Technical Specification

PXI / PCI 3090

FlexRay Interfaces

User Manual Version 2.4

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1 Board Installation

1.1 Hardware Installation

Warning

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

The PXI™- or CompactPCI™ system is to be opened according to its conditions. A free slot is to be selected in your system.
Now, the slot cover is to be taken away from the slot selected. To do this, unscrew the two fixation screws and remove the cover from the slot.

(If it is necessary to exchange extension boards, pay attention to the general rules to avoid electrostatic charging.
The modules must never be removed or mounted with the power switched on! Additionally, the right alignment is absolutely required.)

Warning

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

Insert the board carefully into the prepared slot. Use the lever at the front plate in order to push in the board finally.

When the board has been inserted properly, it is to be fixed by means of the two screws at the front plate. Now, the board has been installed correctly.
Afterwards, carry out the operations required at the system to make it ready for operation anew.

1.2 Driver Installation

Due to the plug and play capability of Windows® 2000/ XP, for every newly recognized hardware component a driver installation is started automatically via the hardware assistant. The hardware assistant can carry out the installation of the device driver by using the *inf* file contained on the enclosed CD.

It is not absolutely essential to restart the system.

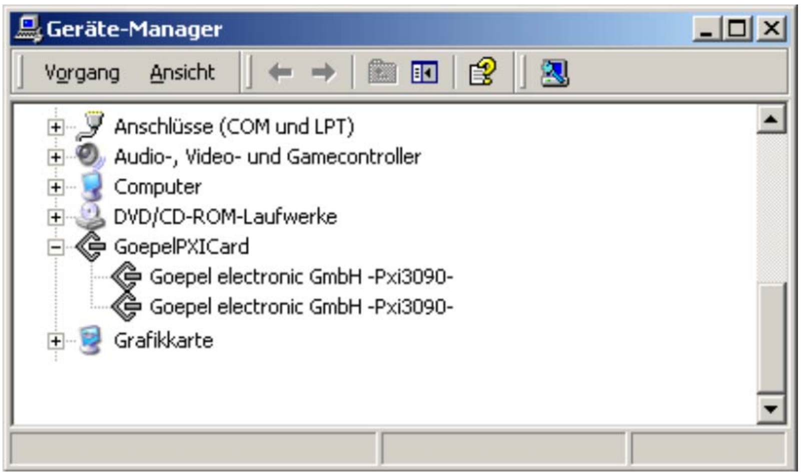
At present, the available device driver only supports Windows® 2000/ XP systems.

If you want to create your own software for the boards, you possibly need additional files for user specific programming (**.LLB*, **.H*). These files are not automatically copied to the computer and have to be transferred individually from the supplied CD to your development directory.

The I/O base address is generated during the boot operation of the system and is written into the configuration area of the board. A manual setting is not necessary.

After driver installation, you can check whether the boards are properly imbedded by the system.

The following figure show the successful imbedding of two PXI 3090 boards:



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- Computer
- DVD/CD-ROM-Laufwerke
- GoepelPXICard
  - Goepel electronic GmbH -Pxi3090-
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- Grafikkarte

Figure 1-1: Display of Device Manager

2 Hardware

2.1 Definition

FlexRay controller boards PXI/ PCI 3090 are communication boards of GOEPEL electronic GmbH.

These boards can be used in general control technology, especially for applications in automotive technology.

A PXI/ PCI 3090 board in the maximum construction stage offers the following resources:

- 2 Independent FlexRay nodes
- 2 Independent CAN nodes
- 2 x Digital Input
- 2 x Digital Output

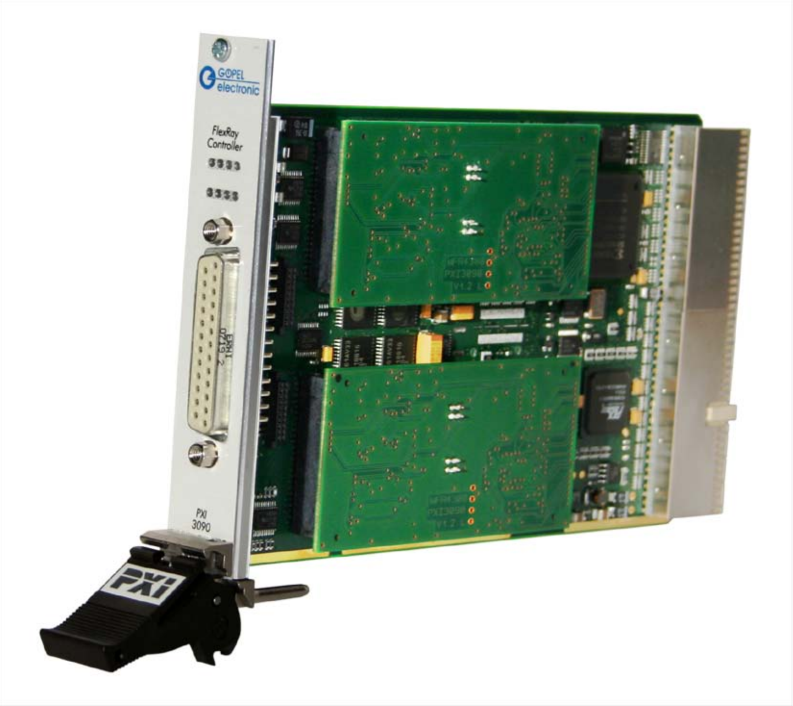

Figure 2-1: PXI 3090

In this User Manual, Controller ALWAYS means the microcontroller assigned to a FlexRay interface (type Infineon TC1796, µC, 150 MHz in Figure 2-3), with the exception of the “FlexRay Controller” designation on the front panel for the entire board).

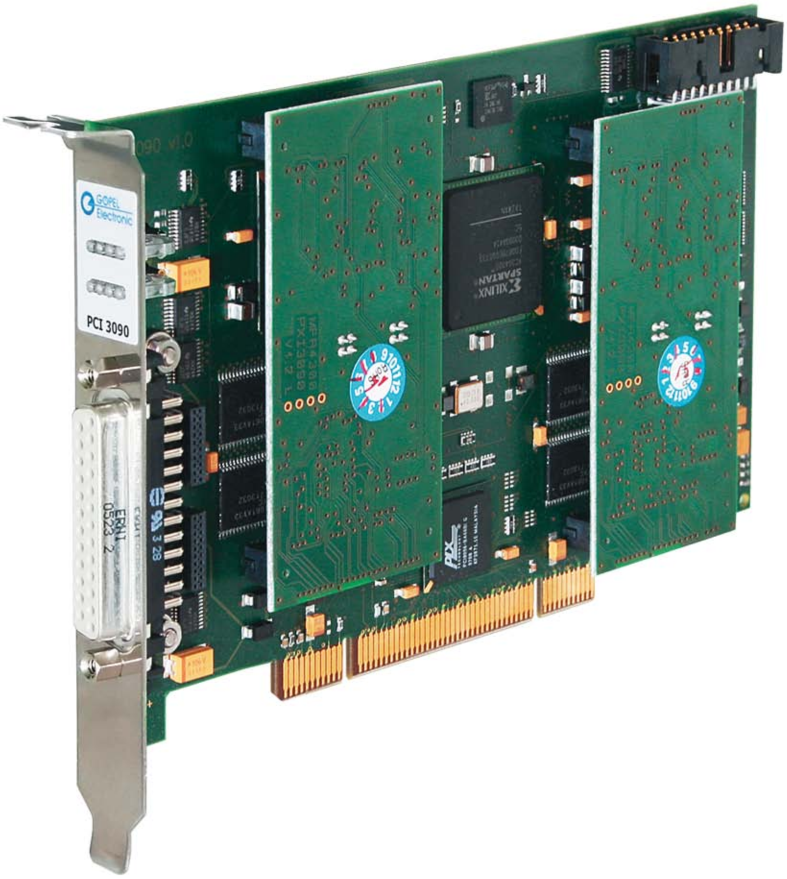

*Figure 2-2:
PCI 3090*

2.2 Technical Information

2.2.1 General

The PXI 3090 communication board is a plug-in board developed for the PXI™ bus (**P**CI e**X**tensions for **I**nstrumentation). Basis of this bus is the CompactPCI™ bus.

The board can be plugged into any desired slot of a CompactPCI™ or PXI™ system (except for slot 1). It can be definitely identified also in the case that several boards of this type are used in the same rack.

The board does not have jumpers for hardware detection and is automatically integrated into the respective system.

The PCI 3090 communication board is a PC plug-in board for the PCI Local Bus Rev. 2.2.
It can be operated at any PCI slot (32 bits, 33 MHz, 3.3 V)

Both boards do not have jumpers for hardware detection and are automatically integrated into the respective system.

2.2.2 Dimensions

The dimensions of the board correspond to standard dimensions of the accompanying bus system:

- PXI 3090 FlexRay Interface Board: 160 mm x 100 mm (L x W)
- PCI 3090 FlexRay Interface Board: 168 mm x 106 mm (L x W)

2.2.3 3090 Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
V_{BAT}	Battery voltage		12	30	V	Acc. to transceiver’s type
	Transmission rate FlexRay			10	MBaud	
	Transmission rate CAN			1	MBaud	
R_{bus}	Terminating resistors		120		Ohm	
V_{in}	Input voltage	3.0		5.5	V	Digital input
V_{out}	Output voltage		5		V	Digital output

2.3 Construction

2.3.1 General

In the basis version, PXI 3090/ PCI 3090 boards have two FlexRay interfaces, extendable by two CAN interfaces of version 2.0b. Figure 2-3 shows schematically the construction of the PXI 3090 board in a block diagram.

An ASIC is used as the interface to the PCI or cPCI bus on the PXI/ PCI 3090 boards. It includes all the function blocks required for the communication with the computer bus.
The PCI 3090 communication board does not have a PXI interface. To exchange trigger signals with other GOEPEL electronic PCI boards despite of that, there is an additional connector on the board with eight freely configurable lines (TriggerIO in Figure 2-5).

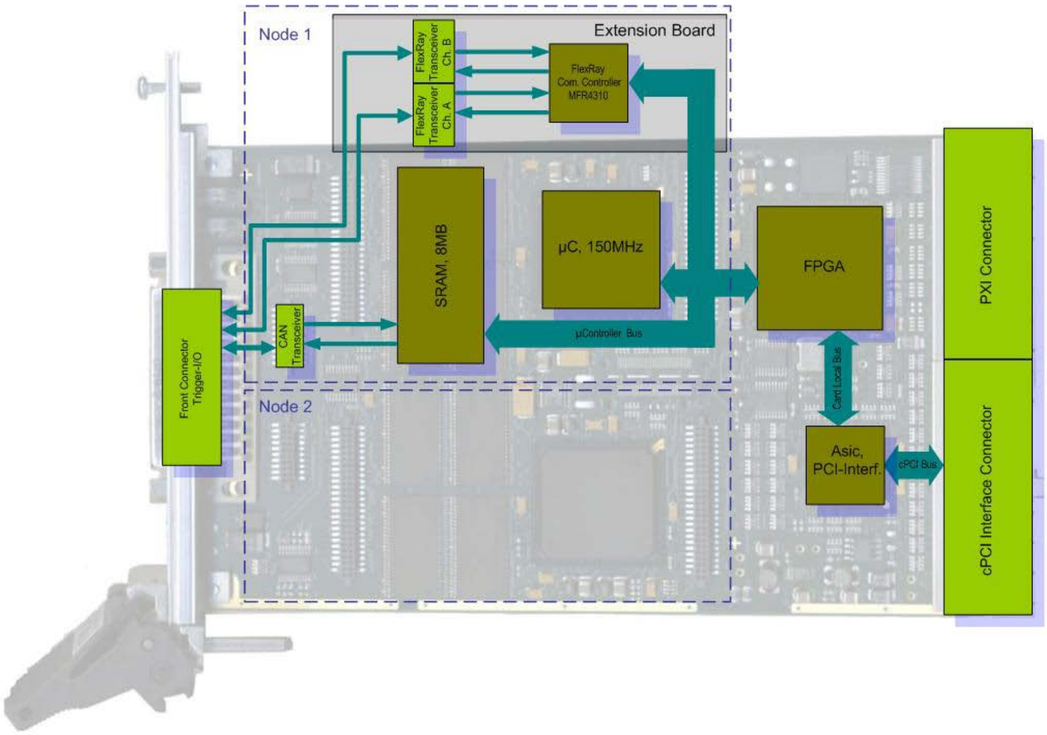

Figure 2-3: Block diagram of a PXI 3090 Communication board

Extension Board 1	FlexRay node 1 with Communication Controller and Transceivers for Channel A and Channel B of Node 1
Extension Board 2	FlexRay node 2 with Communication Controller and Transceivers and Transceivers for Channel A and Channel B of Node 2

2.3.2 Addressing

PXI 3090: PXI racks do have an own geographical slot addressing of the backplane.
Numbering starts with 1 and can be seen at the cover's front side.
Mount always an embedded controller or an MXI card at slot 1.

PCI 3090: PCI racks do not have an own geographical slot addressing. There is a separate address jumper field (Address jumper in Figure 2-5) for clear identification of the board (analogously to "geographical addressing" of the PXI specification) in a system with several PCI 3090 boards.You can select up to 16 addressing variants by this. The corresponding binary value (0..15) set with the jumpers can be read out by the delivered software.

2.3.3 Communication Interfaces

2 x FlexRay Nodes (Protocol Specification V2.1):

Both FlexRay nodes are designed as pluggable Extension boards.
The Freescale MFR4310 (FlexRay system Protocol Specification V2.1A) is used as communication controller.

Each Extension Board has two transceivers of NXP TJA1080 type. These transceivers realize the bus levels for Channel A and Channel B.

By the modular construction upgrades to higher protocol specifications are possible at any time if necessary.

2 x CAN Interfaces Version 2.0b:

The CAN interfaces on a PXI/ PCI 3090 board can only be used as highspeed interfaces.
The 120 Ohm bus terminating resistor for each CAN interface is mounted on the board.

The type of the mounted transceiver is decisive for proper operation of a CAN interface in a network. Often CAN networks do only operate properly in the case that all members use a compatible type of transceiver.
To offer maximal flexibility to the users of PXI/ PCI 3090 boards, the transceivers are designed as plug-in modules.
There are several types that can be easily exchanged:

- TJA1041A
- PCA82C251

These CAN transceivers require a connection to the battery voltage (which is provided onboard as +12V).
In the case a higher battery voltage is needed (max. +27V), that can be supplied via the pins 18 or 12 of connector XS1 (V_Bat1..V_Bat2, see Front Connector Pinout).

2.3.4 Assembly

Figure 2-4 shows schematically the component side of a PXI 3090 board. You can see the positions of the extension boards and connectors.

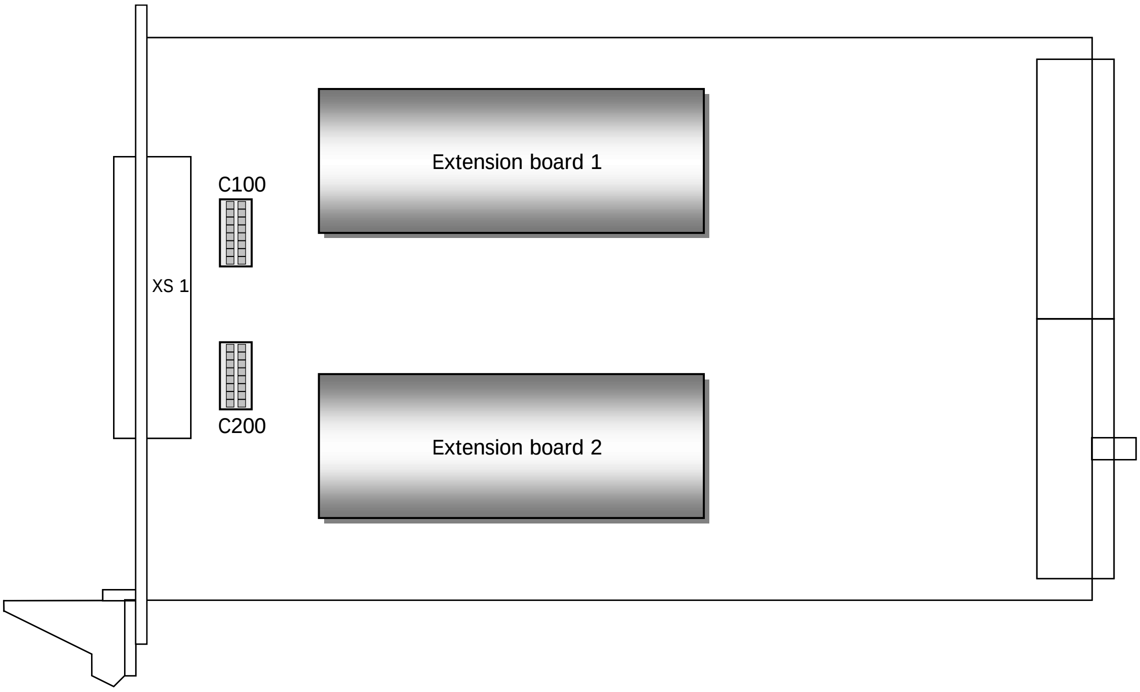

Figure 2-4: Component side of a PXI 3090 communication board (schematically)

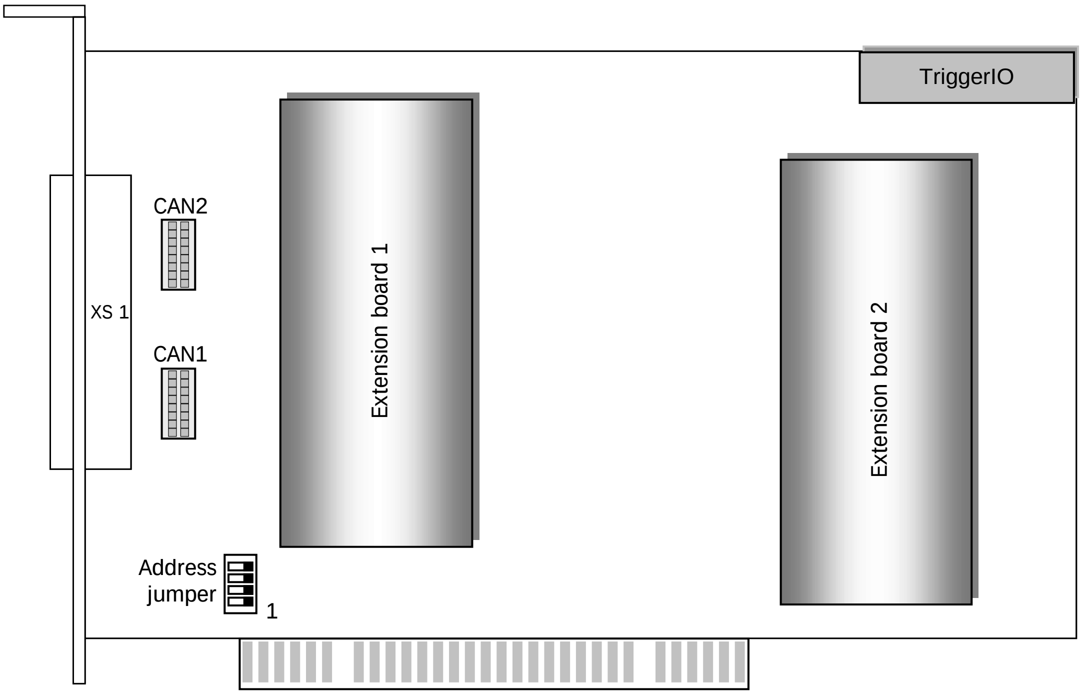

Figure 2-5: Component side of a PCI 3090 communication board (schematically)

Extension board 1	FlexRay node 1 with communication controller and transceivers
Extension board 2	FlexRay node 2 with communication controller and transceivers
CAN1, CAN2	Positions for pluggable CAN transceivers

2.3.5 Front Connector Pinout

Type: DSub 25 poles socket

The FlexRay interfaces are provided via this connector at the frontal edge of the PXI 3090 communication board.

No.	XS1 pin	Signal name	Remarks
1	1	FlexRay1A_BP	FlexRay node 1 (plus bus line channel A)
2	14	FlexRay1A_BM	FlexRay node 1 (minus bus line channel A)
3	2	GND	Ground potential transceiver
4	15	FlexRay1B_BP	FlexRay node 1 (plus bus line channel B)
5	3	FlexRay1B_BM	FlexRay node 1 (minus bus line channel B)
6	16	GND	Ground potential transceiver
7	4	CAN1_H	CAN node 1 (High)
8	17	CAN1_L	CAN node 1 (Low)
9	5	GND	Ground potential transceiver
10	18	VBAT1	Reference potential transceiver (node 1)
11	6	INPUT1	Digital input FlexRay node 1
12	19	OUTPUT1	Digital output FlexRay node 1
13	7	n.c.	Not assigned
14	20	FlexRay2A_BP	FlexRay node 2 (plus bus line channel A)
15	8	FlexRay2A_BM	FlexRay node 2 (minus bus line channel A)
16	21	GND	Ground potential transceiver
17	9	FlexRay2B_BP	FlexRay node 2 (plus bus line channel B)
18	22	FlexRay2B_BM	FlexRay node 2 (minus bus line channel B)
19	10	GND	Ground potential transceiver
20	23	CAN2_H	CAN node 2 (High)
21	11	CAN2_L	CAN node 2 (Low)
22	24	GND	Ground potential transceiver
23	12	VBAT2	Reference potential transceiver (node 2)
24	25	INPUT2	Digital input FlexRay node 2
25	13	OUTPUT2	Digital output FlexRay node 2

At present, the CAN functions are not software supported.

2.3.6 LED Indication

The LEDs arranged at the front panel indicate the current operating state of the microcontrollers assigned to each FlexRay interface.

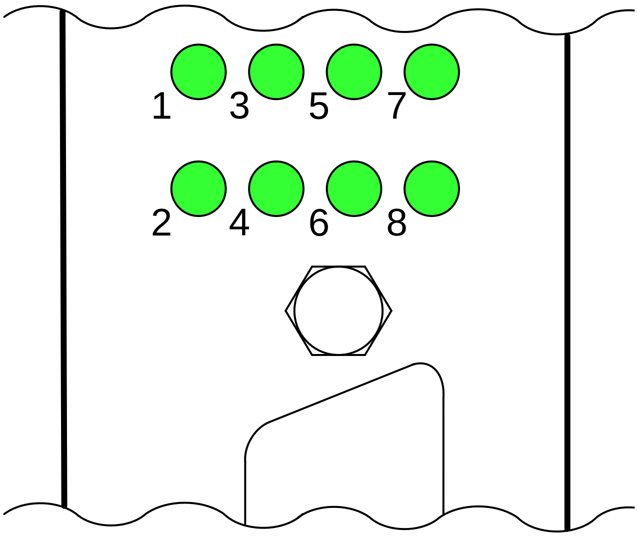

Figure 2-6: LED Indication

The LEDs indicate the following states (different for PXI/ PCI 3090!):

State					Notes
LED 1	LED 2	LED 3	LED 4	LED 5..8	PXI 3090
LED 1	LED 3	LED 5	LED 7	LED 2,4,6,8	PCI 3090
Permanently ON				not used	µC 1: Controller not running
Alternately blinking					µC 1: Bootloader software runs Error cause (probably): Software reset not executed
OFF					µC 1: Firmware runs
ON (shortly)	OFF				µC 1: Firmware runs executing commands
		Permanently ON			µC 2: Controller not running
		Alternately blinking			µC 2: Bootloader software runs Error cause (probably): Software reset not executed
		OFF			µC 2: Firmware runs
		ON (shortly)	OFF		µC 2: Firmware runs executing commands

2.4 Delivery Notes

PXI/ PCI3090 boards are delivered in the following basic variant:

- 2x FlexRay node

3 Control Software

There are three ways to integrate PXI 3090/ PCI 3090 hardware in your own applications:

- Programming via G-API
- Programming via DLL Functions
- Programming with LabVIEW

3.1 Programming via G-API

The G_API (GOEPEL-API) is the favored user interface for this GOEPEL hardware.

You can find all necessary information in the *G-API* folder of the delivered CD.

3.2 Programming via DLL Functions

Programming via DLL Functions is possible also in future for existing projects which can not be processed with the GOEPEL electronic programming interface G-API.

We would be pleased to send the GOEPEL Firmware documentation to you on your request.
Please get in touch with our sales department in case you need that.

For the used structures, data types and error codes, please refer to the headers – you find the corresponding files on the supplied CD.

3.2.1 Windows Device Driver

The DLL functions for programming using the Windows device driver are described in the following sections:

- Driver Info
- Write Instruction
- Read Response
- Read Monitor
- XilinxReadWriteRegister

The following type definitions are used:

S32 – signed long

U8 – unsigned char

U16 – unsigned short

U32 – unsigned long

3.2.1.1 Driver Info

The Pxi3090__DriverInfo function is for the status query of the hardware driver.

Format:

```
S32 Pxi3090__DriverInfo(t_Driver_Info *pDriverInfo, U32 Length)
```

Parameters:

Pointer, for example pDriverInfo
to a data structure
For the structure, see the *Pxi3090_UserInterface.h* file on the supplied CD

Length
Size of the storage area DriverInfo is pointing to, in bytes

Description:

The Pxi3090__DriverInfo function returns information regarding the status of the hardware driver.

For this reason, the address of a pDriverInfo pointer has to be transferred to the function.

The structure pDriverInfo is pointing to is filled with various information within the function.

3.2.1.2 Write Instruction

The Pxi3090__WriteInstruction is for sending a command to the selected PXI 3090/ PCI 3090 controller.

Format:

```
S32 Pxi3090__WriteInstruction(U8 *pData, U16 DataLength)
```

Parameters:

Pointer, for example pData
to the write data area
consisting of Command Header and Command Bytes
(currently max. 4096 bytes per command)

DataLength
Size of the storage area pData is pointing to, in bytes

Description:

The Pxi3090__WriteInstruction function sends a command to the PXI 3090/ PCI 3090 controller.

In the header of the structure pData is pointing to, there is the information regarding the PXI 3090/ PCI 3090 board and the corresponding controller to be activated by this function. Therefore these parameters are not to be given separately.

The general structure is described in the General Firmware Notes section of the GOEPEL Firmware documentation.

3.2.1.3 Read Response

The Pxi3090__ReadResponse function is for reading a response from the selected PXI 3090/ PCI 3090 controller.

Format:

```
S32 Pxi3090__ReadResponse(U8 Device, U8 Node, U8 *pData, U32 *DataLength)
```

Parameters:

Device

Index of the PXI 3090/ PCI 3090 board, left beginning with 1

Node

Number of the controller (1..2)

Pointer, for example pData
to the read data area,
consisting of Response Header and Response Bytes
(currently max. 4096 bytes per response)

DataLength

Value of the parameter before function call:
Size of the buffer pointed by pData in bytes

Value of the parameter after function call:
Number of bytes actually read

Description:

The Pxi3090__ReadResponse function reads back the oldest response written by the selected PXI 3090/ PCI 3090 controller into the Response area of the DPRAM.

If several responses have been provided by the controller, but not sent, they are not lost but stored as a list.

On calling up, the Pxi3090__ReadResponse function continues to supply data until this list contains no more entries.

3.2.1.4 Read Monitor

The Pxi3090__ReadMonitor function is for reading monitor data provided by the selected FlexRay controller of the PXI 3090/ PCI 3090 board.

Format:

```
S32 Pxi3090__ReadMonitor(U8 Device, U8 Node, U8 *pData, U32 *DataLength)
```

Parameters:

Device

Index of the PXI 3090/ PCI 3090 board, left beginning with 1

Node

Number of the controller (1..2)

Pointer, for example pData
to the read data area (max. 65536 bytes)

DataLength

Value of the parameter before function call:
Size of the buffer pointed by pData in bytes

Value of the parameter after function call:
Number of monitor entries actually read

Description:

The Pxi3090__ReadMonitor function reads the data found in the monitor of the selected FlexRay controller.

This concerns exclusively the monitor data provided by the selected FlexRay controller. That means, the normal Response area is separated from the monitor data area.

The data amount per monitor entry depends on the payload length of the identifier.

3.2.1.5 XilinxReadWriteRegister

The Pxi3090__XilinxReadWriteRegister function allows the access to the FPGA.

Format:

```
S32 Pxi3090__XilinxReadWriteRegister(U8 *pData, U32 *DataLength);
```

Parameters:

Pointer, for example pData
to the write data area
(currently max. 128 bytes per command)

DataLength
Size of the storage area pData is pointing to, in bytes

Description:

The data format consists of four bytes including the command.
If necessary parameter bytes can follow

Data format: 1st byte: 0x48 (StartByte)
2nd byte: card (index of the PXI board, left beginning with 1)
3rd byte: 0x00 (Reserved Byte)
4th byte: 0x12 XILINX command: Register Read/Write

The command parameter description for the 0x12 XILINX Register Read/Write command is listed below:

Byte	Indication	Description
0..3	Mode	0: Read from a register of the XILINX 1: Write to a register of the XILINX
4..7	Register	Address of the register for the read/write access
8..11	Value	Value read from or to be written to the addressed register

After PowerOn it is recommended to reset the whole PXI 3090/ PCI 3090 board via a XILINX PowerOnReset.

The address of the ResetRegister is `0x00000002`
and the register value is `0xFFFFFFFF` (see next page).

ℹ After a board reset, a delay of about 500 ms is required (as the controllers execute a power-on reset).
Then, carry out the 0x10 Software Reset Firmware command for all controllers to come into the normal operating mode from bootloader mode.

Below the XILINX command for the hardware PowerOnReset operation is listed:

Byte Index	Byte Value	Indication	Description
0	**0x48**	StartByte	Indicates the StartByte
1	**0x01**	card	Address of the board
2	**0x00**	reserved	Reserved byte (to be set to 0)
3	**0x12**	Command	XILINX command Register Read/Write
4	**0x01**	Mode	Write mode (0x01), LowByte
5	**0x00**		Write mode (0x01), MidByte1
6	**0x00**		Write mode (0x01), MidByte2
7	**0x00**		Write mode (0x01), HighByte
8	**0x02**	Register	Address of the register (0x02), LowByte
9	**0x00**		Address of the register (0x02), MidByte1
10	**0x00**		Address of the register (0x02), MidByte2
11	**0x00**		Address of the register (0x02), HighByte
12	**0xFF**	RegisterValue	Reset vector (0xFFFFFFFF), LowByte
13	**0xFF**		Reset vector (0xFFFFFFFF), MidByte1
14	**0xFF**		Reset vector (0xFFFFFFFF), MidByte2
15	**0xFF**		Reset vector (0xFFFFFFFF), HighByte

3.3 Programming with LabVIEW

3.3.1 LabVIEW via the G-API

The supplied CD contains VIs for activating PXI/ PCI 3090 boards under LabVIEW.

These LabVIEW VIs use the functions of the GOEPEL G-API.

3.3.2 LLB using the Windows Device Driver

The supplied CD contains VIs for activating PXI/ PCI 3090 boards under LabVIEW.

These LabVIEW VIs use the functions described in chapter Windows Device Driver.

3.4 Further GOEPEL Software

PROGRESS and Program Generator of GOEPEL electronic are comfortable user interfaces for creating and executing Test programs for the test with GOEPEL hardware.

Please refer to the corresponding Software Manuals to get more information regarding these programs.