Product Specification

PXI 3250

CVT Meter

User Manual   Version 1.1

GOEPEL electronic

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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.

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

Windows Device Driver

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 need the files for user specific programming (*.DLL*, *.LLB*, *.H*). These files are not automatically copied to the computer and have to be transferred individually from the supplied Product 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 shows among others the successful imbedding of a PXI 3250 board.

Figure 1-1: Device Manager

2 Hardware PXI 3250

2.1 Definition

The **PXI 3250** CVT Meter (Current/ Voltage/ Temperature) is a PXI board of **GOEPEL electronic GmbH** for measuring Current, Voltage and Temperature (PT1000) with a resolution of 5½ digits. The base of this board is a special measuring module, which is part of the **PXI 3250** as an extension board.

PXI 3250 has a special **Autorange** function, allowing current measurements completely uninterruptible over all measurement ranges. This way it is quite simple to measure quiescent currents as well as full load currents.

The multitude of connectable measuring probes allows the perfect adaption of resolution and measurement range to the corresponding application.

PXI 3250 can be delivered with 2 or 4 independent and galvanically separated measurement channels.

Figure 2-1:
PXI 3250

2.2   Construction

2.2.1 General

The measuring section consists of the measurement module plugged on the PXI 3250 and an externally connected measuring Probe for the conversion of the measurement value. There are Probes to measure current, voltage or temperature.

The PXI 3250 board can be delivered as variants with 1 or 2 measurement modules, with 2 measuring channels each.
Every channel has 5 measurement ranges with a resolution of 16 bits per measurement range and an adjustable sample rate between 0.546ms and 70.4ms.
In addition, the board can proceed an internal averaging over max. 100 values. For each measurement value, a time stamp is transferred.

2.2.2 PXI Interface

The PXI 3250 CVT Meter 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).

The highest bus transmission rate is 133MByte/s. The PXI 3250 board can be definitely identified also in the case that several boards of this type are used in the same rack.

2.2.3 Dimensions

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

- 160 mm x 100 mm x 20.32 mm (L x W x H)

2.2.4 PXI 3250 Characteristics

The PXI 3250 board has the following characteristics:

Symbol	Indication	Min.	Typ.	Max.	Unit
	Operating conditions				
V_{CC1}	Supply voltage 1	3.0	3.3	3.6	V
I_{CC1}	Input current 1			200	mA
V_{CC2}	Supply voltage 2	4.8	5.0	5.2	V
I_{CC2}	Input current 2			300	mA
T_A	Operating temperature	-20	25	60	°C
	Galvanic isolation		80		VDC

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2.3   Structure

2.3.1   General

According to the delivered version, the PXI 3250 CVT Meter has 2 or 4 sockets to connect the Probes.
All probes as well as the measurement module are especially adapted to be used with the GOEPEL PXI 3250 board.

The board recognizes the connected Probe automatically and considers the calibrating values when measuring.

All measurement channels are galvanically separated from each other.

The user can define all parameters himself (sample rate, measurement range or averaging) as well as assign the obtained measuring values to deterministic events due to the belonging time stamps.

4 LEDs indicate the status of the measurement modules.

2.3.2   Addressing

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.

PXI 3250 boards can read out the geographical slot address.

2.3.3   Front View
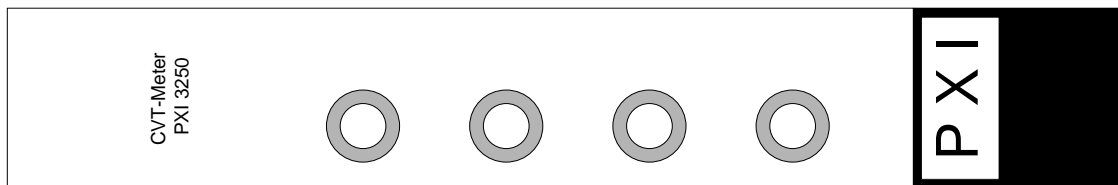
Figure 2-2: PXI 3250 Front View

The following table explains the front plate elements:

Type	Name	Description
LED	1	Blinking if Meas. module 1 (Ch1/2) is operable
	2	Blinking if Meas. module 2 (Ch3/4) is operable
	3	Blinking if Meas. module 1 (Ch1/2) has a failure
	4	Blinking if Meas. module 2 (Ch3/4) has a failure
Socket	Ch 1	Connection for Meas. probe to channel 1
	Ch 2	Connection for Meas. probe to channel 2
	Ch 3	Connection for Meas. probe to channel 3
	Ch 4	Connection for Meas. probe to channel 4

2.4   Measuring Technique

2.4.1   Modules

The measurement system is a millivoltmeter.

It is possible to connect different probes providing voltage levels to the sockets.

The **Probes** are recognized automatically by the measurement module.

The measurement module provides the following internal measurement ranges and arithmetical resolutions:

Range	Gain	Meas. range	Resolution
0	1	+720/-300mV	24 µV
1	6	+/- 120mV	4 µV
2	24	+/- 30mV	1 µV
3	50	+/- 15mV	0.5 µV
4	100	+/- 7.5mV	0.25 µV

The measurement ranges are automatically adapted to the corresponding measurement value by the **Autorange** function.

Resolution and accuracy of voltage measurement:

Characteristics	Symbol	Meas. range	Min.	Typ.	Max.	Unit
Maximum value of measurement voltage	|U|max	All	-	-	720	mV
Measurement voltage (Overrange for Uin outside the stated range)	Uin	720 mV	-300	-	720	mV
		120 mV	-120	-	120	
		30 mV	-30	-	30	
		15 mV	-15	-	15	
		7.5 mV	-7.5	-	7.5	
Resolution	LSB	720 mV	-	24	-	µV
		120 mV	-	4	-	
		30 mV	-	1	-	
		15 mV	-	0.5	-	
		7.5 mV	-	0.25	-	
Offset error of the measurement values*)	Foffset	720 mV	-	-	3	LSB
		120 mV	-	-	3	
		30 mV	-	-	3	
		15 mV	-	-	5	
		7.5 mV	-	-	10	
Gain error of the measurement values (ambient temperature 15°C to 30°C)	Fgain1	7.5 mV	-	-	0.5	%
		All others	-	-	0.2	%
Gain error of the measurement values (ambient temperature 0°C to 50°C)	Fgain2	All	-	-	0.5	%
Gain error of the measurement values (ambient temperature -20°C to 60°C)	Fgain3	All	-	-	1	%
Background noise: Standard deviation of the measurement values (Sample rate 1ms)	σ0	720 mV	-	-	20	LSB
		120 mV	-	-	20	
		30 mV	-	-	20	
		15 mV	-	-	20	
		7.5 mV	-	-	20	
Standard deviation of the measurement values (Sample rate 128 ms)	σ128	720 mV	-	-	2	LSB
		120 mV	-	-	2	
		30 mV	-	-	2	
		15 mV	-	-	2	
		7.5 mV	-	-	2	

*) After 10 minutes of operation at least.

2.4.2 Probes

The type of the **Probe** defines which kind of measuring feeder is connected with the corresponding channel.
By this, also the scaling factor and the unit of the measurement value to be transferred are defined.

There are the following types of probes:

Type	Kind of measurement	Measurement value resolution (Meas. system resolution at Gain 100)
1	low current (LI)	10 µA/Bit
2	mean current (I)	100 µA/Bit
3	high current (HI)	1 mA/Bit
4	voltage (up to 80V)	0.1 mV/Bit
5	temperature measurement (linearized)	0.01 °C/Bit
8	low current (LI)	1 µA/Bit
9	low current (LI)	0.1 µA/Bit

The **Probes** are constructed as follows:
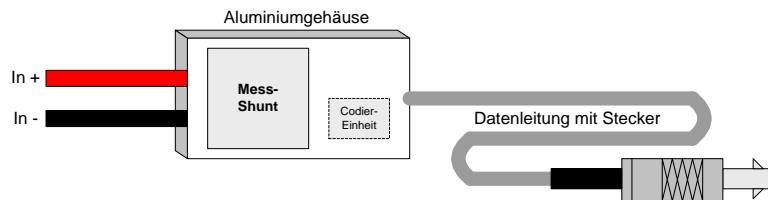
The measurement accuracy that can be reached with a **Probe** and the measurement system depends on three factors:

- Error of the saved calibrating value of the coding unit
- Temperature drift of the resistance value of the measurement shunt
- Measurement failure of the measurement system

For I probes the following is valid:

Accuracy of the measurement resistor at room temperature (23 +/- 5 °C)	2 %
Failure of the calibrating value at room temperature (23 +/- 5 °C)	< 0.5 %
Temperature drift for the total temperature range (-25 to +125 °C)	< 1.0 %

Due to the multitude of available measuring shunts there is also a multitude of Probes available.

Some examples can be found in the following table:

Type	Meas. shunt	Resolution at Gain 100	Meas. Range at Gain 1
LI-Probe	1 Ohm	0.25 µA	-300 ... +720mA
I-Probe	0.5 mOhm	500 µA	Limited by fuse at ±70A
HI-Probe	0.025 mOhm	10 mA	Limited by fuse at ±4800A
U-Probe	---	170 µV	-80V ... +80V
T-Probe	PT1000	0.01 °C	-40 ... +250°C

You can get more information regarding the Probes and the adaptation to the corresponding application from GOEPEL electronic upon request.

2.4.3 Aging

As any other component or device, the probes are subjected to aging regarding their mechanical, electrical and measurement technical properties.

The most important effects of aging are:

- Drift of the resistance value of the measurement resistor (measurement accuracy)
- Hardening of the cables etc.

By operating the system under high ambient temperature and / or connector temperature, aging is accelerated.

The specifications given in this document are kept for the following operating conditions:

All variants: Max. 2.000h operation time at 75 °C

Longer operation at higher temperatures can cause untimely aging of the cable.

The function is not impaired by this.

2.4.4 Calibration

The modules as well as the individual Probes are calibrated, and the detected deviations for failure correction are deposited at the module or the Probe.

The date of the last calibration can be read out by software.

2.5 Accessories

The following accessories are available for your PXI 3250 board:

- Measurement probes
- Extensions for measurement probes
- Fuse carrier for HI-Probe

3   Control Software

3.1   Programming via DLL Functions

With the function calls described in this section,
PXI 3250 boards can be addressed directly from several standard
languages (VisualC++, CVI).

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

Windows Device Driver

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

- DriverInfo
- Xilinx Read Write Register
- Reset
- Probe Status
- Module Version
- Module Error Flags
- Set Config Measurement
- Get Config Measurement
- Single Read
- Read
- Start Stop

3.1.1 DriverInfo

The Pxi3250__DriverInfo function is for the status query of the hardware driver.

Format:

```
S32 Pxi3250__DriverInfo
    (t_Driver_Info *pDriverInfo,
     U32 LengthInByte);
```

Parameters:

Pointer, e.g. **pDriverInfo**,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

LenthInByte
Size of the storage area pDriverInfo is pointing to in Bytes

Description:

The Pxi3250__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. By means of the LengthInByte parameter the function checks internally the correct initialized user memory.

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

3.1.2 Xilinx Read Write Register

The Pxi3250__XilinxReadWriteRegister allows FPGA access.

Format:

```
S32 Pxi3250__XilinxReadWriteRegister
    (U8 *pData,
     U32 *DataLength);
```

Parameters:

Pointer, e.g. pData,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

DataLength
Number of bytes to be written to the structure pData is pointing to

Description:

By the Pxi3250_XilinxReadWriteRegister function the FPGA registers can be directly read out or written.

3.1.3 Reset

Activate several reset modes on the PXI 3250 board by function
Pxi3250__Reset.

Format:

```
S32 Pxi3250__Reset
    (U8 Device,
     U32 Value);
```

Parameters:

Device
Index of the PXI 3250 board, left beginning with 1

Value
Reset value bit oriented
See *Pxi3250_UserInterface.h*

K_XILINX_RESET_NONE	no reset selected
K_XILINX_RESET_REGISTER	all registers are reset
K_XILINX_RESET_MEAS_1	Meas. module 1 (Channel 1 and 2)
K_XILINX_RESET_MEAS_2	Meas. module 2 (Channel 3 and 4)
K_XILINX_RESET_MEAS_1_FIFO_CH_1	FIFO Ch1 Meas. module 1
K_XILINX_RESET_MEAS_1_FIFO_CH_2	FIFO Ch2 Meas. module 1
K_XILINX_RESET_MEAS_2_FIFO_CH_1	FIFO Ch1 Meas. module 2
K_XILINX_RESET_MEAS_2_FIFO_CH_2	FIFO Ch2 Meas. module 2

The different modes can be combined by OR.

3.1.4 Probe Status

By function **Pxi3250__ProbeStatus** status information can be read out for all four measurement probes.

Format:

```
S32 Pxi3250__ProbeStatus
    (U8 Device,
     U8 Channel,
     t_ProbeStatus *Data);
```

Parameters:

Device

Index of the PXI 3250 board, left beginning with 1

Channel

Index of the measurement channel

Range of values 1..4

Pointer, e.g. Data,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

U32 ProbeType;	see Probes
U32 CalibValueProbe;	only informative
U32 OffsetValueProbe;	only informative
U32 CalibMonthProbe;	Month of the last probe calibration
U32 CalibYearProbe;	Year of the last probe calibration
U32 CalibMonthModule;	Month of the last measurement module calibration
U32 CalibYearModule;	Month of the last measurement module calibration
U32 ErrorFlags;	Bit 0 = Failure when Reading/ Writing to the EEPROM
	Bit 1 = Communication with Meas. ASIC Ch1 faulty
	Bit 2 = Communication with Meas. ASIC Ch2 faulty
	Bit 4 = Measurement value buffer overflow
	Bit 5 = Communication buffer overflow
	Bit 6 = Module is not calibrated

CalibMonthModule, **CalibYearModule** and **ErrorFlags** are specific for the measurement module, providing the same values for Channel 1 and 2 as well as Channel 3 and 4.

3.1.5 Module Version

Read out general information for the available measurement modules by function **Pxi3250__ModuleVersion**.

Format:

```
S32 Pxi3250__ModuleVersion
    (U8 Device,
     U8 Channel,
     t_ModuleVersion *Version);
```

Parameters:

Device

Index of the **PXI 3250** board, left beginning with **1**

Channel

Index of the measurement channel

Range of values **1..4**

Pointer, e.g. **Version**,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

U32 **HW_Version**;	Hardware version of the module
U32 **SW_Version**;	Software version of the module
U32 **SerialNumber**;	Serial number of the module
U32 **Signature**;	The signature is always the same, it specifies the type of the module

Identical values are displayed for **Channel 1/ 2** and **Channel 3/ 4**.

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3.1.6 Module Error Flags

Query the current error states for all 4 measurement probes by function Pxi3250__ModuleErrorFlags.

Format:

```
S32 Pxi3250__ModuleErrorFlags
    (U8 Device,
     U8 Channel,
     U32 *ErrorFlags);
```

Parameters:

Device

Index of the PXI 3250 board, left beginning with 1

Channel

Index of the measurement channel

Range of values 1..4

Pointer, e.g. **ErrorFlags**,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

Bit 0 = Failure when Reading/ Writing to the EEPROM

Bit 1 = Communication with Meas. ASIC Ch1 faulty

Bit 2 = Communication with Meas. ASIC Ch2 faulty

Bit 4 = Measurement value buffer overflow

Bit 5 = Communication buffer overflow

Bit 6 = Module is not calibrated

The error states are measurement module specific, providing the same values for Channel 1 and 2 as well as Channel 3 and 4.

3.1.7 Set Config Measurement

By function **Pxi3250__SetConfigMeasurement** the measurement channels are configured.

Format:

```
S32 Pxi3250__SetConfigMeasurement
    (U8 Device,
     U8 Channel,
     t_MeasConfig *Data);
```

Parameters:

Device

Index of the **PXI 3250** board, left beginning with **1**

Channel

Index of the measurement channel

Range of values **1..4**

Pointer, e.g. **Data**,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

The following measurement channel specific parameters are available:

U8 **Autorange**;	1 = Autorange On 0 = Autorange Off
U8 **Gain**;	Sets the used measurement range (gain) Not relevant for **Autorange** = 1
U8 **MeasPeriod**;	Statement for the length of a measurement period (e.g., how many internal averages the ASIC executes):

- ♦ 0.546ms = 8 internally averaged values
- ♦ 1.1ms = 16 internally averaged values
- ♦ 2.2ms = 32 internally averaged values
- ♦ 4.4ms = 64 internally averaged values
- ♦ 8.8ms = 128 internally averaged values
- ♦ 17.6ms = 256 internally averaged values
- ♦ 35.2ms = 512 internally averaged values
- ♦ 70.4ms = 1024 internally averaged values

U8 **Average**;	Statement, over how many values the module should proceed a further averaging Range of values **0x01..0x64** = 1 to 100 averagings

See also Hardware PXI 3250

3.1.8 Get Config Measurement

The function **Pxi3250__GetConfigMeasurement** reads the current configuration of the measurement channels.

Format:

```
S32 Pxi3250__GetConfigMeasurement
    (U8 Device,
     U8 Channel,
     t_MeasConfig *Data);
```

Parameters:

Device

Index of the **PXI 3250** board, left beginning with **1**

Channel

Index of the measurement channel

Range of values **1..4**

Pointer, e.g. **Data**,

to a data structure, for the structure see the *Pxi3250_Userinterface.h* file on the supplied product CD

The following measurement channel specific parameters are available:

U8 **Autorange**;	1 = Autorange On 0 = Autorange Off
U8 **Gain**;	Sets the used measurement range (gain) Not relevant for **Autorange = 1**
U8 **MeasPeriod**;	Statement for the length of a measurement period (e.g., how many internal averages the ASIC executes):

- ♦ 0.546ms = 8 internally averaged values
- ♦ 1.1ms = 16 internally averaged values
- ♦ 2.2ms = 32 internally averaged values
- ♦ 4.4ms = 64 internally averaged values
- ♦ 8.8ms = 128 internally averaged values
- ♦ 17.6ms = 256 internally averaged values
- ♦ 35.2ms = 512 internally averaged values
- ♦ 70.4ms = 1024 internally averaged values

U8 **Average**;	Statement, over how many values the module should proceed a further averaging Range of values **0x01 0x64** = 1 to 100 averagings

See also <u>Hardware PXI 3250</u>

3.1.9 Single Read

The function **Pxi3250__SingleRead** executes <u>one</u> individual measurement.

Format:

```
S32 Pxi3250__SingleRead(U8 Device,
    U8 channel,
     U32 Timeout,
     double *Value, U8 *Probe);
```

Parameters:

Device

Index of the PXI 3250 board, left beginning with 1

Channel

Index of the measurement channel

Range of values 1..4

Timeout

To be given in ms

Value

Measurement value

Probe

Find out the unit belonging to the measurement value via the value of this variable:

Probe		Unit		Probe		Unit
1	->	A		6	->	not used
2	->	A		7	->	not used
3	->	A		8	->	A
4	->	V		9	->	A
5	->	°C				

Description:

The function **Pxi3250__SingleRead** starts <u>one</u> measurement (single measurement) and reads the measurement value detected for the corresponding channel. If no measurement value is provided, the function is cancelled after the given Timeout time.

3.1.10 Read

By function **Pxi3250__Read** the measurement value of the current FIFO element for the indicated channel is read.

Format:

```
S32 Pxi3250__Read
    (U8 Device,
     u8 Channel,
     U8 *ChannelState,
     double *Value,
     U32 *Timestamp,
     U8 *Flag,
     U8 *Probe);
```

Parameters:

Device
Index of the PXI 3250 board, left beginning with 1

Channel
Index of the measurement channel
Range of values 1..4

ChannelState
Status of the channel to be queried

K_CHANNEL_MEASUREMENT_ACTIV or
K_CHANNEL_MEASUREMENT_INACTIV

Value
Measurement value

Timestamp
Time stamp belonging to the measurement value in ms

Flag
FIFO state
Bit 0 = 1: K_FLAG_FIFO_EMPTY
Bit 1 = 1: K_FLAG_FIFO_OVERFLOW

Probe
Find out the unit belonging to the measurement value via the value of this variable:

```
Probe   |   Unit        Probe   |   Unit
  1   ->    A             6   ->    not used
  2   ->    A             7   ->    not used
  3   ->    A             8   ->    A
  4   ->    V             9   ->    A
  5   ->    °C
```

Description:

The Pxi3250__Read function reads the measurement value of the current FIFO element with the belonging time stamp for the indicated channel. By repeated call, a continued measurement can be realized.

3.1.11 Start Stop

The function **Pxi3250__StartStop** starts the continued measurement on the indicated channel/ stops the continued measurement on the indicated channel.

Format:

```
S32 Pxi3250__StartStop
    (U8 Device,
     U8 Channel,
     U8 Mode);
```

Parameters:

Device
Index of the PXI 3250 board, left beginning with 1

Channel
Index of the measurement channel
Range of values 1..

Mode
K_MODE_START | K_MODE_STOP

Description:

The function **Pxi3250__StartStop** starts/ stops the continued measurement fort he indicated channel. The detected values are deposited in an internal FIFO. They must be read out separately by function Read.

3.2 Programming by LabVIEW

LLB using the Windows Device Driver

The *GPxi3250/Win2000(V*.*)* folder of the supplied CD contains VIs for activating PXI 3250 boards directly under LabVIEW.

The functions described in the Programming via DLL Functions section are used for this.