN-ISO-TP onboard CAN diagnostic software
DIAG GMLan	GMLan onboard CAN diagnostic software
DIAG J1939	J1939 onboard CAN diagnostic software
CAL CCP2.1	CAN Calibration Protokol CCP2.1
LIN adv-lib	Advanced Library for the test of the LIN protocols specific. 2.0/ 2.1
Net2Run	Software tool for generating signal-based residual bus simulations in heterogeneous vehicle networks. This software solution is based on the AUTOSAR approach. Direct signal access (read and edit) is enabled via G-API functions. In addition, Net2Run also provides a gateway routing editor with PDU and signal mapping functionality. Net2Run supports automatic import of vehicle electrical system data in ****.dbc***, ****.ldf*** and Fibex format.
Net2Run Runtime	Runtime engine for executing the rest bus simulation files created with Net2Run (*.rbs -files). This option is required for each **Series 62** Multibus Controller.
Net2Run IDE	Software programming environment (Windows host) for creating G-API based onboard user code programs; includes: Net2Run IDE, QNX Neutrino CLT, G-API onboard API libraries, single developer license
UserCode Runtime	UserCode runtime module for the execution of G-API based onboard UserCode programs. This option is required for each **Series 62** Multibus Controller.

Table 5.2 Additional options for the **Series 62** Multibus Controller

If necessary, please contact our sales department:

GOEPEL electronics GmbH
ATS-Vertrieb
Goeschwitzer Str. 58 / 60
D-07745 Jena
Tel.: +49-3641-6896-508
E-Mail: ats.sales@goepel.com
http://www.goepel.com

5.2 Warranty and Repair

5.2.1 Conditions

We guarantee the accuracy of the test system for a period of 24 months from the date of sale. The warranty does not apply to errors that are based on improper interventions or changes or improper use.

5.2.2 Identification

Furthermore, we ask you to announce possible warranty cases as such. Repair orders without reference to an existing warranty claim will in any case initially be paid. If the warranty has expired, we will of course also repair your test system in accordance with our general installation and service conditions.

If necessary, please contact our support service:

GOEPEL electronics GmbH
ATS-Support
Goeschwitzer Str. 58 / 60
D-07745 Jena
Tel.: +49-3641-6896-597
E-Mail: ats.support@goepel.com
http://www.goepel.com

6 Disposal

6.1 Disposal of used Electrical / Electronic Equipment

The device implements the following EU directives:

- 2012/19/EU (WEEE) Waste Electrical and Electronic Equipment and
- 2011/65/EU on the restriction of the use of certain hazardous substances in electronic equipment (RoHS directive)

At the end of the life of the device, this product must not be disposed of with other household waste. The improper disposal of this type of waste can have a negative impact on the environment and health due to the potential hazardous substances in electrical and electronic equipment. Dispose of the product at a suitable collection point.

When disposing of the device in countries outside the EU, local laws and regulations must be observed.

6.2 Disposal of used Disposable Batteries / Rechargeable Batteries

At the end of the service life of disposable batteries / rechargeable batteries, these must not be disposed of with the normal household waste. Dispose of the disposable batteries / rechargeable batteries at a recycling center for disposable batteries and rechargeable batteries.

Please dispose of only discharged disposable batteries / rechargeable batteries.

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