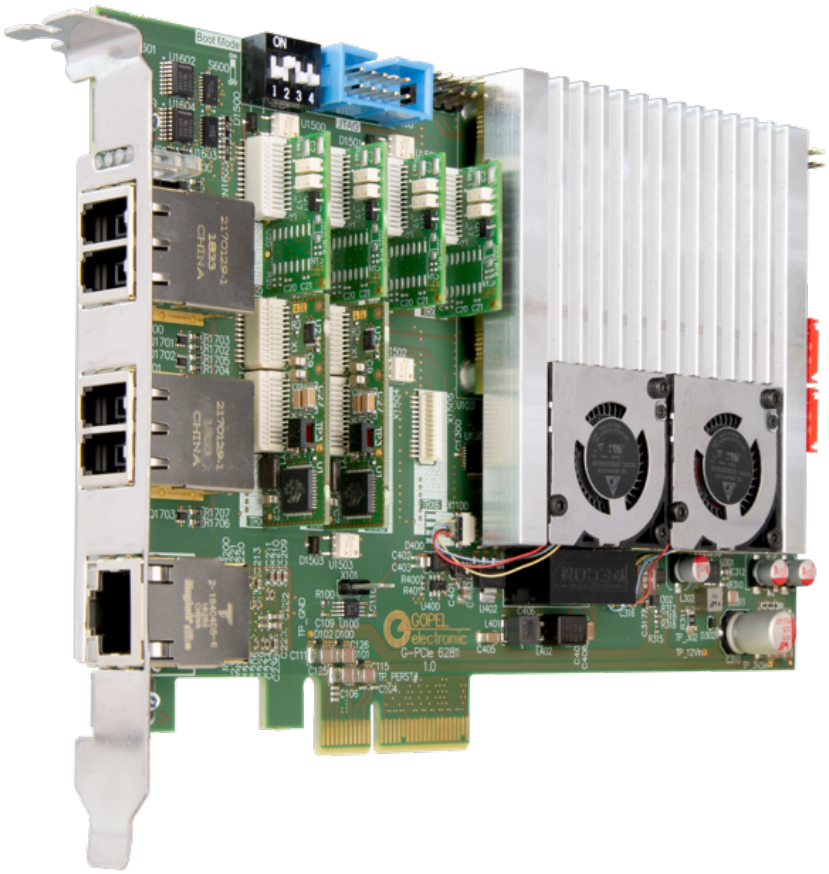
G PCIe 6281

Manual (Original documentation)



GOPEL electronics

Enjoy Testing

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Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Notes on this document

This document applies only to the device type **G PCIe 6281** . 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 PCIe 6281** 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

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 PCIe 6281** 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 PCIe 6281** Multibus Controllers.

1.7 Supplied Accessories

As accessories to **G PCIe 6281** Multibus Controller you get:

- **Series 62** Multibus Controller as PCIe board
- CD with driver, software and manual

2 Commissioning

2.1 System Requirements

Your system must comply with the following requirements:

- At least 4-times PCIe slot
- At least Dual Core CPU
- Windows 7 or later

2.2 Hardware Installation

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

After you have completely unpacked the **G PCIe 6281** Multibus Controller, please check the tight fit of the transceiver boards.

Electrostatic discharge (ESD) can damage your system and destroy electronic components. This can lead to irreparable damage to the PCIe board or to the system in which the board is operated. The result is unexpected malfunctions of your test system. Never touch the board surface, connector terminals or electronic components.

Please also use the manual for your PCIe system. If necessary, further installation instructions to be observed are included.

Open your **PCIe™** system according to its circumstances. Select a free slot in your **PCIe™** system. Remove the existing slot plate of the selected slot. For this, the fastening screws must be loosened.

The board should be inserted carefully in the prepared slot. After contacting the board, it is fastened to the front panel with the screw. Thus, the board is installed properly. Afterwards, if necessary, the work on the system must be carried out to make it ready for operation again.

Finally, connect the communication interfaces of the **G PCIe 6281** Multibus Controller with the devices that you want to test (DUT).

2.3 Driver Installation

The **G PCIe 6281** Multibus Controller can be operated under Windows 7, 8 and 10 as well as under Linux.

2.3.1 Windows Device Driver

PCIe devices can run on Windows 7, 8 and 10. The plug-and-play capability of Windows automatically launches a driver installation for each newly detected hardware component through the Hardware Wizard. With the ***exe*** file included on the enclosed CD, the Hardware Wizard can install the device driver. A restart of the system is not mandatory.

2.3.2 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** .

2.4 Network Configuration

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 PCIe 6281** 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)".

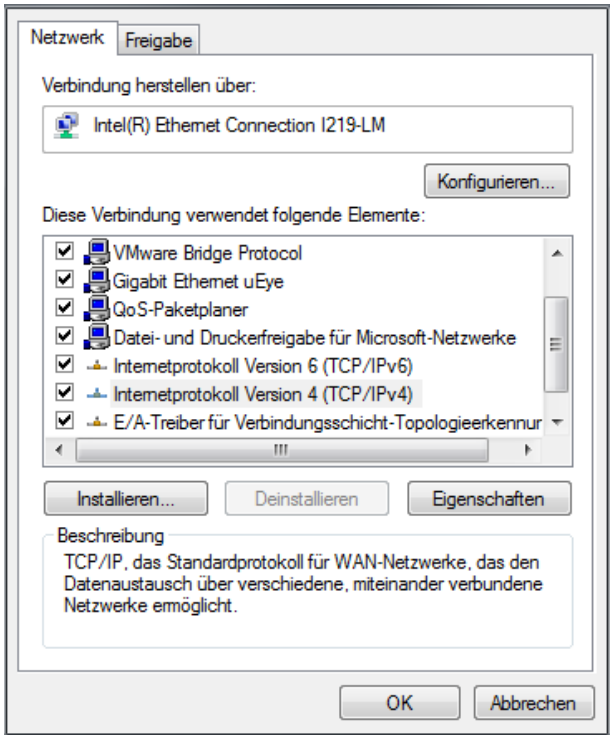

Figure 2.1 Properties of the network adapter

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 PCIe 6281** 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 PCIe 6281** Multibus Controller and network adapter) are located in the same subnet.

Example:
The default IP address of the **G PCIe 6281** 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.

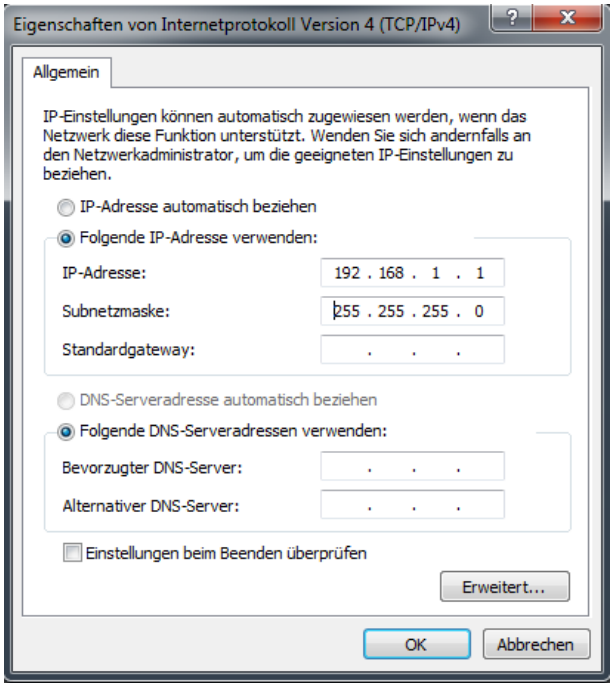

Figure 2.2 Example IP address of the network adapter

After the network adapter has been set up correctly, the **G PCIe 6281** Multibus Controller can be addressed directly after its hardware installation via its IP address. The IP address of the **G PCIe 6281** Multibus Controllers can be changed by means of the **HardwareExplorers** , whereby the entered IP address only becomes effective after a successful restart.

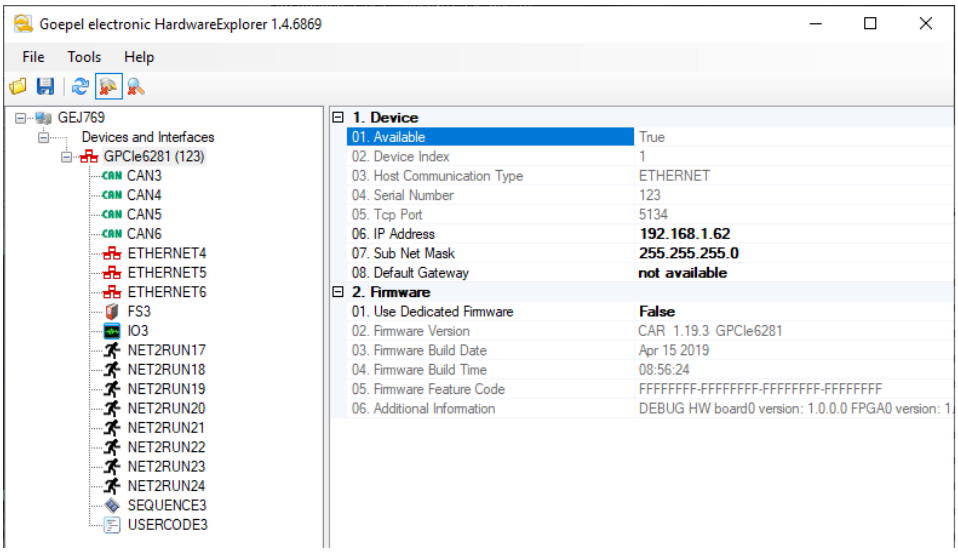

Figure 2.3 HardwareExplorer with **G PCIe 6281** Multibus Controller

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.

2.5 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 "PCIe6281") and select "Flash Firmware"
- Select the appropriate update file in the selection window and confirm with "OK"
- Confirm after successful flashing with "OK"

2.6 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:

- Loosen the screw on the front panel and carefully pull the board out of the slot.
- Then pull the appropriate transceiver from the main board upwards without tilting it.
- Plug the new transceiver into the connector on the main board. When plugging in the transceivers, please pay attention to their position and orientation. The Automotive Ethernet transceivers can only be plugged into the slots TRX7 and TRX8. There are two connectors per slot required for communication with the Automotive Ethernet transceivers.
- Carefully insert the board into the slot again and secure it with the screw on the front panel.

3 Technical Description

3.1 Product Description

The **G PCIe 6281** Multibus Controller is an industrial test system from **GOEPEL electronics** with a wide range of applications and high flexibility. This test system is specially adapted to the needs and transmission standards in the vehicle sector.

The following features make the **G PCIe 6281** 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 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 PCIe 6281 Multibus Controller

PCIe- (Peripheral Component Interconnect Express) devices can be easily plug-and-play with little installation effort into your desktop or other peripherals. Using point-to-point connections, the PCIe board connects directly to the RAM (or other assemblies) through a switch. PCIe provides a stable mechanical form factor and is standardized by an industry consortium that specifies hardware, electronics, software, power and cooling requirements.

The **G PCIe 6281** Multibus Controller is designed as PCIe Version 2.1 and has 4 lanes. It has a bandwidth of 5 GBit/s per lane and a maximum transfer rate of 2 GByte/s (without protocol overhead).

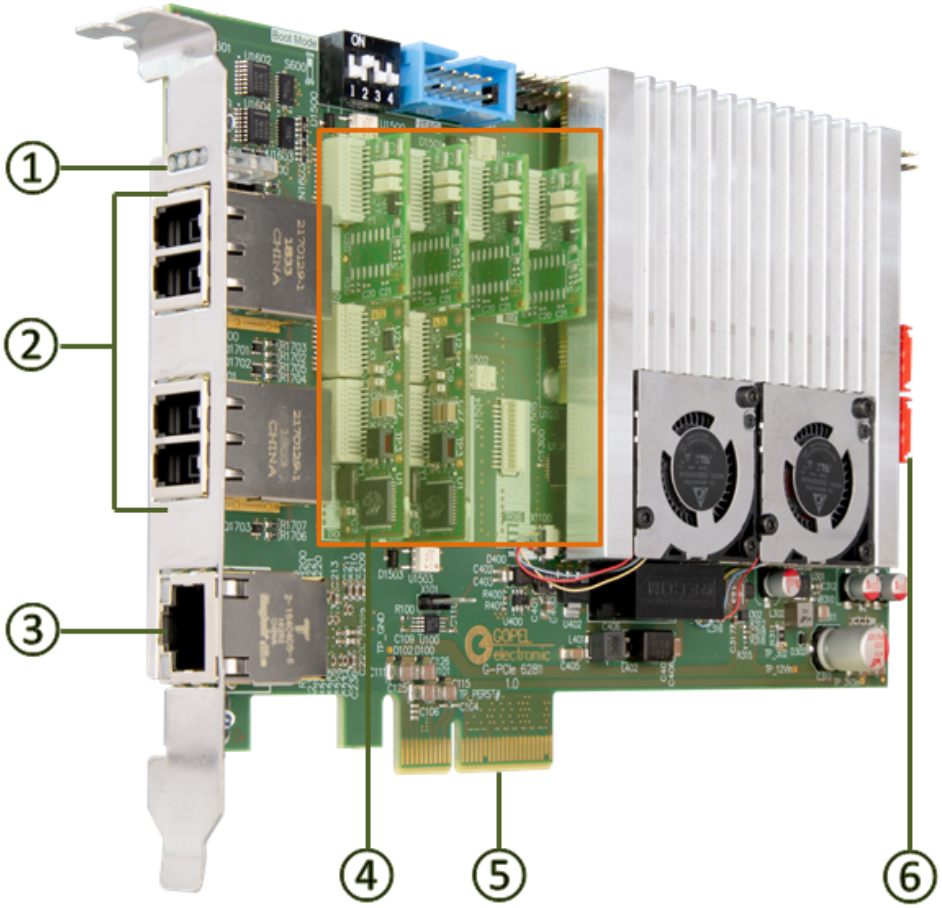

Figure 3.1 Overview **G PCIe 6281** as PCIe

Position	Description
1	LEDs/ status indication; LED1 = left .. LED4 = right (in the picture)
2	4x socket "RJ.5"
3	Socket "LAN"
4	Slots for transceivers
5	PCIe interface
6	2x socket "SYNC"; upper socket in the picture: "SYNC left", lower socket: "SYNC right"

Table 3.1 Components of the **G PCIe 6281** PCIe board

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 .. +45	°C	
Dimensions of PCIe	181 x 122 x 21	mm^3	L x W x H
Weight of PCIe	250	g	

Table 3.2 General Specifications

3.3.2 General Electrical Specifications

The following table shows the general electrical characteristics of the **G PCIe 6281** 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		3.3/ 12		V	±10%
P_{SS}	Power consumption	8	9.5	12	W	

Table 3.3 General Electrical Specifications

3.4 Design and Function

The **G PCIe 6281** Controller has been developed as a highly flexible multibus controller platform. It offers up to eight serial bus interfaces and another eight digital 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 TXR2, this node forms the interface CAN2 (ID 2). If instead a LIN transceiver inserts, this node forms the interface LIN2 (ID 10). The software addresses the interfaces according to the ID (ID 2 and ID 10 in this example).

The **G PCIe 6281** Multibus Controller offers four digital inputs and four digital outputs. Two of these can be reconfigured to SENT Rx or SENT Tx.

There are four RJ.5 connectors on the front of the controller board, through which the connections of all bus interfaces and digital inputs / outputs are routed. In addition, you will find four status LEDs that indicate the operating status of the controller board.

Below the RJ.5 connector is the socket for the 1GBit Ethernet interface. It is either used to control the controller or can serve as a debug interface as well as to transfer large amounts of data (e.g., monitor data).

3.4.1 Block Diagram

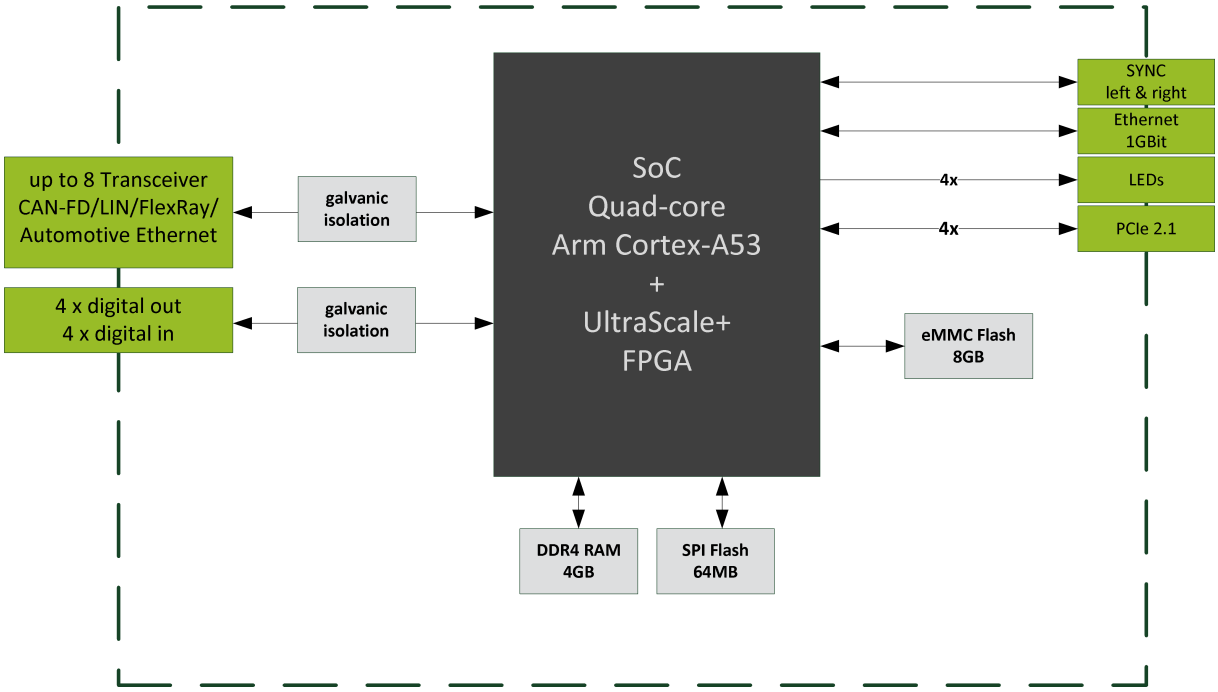

Figure 3.2 Block Diagram of the **G PCIe 6281** Multibus Controller

3.4.2 Pin Assignment

For connecting the communication interfaces a total of four **RJ.5** connectors are provided. On each of the RJ.5 connectors are the signals from two bus interfaces and one digital IN and one digital OUT signal.

Pin	RJ.5 - Nr.1	RJ.5 - Nr.2	RJ.5 - Nr.3	RJ.5 - Nr.4
1	TRX1-DATA P	TRX3-DATA P	TRX5-DATA P	TRX7-DATA P
2	TRX1-DATA N	TRX3-DATA N	TRX5-DATA N	TRX7-DATA N
3	TRX2-DATA P	TRX4-DATA P	TRX6-DATA P	TRX8-DATA P
4	TRX2-DATA N	TRX4-DATA N	TRX6-DATA N	TRX8-DATA N
5	EXT $V_{BAT}1$	EXT $V_{BAT}2$	EXT $V_{BAT}3$	EXT $V_{BAT}4$
6	GND_ISO	GND_ISO	GND_ISO	GND_ISO
7	Digital IN1	Digital IN2	Digital IN3	Digital IN4
8	Digital OUT1	Digital OUT2	Digital OUT3	Digital OUT4
Shield	GND	GND	GND	GND

Table 3.4 Pin assignment of the RJ.5 connector

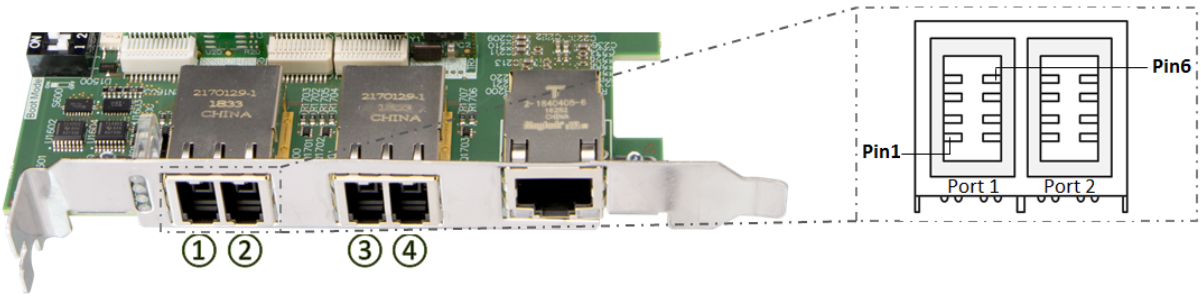

Figure 3.3 Numbering of the RJ.5 connectors

Optionally, an adapter cable from RJ.5 to two D-SUB9 connectors is available through distribution. The following table shows the pin assignment of the two D-SUB9 sockets of the adapter cable:

Pin	D-SUB9 - 1	Pin	D-SUB9- 2
1	Digital OUT	1	n.c.
2	TRX_n-DATA N	2	TRX_{n+1}-DATA N
3	GND_ISO	3	GND_ISO
4	n.c.	4	n.c.
5	Digital IN	5	n.c.
6	n.c.	6	n.c.
7	TRX_n-DATA P	7	TRX_{n+1}-DATA P
8	n.c.	8	n.c.
9	U_{BAT}	9	n.c.
Shield	GND	Shield	GND

Table 3.5 Pin assignment of the D-SUB9 sockets of the adapter cable

Adapter cables from RJ.5 to RJ.5 or RJ.5 to RJ45 are not available through **GOEPEL electronics**. We recommend using adapter cables from **TE Connectivity** . The availability of the cables can be checked at https://www.findchips.com/, for example. The following table lists the article numbers of the **TE Connectivity** adapter cables:

RJ.5 to RJ.5 cable assembly		RJ.5 to RJ45 cable assembly		
Cat5e F/UTP AWG 26 LszH	Cat5e F/UTP AWG 26 LszH (short boot)	Cat5e F/UTP AWG 26 LszH	Cat5e F/UTP AWG 26 LszH (short boot)	cable length
Article number	Article number	Article number	Article number	
2142758-1	2159683-1	2142759-1	2159684-1	0.5 meters
2142758-2	2159683-2	2142759-2	2159684-2	1.0 meters
2142758-3	2159683-3	2142759-3	2159684-3	1.5 meters
2142758-4	2159683-4	2142759-4	2159684-4	2.0 meters
2142758-5	2159683-5	2142759-5	2159684-5	2.5 meters
2142758-6	2159683-6	2142759-6	2159684-6	3.0 meters
2142758-7	2159683-7	2142759-7	2159684-7	4.0 meters
2142758-8	2159683-8	2142759-8	2159684-8	5.0 meters
2142758-9	2159683-9	2142759-9	2159684-9	7.5 meters
1-2142758-0	1-2159683-0	1-2142759-0	1-2159684-0	10.0 meters
1-2142758-1	1-2159683-1	1-2142759-1	1-2159684-1	12.5 meters
1-2142758-2	1-2159683-2	1-2142759-2	1-2159684-2	15.0 meters

Table 3.6 Article numbers of the **TE Connectivity** adapter cables

3.4.3 LAN/ Ethernet

The board has an RJ45 Ethernet socket for configuring and controlling the **G PCIe 6281** Multibus Controller using a PC. If necessary, if the board is e.g. in a rack that is only for power, this interface can act as a host interface.

3.4.4 LEDs/ Status Indication

The LEDs arranged on the front panel provide information about the current operating status of the **G PCIe 6281** Multibus Controller. The display states of the LEDs are explained in the following table:

LED1	LED2	LED3	LED4	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 3.7 Display states of the status LEDs

3.4.5 Power Supply

The **PCIe** board of the **G PCIe 6281** Multibus Controllers is supplied via the PCIe interface.

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 PCIe 6281** Multibus Controller, the host system is electrically isolated from the interfaces leading to the RJ.5 connectors. This includes the CAN/ CAN FD, LIN/ K-Line, Automotive Ethernet and FlexRay communication interfaces as well as the digital inputs and outputs.

3.4.7 SYNC

There are two SYNC (Synchronization) connectors on the back of the PCIe board of the **G PCIe 6281** Multibus Controller. These can be used to connect multiple PCIe boards so that the cards can synchronize with each other. "SYNC left" (see Overview of G PCIe 6281 Multibus Controller) will be connected with the left placed card and "SYNC right" with the right placed card. This means that the "SYNC left" connector of one PCIe board is connected to "SYNC right" of the other board.

The SYNC connectors are not to be used for any purpose other than the above purpose. The pin assignment will therefore only be issued on request.

3.5 Onboard Interfaces

The **G PCIe 6281** Multibus Controller offers the possibility to use a total of eight Automotive Bus interfaces. For each bus (CAN/ CAN FD, LIN/ K-Line, FlexRay and Automotive Ethernet), transceivers are available that can be replaced with little effort in accordance with the test requirement (see Change of the Transceiver). It also supports up to eight conventional signals (digital in/ out and SENT), four as input and four as output. 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.

The interfaces are generally supplied with an **internal 12V voltage** ($VBAT_{int}$). The supply can also be done externally (further details for the different interfaces can be found in the respective section). Please note that the external power supply always affects the two transceivers connected to one RJ.5 connector:

$VBAT_{ext}$	Transceiver
$VBAT_{ext}0$	TRX1/2
$VBAT_{ext}1$	TRX3/4
$VBAT_{ext}2$	TRX5/6
$VBAT_{ext}3$	TRX7/8

Table 3.8 Assignment of transceivers to $VBAT_{ext}$

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 PCIe 6281** 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	LIN_1	ID 9
2	CAN_2	ID 2	LIN_2	ID 10
3	CAN_3	ID 3	LIN_3	ID 11
4	CAN_4	ID 4	LIN_4	ID 12
5	CAN_5	ID 5	LIN_5	ID 13
6	CAN_6	ID 6	LIN_6	ID 14
7	CAN_7 or Ethernet_2	ID 7 (CAN) or ID 41	LIN_7 or Ethernet_2	ID 15 (LIN) or ID 41
8	CAN_8 or Ethernet_3	ID 8 (CAN) or ID 42	LIN_8 or Ethernet_3	ID 16 (LIN) or ID 42
Host	Ethernet_1	ID 40	Ethernet_1	ID 40

Table 3.9 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 PCIe 6281** Multibus Controller supports a total of eight 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	
$VBAT_{int}$	Internal battery voltage		12		V	switchable
$VBAT_{ext}$	External battery voltage			27	V	
R_{CAN}	Termination resistance		120		Ω	switchable

Table 3.10 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 **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 PCIe 6281** Multibus Controller supports a total of eight LIN/ K-Line interfaces

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	
$VBAT_{int}$	Internal battery voltage		12		V	switchable
$VBAT_{ext}$	External battery voltage		12	27	V	
R_{LIN}	Pull up resistance	1	30		kΩ	switchable for Master (1k)/ Slave (30k)

Table 3.11 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 **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	
$VBAT_{int}$	Internal battery voltage		12		V	switchable
$VBAT_{ext}$	External battery voltage		12	27	V	

Table 3.12 Electrical characteristics for K-Line

3.5.3 FlexRay

The **G PCIe 6281** 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
$VBAT_{int}$	Internal battery voltage		12		V	switchable
$VBAT_{ext}$	External battery voltage	5	12	48	V	
R_{FR}	Termination resistance		100		Ω	switchable

Table 3.13 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 **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 PCIe 6281** Multibus Controller supports a total of two Automotive Ethernet interfaces. The coupling to a test device is capacitive. The two possible Automotive Ethernet transceivers can only be plugged into the slots TRX7 and TRX8.

We recommend to connect all hardware of your application to one ground. If there are high potential differences, a stable Ethernet connection cannot otherwise be established.

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 IO

The **G PCIe 6281** Multibus Controller supports a total of eight interfaces for Digital I/O. Of these four interfaces can be used as a digital input and four as a digital output. These are firmly installed on the board.

The following specifications apply to the interfaces:

Symbol	Parameter	Min.	Typ.	Max.	Unit	Comment
Digital Inputs						
U_{IH}	High-level input voltage	4		24	V	
U_{IL}	Low-level input voltage			1.5	V	
Digital Outputs						
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	

Table 3.14 Electrical characteristics for Digital I/O

3.5.6 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 four digital inputs can be routed to SENT Rx. Equivalently two of the four 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 PCIe 6281** 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 and Linux. 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 HardwareExplorer). 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 PCIe 6281** Multibus Controller under LabVIEW. The LabVIEW VIs use the functions of the **G-API** .

4.3 UserCode Programming

The **G PCIe 6281** 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

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 5.1 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.

Index

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Enjoy Testing

EU-Konformitätserklärung
EU Declaration of Conformity

GÖPEL electronic GmbH, Göschwitzer·Straße 58-60, D-07745 Jena

Wir erklären hiermit die Übereinstimmung des genannten Produktes mit der Richtlinie 2011/65/EU über Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (RoHS). Bei Änderungen am Produkt, die nicht von uns autorisiert wurden, verliert diese Erklärung ihre Gültigkeit.

We declare the compliance of the product with the requirements of the Directive 2011/65/EU on the use of certain dangerous substances in electrical and electronic equipment (RoHS). Any modification to the product, not authorized by us, will invalidate this declaration.

Produktbezeichnung / Product name:

G PCIe 6281
Multibus Controller

Normen / Standards:

EN 60068-2-1
EN 60068-2-2
EN 60068-2-14

Das Produkt ist gekennzeichnet mit / The product is marked with CE

Jena, 07.06.2019

GÖPEL electronic GmbH

Jörg Schneider
Geschäftsführer

Geschäftsführer: Alice Göpel, Jörg Schneider, Thomas Wenzel
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