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PARTNER FÜR PRÄZISION

Function Description

Counter/Timer

APCIe-1711, CPCIs-1711, APCI-1710 and CPCI-1710
Multifunction counter board, optically isolated

DIN EN ISO 9001:2015 certified

Edition: 02.10-04/2022

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The following risks result from the improper implementation of the board and from use contrary to the regulations:

Personal injury

Damage to the board, the PC and peripherals

Pollution of the environment.

- Protect yourself, others and the environment!
- Read the safety precautions (yellow leaflet) carefully!

  If this leaflet is not enclosed with the documentation, please contact us and ask for it.
- Observe the instructions of this manual!

  Make sure that you do not forget or skip any step!
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- Pay attention to the following symbols:

NOTICE!
Designates hints and other useful information.

NOTICE!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed**.

WARNING!
Designates a possibly dangerous situation.
If the instructions are ignored, the board, the PC and/or peripherals may be **destroyed** and persons may be **endangered**.

Contents

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Chapter overview

In this manual, you will find the following information:

Chapter	Content
1	Function description including block diagram and pin assignment
2	Standard software: Information on the API software functions
3	Appendix with index
4	Contact and support address

This document solely describes the function “Counter/Timer”.

For general information on the **APCIe-/CPCIs-1711** or **APCI-/CPCI-1710**, please read the respective Technical Description of these boards (see PDF links). It contains, for example, the chapter “Inserting and installing the board” that supports you in commissioning.

1 Function description

The “Counter/Timer” function is a programmable interval counter/timer, which is comparable to the Intel 82C54.
Each function module supports three individual 32-bit counters/timers, which can be read out or written on via the data bus, as well as a function and control logic.

Delay times are generated by the software control. It is possible for the user to program the desired delay time for the function module instead of setting time loops in the software. After the delay time has elapsed, an interrupt can be generated.

Features:

- 4 function modules with three 32-bit counters/timers each (only binary numbers)
- Optical isolation of the inputs and outputs through opto-couplers to prevent ground loops
- Processing of up to 5 MHz signals
- 6 programmable modes
- Status read-back and latch command
- Inputs and outputs invertible through software
- Hardware and software gates possible, can be read back
- Single interface: no multiple assignment of addresses
- Interrupt triggered by an individual release bit per counter/timer and an interrupt status register
- Available clock: PCI bus clock divided by 4 (only **APCI-/CPCI-1710**) or 10 MHz from the quartz oscillator on the board, can be selected through software

1.1 Board versions with “Counter/Timer” function

NOTICE!
With the 24 V version of the **APCIe-1711, CPCIs-1711** or **APCI-1710**, the “Counter/Timer” function can be used only to a limited extent.

Table 1-1: Board versions with “Counter/Timer” function

Board version	“Counter/Timer” function
APCIe-1711	x
APCIe-1711-24V	x*
APCIe-1711-5V-I	x
CPCIs-1711	x
CPCIs-1711-24V	x*
CPCIs-1711-5V-I	x

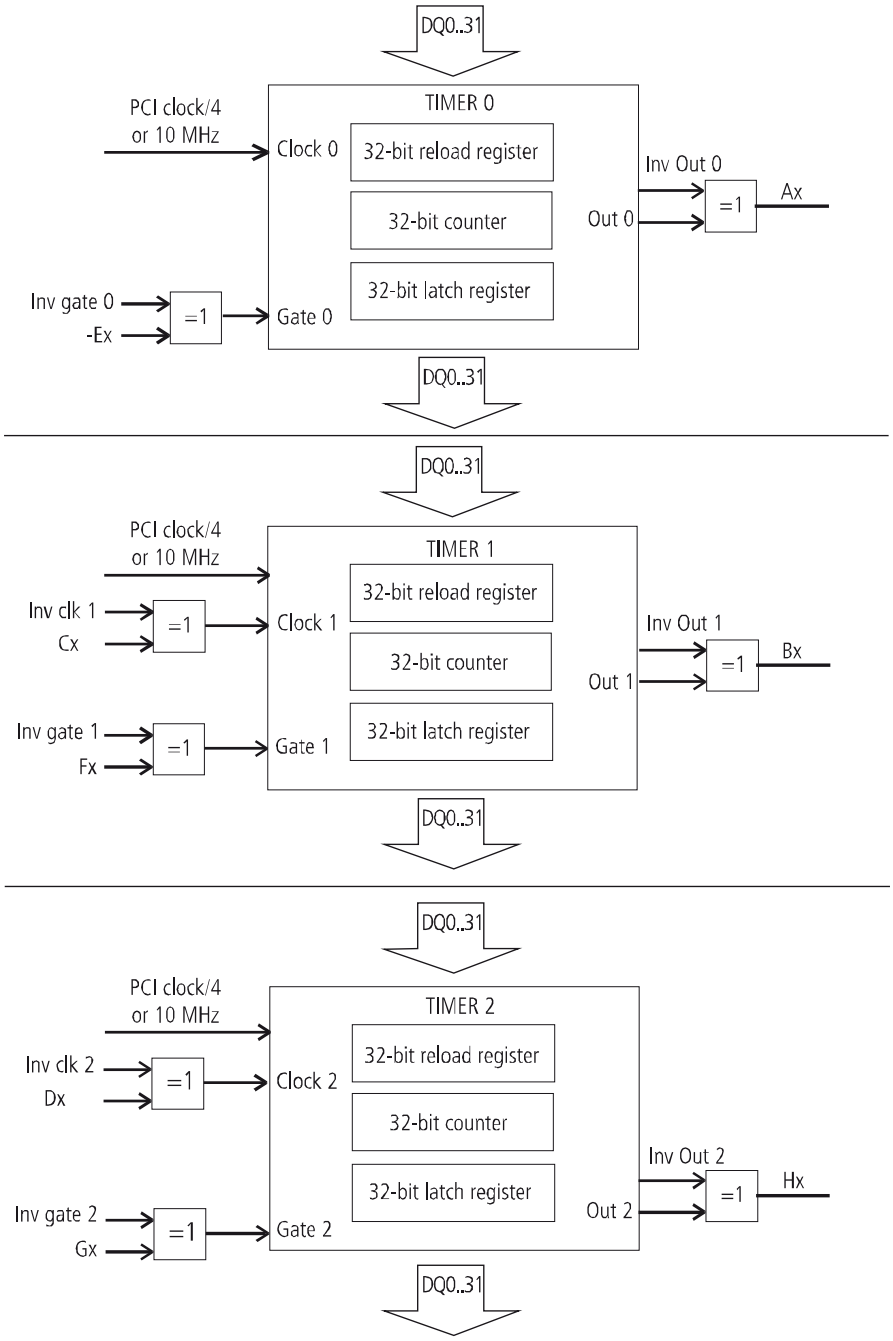
Board version	"Counter/Timer" function
APCI-1710	x
APCI-1710-24V	x*
APCI-1710-5V-I	x
APCI-1710-5V-I-O	x
CPCI-1710	x

* Pin Ax or Bx: Only a 24 V input is available, i.e., the output of counter/timer 0 or counter/timer 1 cannot be used.

The I/O specifications of the different board versions are available in the Technical Description of the **APCIe-/CPCIs-1711** or **APCI-/CPCI-1710** (see PDF links).

1.2 Block diagram

Fig. 1-1: Block diagram: “Counter/Timer” function



1.3 Used signals

With each function module, the counter/timer function uses five inputs (C to G) and three outputs (A, B, H).

Table 1-2: Used signals

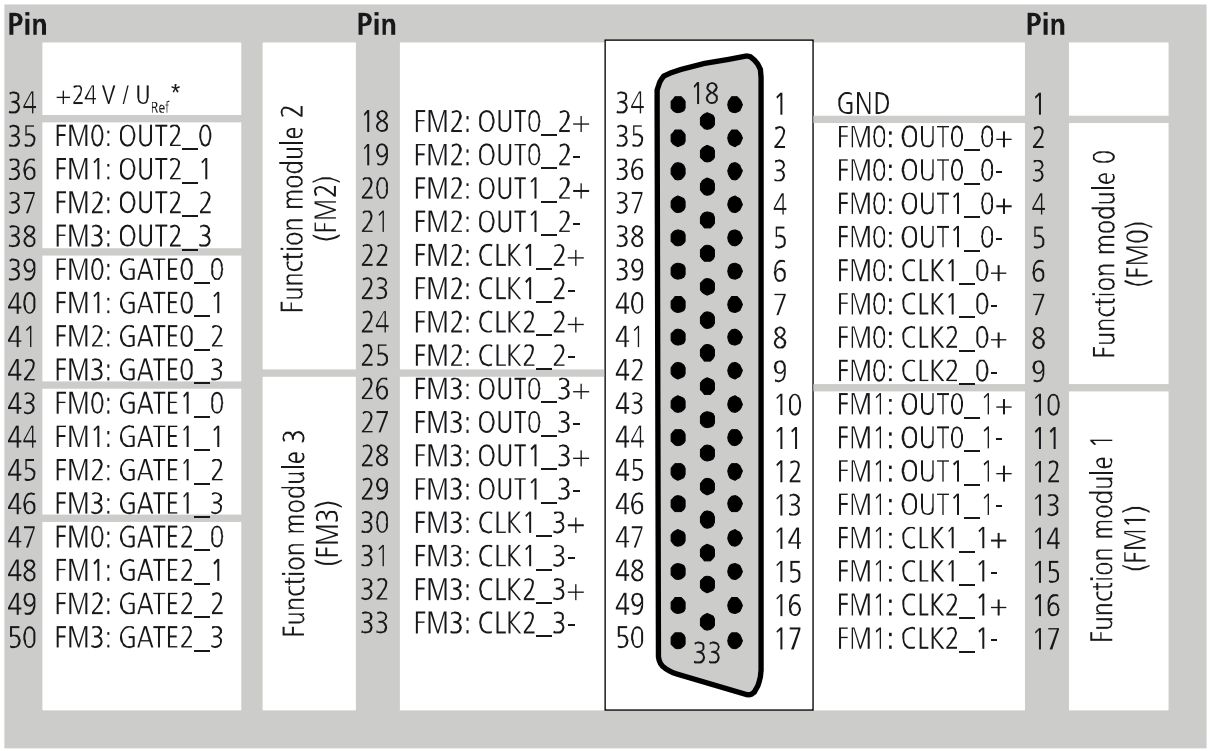
Signal name	Pin name	Signal type	Function
OUT0_x+/-	Ax+/-	Differential/TTL/ 24 V*	Output of counter/timer 0 (only input with 24 V*)
OUT1_x+/-	Bx+/-	Differential/TTL/ 24 V*	Output of counter/timer 1 (only input with 24 V*)
OUT2_x	Hx	24 V / optional 5 V	Output of counter/timer 2
GATE0_x	Ex	24 V / optional 5 V	Gate input of counter/timer 0
GATE1_x	Fx	24 V / optional 5 V	Gate input of counter/timer 1
GATE2_x	Gx	24 V / optional 5 V	Gate input of counter/timer 2
CLK0_x	-	-	Connected with internal clock (PCI bus clock divided by 4 (only **APCI-/CPCI-1710**) or 10 MHz)
CLK1_x+/-	Cx+/-	Differential/TTL/ optional 24 V	Clock/counter input of counter/timer 1
CLK2_x+/-	Dx+/-	Differential/TTL/ optional 24 V	Clock/counter input of counter/timer 2

x = Number of the function module (0-3)

* 24 V with 24 V board version

1.4 Pin assignment: Function module

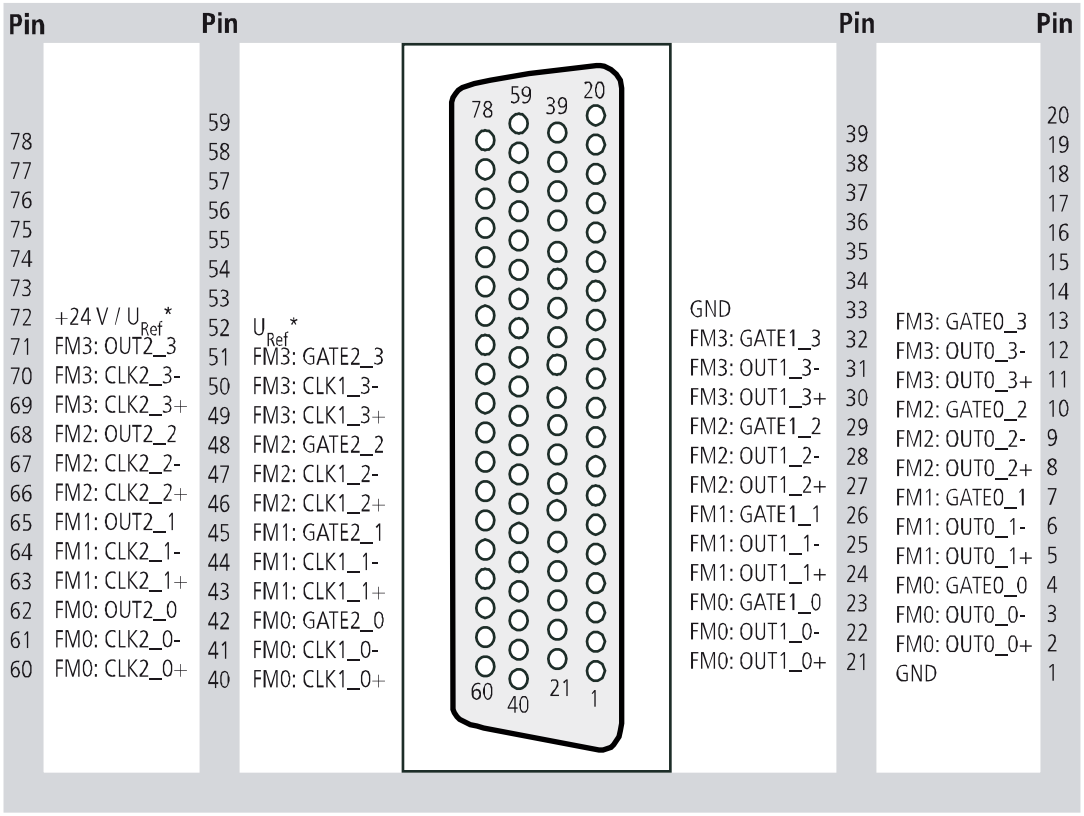
Fig. 1-2: Pin assignment: 50-pin D-Sub male connector (4 counter/timer modules)



* Pin 34: see Technical Description of the board

This pin assignment also applies to the **APCIe-1711** or **CPCIs-1711** if the cable **ST1711-50** is connected to the 78-pin D-Sub female connector of the board. For further information on this, please refer to the Technical Description of the **APCIe-1711** and **CPCIs-1711** (see PDF link).

Fig. 1-3: Pin assignment: 78-pin D-Sub female connector (APCIe-1711 and CPCIs-1711)



FM = Function module
* Pins 52 and 72: see Technical Description of the board

1.5 Connecting the signal generators

1.5.1 Connection to the screw terminal panel

On the screw terminal panel **PX8001**, the pins of the 50 pin D-Sub female connector and the terminals connected to them are numbered in the same way. Thus, the terminal assignment of the screw terminal panel is identical with the pin assignment of the 50-pin D-Sub male connector of the **APCI-/CPCI-1710** or with that of the 50-pin D-Sub male connector on the **ST1711-50** cable **(APCIe-/CPCIs-1711)**.

The following table is to serve as a help for you when connecting the signal generators to the screw terminal panel. The blank fields in the “Signal generator” column can be filled in on the basis of the selected signal generator type.

Table 1-3: Connection of the signal generators to the screw terminal panel

Signal generator			Screw terminal panel PX8001 (50-pin)							
Pin No.	Pin name	Lead colour (cable)	Signal name	Terminal name	Signal type	Terminal No. FM0	FM1	FM2	FM3	Terminal function
	+24 V / U_{Ref}		+24 V / U_{Ref}	+24 V / U_{Ref}	-	34	34	34	34	see Technical Description of the board
	GND		GND	GND	-	1	1	1	1	Ground
			OUT0_x+	Ax+	Diff./TTL/24 V*	2	10	18	26	Output of counter/timer 0 (only input with 24 V*)
			OUT0_x-	Ax-	Diff./TTL/24 V*	3	11	19	27	
			OUT1_x+	Bx+	Diff./TTL/24 V*	4	12	20	28	Output of counter/timer 1 (only input with 24 V*)
			OUT1_x-	Bx-	Diff./TTL/24 V*	5	13	21	29	
			CLK1_x+	Cx+	Diff./TTL/ optional 24 V	6	14	22	30	Clock/counter input of counter/timer 1
			CLK1_x-	Cx-		7	15	23	31	
			CLK2_x+	Dx+	Diff./TTL/ optional 24 V	8	16	24	32	Clock/counter input of counter/timer 2
			CLK2_x-	Dx-		9	17	25	33	
			GATE0_x	Ex	24 V / opt. 5 V	39	40	41	42	Gate input of counter/timer 0
			GATE1_x	Fx	24 V / opt. 5 V	43	44	45	46	Gate input of counter/timer 1
			GATE2_x	Gx	24 V / opt. 5 V	47	48	49	50	Gate input of counter/timer 2
			OUT2_x	Hx	24 V / opt. 5 V	35	36	37	38	Output of counter/timer 2
			CLK0_x	-	-	-	-	-	-	see Table 1-2
			-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-

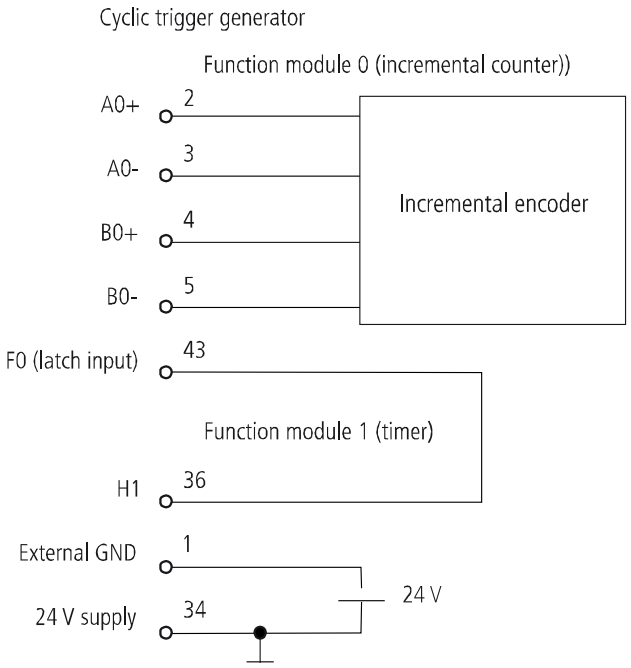
x = Number of the function module (0-3)

* 24 V with 24 V board version

1.6 Connection example

The counter/timer function is implemented on all function modules.

Fig. 1-4: Connection example: Function modules



1.7 Mode description

To program the individual counters/timers, six modes are available.
The counter/timer can be loaded with a new value and be read at any time. Before it is read though, the value has to be latched.

a) Mode 0: Interrupt at end of sequence

Mode 0 is used for counting events.
After the initialisation, the output is set to “Low”. When the counter has reached the value 0, the output is set to “High”. It keeps this position until a new counting sequence starts or a new counter value is written.

b) Mode 1: Hardware-retriggerable monoflop

In this mode, the GATE input is used to trigger the timer instead of activating or deactivating it. Except for this, this mode corresponds to Mode 0.

c) Mode 2: Pulse generator

In this mode, the counter divides the selected input clock by the start value “ul_ReloadValue”. Mode 2 is suited to generate a real-time clock interrupt.

After the initialisation, the output is set to “High”. When the counter has reached the value 1, the output is set to “Low”. After just one clock pulse, it is reset to “High”. The counter reloads the start value (“ul_ReloadValue”) and the counting sequence is rerun. The number of sequences is infinite. An interrupt can always be generated at the end of a sequence.

Time computation: *(ul_ReloadValue + 2) x input clock*

d) Mode 3: Square wave signal generator

In Mode 3, the baud rate is generated. This mode differs from Mode 2 only as far as the output sequence is concerned.
After the initialisation, the output is set to “High”. When the counter has run down to the half of the start value, the output is set to “Low”. It keeps this position until a new counting sequence starts. The number of sequences is infinite.

Time computation: *(ul_ReloadValue + 2) x input clock*

e) Mode 4: Software-triggered strobe

After the initialisation, the output is set to “High”. When the counter has run down, the output is set to “Low”. After just one clock pulse, it is reset to “High”.
The counting sequence is triggered by writing the start value. If a new value is written during the counting sequence, this value is loaded as the new start value at the next clock pulse.

f) Mode 5: Hardware-triggered strobe (retriggerable)

In this mode, the GATE input is used to trigger the timer instead of activating or deactivating it. Except for this, this mode corresponds to Mode 4.

1.8 Procedure for using the “Counter/Timer” function

In order to use the “Counter/Timer” function, the following steps need to be performed:

1. Program the counter/timer in the desired mode.

2. Adapt the signals GATE or OUT to the desired level.

3. Write the reload value to the timer.

The counter/timer is now ready for use.

If you want to use the interrupt function, you first have to set the release bits for the interrupt to “1”.

2 Standard software

The API software functions supported by the board are listed in an HTML document. A description of how to access the respective file can be found in the document “Quick installation PC boards” (see PDF link), in the chapter “Standard software”.

3 Appendix

3.1 Index

4 Contact and support

Do you have any questions? Write or call us:

Address: ADDI-DATA GmbH
Airpark Business Center
Airport Boulevard B210
77836 Rheinmünster
Germany

Phone: +49 7229 1847-0
Fax: +49 7229 1847-222

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