



USB/ basicCAN 6153

USB/ basicLIN 6173

USB/ basicCAR 6182

USB/ basicFlex 6191

Intelligent Programmable Multibus Controllers

User Manual

(Translation of Original docu)

Document Version 2.0



GOPEL electronic GmbH

Goeschwitzer Str. 58/60 • D-07745 Jena

+ 49-3641-6896-597 • ats_support@goepel.com • www.goepel.com

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1	NOTES ON THE EC DECLARATION OF CONFORMITY	1-2
2	INSTALLATION	2-1
2.1	HARDWARE INSTALLATION	2-1
2.1.1	<i>Series 61 USB Boards</i>	2-1
2.1.2	<i>Series 61 Stand-alone Devices</i>	2-1
2.2	DRIVER INSTALLATION.....	2-2
2.2.1	<i>USB</i>	2-2
2.2.2	<i>Ethernet</i>	2-4
2.3	NOTES ON THE FIRMWARE	2-5
2.3.1	<i>Firmware Update</i>	2-5
2.3.2	<i>Firmware Variants</i>	2-6
3	HARDWARE	3-1
3.1	DEFINITION	3-1
3.2	TECHNICAL DATA	3-3
3.2.1	<i>General</i>	3-3
3.2.2	<i>Dimensions</i>	3-4
3.2.3	<i>Series 61 Characteristics</i>	3-4
3.3	CONSTRUCTION AND FUNCTION	3-5
3.3.1	<i>General</i>	3-5
3.3.2	<i>Addressing</i>	3-7
3.3.3	<i>Isolation</i>	3-8
3.3.4	<i>Status LEDs</i>	3-8
3.3.5	<i>Connector Pinout</i>	3-9
3.3.6	<i>OnBoard Interfaces</i>	3-10
3.3.7	<i>FlexRay Extension Board</i>	3-12
3.3.8	<i>CAN Extension Board</i>	3-13
3.3.9	<i>IO Extension Board</i>	3-14
3.3.10	<i>SENT Interfaces</i>	3-16
3.4	PRODUCT INFORMATION.....	3-17
4	SOFTWARE	4-1
4.1	G-API PROGRAMMING	4-2
4.2	USERCODE PROGRAMMING.....	4-3
4.3	ADDITIONAL SOFTWARE INTERFACES	4-1
4.3.1	<i>FS</i>	4-1
4.3.2	<i>Net2Run</i>	4-1
4.3.3	<i>Sequence</i>	4-1
4.3.4	<i>UserCode</i>	4-2
4.4	FURTHER GOEPEL SOFTWARE	4-2

1 Notes on the EC Declaration of Conformity

**GOEPEL electronic GmbH
Goeschwitzer Straße 58-60
D-07745 Jena**

With the EC Declaration of Conformity we declare the compliance of the GOEPEL electronic GmbH product described in this Manual with the requirements of the Directive 2006/95/EG – Low Voltage Directive and with the Directive 2004/108/EG about the Electromagnetic Compatibility. Any modification to the product, not authorized by us, will invalidate the corresponding declaration.

The product is marked with the symbol



2 Installation

2.1 Hardware Installation



Please make absolutely certain that all of the hardware installation procedures described below are carried out with your system switched off.

2.1.1 Series 61 USB Boards

As a rule a Series 61 USB board is installed in one of the GOEPEL electronic USB Racks (USB 1004/ USB 1008/ USB 1016).



We recommend to install/ update the device driver software before connecting the GOEPEL electronic USB Rack to the PC/ Laptop (see [Driver Installation/ USB](#)).



When installing the board into the rack, touch it at its edges only. Never touch the surface of the board, because otherwise it may be destroyed by electrostatic discharges.

To install a Series 61 USB board in a GOEPEL electronic USB Rack, proceed as follows: Select an empty slot of your USB Rack. First, remove the slot plate covering the slot (if mounted). To do that, loose the two screws. Insert the board carefully via the guides into the prepared slot.

Push it finally into the slot till to the arrester by applying a little pressure.

Use the lever at the front plate in order to push in the board finally.

Then, tighten the two outer screws at the front panel to fix the board.

To remove a board from the USB Rack (if necessary), unscrew the two outer screws. By the lever at the front panel the board can be dissolved from the slot and then it can be unplugged.

2.1.2 Series 61 Stand-alone Devices



We recommend to install/ update the device driver software before connecting the device to the PC/ Laptop (see [Driver Installation/ USB](#)).

As a rule hardware installation for basicCAN 6153, basicLIN 6173, basicCAR 6181 and basicFlex 6191 means to connect the power supply cables and the USB/ Ethernet cable to the control PC.



Please use the supplied USB cable to connect Series 61 USB/ Ethernet stand-alone devices to the PC's USB interface. Other cables may be inapplicable.

2.2 Driver Installation

- 2.2.1 USB To install the GOEPEL electronic USB drivers on your system, execute the GUSB driver setup. For this, start the setup program *G-USB-Setup-*.exe* (the asterisk stands for the version number) of the delivered CD and follow the instructions.



At present, the available device driver supports Windows® XP as well as Windows® 7/ 32bit and Windows® 7/ 64bit systems.

Before connecting the Series 61 USB stand-alone hardware to a USB port of your PC, please ensure that the external power supply of the device is ready for operation (the hardware of Series 61 stand-alone devices, e.g. basicCAN 6153, is NOT supplied via USB).

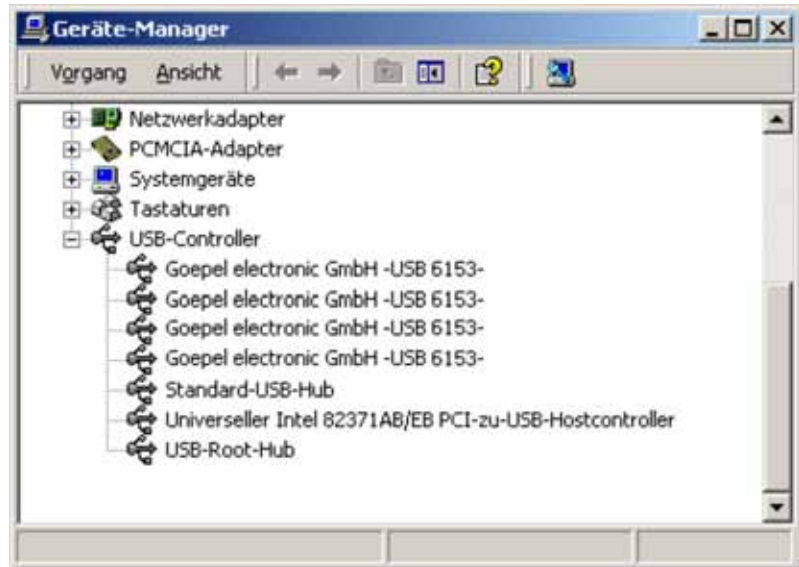
Due to the plug and play capability of Windows®, the operating system will recognize the device automatically. As soon as it has been detected the Windows® "Hardware wizard" will start and guide you through the device driver installation process.

Select the "Install software automatically" option and click "Next" to continue.

On completion of the installation process Windows® will request you to reboot your computer. For safe and reliable operation this step is strongly recommended.

After Hardware Installation/ Driver Installation, you can check whether the unit is properly embedded by the system.

As an example, the following figure shows the successful embedding of four USB 6153 boards (the same is displayed for basicCAN 6153):



*Figure 2-1:
USB 6153 installed*



Please note that the Device Manager shows ALL USB controllers.

2.2.2 Ethernet

If the Ethernet interface is used for communication with the control PC, there is no driver installation required. The board/ device can be directly addressed via the IP Address (see also [Addressing](#)).

This IP Address can be changed by the HardwareExplorer. The newly set IP Address becomes effective after a restart.

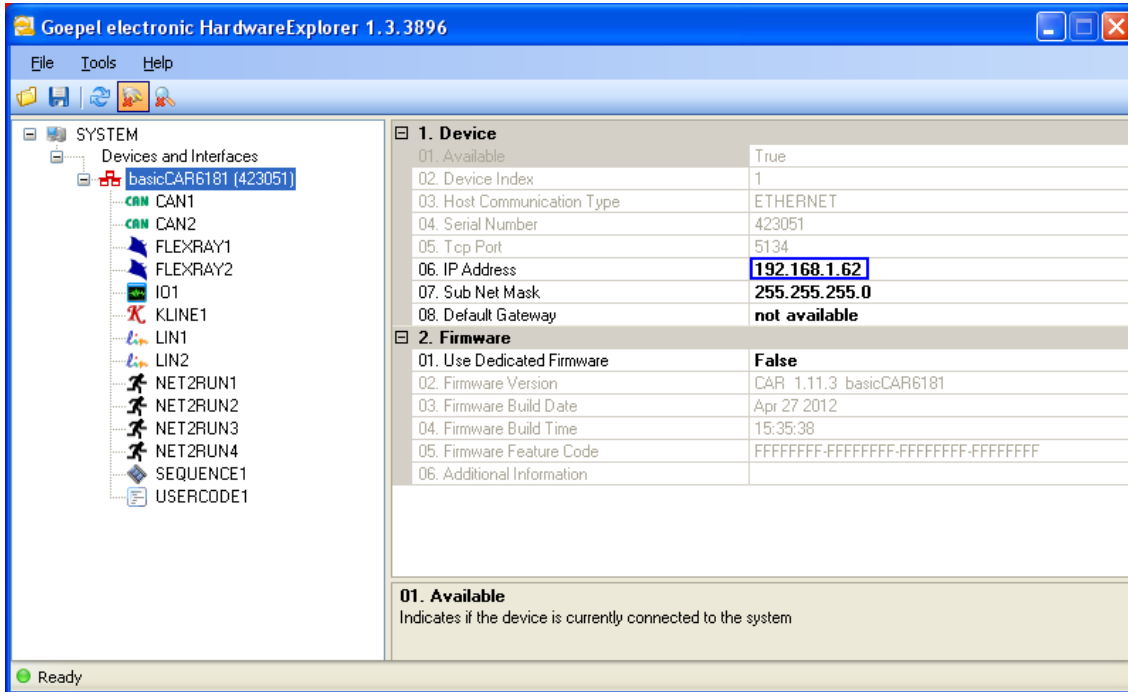


Figure 2-2: IP Address In the GOEPEL electronic HardwareExplorer

2.3 Notes on the Firmware

2.3.1 Firmware Update

In the course of the technical progress, it can be necessary from time to time "to treat" your hardware to a new Firmware release. Proceed as follows:

- Download the current Firmware Update-File (see [Firmware Variants](#)) from *genesis.goepel.com*
- Open the GOEPEL HardwareExplorer
- On "Devices..." (e.g. USB6153), select "Flash Firmware" with the right mouse button
- On "Flash Firmware", select the Update-File (see [Firmware Variants](#)) with the left mouse button and execute it (e.g. by double clicking)
- After finishing of the progress bar in the "Flashing..." window, press the "OK" button in the following "Success" window with the left mouse button



Please ensure that you use the right Firmware Variant when updating the Firmware (see [Firmware Variants](#)). Installing the wrong Firmware Variant may result in the loss of functionality and can cause your application to malfunction.

In such events, reinstallation of the correct Firmware Variant will restore the functionality.

2.3.2 Firmware Variants

With the introduction of CAN-FD support for the Series 61 communication controller family, also Firmware Variants have been introduced. Because of the increased IP footprint of the CAN-FD IP core, the LIN and K-Line Interfaces have been removed in the CAN-FD Firmware.

The Firmware Variant is coded into the Firmware version string as well as in the file name of the update file.

Example:

Version: CAR 1.16.1 USB6153 VAR1

Update-File: CAR32_6100_VAR1__1_16_1__2015_05_19.update

Version: CAR 1.16.1 USB6153 VAR2

Update-File: CAR32_6100_VAR2__1_16_1__2015_05_19.update

Please refer to the table below for the interface options supported by each Firmware Variant.

Software Interface	Hardware Interface (Plug-in position)	CAR32 Firmware Variant	
		VAR1 (CAN 2.0)	VAR2 (CAN-FD)
CAN1	Node 1 (TRX 1)	x	x
CAN2	Node 2 (TRX 2)	x	x
CAN3	Node 3 (TRX 3)	x	x
CAN4	Node 4 (TRX 4)	x	x
CAN5/ 6	Node B (FlexRay 2)	x	-
LIN1	Node 1 (TRX 1)	x	-
LIN2	Node 2 (TRX 2)	x	-
LIN3	Node 3 (TRX 3)	x	-
LIN4	Node 4 (TRX 4)	x	-
K-Line1	Node 1 (TRX 1)	x	-
K-Line2	Node 2 (TRX 2)	x	-
K-Line3	Node 3 (TRX 3)	x	-
K-Line4	Node 4 (TRX 4)	x	-
FlexRay1	Node A (FlexRay 1)	x	x
FlexRay2	Node B (FlexRay 2)	x	x
IO1	Node IO (A/D-IO)	x	x
FS1	-	x	x
Sequence1	-	x	x
UserCode1	-	x	x
Net2Run1	-	x	x
Net2Run2	-	x	x
Net2Run3	-	x	x
Net2Run4	-	x	x



Please note: Not all interfaces are useable at the same time. Some interfaces are optional and require specific transceivers or expansion modules to be installed on the device, as well as the corresponding licensing option to be unlocked, in order to use them.

For example, CAN-FD is an additional licensing option. If this option is not installed on your controller device, all available CAN interfaces will function according to CAN 2.0 specification regardless of the Firmware Variant installed.

Please contact our sales department or technical support for questions to the available license and hardware options.

3 Hardware

3.1 Definition

GOPEL electronic GmbH Series 61 boards for USB/ Ethernet are programmable intelligent multibus controllers providing various communication interfaces for vehicle network testing and general control applications.

The Series 61 USB/ Ethernet boards provide the following resources:

- Basic types of communication interfaces:
 - USB 6153 – 2 CAN interfaces onboard
 - USB 6173 – 2 LIN or K-Line interfaces onboard
 - USB 6181 – 1 CAN and 1 LIN or 1 K-Line interfaces onboard
 - USB 6191 – 2 FlexRay nodes with 2 channels each
(see [OnBoard Interfaces](#) and [FlexRay Extension Board](#))
- optionally 2 further (for USB 6191 4 further) CAN/ LIN/ K-Line interfaces onboard
(see [OnBoard Interfaces](#))
- optionally 2 FlexRay nodes with 2 channels each on FlexRay Extension boards (not for USB 6191)
(see [FlexRay Extension Board](#))
- optionally instead of the second FlexRay Extension Board 1 CAN Extension Board with 2 CAN interfaces
(see [CAN Extension Board](#))
- 4 digital input and output channels with TTL level onboard
- optionally 4 additional digital input and 4 output channels with extended voltage range
(see [IO Extension Board](#))
- optionally 4 resp. 6 analog input and output channels
(see [IO Extension Board](#))
- optionally up to 2 SENT outputs according to SAE J2716 (Jan. 2010) for Sensor simulation
(see [SENT Interfaces](#))
- 600MHz Power PC with 512MB RAM, 256MB Flash
- Communication interfaces and IO channels galvanically separated from the user interface
- High flexibility through pluggable transceiver modules and Extension boards
- Control of the device via USB 2.0 or Ethernet
(see [Addressing](#) and [Ethernet](#))
- The 1Gbit Ethernet interface at the Front panel is also useable as volume data and debug interface
- 4 front panel LEDs for status indication
(see [Status LEDs](#))



Instead of 2..4 CAN Interfaces, a USB 6153 card/ basicCAN 6153 device can also have 2..4 CAN-FD Interfaces onboard. Currently, the options LIN/ K-Line as well as CAN5/ 6 (CAN Extension board) are not possible in this case (see also [Firmware Variants](#)).

The following figure shows the USB 6153 board in its maximum hardware configuration with optional plug-in modules (but without CAN Extension Board):



*Figure 3-1:
USB 6153*



For operating USB 6153, USB 6173, USB 6181 and USB 6191 boards you need a GOPEL electronic USB Rack which can cover up to 16 GOPEL electronic USB boards.

In this case, power supply comes from the rack's built-in power supply unit.

3.2 Technical Data

3.2.1 General

basicCAN 6153, basicLIN 6173, basicCAR 6181 and basicFlex 6191 are GOPEL electronic GmbH stand-alone devices based on the corresponding Series 61 USB/ Ethernet boards to be connected to a PC or laptop, developed for applications out of complex test systems.

The external power supply of 7-25 VDC allows the use of these devices for data acquisition and the inspection of signals for a multitude of applications, e.g. in motor vehicles.

The following figure shows a basicCAN 6153 as an example:



Figure 3-2:
basicCAN 6153 frontal view

For operating basicCAN 6153, basicLIN 6173, basicCAR 6181 or basicFlex 6191, there is an external power supply of 7..25 VDC required. For this, you may use the ext. Power Supply connector for the delivered AC adaptor plug at the device's rear side, with coaxial power plug (2.1 x 5.5mm/ plus polarity inside).



Figure 3-3:
basicCAN 6153 rear view

This connector is used to supply the internal logic. Its GND connection is connected to the GND connection of the USB interface.

Alternatively, you may use also the two banana females for external Power Supply (red = plus, blue = minus).



Please use either the coaxial power connector or the two banana females for the unit's power supply.

All connections of the communication interfaces as well as the peripheral voltages are galvanically separated from the USB interface and from the internal logic.

Also on the device's rear side there is the connector for the USB-cable.

3.2.2 Dimensions

- Series 61 USB: 160 mm x 100 mm x 20 mm (L x B x H)
- basic61xx: 180 mm x 120 mm x 50 mm (L x B x H)



The dimensions given for Series 61 USB refer to a board inside a USB Rack of GOPEL electronic GmbH.

3.2.3 Series 61 Characteristics

A Series 61 USB/Ethernet unit has the following characteristics:

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
	CAN/ LIN or K-Line interfaces (onboard)		2	4		See OnBoard Interfaces
	FlexRay Extension Board			2		See FlexRay Extension Board
	CAN Extension Board			1		See CAN Extension Board
	IO resources extension			1		See IO Extension Board
Digital inputs 1..4 (onboard)						
N	Number			4		
U _{IH}	High-level input voltage	3.5		5.5	V	
U _{IL}	Low-level input voltage			1.5	V	
I _L	Input leakage current			35	µA	
Digital outputs 1..4 (onboard)						
N	Number			4		
U _{OH}	High-level output voltage	4.8		5	V	
U _{OL}	Low-level output voltage			0.5	V	
I _{OUT}	Output current			8	mA	



If required, the [CAN Extension Board](#) with two CAN interfaces including Transceivers is plugged in the same position as the second FlexRay Extension Board.

3.3 Construction and Function

3.3.1 General

The core of the Series 61 USB/ Ethernet unit builds a strong 600MHz AMCC 460EX PowerPC. This dual-issue, superscalar 32bit RISC CPU is based on the Book-E enhanced PowerPC architecture. With features including out-of-order execution, dynamic branch prediction and a highly pipelined double precise floating-point unit, this processor provides the calculation power required for processing complex residual bus simulation on multiple bus interfaces. Furthermore the controller comes equipped 512MB fast 400MHz DDR2 RAM and 256MB Flash memory of which over 80% is available for user programs.

Series 61 USB/ Ethernet units have been designed as a highly flexible multibus controller platform. Providing two universal serial bus nodes onboard in the basic version, where each can be configured to operate as either CAN or LIN/ K-Line interface. Each node has a transceiver socket assigned to it. The transceiver module that is plugged into that socket defines the interface that operates the node. For example: If a CAN transceiver is plugged into transceiver socketed TXR 2, then this node connects to interface CAN 2 (Interface number 2). The software addresses the interfaces by their Interface numbers (2 in this example).

In addition to the two universal serial bus nodes explained before, the board of a Series 61 USB/ Ethernet unit provides two additional plug-in positions for optional CAN/ LIN or K-Line transceivers and three extension sockets. Two of them are prepared to take on a dual channel FlexRay module (see [FlexRay Extension Board](#)), whereas the third socket is prepared to carry a multi IO Extension module (two types, see [IO Extension Board](#)).

A FlexRay Extension Board has an independent FlexRay controller with two transceivers for channel A and B, providing full dual channel functionality.

The FlexRay nodes are assigned to the interfaces with the Interface numbers 13 and 14.

Optionally, a Series 61 USB/ Ethernet unit can be equipped with a CAN Extension Board with two CAN interfaces instead of the second FlexRay Extension Board (see [CAN Extension Board](#)). These two CAN nodes are statically mapped to the interfaces 15 und 16.

With this, up to six CAN interfaces are possible for a Series 61 USB/ Ethernet unit.



Optionally, a Series 61 USB/ Ethernet unit can have 2..4 CAN-FD interfaces onboard (see [Firmware Variants](#)).

As a further option, up to 2 SENT interfaces are available (see [SENT Interfaces](#)).

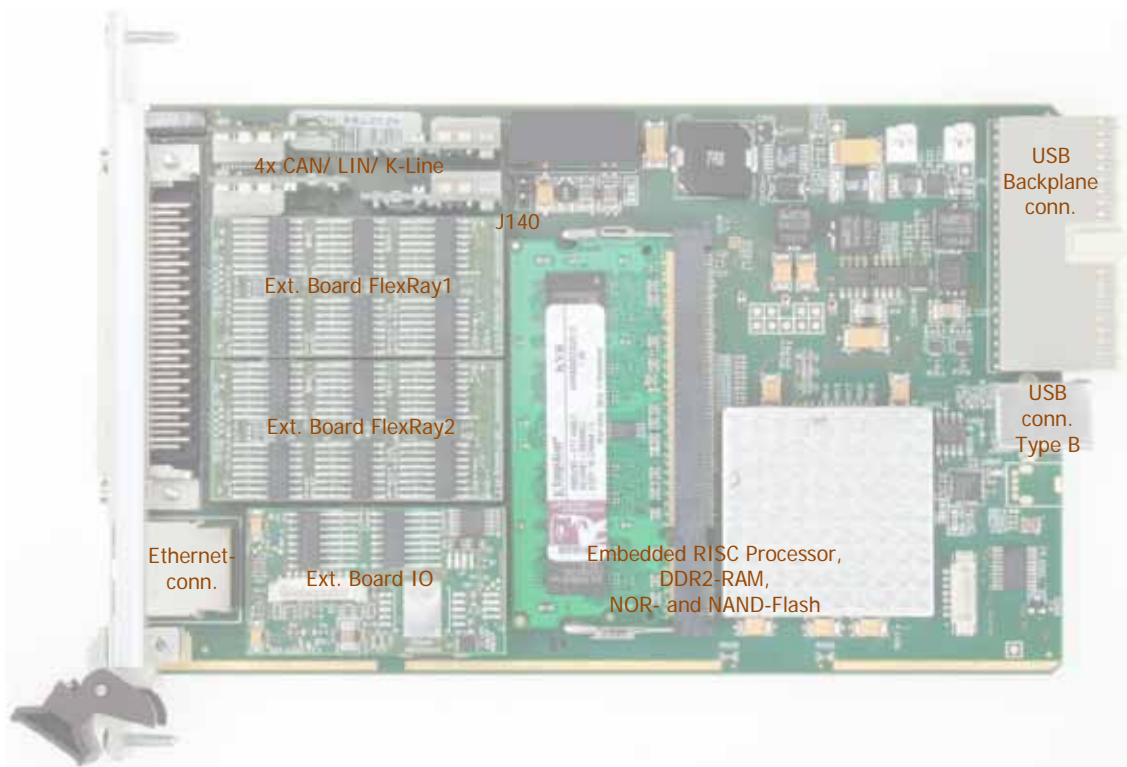


Figure 3-4: Schematic View of a Series 61 USB/ Ethernet board



The USB Backplane connector is mounted for use in one of the GOPEL electronic USB Racks to adapt the Series 61 USB boards whereas the USB connector Type B is mounted as the USB interface for the basicCAN 6153, basicLIN 6173, basicCAR 6181 and basicFlex 6191 stand-alone devices.

The Serie61 USB/ Ethernet unit's basic board provides 4 digital inputs and 4 digital outputs. By inserting a multi IO module into the third extension socket (Ext. Board IO in Figure 3-4) the IOs can be extended by up to 4 digital inputs and 4 digital outputs plus, according to the type of the corresponding extension board, 4 or 6 analog inputs and 4 or 6 analog outputs. Please refer to chapter [IO Extension Board](#) for detailed information.

The front side of a Series 61 USB/ Ethernet unit features a 68 pin male SCSI connector (see also [Connector Pinout](#)), providing access to all bus interfaces and auxiliary IO. Above the SCSI connector there are 4 status LEDs placed, which are indicating the operation states on the unit (see [Status LEDs](#)).

Below the SCSI connector there is a female for the 1Gbit Ethernet interface. It can be used to control the unit instead of the USB interface, but it can also serve as debug interface for user programs as well as volume data interface (e.g. for streaming monitoring data).

The table below shows the mapping of communication interfaces:

ID	Interface	Plug-in position Transceiver/ Ext. FlexRay Board
1	CAN 1	TRX 1
2	CAN 2	TRX 2
3	CAN 3	TRX 3
4	CAN 4	TRX 4
5	LIN 1	TRX 1
6	LIN 2	TRX 2
7	LIN 3	TRX 3
8	LIN 4	TRX 4
9	KLine 1	TRX 1
10	KLine 2	TRX 2
11	KLine 3	TRX 3
12	KLine 4	TRX 4
13	FlexRay 1	FlexRay 1
14	FlexRay 2	FlexRay 2
15	CAN 5	FlexRay 2
16	CAN 6	



Please refer also to chapters [OnBoard Interfaces](#), [FlexRay Extension Board](#), [CAN Extension Board](#) and Figure 3-4.

3.3.2 Addressing

Series 61 USB/ Ethernet units provide a 1Gbit Ethernet interface and a USB2.0 interface. Both interfaces can be used for the communication of the unit with the host PC.

In case of using the Ethernet interface, the device can be controlled via the default IP Address 192.168.1.62, Port 5134, which can be changed if required (see [Driver Installation/ Ethernet](#)).

In principle, there are two ways for this:

- HardwareExplorer: Select the device, under Device set the required IP Address; the new IP Address is effective after restart
- G API Command G_Common_Ethernet_IpAddress_Set; the new IP Address is effective after restart

Addressing of Series 61 USB boards in a GOPEL electronic USB Rack or of the corresponding stand-alone device is exclusively effected via their serial numbers: The unit with the LEAST serial number is always the device with the number 1.



To improve clarity, we recommend to arrange several Series 61 USB boards in the USB rack in the order of ascending serial numbers (or to connect several Series 61 USB/ Ethernet stand-alone devices in the same order to the computer).

3.3.3 Isolation

Electric surges can harm expensive test equipment and lead to unreliable test results. Electric isolation protects against electric surges and can help to suppress dangerous electrical transients. It also eliminates ground loops, responsible for data errors due to ground potential differences.

A Series 61 USB/ Ethernet unit provides electric isolation between the USB system and all input and output signals of the frontal connector. This includes the CAN, LIN/ K-Line and FlexRay communication interfaces as well as digital and analog IOs.

Sometimes the test system requires a ground reference between the GND_{iso} potential on the front connector and the ground potential of the device under test (ECU, etc.).

Jumper J140 (see Figure 3-4) provides a means of introducing a ground reference between the GND_{iso} potential on the front connector and the ground potential of the USB system.



CAUTION: Introducing a ground reference to the USB system may result in high current flow over the test lead and the Series 61 USB/ Ethernet unit.

This could lead to malfunction, wrong test results as well as damage the Series 61 USB/ Ethernet unit or other test equipment.

Before closing jumper J140, you should ensure that the device under test and all other devices connected to the front connector of the Series 61 USB/ Ethernet unit are only supplied via an isolated power supply!

3.3.4 Status LEDs

The LEDs arranged at the front panel indicate the current operation state of a Series 61 USB/ Ethernet unit:



Figure 3-5: Status LEDs

The table below describes the meaning of the LED states:

LED 1	LED 2	LED 3	LED 4	Remarks
Permanently ON				Controller does not run (error!)
Alternately blinking				Bootloader software runs
blinking				Firmware runs
ON (shortly)				State during execution of a Firmware command
			ON	Ethernet connection established

3.3.5 Connector Used connector: SCSI 68pol. male
 Pinout Connector for connection cable: SCSI 68pol. female

The following table shows the pinout of the frontal connector:

Pin	Signal			Pin	Signal	
1	CAN1_H	LIN1	K-Line1	35	R _{low} -CAN1_H	*) UBat _{extern_iso1}
2	CAN1_L		L-Line1	36	R _{low} -CAN1_L	*) GND _{iso1}
3	GND _{iso}			37	UBAT _{extern1}	*) do not connect!
4	CAN2_H	LIN2	K-Line2	38	R _{low} -CAN2_H	*) UBat _{extern_iso2}
5	CAN2_L		L-Line2	39	R _{low} -CAN2_L	*) GND _{iso2}
6	GND _{iso}			40	UBAT _{extern2}	*) do not connect!
7	CAN3_H	LIN3	K-Line3	41	R _{low} -CAN3_H	*) UBat _{extern_iso3}
8	CAN3_L		L-Line3	42	R _{low} -CAN3_L	*) GND _{iso3}
9	GND _{iso}			43	UBAT _{extern3}	*) do not connect!
10	CAN4_H	LIN4	K-Line4	44	R _{low} -CAN4_H	*) UBat _{extern_iso4}
11	CAN4_L		L-Line4	45	R _{low} -CAN4_L	*) GND _{iso4}
12	GND _{iso}			46	UBAT _{extern4}	*) do not connect!
13	FlexRay1A_BP			47	FlexRay1B_BP	
14	FlexRay1A_BM			48	FlexRay1B_BM	
15	GND _{iso}			49	GND _{iso}	
16	FlexRay2A_BP	CAN5_H		50	FlexRay2B_BP	CAN6_H
17	FlexRay2A_BM	CAN5_L		51	FlexRay2B_BM	CAN6_L
18	GND _{iso}			52	GND _{iso}	
19	DIGITAL_OUT1			53	DIGITAL_IN1	
20	DIGITAL_OUT2			54	DIGITAL_IN2	
21	DIGITAL_OUT3			55	DIGITAL_IN3	
22	DIGITAL_OUT4			56	DIGITAL_IN4	
23	IO_EXP1			57	IO_EXP11	
24	IO_EXP2			58	IO_EXP12	
25	IO_EXP3			59	IO_EXP13	
26	IO_EXP4			60	IO_EXP14	
27	GND _{iso}			61	U _{EXT_IO}	
28	IO_EXP5			62	IO_EXP15	
29	IO_EXP6			63	IO_EXP16	
30	IO_EXP7			64	IO_EXP17	
31	IO_EXP8			65	IO_EXP18	
32	IO_EXP9			66	IO_EXP19	
33	IO_EXP10			67	IO_EXP20	
34	GND _{iso}			68	GND _{iso}	

The pinout of the **Communication interfaces** is in accordance with the plugged-in Transceiver resp. the Additional FlexRay or CAN board (see [OnBoard Interfaces](#), [FlexRay Extension Board](#) and [CAN Extension Board](#)), while the pins **23..33** and **57..67** have different functionality according to the type of the used [IO Extension Board](#).

*) For isolated LIN Transceivers

3.3.6 OnBoard Interfaces

A Series 61 USB/ Ethernet unit provides up to four communication interfaces onboard, two of them having preferred assignments in the basic version of the units (see [Definition](#)). The two others can remain empty or optionally designed as additional CAN, LIN or K-Line interfaces. If necessary, you can even change the preferred assignment of an interface by plugging in another transceiver.



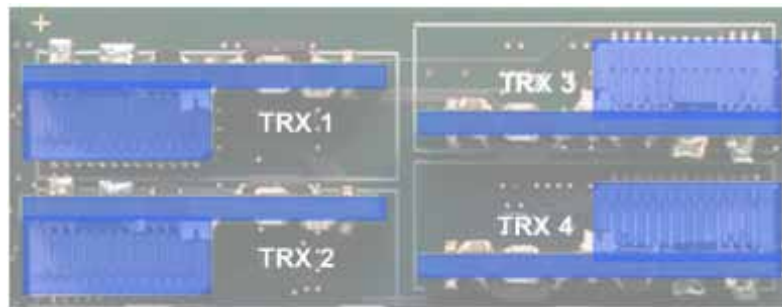
For changing or plugging in additional transceivers, open the stand-alone device (with the system **switched off**). To do that, unscrew the four screws of the frontal plate and extract the board until the transceiver positions can be seen.

Please proceed extremely carefully, otherwise the device could be damaged.

When plugging in transceivers, please attend to their correct position and orientation.

In the case of further inquiries, please contact our support department (ats_support@goepel.com).

The transceiver's position and orientation are shown in the following figure:



*Figure 3-6
Transceiver positions*

Each transceiver type is coded and can be identified clearly. For the available types of transceivers, see [Product Information](#).

As a rule all four interfaces are supplied by an internal voltage of 12V ($UBAT_{int}$) generated from ext. Power Supply (see Figure 3-3). In case of using other voltages, this internal voltage can be switched off individually by software.

(G-API commands
G_Can_Node_InternalVBat_Disable or
G_Lin_Node_InternalVBat_Disable or
G_KLine_Node_InternalVBat_Disable)

Then, an external voltage ($UBAT_{extern}$) must be supplied via the predefined pins of the frontal connector.

In case the internal power supply must be used again later, execute the G-API commands G_Can_Node_InternalVBat_Enable or G_Lin_Node_InternalVBat_Enable or G_Kline_Node_InternalVBat_Enable.



When using CAN-FD, the options LIN/ KLine are currently not possible.

The CAN-FD Onboard Interfaces are based upon the “M_CAN” IP-Module (Revision 3.2.0) of Bosch company, featuring the following characteristics:

- CAN 2.0 Specification compliant (Parts A and B) as well as ISO 11898-1:2015 Standard compliant
- Transfer of up to 64 Data bytes in one CAN-FD frame
- Support of the CRC Algorithmus in the CAN-FD frame according to ISO 11898-1:2015 as well as Bosch CAN-FD Spezifikation V1.0 (Non_ISO)

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
CAN V2.0B ISO 11898-1:2003 Interfaces, onboard, Node 1..2 (optionally ..4)						
	Transmission rate			1	Mbit/s	
UBAT _{intern}	Internal battery voltage		12		V	detachable
UBAT _{extern}	External battery voltage			27	V	
R _{CAN}	Termination high-speed Tcvr.		120		Ω	detachable
R _{CAN}	Termination low-speed Tcvr.			10	kΩ	
CAN-FD ISO 11898-1:2015 Interfaces, onboard, Node 1..2 (optionally ..4)						
C	Transmission rate			10	MBit/s	Depending on transceiver
UBAT _{intern}	internal battery voltage		12		V	detachable
UBAT _{extern}	external Battery voltage			27	V	
R _{CAN}	Termination high-speed Tcvr.		120		Ω	detachable
R _{CAN}	Termination low-speed Tcvr.			10	kΩ	
LIN V2.1 interfaces, onboard, Node 1..2 (optionally ..4)						
	Transmission rate			19.2	kbit/s	
UBAT _{intern}	Internal battery voltage		12		V	detachable
UBAT _{extern}	External battery voltage		12	27	V	
R _{LIN}	Pullup resistor	1	30		kΩ	switchable Master/Slave
K-Line interfaces, onboard, Node 1..2 (optionally ..4)						
	Transmission rate			9.6	kbit/s	
UBAT _{intern}	Internal battery voltage		12		V	detachable
UBAT _{extern}	External battery voltage		12	27	V	



Notes on R_{CAN} for the high-speed Transceiver:
The 120Ω Bus termination resistor can be deactivated by software (G-API command G_CAN_Node_BusTermination_Disable, reactivation by G_CAN_Node_BusTermination_Enable).

Notes on R_{CAN} for the low-speed Transceiver:
The internal 10kΩ bus termination resistance can be reduced by adding external resistors between the pins with the signals R_{low}-CANx_H and CANx_H as well as R_{low}-CANx_L and CANx_L (see [Connector Pinout](#)).



Notes on R_{LIN}: The 1kΩ pullup resistor corresponds to the LIN Master bus termination, it can be activated by software (G-API command G_Lin_PullUpResistor_Enable à Master, deactivation by G_Lin_PullUpResistor_Disable à Slave).
In the deactivated state the internal termination resistance of the LIN transceiver is effective (typical 30kΩ for TJA1020).

3.3.7 FlexRay Extension Board

The Series 61 USB/ Ethernet unit has two extension sockets on the board's top side prepared to take on a FlexRay plug-in module (see Figure 3-4). Each module has an independent FlexRay controller and two FlexRay transceivers, providing full dual channel functionality.



For a Series 61 USB/ Ethernet unit with CAN Extension Board, only one FlexRay Extension Board can be plugged in.

Each FlexRay Extension Board provides the following features:

- FlexRay controller (Freescale MFR4310)
- FlexRay 2.1 protocol compliant
- supports FlexRay transmission rates of 10, 8, 5 and 2.5Mbit/s
- 2 FlexRay transceivers (NXP TJA 1080)
- wake-up detection
- switchable termination resistors
- full galvanic isolation
- isolated power supply of transceivers

The following table shows the main characteristics of the FlexRay module:

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
FlexRay interface						
	Transmission rate	2.5		10	Mbit/s	per channel
R _{FR}	Termination resistor		100		Ω	detachable



Notes on R_{FR}: The 100Ω bus termination resistor can be deactivated by software (G-API command G_FlexRay_Node_BusTermination_Disable, reactivation by G_FlexRay_Node_BusTermination_Enable).

When configured with two FlexRay modules, both FlexRay modules can be used jointly to startup a FlexRay cluster. In this case one node will be the leading cold starter and the other one the following cold starter.



In cases where the ECU under test is a cold start node itself a single module could start up the cluster. This way the second module could be used to operate a second FlexRay cluster independently.

3.3.8 CAN Extension Board

In the case more CAN interfaces are required, a CAN Extension Board with two CAN interfaces can be plugged in the position of FlexRay Node B (generally for CAN5 and CAN6).

The TJA1041A highspeed transceivers for these interfaces can not be substituted by other transceiver types. Additionally, no external supply by $UBAT_{ext}$ is possible; supply is effected with the fixed $UBAT_{int}$ (12V) voltage.

The terminating resistor for both transceivers can be switched off.

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
CAN V2.0B ISO 11898-1:2003 Interfaces, generally Node 5..6 (optionally)						
C	Transmission rate			1	Mbit/s	
$UBAT_{Intern}$	Internal battery voltage		12		V	
R_{CAN}	Termination high-speed transceiver		120		Ω	detachable



When using CAN-FD, this option is currently not possible.

3.3.9 IO Extension Board

Additional analog and digital inputs and outputs as well as various other interfaces become available by plugging in an IO Extension board.

GOPEL electronic GmbH offers two different types: Type 1 and Type 2.

The Type 1 IO Extension board has additional resources as follows:

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
Digital inputs 5..8						
N	Number of inputs			4		
U _{IH}	High-level input voltage	3.5		25	V	
U _{IL}	Low-level input voltage			3.0	V	
I _L	Input current			1.8	mA	
Digital outputs 5..8						
N	Number of outputs			4		
U _{OH}	High-level output voltage	4.8		5	V	
U _{OL}	Low-level output voltage			0.5	V	
I _{OUT}	Output current			8	mA	
Analog inputs						
N	Number of inputs			6		
U _{IN}	Input voltage	0		10	V	
R	Resolution			10	bit	
Analog outputs						
N	Number of outputs			6		
U _{OUT}	Output voltage	0		10	V	
	Resolution			10	bit	

The following table shows the pinout of the frontal connector when the Type 1 IO Extension board is plugged in:

Pin	Signal	Signal	Pin
23	DIGITAL_OUT5	DIGITAL_IN5	57
24	DIGITAL_OUT6	DIGITAL_IN6	58
25	DIGITAL_OUT7	DIGITAL_IN7	59
26	DIGITAL_OUT8	DIGITAL_IN8	60
27	GND _{iso}	U _{EXT_IO}	61
28	ANALOG_OUT1	ANALOG_IN1	62
29	ANALOG_OUT2	ANALOG_IN2	63
30	ANALOG_OUT3	ANALOG_IN3	64
31	ANALOG_OUT4	ANALOG_IN4	65
32	ANALOG_OUT5	ANALOG_IN5	66
33	ANALOG_OUT6	ANALOG_IN6	67
34	GND _{iso}	GND _{iso}	68

The Type 2 IO Extension board has additional resources as follows:

Symbol	Indication	Min.	Typ.	Max.	Unit	Remarks
Digital inputs 5..8						
N	Number of inputs			4		
U_{IH}	High-level input voltage	3.5		25	V	
U_{IL}	Low-level input voltage			3.0	V	
I_L	Input current			1.8	mA	
Digital outputs 5..8						
N	Number of outputs			4		
U_{OH}	High-level output voltage			25	V	Supply via pin U_{EXT_IO}
U_{OL}	Low-level output voltage		open		V	Integrated recovery diode
I_{OUT}	Output current			200	mA	
Analog inputs						
N	Number of inputs			4		
U_{IN}	Input voltage	0		25	V	
	Resolution			10	bit	
R_L	Input resistance		125		k Ω	
Analog outputs						
N	Number of outputs			4		
U_{OUT}	Output voltage	0		25	V	Supply via pin U_{EXT_IO}
I_{OUT}	Output current per channel			10	mA	
	Resolution			10	bit	
External supply voltage input U_{EXT_IO}						
U_{EXT_IO}	External supply voltage	7		26	V	

The following table shows the pinout of the frontal connector when the Type 2 IO Extension board is plugged in:

Pin	Signal	Signal	Pin
23	DIGITAL_OUT5	DIGITAL_IN5	57
24	DIGITAL_OUT6	DIGITAL_IN6	58
25	DIGITAL_OUT7	DIGITAL_IN7	59
26	DIGITAL_OUT8	DIGITAL_IN8	60
27	GND_{iso}	U_{EXT_IO}	61
28	ANALOG_OUT1	ANALOG_IN1	62
29	ANALOG_OUT2	ANALOG_IN2	63
30	ANALOG_OUT3	ANALOG_IN3	64
31	ANALOG_OUT4	ANALOG_IN4	65
32	Do not connect!	Do not connect!	66
33	Do not connect!	Do not connect!	67
34	GND_{iso}	GND_{iso}	68

3.3.10 SENT Interfaces

Optionally up to 2 SENT outputs according to SAE J2716 Standard (Revision Jan. 2010) are available.

The data-link layer of the SENT transmitter is implemented as programmable FPGA logic. Digital outputs of the base board or the Type 1 Extension board serve as physical layer.

The routing between the SENT transmitter and the effective digital output is defined via the Trigger matrix.

The SENT interfaces are provided by a licensing option per card. Existing cards can be upgraded via a specific unlock code. Please contact your sales representative for an upgrade offer.

In order to use the SENT interfaces the following software is required:

- Firmware version 1.15.5 or higher resp.
- G-API version 1.3.4635 or higher

(See section **IO-Function** in the G-API Help for Software Documentation.)



Please note: The SENT interfaces are part of the IO interface. Therefore they do not appear as separate interfaces in the **GOPEL Hardware Explorer**.

3.4 Product Information

The Series 61 USB/ Ethernet intelligent, programmable controller family is a highly customizable controller platform. Currently this series consist of four base versions for CAN, LIN/ K-Line, FlexRay and Multibus systems that can be combined with a whole number of options. Please refer to the list below for all the options available:

Version	Description
USB 6153/ basicCAN 6153	CAN Controller for Windows XP/ Windows 7
	CAN Controller with 2 CAN nodes and 2 CAN transceiver modules as well as 4 digital inputs and 4 digital outputs (all onboard)
USB 6153/ basicCAN 6153	CAN-FD Controller for Windows XP/ Windows 7
	CAN-FD Controller with 2..4 CAN-FD nodes and 2..4 CAN transceiver modules as well as 4 digital inputs and 4 digital outputs (all onboard) Currently, the options LIN/ K-Line and CAN5/ 6 are NOT possible in this case
USB 6173/ basicLIN 6173	LIN/ K-Line Controller for Windows XP/ Windows 7
	LIN Controller with 2 LIN nodes and 2 LIN transceiver modules OR K-Line Controller with 2 K-Line nodes and 2 K-Line transceiver modules as well as 4 digital input channels and 4 digital output channels (all onboard)
USB 6181/ basicCAR 6181	Multibus Controller for Windows XP/ Windows 7
	Multibus controller with 1 CAN node and 1 CAN transceiver module and 1 LIN node and 1 LIN transceiver module OR 1 K-Line node and 1 K-Line transceiver module as well as 4 digital input channels and 4 digital output channels (all onboard)
USB 6191/ basicFlex 6191	FlexRay Controller for Windows XP/ Windows 7
	FlexRay Controller with 2 FlexRay nodes and 2 two-channel FlexRay modules (at FlexRay Extension Boards) as well as 4 digital input channels and 4 digital output channels (onboard)

Options for Series 61 USB/ Ethernet Units	
CAN Node	Further CAN node for Series 61 USB/ Ethernet units onboard, general to upgrade on 3 or 4 communication nodes, incl. transceiver module(s) Note: The total quantity of installable CAN/ LIN/ K-Line nodes at the same time amounts 4 per unit without CAN Extension board
CAN Extension Board	Additional board for Series 61 USB/ Ethernet units, generally to upgrade on 5 or 6 communication nodes, incl. transceiver modules Note: Total quantity of additional CAN Extension Boards amounts 1 per unit (not for CAN-FD)
LIN Node	Additional LIN node for Series 61 USB/ Ethernet units onboard to upgrade on 3 or 4 communication nodes, incl. transceiver module Note: The total quantity of installable CAN/ LIN/ K-Line nodes onboard at the same time amounts 4 per unit without CAN Extension board
K-Line Node	Additional K-Line node for Series 61 USB/ Ethernet units onboard to upgrade on 3 or 4 communication nodes, incl. transceiver module Note: The total quantity of installable CAN/ LIN/ K-Line nodes onboard at the same time amounts 4 per unit without CAN Extension board
FlexRay Node	Additional FlexRay node for Series 61 USB/ Ethernet units (but not for USB/ basicFlex 6191) incl. 2-channel FlexRay module, FlexRay controller MFR 4310 with 2 transceivers of TJA 1080 type (at FlexRay Extension board) Note: Total quantity of installable FlexRay nodes at the same time amounts 2 per unit (1 if the CAN Extension Board is installed) This option is useable independent from and additional to options CAN/ LIN/ K-Line and General Input/ Output
SENT Node	Additional SENT transmitter nodes for Series 61 USB/ Ethernet units Note: This licensing option provides up to 2 SENT output channels via digital outputs of either the base board or the optional IO Extension board Type 1.

Options for Series 61 USB/ Ethernet Units	
IO-Extension board Type 1	General Input/ Output module for Series 61 USB/ Ethernet units, incl. 6 analog input and 6 analog output channels, 4 digital input and 4 digital output channels Note: Total quantity of installable IO-Extension boards at the same time amounts 1 per unit; this option is useable independent from and additional to options CAN/ LIN/ K-Line and FlexRay
IO-Extension board Type 2	General Input/ Output module for Series 61 USB/ Ethernet units, incl. 4 analog input and 4 analog output channels, 4 digital input and 4 digital output channels Note: Total quantity of installable IO-Extension boards at the same time amounts 1 per unit; this option is useable independent from and additional to options CAN/ LIN/ K-Line and FlexRay
CAN TJA1054	CAN low speed transceiver type TJA1054
CAN TJA1041A	CAN high speed transceiver type TJA1041A
CAN NCV7356D1G	CAN single wire transceiver type NCV7356D1G
LIN TJA1020	LIN transceiver type TJA1020
LIN TJA1020 Iso	LIN transceiver type TJA1020 isolated channel selective
LIN TLE7259G	LIN transceiver type TLE7259G
K-Line L9637D	KLine transceiver type L9637D
K-Line L9637D Iso	K-Line transceiver type L9637D isolated channel selective
RS232 TRSF3221E	RS232 transceiver type TRSF3221E

Options for Series 61 USB/ Ethernet Units	
DIAG KW2000 TP1.6	Keyword 2000 on TP1.6 onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
DIAG KW2000 TP2.0	Keyword 2000 on TP2.0 onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
DIAG KW2000 ISO-TP	Keyword 2000 on CAN-ISO-TP onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
DIAG UDS ISO-TP	UDS on CAN-ISO-TP onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
DIAG GMLan	GMLan onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
DIAG J1939	J1939 onboard CAN Diagnostic software for Series 61 USB/ Ethernet units
CAL CCP2.1	CAN Calibration Protocol CCP2.1 for Series 61 USB/ Ethernet units
LIN adv-lib	Advanced library for the Test of the LIN Protocols specific. 2.0/ 2.1 for Series 61 USB/ Ethernet units
CAN DBC	Automated read-in of the CAN data base (DBC file) for Series 61 USB/ Ethernet units (LabVIEW based)
LIN LDF	Automated read-in of the LIN data base (LDF file) for Series 61 USB/ Ethernet units (LabVIEW based)
Net2Run	Software tool to generate signal based Rest bus Simulation(s) in heterogeneous car networks. This software solution is based on the AUTOSAR approach. Direct signal access (reading and manipulation) is provided via G-API functions. Further Net2Run features a gateway routing editor with PDU and signal mapping functionality. Net2Run supports the automatic import of bord net data in the *.dbc, *.ldf and Fibex formats.
Net2Run Runtime	Runtime module for executing the rest bus simulation files (*.rbs files) created by Net2Run. This option is necessary for each Series 61 USB/ Ethernet unit.
Net2Run IDE	Software programming environment (Windows host) to build G-API based on-board UserCode programs for Series 61 USB/ Ethernet units; includes: Net2Run IDE, QNX Neutrino CLT, onboard G-API libraries, single developer license
UserCode Runtime	UserCode runtime module for the execution of G-API based on-board UserCode programs on Series 61 USB/ Ethernet units; This option is necessary for each Series 61 USB/ Ethernet unit.

4 Software

For the embedding of Series 61 USB/ Ethernet units in your own applications there are the following possibilities available:

- [G-API Programming](#)
- [UserCode Programming](#)

4.1 G-API Programming

The G-API (GOPEL-API) is the C-based user interface for GOPEL electronic hardware under Windows®.

It provides a wide hardware independent command set for CAN, CAN-FD, LIN, K-Line, MOST, FlexRay, LVDS, SENT, ADIO and Diagnostic services. No matter whether a PXI/ PCI, USB and Ethernet device is used, the commands remain the same.

The hardware abstraction introduced with the G-API gives the test application parallel access to the hardware, allowing one application to access multiple hardware interfaces. As well as multiple applications can access the same hardware interfaces in parallel.

Another feature introduced by the G-API is the asynchronous hardware access. This means no blocking execution for pending firmware commands. The command acknowledgement is provided via callback mechanism.

With the HardwareExplorer (see also [Ethernet](#)) GOPEL electronic provides a hardware configuration and management tool, offering users an easy way to manage their hardware configurations and identifying specific hardware interfaces by logical names. Using logical interface names in the application saves from rebuilding the application when porting it to another interface or controller board, as the interface can be easily reassigned in the HardwareExplorer.

Furthermore the HardwareExplorer provides a simple means of testing the interaction between hardware and software by executing the integrated self-tests.



Please consult the G-API documentation for further information. This documentation and the installation software are located in the *G-API* folder of the supplied "Product Information" CD.

4.2 UserCode Programming

Series 61 USB/ Ethernet units can execute user programs direct on their PowerPC processor. This requires the UserCode run-time module being enabled.

The UserCode run-time module is an option for Series 61 USB/ Ethernet units (plus other GOEPEL devices) and requires one license per unit.

Executing programs directly on the PowerPC improves the real-time performance remarkable and frees up PCI bandwidth on the host system.

Therefore GOEPEL electronic has ported and enhanced by additional on-board functionality their C-programming user interface called G-API from Windows® to the QNX Neutrino real-time operating system. The QNX Neutrino real-time operating system is based on a micro kernel architecture, providing clear separation between the kernel and each individual application.

This allows user applications to run in a separate virtual memory space, which ensures safe test execution and improves reliability.

The UserCode run-time module uses a superset of the G-API commands for Windows® ensuring an easy migration of existing program source code. Additional functions will provide access to event notifications, timer tasks, the FLASH file system and other RT OS resources as well as standard C libraries.

The PowerPC processor uses big-endian byte order which must be taken care of when writing or porting code for the UserCode run-time module.

For smooth migration from little to big-endian, a library of conversion macros is provided with the Net2Run IDE development system.

With the Net2Run IDE development system, GOEPEL electronic provides a complete tool chain for creating UserCode programs and for their direct execution on Series 61 USB/ Ethernet units.

The Net2Run IDE development system is based on Eclipse IDE and contains the QNX Neutrino Command Line Tools (CLT), including PowerPC-Compiler, Linker and Debugger.

UserCode programs can be downloaded and debugged direct from Net2Run IDE via an Ethernet connection.

The following figure shows the Net2Run IDE:

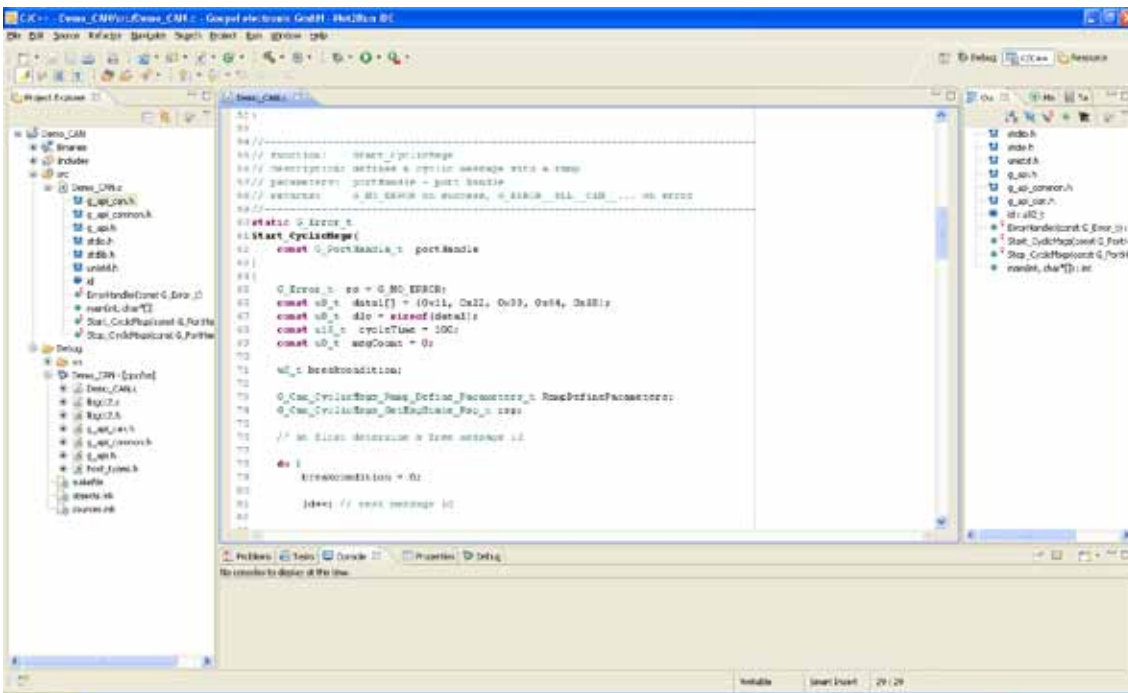


Figure 4-2: Net2Run IDE development system



Please consult the G-API documentation for further information. This documentation and the installation software are located in the G-API folder of the supplied "Product Information" CD.

4.3 Additional Software Interfaces

4.3.1 FS The Software Interface "FS1" (File System) allows, amongst others, creating, copying, deleting, executing and searching of files on the hardware.
Thus, it allows uniform access to the OnBoard File System.

4.3.2 Net2Run The Software Interface "Net2Run" (Net2Run1..Net2Run4) serves for the creation, configuration and execution of Residual bus simulation. Several bus interfaces for CAN, LIN and FlexRay networks can be simulated simultaneously and continuously.
The "Net2Run" interface supports loading and executing of so-called Residual bus simulation files (*.rbs). These are preconfigured command sequences containing a static Residual bus simulation. The corresponding files are created by means of the "Net2Run" Configurator Tool.

"Net2Run" is subdivided into several Software modules, strongly leaning to "AUTOSAR".

The following Software modules do exist:

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

Hence, the routing of PDUs of e.g. CAN1 to CAN2, CAN1 to LIN3 or FlexRay2 to CAN4 is possible (PDU-Gateway). The routing of individual signals can be realized by a COM-Signal-Gateway. In order that several independent Residual bus simulations can be executed on one device (e.g. one Residual bus simulation on CAN1, CAN2, CAN3 and CAN4 each), several "Net2Run" Interfaces do exist (4).

4.3.3 Sequence The Software Interface "Sequence1" allows recording and playing of Firmware commands as a command sequence, short "Sequence". A Sequence can also permanently stored under an arbitrary name on the device.
By using its name, this Sequence can be loaded again and played. The automatic loading of a Sequence after switching on the device e.g. allows the automatic configuration and starting of a Residual bus simulation (in the case the required commands are included in the Sequence).

4.3.4 UserCode

The Software Interface "UserCode1" allows the OnBoard execution of user programs (see also [UserCode Programming](#)).

For the communication between OnBoard programs and the Host, Message-FIFOs do exist.

Each side (OnBoard program or Host) can create, write to or read from a Message-FIFO.

Each FIFO can be read and written from both sides. For consistency it is recommended to have a separate FIFO for each direction. So that one side only writes to and the other side only reads from a FIFO.

4.4 Further GOPEL Software

PROGRESS, Program Generator and myCAR of GOPEL electronic GmbH are comfortable software programs for testing with GOPEL hardware.

Please refer to the corresponding User Manual to get more information regarding these programs.

A

Addressing
 Ethernet3-7
 USB3-7

B

basic 61xx
 Power supply3-3

C

CAN Extension..... 3-13
 Communication interfaces ..3-7
 Computer interface.....3-7
 Connector3-9

D

Driver installation
 USB2-2

E

Ethernet 2-4, 3-7
 Extension
 CAN 3-13
 FlexRay 3-12
 IO 3-14

F

Firmware Update2-5
 Firmware Variants2-6
 FlexRay Extension 3-12
 FS4-1

G

G-API4-2

H

Hardware Installation.....2-1
 HardwareExplorer..... 2-4, 4-2

I

Installation.....2-1
 Interface Options.....2-7
 IO Extension3-14
 Type 13-14
 Type 23-15
 Isolation3-8

M

myCAR4-2

N

Net2Run4-1
 Net2Run IDE4-3

P

Pinout..... 3-9, 3-14, 3-15
 Power supply
 basic 61xx3-3
 Program Generator4-2
 PROGRESS.....4-2

S

SENT Interfaces3-16
 Sequence.....4-1
 Series 61
 Addressing3-7
 Characteristics3-4
 Construction3-5
 Dimensions.....3-4
 Ethernet2-4
 Options3-18
 Resources.....3-1
 USB2-1
 USB Driver installation2-2
 Status LEDs.....3-8

U

USB 61xx
 Basic version.....3-17
 Version CAN-FD3-17
 UserCode..... 3-20, 4-3, 4-2