



# CPCI-DIO1616

## CompactPCI® Digital I/O-Board



## Hardware Manual

to Product I.2309.02



## NOTE

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This manual contains important information and instructions on safe and efficient handling of the CPCI-DIO1616. Carefully read this manual before commencing any work and follow the instructions.

The manual is a product component, please retain it for future use.

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## Document History

The changes in the document listed below affect changes in the hardware as well as changes in the description of the facts, only.

Rev.	Chapter	Changes versus previous version	Date
1.6	-	Safety Instructions inserted	2016-02-24
	-	All chapters restructured	
	1.2	Note inserted	
	2.	Chapter "Hardware Installation" inserted	
	3.1	Extended temperature range option deleted	
	3.3	Switching threshold of digital inputs changed	
	-	Description of X101 and X300 deleted	
	6.	Declaration of Conformity inserted	
	7.	Chapter "Order Information" moved and revised	

Technical details are subject to change without further notice.

## Classification of Warning Messages and Safety Instructions

This manual contains noticeable descriptions, warning messages and safety instructions, which you must follow to avoid personal injuries or death and property damage.



This is the safety alert symbol.

It is used to alert you to potential personal injury hazards. Obey all safety messages and instructions that follow this symbol to avoid possible injury or death.

### DANGER, WARNING, CAUTION

Depending on the hazard level the signal words DANGER, WARNING or CAUTION are used to highlight safety instructions and warning messages. These messages may also include a warning relating to property damage.



#### DANGER

Danger statements indicate a hazardous situation which, if not avoided, will result in death or serious injury.



#### WARNING

Warning statements indicate a hazardous situation that, if not avoided, could result in death or serious injury.



#### CAUTION

Caution statements indicate a hazardous situation that, if not avoided, could result in minor or moderate injury.

### NOTICE

Notice statements are used to notify people on hazards that could result in things other than personal injury, like property damage.



#### NOTICE

This NOTICE statement indicates that the device contains components sensitive to electrostatic discharge.



#### NOTICE

This NOTICE statement contains the general mandatory sign and gives information that must be heeded and complied with for a safe use.

### INFORMATION



#### INFORMATION

Notes to point out something important or useful.



## Safety Instructions

- When working with the CPCI-DIO1616 follow the instructions below and read the manual carefully to protect yourself from injury and the CPCI-DIO1616 from damage.
  - The device is a built-in component. It is essential to ensure that the device is mounted in a way that cannot lead to endangering or injury of persons or damage to objects.
  - Do not use damaged or defective cables to connect the CPCI-DIO1616.
  - In case of damages to the device, which might affect safety, appropriate and immediate measures must be taken, that exclude an endangerment of persons and domestic animals and property.
  - Current circuits which are connected to the device have to be sufficiently protected against hazardous voltage (SELV according to EN 60950-1).
  - The CPCI-DIO1616 may only be driven by power supply current circuits, that are contact protected. A power supply, that provides a safety extra-low voltage (SELV) according to EN 60950-1, complies with this conditions.
- 
- The device has to be securely installed in the control cabinet before commissioning.
  - Protect the CPCI-DIO1616 from dust, moisture and steam.
  - Protect the CPCI-DIO1616 from shocks and vibrations.
  - The CPCI-DIO1616 may become warm during normal use. Always allow adequate ventilation around the CPCI-DIO1616 and use care when handling.
  - Do not operate the CPCI-DIO1616 adjacent to heat sources and do not expose it to unnecessary thermal radiation. Ensure an ambient temperature as specified in the technical data.



### DANGER

Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the CPCI-DIO1616 is to be integrated.

- Disconnect all hazardous voltages (mains voltage) before opening the system.
- Ensure the absence of voltage before starting any electrical work



### NOTICE

**Electrostatic discharges may cause damage to electronic components.**

To avoid this, perform the steps described on page 11 *before* you touch the CPCI-DIO1616, in order to discharge the static electricity from your body.

## Qualified Personal

This documentation is directed exclusively towards personal qualified in control and automation engineering. The installation and commissioning of the product may only be carried out by qualified personal, which is authorized to put devices, systems and electric circuits into operation according to the applicable national standards of safety engineering.

## Conformity

The CPCI-DIO1616 is an industrial product and meets the demands of the EU regulations and EMC standards printed in the conformity declaration at the end of this manual.

## Intended Use

The intended use of the CPCI-DIO1616 is the operation as CompactPCI® Digital I/O-Board.

The guarantee given by esd does not cover damages which result from improper use, usage not in accordance with regulations or disregard of safety instructions and warnings.

- The CPCI-DIO1616 is intended for installation in a CompactPCI system
- The operation of the CPCI-DIO1616 in hazardous areas, or areas exposed to potentially explosive materials is not permitted.
- The operation of the CPCI-DIO1616 for medical purposes is prohibited.

## **Service Note**

The CPCI-DIO1616 does not contain any parts that require maintenance by the user. The CPCI-DIO1616 does not require any manual configuration of the hardware. Unauthorized intervention in the device voids warranty claims.

## **Disposal**

Devices which have become defective in the long run have to be disposed in an appropriate way or have to be returned to the manufacturer for proper disposal. Please, make a contribution to environmental protection.

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## **Number Representation**

All numbers in this document are base 10 unless designated otherwise. Hexadecimal numbers have a prefix of 0x. For example, 42 is represented as 0x2A in hexadecimal.

## **Abbreviations**

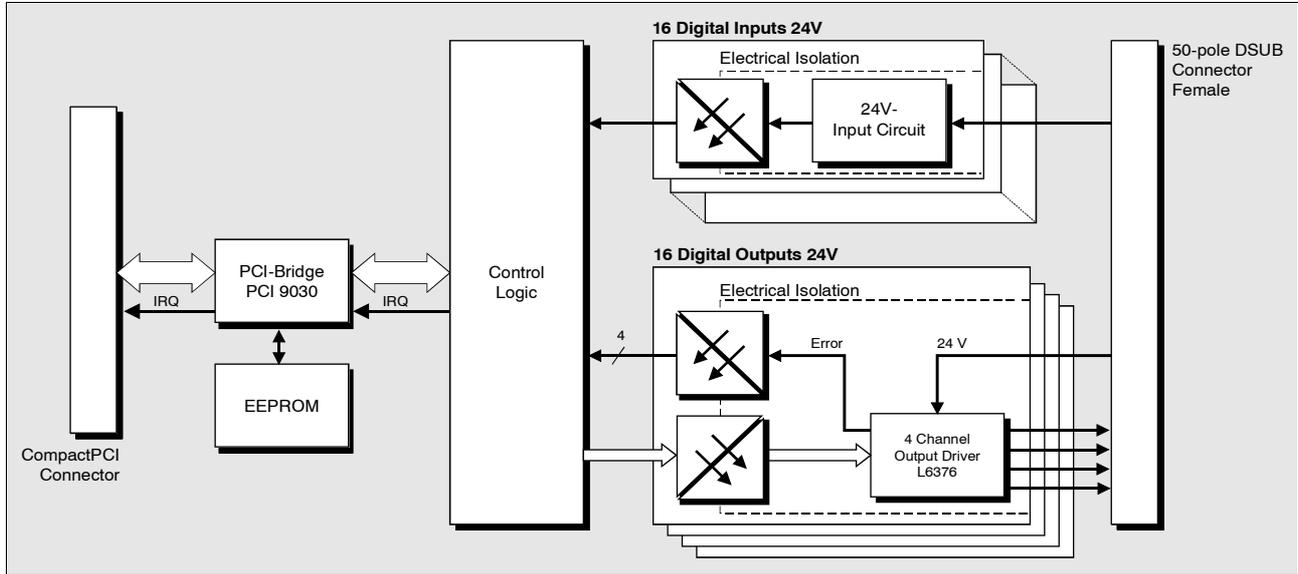
CPU	Central Processing Unit
I/O	Input/Output
LSB	Least Significant Bit
MSB	Most Significant Bit
PLD	Programmable Logic Device

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# 1. Overview

## 1.1 Description of CPCI-DIO1616



**Figure 1:** Block circuit diagram

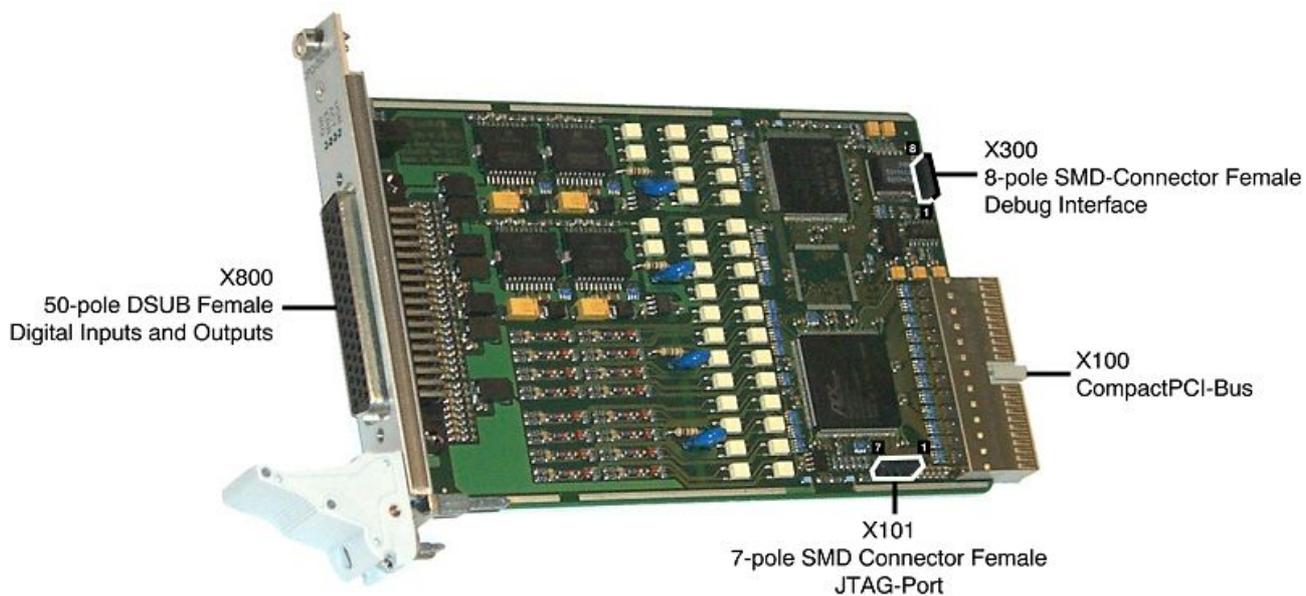
The CPCI-DIO1616 board is an I/O-board which can be universally used in the CompactPCI® system. It consists of an input circuit, a control logic (2 PLDs or an FPGA) and a PCI-bridge.

The module is connected to the CompactPCI bus via a PCI-bridge PCI9030 by PLX Technology.

All inputs and outputs are electrically isolated by optocouplers. The inputs can be evaluated individually as interrupt inputs. The rising or falling edge of the input signal can be evaluated.

The digital outputs are designed to switch 24 V to GND. They automatically switch off at excess temperature or a short circuit. The error signals of the output drivers can be evaluated by means of the software.

## 1.2 PCB View with Connectors



**Figure 2:** PCB top view

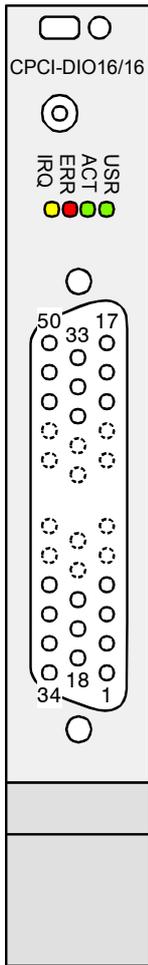


### NOTICE

Read chapter "Hardware Installation" on page 11, before you start with the installation of the hardware!

See also page 14 for signal assignment of the connectors.

### 1.3 Front Panel View and Description of the LEDS



LED	Colour	Status	Meaning
USR (User-LED)	green	on	User-LED-bit = '1'
		off	User-LED-bit = '0'
ACT (Active)	green	on	access to CPCI-DIO1616-board
		off	no access to CPCI-DIO1616-board
ERR (Error)	red	on	error of digital outputs (excess current, excess temperature or power supply too low)
		off	no error
IRQ (Interrupt)	yellow	on	CPCI-DIO1616-board triggers an interrupt
		off	no interrupt

**Table 1:** LED-status

**Figure 3:** Front panel connectors and LEDS

**Notes:**

USR The User-LED can be freely set by the user. It is controlled like the 16 digital outputs.

ERR The LED is on, if an error condition for at least one of the 16 outputs does apply. The Error-LED is on at excess temperature, excess current and too low power supply of the output drivers, i.e. also if no power is supplied.

## 2. Hardware Installation

**NOTICE**

Read the safety instructions at the beginning of this document carefully, before you start with the hardware installation!

**Danger**

Hazardous Voltage - **Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages inside of the system into which the CPCI-DIO1616 is to be integrated.

→ Disconnect all hazardous voltages (mains voltage) before opening the system.

→ Ensure the absence of voltage before starting any electrical work

**NOTICE**

**Electrostatic discharges may cause damage to electronic components.**

→ To avoid this, please discharge the static electricity from your body by touching the metal case of the CompactPCI system *before* you touch the CPCI-DIO1616.

→ Furthermore, you should prevent your clothes from touching the CPCI-DIO1616, because your clothes might be electrostatically charged as well.

**Procedure:**

1. Switch off your system and all connected peripheral devices (monitor, printer, etc.).
2. Discharge your body as described above.
3. Disconnect the system from the mains.

**DANGER**

Hazardous Voltage

**Risk of electric shock** due to unintentional contact with uninsulated live parts with high voltages.

→ Disconnect all hazardous voltages (mains voltage) before opening the system.

→ If the system does not have a flexible mains cable, but is directly connected to mains, disconnect the power supply via the safety fuse and make sure that the fuse cannot switch on again unintentionally (i.e. with caution label).

4. Open the case if necessary.
5. Insert the CPCI-DIO1616 board into the selected CompactPCI slot. Carefully push the board until it snaps into place.
6. Close the system's case again.
7. Connect the digital I/Os via the connector in the front panel of the CPCI-DIO1616.
8. Connect the system to mains again (mains connector or safety fuse).
9. Switch on the system and the peripheral devices.
10. End of hardware installation.
11. For the installation of the driver please refer to the software manual.

### 3. Technical Data

#### 3.1 General Technical Data

Power supply voltage	via CompactPCI bus nominal voltage: 5 V ± 5%, and 3.3 V ± 5%
Current consumption	5 V supply voltage: I <sub>5V</sub> = ca. 90mA 3.3 V supply voltage: I <sub>3.3V</sub> = ca. 350 mA
Connectors	X100 (132-pole post connector) - CompactPCI-board connector X800 (50-pole DSUB-connector) - digital I/Os Only for test- and programming purposes: X101 (7-pole SMD socket strip) - JTAG-interface X300 (8-pole SMD socket strip) - Debug-interface
Temperature range	0...50 °C ambient temperature
Humidity	max. 90%, non-condensing
Dimensions	100 mm x 160 mm
Weight	180 g

**Table 2:** General data of the module

#### 3.2 CompactPCI Interface

Host-Bus	PCI bus according to PCI Local Bus Specification 2.1
PCI data/address bus	32 bit
Controller	PCI9030 by PLX Technology
Interrupt	Interrupt signal A
Board dimension	in accordance with CompactPCI Specification, Rev. 2.0
Connector	
Connector coding	Universal Board, not keyed (3.3 V or 5 V signalling voltage)

**Table 3:** Data of the CompactPCI interface

### 3.3 Digital Inputs

Number of digital inputs	16
Input voltage	$-20 \text{ V} \leq U_{\text{IN}} \leq +33 \text{ V}$
Switching threshold	'0': $U_{\text{IN}} < 9 \text{ V}$ '1': $U_{\text{IN}} > 16.5 \text{ V}$
Permissible input frequency	at pulse duty ratio 1:1 $f_{\text{MAX}} = 60 \text{ kHz}$
Interrupts	IRQ at rising or falling edge of an input, individually configurable
Electrical isolation	electrical isolation via optocouplers eight inputs each share a GND
Safety circuit	protected against wrong polarity up to $-20 \text{ V}$
Connectors	X800 (50-pole DSUB-connector)

**Table 4:** Digital Inputs

### 3.4 Digital Outputs

Number of digital outputs	16
Driver	4x L6376 with four outputs each
Output voltage	nominal value $U_{\text{OUT}} = 24 \text{ VDC}$
Power supply of output drivers	$U_{\text{VSS}} = 9.5 \text{ VDC} \dots 35 \text{ VDC}$
Capacity	$I_{\text{MAX}} = 250 \text{ mA /channel}$
Output switching frequency	at pulse duty ratio 1:1 $f_{\text{MAX}} = 25 \text{ kHz}$
Electrical isolation	electrical isolation via optocouplers, eight outputs each share a GND
Safety circuit	protection against excess current and excess temperature with automatic disconnection of all four outputs of a driver
Error signal	error message at excess current, excess temperature and too low power supply
Connectors	X800 (50-pole DSUB connector)

**Table 5:** Digital Outputs

### 3.5 Software Support

Drivers are available as object codes (source code for VxWorks®) to drive the board. They offer functions for reading the inputs and outputs.

## 4. Description of the Units

### 4.1 Input and Output Circuits

#### 4.1.1 Input Circuit

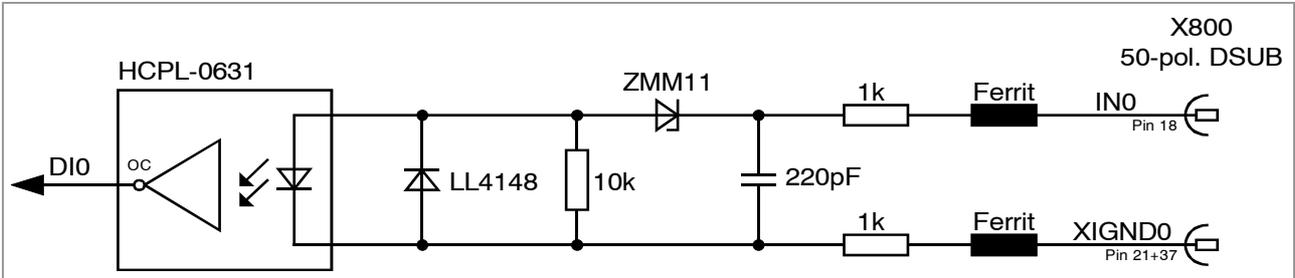


Figure 4: Input circuit (example IN0)

#### 4.1.2 Output Circuit

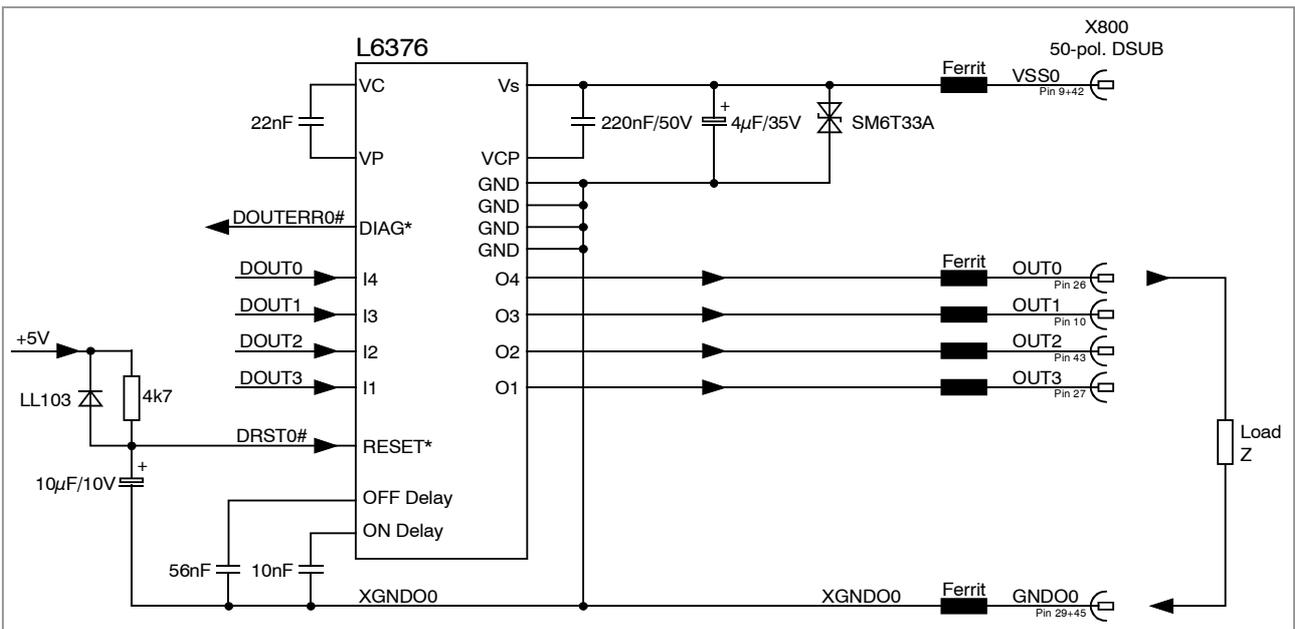


Figure 5: Output circuit (example OUT0)

## 4.2 Register

### 4.2.1 Addressing

Vendor-ID:	0x10B5
Device-ID:	0x9030
Sub-Vendor-ID:	0x12FE
Sub-System-ID:	0x108 (hardware version with PLDs) 0x118 (hardware version with PLDs) 0x109 (hardware version with FPGA) 0x119 (hardware version with FPGA)

### 4.2.2 Register Assignment

The CPCI-DIO1616 assigns four PCI-address spaces:

Address space	Assignment	
0	128 byte memory-mapped	PCI9030
1	128 byte I/O-mapped	PCI9030
2	32 byte I/O-mapped	I/O-register
3	256 byte memory-mapped	I/O-register

**Table 6:** Assignment of PCI-address spaces

The following I/O-registers are available on the CPCI-DIO1616:

Relative address	Register	
	write access	read access
+0	output register	output register
+4	-	input register
+8	IRQ-reset register	IRQ-status register
+0xC	IRQ-enable-register_LH	IRQ-enable-register_LH
+0x10	IRQ-enable-register_HL	IRQ-enable-register_HL

**Table 7:** Relative address of registers

All registers are 32 bits wide. The 16 LSB each contain the data of inputs or outputs. Below the assignment of the individual registers will be explained.

### 4.2.2.1 Output Register

Relative address: 0  
 Access: read/write  
 Default after RESET: 0x0000  
 Function: setting the digital outputs and the User-LED

Bit	Assignment	Level assignment
31 : 17	not evaluated : not evaluated	
16	<i>User-LED-Bit</i>	'0' -> LED off '1' -> LED on
15 : 0	<i>OUT15</i> : <i>OUT0</i>	'0' -> output off '1' -> output on

**Table 8:** Assignment of output register

### 4.2.2.2 Input Register

Relative address: 4  
 Access: read only  
 Function: reading the digital inputs and the error status of the output drivers

Bit	Assignment	Level assignment
31 : 20	insignificant : insignificant	-
19 18 17 16	<i>Error_12-15</i> <i>Error_8-11</i> <i>Error_4-7</i> <i>Error_0-3</i>	'0' -> no error '1' -> output error
15 : 0	<i>IN15</i> : <i>IN0</i>	'0' -> input inactive '1' -> input active

**Table 9:** Assignment of input register

### 4.2.2.3 IRQ-Status Register

Relative address: 8  
 Access: read only  
 Function: reading the interrupt source after an interrupt has been triggered

Bit	Assignment	Level assignment
31 : 20	not evaluated : not evaluated	-
19 18 17 16	<i>IRQ_Error_12-15</i> <i>IRQ_Error_8-11</i> <i>IRQ_Error_4-7</i> <i>IRQ_Error_0-3</i>	'0' -> no IRQ '1' -> IRQ has been triggered
15 : 0	<i>IRQ15</i> : <i>IRQ0</i>	'0' -> no IRQ '1' -> IRQ has been triggered

**Table 10:** Assignment of the IRQ-status register

### 4.2.2.4 IRQ-Reset Register

Relative address: 8  
 Access: write only  
 Function: resetting the IRQ-status register after the interrupt source has been determined. In order to reset the IRQ-status register the value read of it is written into the IRQ-reset register

Bit	Assignment	Level assignment
31 : 20	not evaluated : not evaluated	-
19 18 17 16	<i>Reset_Error_12-15</i> <i>Reset_Error_8-11</i> <i>Reset_Error_4-7</i> <i>Reset_Error_0-3</i>	'0' -> no reset '1' -> IRQ is reset
15 : 0	<i>Reset_IRQ15</i> : <i>Reset_IRQ0</i>	'0' -> no reset '1' -> IRQ is reset

**Table 11:** Assignment of the IRQ-reset register

#### 4.2.2.5 IRQ-Enable-Register\_LH (rising edge)

Relative address: 0xC  
 Access: read/write  
 Function: selecting the edge of an input signal at which an interrupt is to be triggered. An interrupt can only be triggered at rising edges.

Bit	Assignment	Level assignment
31 : 20	not evaluated : not evaluated	-
19 18 17 16	<i>Edge_Error_12-15</i> <i>Edge_Error_8-11</i> <i>Edge_Error_4-7</i> <i>Edge_Error_0-3</i>	'0' -> no IRQ '1' -> IRQ at rising edge
15 : 0	<i>Edge_IRQ15</i> : <i>Edge_IRQ0</i>	'0' -> no IRQ '1' -> IRQ at rising edge

**Table 12:** Assignment of the IRQ-edge register LH

#### 4.2.2.6 IRQ-Enable-Register\_HL (falling edge)

Relative address: 0x10  
 Access: read/write  
 Function: selecting the edge of an input signal at which an interrupt is to be triggered. An interrupt can only be triggered at falling edges.

Bit	Assignment	Level assignment
31 : 20	not evaluated : not evaluated	-
19 18 17 16	<i>Edge_Error_12-15</i> <i>Edge_Error_8-11</i> <i>Edge_Error_4-7</i> <i>Edge_Error_0-3</i>	'0' -> no IRQ '1' -> IRQ at falling edge
15 : 0	<i>Edge_IRQ15</i> : <i>Edge_IRQ0</i>	'0' -> no IRQ '1' -> IRQ at falling edge

**Table 13:** Assignment of the IRQ-edge register HL

## 5. Connector Assignment

### 5.1 Assignment of I/O-Connector X800

Pin	Signal
1	-
2	IN1
3	IN4
4	IN7
5	-
6	IN9
7	IN12
8	IN15
9	VSSO0
10	OUT1
11	OUT4
12	OUT7
13	VSSO2
14	OUT9
15	OUT12
16	OUT15
17	VSSO3

Pin	Signal
18	IN0
19	IN3
20	IN6
21	XIGND0
22	IN8
23	IN11
24	IN14
25	XIGND1
26	OUT0
27	OUT3
28	OUT6
29	GNDO0
30	OUT8
31	OUT11
32	OUT14
33	GNDO2

Pin	Signal
34	-
35	IN2
36	IN5
37	XIGND0
38	-
39	IN10
40	IN13
41	XIGND1
42	VSSO0
43	OUT2
44	OUT5
45	GNDO0
46	VSSO2
47	OUT10
48	OUT13
49	GNDO2
50	VSSO3

## 5.2 Assignment of a PHOENIX-Transition Module

The pin assignment of the 50-pole DSUB-connector has been chosen in such a way that you have a clear terminal assignment when connecting a PHOENIX-transition module via flat-ribbon cable.



**Figure 6:** PHOENIX-transition module UM45-FLK50/LA/PLC

The following table shows the assignments of transition modules UM45-FLK50/PLC and UM45-FLK50/LA/PLC (like UM45-FLK50/PLC but with LEDs):

Pin	Signal	Pin	Signal
0.1	IN1	0.0	IN0
0.3	IN3	0.2	IN2
0.5	IN5	0.4	IN4
0.7	IN7	0.6	IN6
0.-	XIGND0	0.+	-
1.1	IN9	1.0	IN8
1.3	IN11	1.2	IN10
1.5	IN13	1.4	IN12
1.7	IN15	1.6	IN14
1.-	XIGND1	1.+	-
2.1	OUT1	2.0	OUT0
2.3	OUT3	2.2	OUT2
2.5	OUT5	2.4	OUT4
2.7	OUT7	2.6	OUT6
2.-	GND00	2.+	VSS00
3.1	OUT9	3.0	OUT8
3.3	OUT11	3.2	OUT10
3.5	OUT13	3.4	OUT12
3.7	OUT15	3.6	OUT14
3.-	GND02	3.+	VSS02/VSS03

### 5.3 Signal Description of I/O-Connector X800 and Transition Module

IN0...IN15	digital inputs
XIGND0, XIGND1	reference potential of digital inputs
OUT0...OUT15	digital outputs
VSS0	power supply of drivers of digital outputs OUT0...OUT7
VSS2, VSS3	power supply of drivers of digital outputs OUT8...OUT15 and optocouplers of output circuits of all channels
GND00, GND02	reference potential of digital outputs

## 6. Declaration of Conformity

### EU-KONFORMITÄTSERKLÄRUNG EU DECLARATION OF CONFORMITY



Adresse **esd electronic system design gmbh**  
Address **Vahrenwalder Str. 207**  
**30165 Hannover**  
**Germany**

esd erklärt, dass das Produkt  
*esd declares, that the product*

**CPCI-DIO1616**

Typ, Modell, Artikel-Nr.  
*Type, Model, Article No.*

**I.2309.02**

die Anforderungen der Normen  
*fulfills the requirements of the standards*

**EN 61000-6-2:2005,**  
**EN 61000-6-3:2007/A1:2011**

gemäß folgendem Prüfbericht erfüllt.  
*according to test certificate.*

**H-K00-0451-12**

Das Produkt entspricht damit der EU-Richtlinie „EMV“  
*Therefore the product conforms to the EU Directive 'EMC'*

**2014/30/EU**

Das Produkt entspricht der EU-Richtlinie „RoHS“  
*The product conforms to the EU Directive 'RoHS'*

**2011/65/EU**

Diese Erklärung verliert ihre Gültigkeit, wenn das Produkt nicht den Herstellerunterlagen entsprechend eingesetzt und betrieben wird, oder das Produkt abweichend modifiziert wird.  
*This declaration loses its validity if the product is not used or run according to the manufacturer's documentation or if non-compliant modifications are made.*

Name / Name T. Ramm  
Funktion / Title CE-Koordinator / CE Coordinator  
Datum / Date Hannover, 2016-02-10

Rechtsgültige Unterschrift / authorized signature

## 7. Order Information

Type	Properties	Order No.
CPCI-DIO1616	CompactPCI interface card, 16 electrically isolated outputs 24V/0.5A, 16 electrically isolated inputs 24V, Drivers for various operating systems to be ordered separately	I.2309.02
<b>Software<sup>1</sup></b>		
CPCI-DIO1616-Linux Source-Code	LINUX driver source, documentation within source code	I.2309.19
CPCI-DIO1616-WIN Object-License	CPCI-DIO1616-WIN driver (object) including documentation for 32 bit Microsoft Windows 2000/XP/Vista	I.2309.26
CPCI-DIO1616-VxW Source-Code	VxWorks driver source, documentation within source code	I.2309.31
CPCI-DIO1616-QNX Object-License	CPCI-DIO1616-QNX driver (object) including documentation for QNX6	I.2309.32

<sup>1</sup> ... For detailed information about the driver availability for your special operating system, please contact our sales team.

**Table 14:** Order information

### PDF Manuals

Manuals are available in English and usually in German as well. For availability of English manuals see table below.

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