DIN EN ISO 9001:2000
certified

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# Function description

# APCI-/CPCI-1710

# Function description
# - TOR -

Edition: 03.02 - 05/2008

## Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current status before printing.
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# WARNING

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

- **Personal injury**

- **Damage to the MSX-Box, PC and peripherals**

- **Pollution of the environment**

- **Protect yourself, the others and the environment!**

- **Read carefully the safety precautions (yellow leaflet).**

  If this leaflet is not with the documentation, please contact us and ask for it.

- **Observe the instructions of the manual.**

  Make sure that you do not forget or skip any step. We are not liable for damages resulting from a wrong use of the board.

- **Used symbols:**

**IMPORTANT!**
designates hints and other useful information.

**WARNING!**
It designates a possibly dangerous situation.
If the instructions are ignored the board, PC and/or peripheral may be destroyed.

## Figures



## Tables

# 1 DEFINITION OF APPLICATION

## 1.1 Intended use

The board **APCI-1710** must be inserted in a PC with PCI 5V/32-bit slots, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm IEC 61010-1.

The board **CPCI-1710** must be inserted in a CompactPCI system with PCI 5V/32-bit slots, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm IEC 61010-1

## 1.2 Usage restrictions

The **APCI-/CPCI-1710** board must not to be used as safety related part for securing emergency stop functions.

The **APCI-/CPCI-1710** board must not be used in potentially explosive atmospheres.

## 1.3 Technical description

This manual refers to the **APCI-1710** as well as to the **CPCI-1710** board. Make sure that you have received the following items:

- The CD 1 “Standard Software Drivers” with the ADDISET parameterizing program and the required software drivers.
- The CD 2 “Technical Manuals”. This CD contains the following:
  1) The technical description **ADDICOUNT APCI-1710 / CPCI-1710: Function-programmable counter board for the PCI bus** (containing general information on the operation of the board)
  2) A function description for each function which you want to program on the board
  3) The yellow leaflet "Safety precautions"

According to the used function you will find the required assignment and programming functions in the different manuals for each function:

**Table 1-1: Delivered manuals**

| Function | PDF file (CD2 technical manuals) | | Function description in SET1710 | CFG file |
|---|---|---|---|---|
| | German | English | | |
| Incremental counter | Inkr_zähler_d.pdf | Incr_counter_e.pdf | Incremental counter | inc_cpt.cfg |
| SSI | SSI_d.pdf | ssi_e.pdf | SSI | ssi.cfg |
| SSI monitor | SSI-Monitor_d | SSIMonitor_e.pdf | SSI_Monitor | ssi_mon.cfg |
| Chronos | chronos_d.pdf | chronos_e.pdf | Chronos | chronos.cfg |
| Counter/timer | Zähler_timer_d.pdf | Counter_timer_e.pdf | counter/timer | 82x54.cfg |
| TOR | TOR_d.pdf | TOR_e.pdf | TOR | tor.cfg |
| PWM | PWM_d.pdf | PWM_e.pdf | Pulse width modulation | PWM.cfg |
| TTL | TTL_IO_d.pdf | TTL_IO_e.pdf | TTL I/O | ttl_io.cfg |
| Digital I/O | dig_EA_d.pdf | dig_IO_e.pdf | Digital I/O | dig_IO.cfg |
| Pulse counter | Impulszähler_d.pdf | pulseCounter_e.pdf | Pulse counter | imp_cpt.cfg |
| ETM (Edge time measurement) | ETM_d.pdf | ETM_e.pf | Edge time measurement | etm.cfg |

**Please note:**
The board **CPCI-1710/1711** is compatible with the board **APCI-1710** regarding the software installation. The programs ADDIREG and SET1710 do not make a difference between PCI boards and CompactPCI boards.

The API functions of the standardsoftware are also identical.

## 1.4 Function description

Besides a global description of the software functions this manual contains:
- The pin assignment of the front connector
- A list of the signals used
- The I/O mapping
- A chapter on the API software functions of the supplied standard software.

## 1.5 Used abbreviations

The signals on the 50-pin SUB-D connector refer all to one function module.
Please observe the following abbreviations:
- UAS: Interference signal
- CLK: Clock
- REF: Referential point - logic
- ENA: Enable

C**1**+ is a signal for **function module 1.**

# 2 TOR

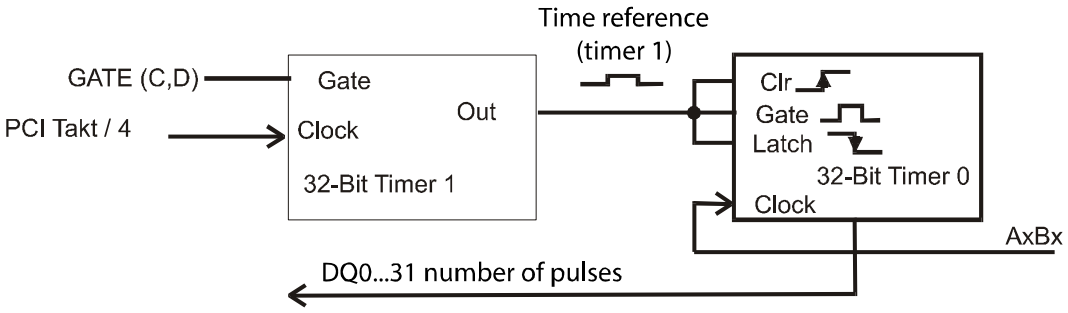
## 2.1 Function description

The function "TOR" is a counter interface which allows counting input signal within a defined time.
On one module 2 TOR counters are available. Each TOR counter contains 2 x 32-bit timer.

**Properties:**
- Isolation through optical couplers for the input and output channels to avoid earth circuit
- Interrupt status at the end of the measuring period
- Inputs and outputs can be inverted by software.
- Software Gate

### 2.1.1 Block diagram

**Fig. 2-1: Block diagram of the TOR function**




### 2.1.2 Typical applications

- Frequency measurement
- Pulse counting per time interval

## 2.2 Used signals

The function "TOR" occupies **4 inputs (A to D)** of the respecting function module of the **APCI-/CPCI-1710**.

**Table 2-1: Used signals**

| AT THE CONNECTOR | POLARITY | FUNCTION |
|---|---|---|
| A **x** +/ - | Diff. / TTL | **Digital input 1 (TOR 1)** |
| B **x** +/ - | Diff. / TTL | **Digital input 2, (TOR2)** |
| C **x** +/ - | Diff. / TTL / Opt. 24V | **External gate (TOR1)** |
| D **x** +/ - | Diff. / TTL / Opt. 24V | **External gate (TOR2)** |

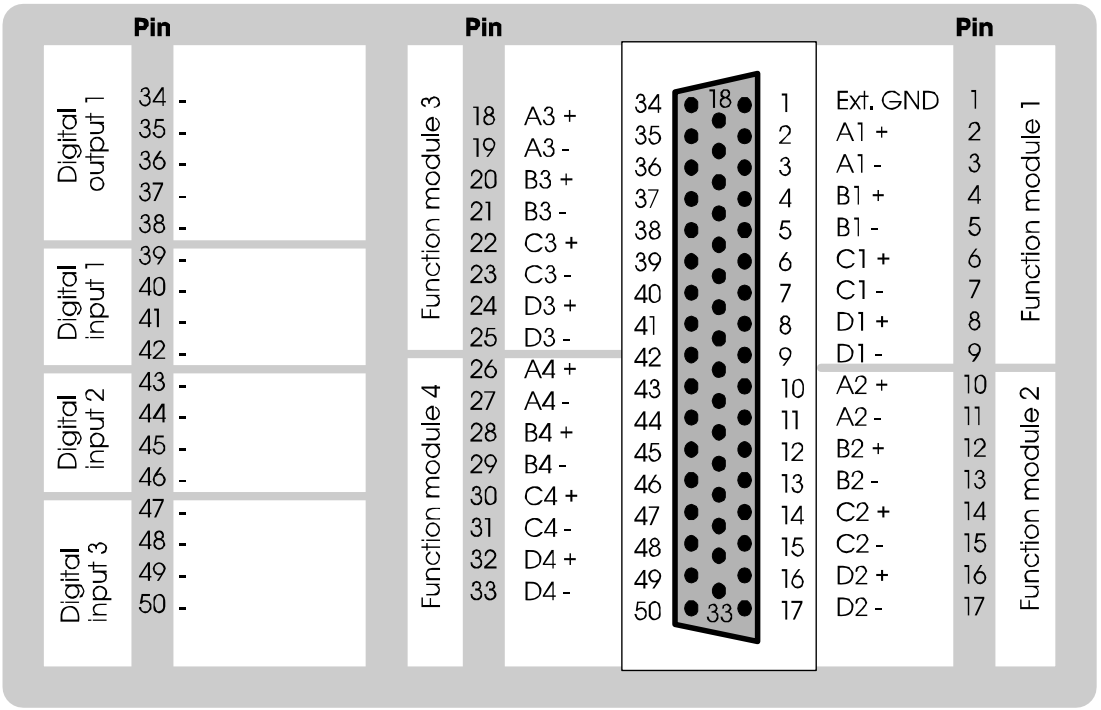
**x**: Number of the function module.

## 2.3 Pin assignment of all modules with TOR function

**IMPORTANT!**
The function modules are defined differently in the hardware and software descriptions.

For the pin assignment (hardware) the module are numbered from 1 to 4. For the SET1710 program or the software functions (software) the module numbering **BEGINS** with 0.

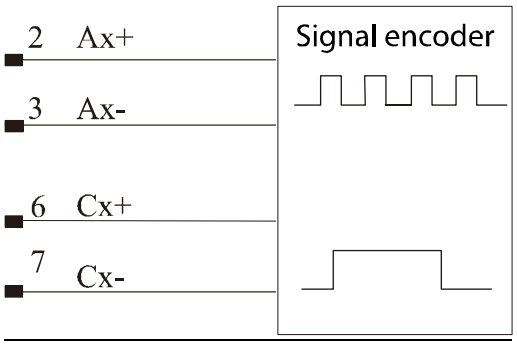
**Fig. 2-2: Pin assignment of the 50-pin SUB-D connector**




- Not connected

## 2.4 Connection example

**Fig. 2-3: Connection example**




## 2.5 I/O mapping

### 2.5.1 Write register

**Table 2-2: I/O mapping (write register)**

| | | D31...D24 | D23...D16 | D15.....D8 | D7.....D0 |
|---|---|---|---|---|---|
| BYTES | Wr | HIGHBYTE | MIDHIGHBYTE | MIDLOWBYTE | LOWBYTE |
| BASE**x** + 0 | ☑ | **TOR1 BASE_TIME** | | | |
| BASE**x** + 4 | ☑ | - | - | - | TOR1 COMMANDO |
| BASE**x** + 8 | ☑ | - | - | - | TOR1 GATE |
| BASE**x** + 12 | ☑ | - | - | - | TOR1/TOR2 SYNCHRO_GATE |
| BASE**x** + 16 | | **TOR2 BASE_TIME** | | | |
| BASE**x** + 20 | ☑ | - | - | - | TOR2 COMMANDO |
| BASE**x** + 24 | ☑ | - | - | - | TOR2 GATE |
| BASE**x** + 28 | ☑ | - | - | - | TOR1/TOR2 SYNCHRO_GATE |
| BASE**x** + 60 | | - | - | - | - |

-: No function; **x:** Number of the function module.

The accesses are always read or written in 32-bit depth.

### 2.5.2 Read register

| | | D31...D24 | D23...D16 | D15.....D8 | D7.....D0 |
|---|---|---|---|---|---|
| BYTES | Rd | HIGHBYTE | MIDHIGHBYTE | MIDLOWBYTE | LOWBYTE |
| BASE**x** + 0 | ☑ | **TOR1 COUNTER_VALUE** | | | |
| BASE**x** + 4 | ☑ | - | - | - | TOR1 STATUS |
| BASE**x** + 8 | ☑ | - | - | - | TOR1 GATE |
| BASE**x** + 12 | ☑ | - | - | - | TOR1 INT_STATUS |
| BASE**x** + 16 | | **TOR2 COUNTER_VALUE** | | | |
| BASE**x** + 20 | ☑ | - | - | - | TOR2 STATUS |
| BASE**x** + 24 | ☑ | - | - | - | TOR2 GATE |
| BASE**x** + 28 | ☑ | - | - | - | TOR2 INT_STATUS |
| BASE**x** + 60 | ☑ | FUNKNBR2 | FUNKNBR1 | REVBYTE2 | REVBYTE1 |

## 2.6 Description of the I/O functions

### 2.6.1 Function description

The function "TOR" is a scaled-down version of the module function “Timer/Counter”. The pulse signals from Timer 1 indicates the start and stop pulse signal for Timer 0. Timer 0 counts the input signals. After the stop signal from Timer 0 the number of pulses is stored and can be read through I/O read commands.

**The timer 1 is used as time reference generator.**

The division factor is set in timer 1 and determines the output frequency. The input frequency is set according to the PCI clock pulse. Timer 0 is synchronised with the start event.

**Pulse measurement**

As soon as a **start** signal occurs from Timer 1**,** Timer 0 is reset and counts the pulse signals of signals from channel A**x** (B**x**).
During the process the status bit "Counter in Progress" is set in the status register.
As soon as a **stop** signal is generated from Timer 1, the Timer 0 is stopped and the status bit "Counter in Progress" is reset.
An interrupt can also be generated. The value can be read. The latest measured value is read in the “counter measurement” register.

## 2.6.2 Timer1 REGISTER

**Base address + 0 for Tor1 and base address + 16 for Tor2**

32-bit register: The "Reload" value for TIMER 1 is written. The output frequency from Timer 1 is determined by the division factor.

## 2.6.3 Timer0 REGISTER

**Base address + 0 for Tor1 and base address + 16 for Tor2**

32-bit register for reading the current value of the pulse measurement (i.e. latest measurement value)

## 2.6.4 TOR COMMANDO Register

**Base address** + 4: TOR1
**Base address** + 20: TOR2

| | | |
|---|---|---|
| DQ0 | 0 | Simple mode |
| | 1 | Continuous mode |
| DQ1 | 0 | Interrupt generation disabled |
| | 1 | Interrupt generation enabled |
| DQ2: | 0 | Counting to "High" level |
| | 1 | Inverted image of the digital input, counting to „Low" level |
| DQ3 | 0 | External input gate not used |
| | 1 | External gate starts the TOR counter |

## 2.6.5 TOR Gate Register

**Base address** + 8: TOR1
**Base address** + 24: TOR2.

**Writing**:

| | | |
|---|---|---|
| DQ0 | 0 | Disables the counter |
| | 1 | Enables the counter |
| DQ4 | 0 | No write error possible |
| | 1 | Resets the initialisation of the TOR counter |

**Reading**:

| | | |
|---|---|---|
| DQ0 | 0 | Counter disabled |
| | 1 | Counter enabled |
| DQ4 | 0 | TOR counter not initialised. |
| | 1 | TOR counter initialised |

## 2.6.6 TOR Synchronisation GATE Register

**Base address** +12: TOR1
**Base address** +28: TOR2.

| | | |
|---|---|---|
| DQ0 | 0 | Disables counter from Tor1 and Tor2 |
| | 1 | TOR counter not initialised from TOR1 and TOR2 |
| DQ4 | 0 | No commands possible |
| | 1 | Resets the initialisation from TOR1 and TOR2 |

## 2.6.7 TOR Status Register

**Base address** + 4: TOR1
**Base address** + 20: TOR2.

32-bit register: Returns the status information from "TOR”.

| | | |
|---|---|---|
| DQ0 | 0 | Measurement is not running |
| | 1 | Measurement is running. Reset at reading the address Base+0 for TOR1 and the address Base+16 for TOR2 |
| DQ1 | 0 | Measurement not ended. |
| | 1 | Measurement ended. Reset at reading the address Base+0 for TOR1 and the address Base+16 for TOR2 |
| DQ2 | 0 | Measurement time not over. |
| | 1 | Measurement time is over. Reset at reading the address Base+0 for TOR1 and the address Base+16 for TOR2 |
| DQ4 | 0 | Simple mode selected |
| | 1 | Continuous mode selected |
| DQ5 | 0 | Interrupt mode disabled |
| | 1 | Interrupt mode enabled |
| DQ6 | 0 | Input signal not inverted |

| | | |
|---|---|---|
| | 1 | Input signal not inverted |
| DQ7 | 0 | Gate input signal not used |
| | 1 | Gate input signal used |
| Other bits | | Set on 0 at reading |

### 2.6.8 TOR Interrupt Status Register

**Base address** + 12: TOR1
**Base address** + 28: TOR2.

32-bit register: Returns the interrupt status information of the TR function.

| | | |
|---|---|---|
| DQ0 | =1 | Interrupt is generated at the end of measurement. The interrupt request is reset after reading the register. |
| DQ31..1 | | Is always set on 0. |

### 2.6.9 Version Register (Base +60)

The function and the revision are identified (read command, ASCI format)

**BASE + 60 "T" "O" "1" "3"**

Meaning: TOR Revision 1.3

## 2.7 Working with the TOR function

1. Signal connection at the connector
2. Initialising the TOR function (Selection of the TOR counter, input frequency etc.)
3. Releasing the measurement (single or continuous measurement with/without interrupt)
4. Reading and evaluating the status of the TOR counter
5. Reading the measurement value of the TOR counter.

# 3 SOFTWARE FUNCTIONS

## 3.1 Introduction

**IMPORTANT!**
Observe the following style conventions in the text:

Function: "i_APCI1710_SetBoardInformation"
Variable *ui_Address*

**Table 3-1: Define Value**

| Define name | Decimal value | Hexadecimal value |
|---|---|---|
| DLL_COMPILER_C | 1 | 1 |
| DLL_COMPILER_VB | 2 | 2 |
| DLL_COMPILER_PASCAL | 3 | 3 |
| DLL_LABVIEW | 4 | 4 |
| DLL_COMPILER_VB5 | 5 | 5 |
| APCI1710_SINGLE | 0 | 0 |
| APCI1710_CONTINUOUS | 1 | 1 |
| APCI1710_30MHZ | 30 | 1E |
| APCI1710_33MHZ | 33 | 21 |
| APCI1710_40MHZ | 40 | 28 |

## 3.2 Interrupt mask

Each TOR counter can generate an interrupt. In order to get this interrupt, you shall enable the interrupt and the interruptroutine with the function "i_APCI1710_SetBoardIntRoutineX".

**Table 3-2: Interrupt mask of the function TOR**

| b_ModuleMask | ul_InterruptMask | Meaning |
|---|---|---|
| 0000 000**1** | 000**1** 0000 0000 0000 | Interrupt occurred on TOR counter 0 from module 0 |
| 0000 000**1** | 00**1**0 0000 0000 0000 | Interrupt occurred on TOR counter 1 from module 0 |
| 0000 00**1**0 | 000**1** 0000 0000 0000 | Interrupt occurred on TOR counter 0 from module 1 |
| 0000 00**1**0 | 00**1**0 0000 0000 0000 | Interrupt occurred on TOR counter 1 from module 1 |
| 0000 0**1**00 | 000**1** 0000 0000 0000 | Interrupt occurred on TOR counter 0 from module 2 |
| 0000 0**1**00 | 00**1**0 0000 0000 0000 | Interrupt occurred on TOR counter 1 from module 2 |
| 0000 **1**000 | 000**1** 0000 0000 0000 | Interrupt occurred on TOR counter 0 from module 3 |
| 0000 **1**000 | 00**1**0 0000 0000 0000 | Interrupt occurred on TOR counter 1 from module 3 |

**Table 3-3: Return table for counter value**

| b_ModuleMask | ul_InterruptMask | Source | ul_CounterLatchValue |
|---|---|---|---|
| b_ModuleMask = 1 | ul_InterruptMask = 4096 | Counter cycle of module 0, TOR counter 0 is stopped. The measurement is latched. | Counter value of TOR 0 |
| b_ModuleMask = 1 | ul_InterruptMask = 8192 | Counter cycle of module 0, TOR counter 1 is stopped. The measurement is latched. | Counter value of TOR 1 |
| b_ModuleMask = 2 | ul_InterruptMask = 4096 | Counter cycle of module 1, TOR counter 0 is stopped. The measurement is latched. | Counter value of TOR 0 |
| b_ModuleMask = 2 | ul_InterruptMask = 8192 | Counter cycle of module 1, TOR counter 1 is stopped. The measurement is latched. | Counter value of TOR 1 |
| b_ModuleMask = 4 | ul_InterruptMask = 4096 | Counter cycle of module 2, TOR counter 0 is stopped. The measurement is latched. | Counter value of TOR 0 |
| b_ModuleMask = 4 | ul_InterruptMask = 8192 | Counter cycle of module 2, TOR counter 1 is stopped. The measurement is latched. | Counter value of TOR 1 |
| b_ModuleMask = 8 | ul_InterruptMask = 4096 | Counter cycle of module 3, TOR counter 0 is stopped. The measurement is latched. | Counter value of TOR 0 |
| b_ModuleMask = 8 | ul_InterruptMask = 8192 | Counter cycle of module 3, TOR counter 1 is stopped. The measurement is latched. | Counter value of TOR 1 |

# 3.3 Initialisation

### 1) i_APCI1710_InitTorCounter (...)

**Syntax:**

```
<Return Wert> =  i_APCI1710_InitTorCounter
                                    (BYTE       b_BoardHandle,
                                     BYTE       b_ModulNbr,
                                     BYTE       b_TorCounter,
                                     BYTE       b_PCIInputClock,
                                     BYTE       b_TimingUnit,
                                     ULONG      ul_TimingInterval,
                                     PULONG     pul_RealTimingInterval)
```

**Parameter:**

**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board APCI-/CPCI-1710 |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1). |
| BYTE | b_PCIInputClock | Selection of the PCI bus clock<br>- APCI1710_30MHZ: The PC has a PCI bus clock of 30 MHz<br>- APCI1710_33MHZ: The PC has a PCI bus clock of 33 MHz<br>- APCI1710_40MHZ: The XPCI-1710 board has an integrated clock of 40 MHz |
| BYTE | b_TimingUnit | Base time unit (0 to 4)<br>0: ns<br>1: µs<br>2: ms<br>3: s<br>4: mn |
| ULONG | ul_TimingInterval | Base time value.<br>See table 3-6: Base time value |

**-Output:**

| | | |
|---|---|---|
| PULONG | pul_RealTimingInterval | Real time value. |

**Table 3-4: Base time value**

| PCI-Bus clock | b_TimingUnit | ul_TimingInterval Mindestwert | ul_TimingInterval Höchstwert |
|---|---|---|---|
| APCI1710_30MHz | ns (0) | 133 | 4294967295 |
| | µs (1) | 1 | 571230650 |
| | ms (2) | 1 | 571230 |
| | s (3) | 1 | 571 |
| | mn (4) | 1 | 9 |
| APCI1710_33MHz | ns (0) | 121 | 4294967295 |
| | µs (1) | 1 | 519691043 |
| | ms (2) | 1 | 51969 |
| | s (3) | 1 | 520 |
| | mn (4) | 1 | 8 |
| APCI1710_40MHZ | ns (0) | 100 | 4294967295 |
| | µs (1) | 1 | 429496729 |
| | ms (2) | 1 | 429496 |
| | s (3) | 1 | 429 |
| | mn (4) | 1 | 7 |

**Task:**
Configures the selected TOR counter (*b_TorCounter*) of the selected module (*b_ModulNbr*). *ul_TimingInterval* and *ul_TimingUnit,* determines the time base for the measurement. *pul_RealTimingInterval* returns the real time value. This function must be called before any other function is called, which accesses to the TOR counter.

**Calling convention**

```
ANSI C :
int             i_ReturnValue;
unsigned char   b_BoardHandle;
unsigned long   ul_RealTimingInterval

i_ReturnValue = i_APCI1710_InitTorCounter
                                (b_BoardHandle,
                                 0,
                                 0,
                                 APCI1710_33MHZ,
                                 1,
                                 100,
                                 &ul_RealTimingInterval);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong
-2: The selected module is wrong
-3: The module is no TOR module
-4: Selected TOR counter is wrong
-5: The selected PCI input clock is wrong
-6: Selected time unit is wrong.
-7: Selected base time is wrong
-8: 40 MHz clock cannot be used with this board.
-9: 40 MHz clock cannot be used with this TOR version.

## 2) i_APCI1710_EnableTorCounter (...)

**Syntax:**

```
<Return Wert> =  i_APCI1710_EnableTorCounter
                                    (BYTE  b_BoardHandle,
                                     BYTE  b_ModulNbr,
                                     BYTE  b_TorCounter,
                                     BYTE  b_InputMode,
                                     BYTE  b_ExternGate,
                                     BYTE  b_CycleMode,
                                     BYTE  b_InterruptEnable)
```

**Parameter:**

**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1). |
| BYTE | b_InputMode | Selection of the input signal level<br>0: TOR counts at each „Low" level<br>1: TOR counts at each "High" level<br>2: APCI1710_TOR_SIMPLE_MODE:<br>Function like 4 fold MODE, but only one of the four edges per period is evaluated.<br>3: APCI1710_TOR_DOUBLE_MODE<br>Function like 4fold-MODE, but only two of the four edges are evaluated.<br>4: APCI1710_TOR_QUADRUPLE _MODE:<br>The edge evaluation switch generates a counting pulse in the 4 fold MODE from two phase shifted signals. |
| BYTE | b_ExternGate | Selected action for the external gate<br>0: External gate signal not used<br>1: External gate signal used. If the single mode is selected, each High level signal will start the counter. If the continuous mode is selected, the first High level signal will start the TOR counter.<br>The gate input is used as signal B. |
| BYTE | b_CycleMode | Acquisition mode of the TOR counter |
| BYTE | b_InterruptEnable | TOR counter interrupt<br>APCI1710_ENABLE: Enables the TOR counter Interrupt<br>APCI1710_DISABLE: Disables the TOR counter Interrupt |

**-Output:**
There is no output

**Task:**
Releases the TOR counter (*b_TorCounter*) of the indicated module (*b_ModulNbr*). The function "i_APCI1710_InitTorCounter" shall be called before this function. If the TOR counter interrupt is released, the TOR counter generates an interrupt after the time cycle is run out. See function "i_APCI1710_SetBoardIntRoutineX" and the description of the interrupt mask in chapter 3.2. The *b_CycleMode* parameter determines if the measurement runs for one for several cycles.

**Calling convention:**
ANSI C :

```
int             i_ReturnValue;
unsigned char   b_BoardHandle;

i_ReturnValue = i_APCI1710_EnableTorCounter
                                    (b_BoardHandle,
                                     0,
                                     0,
                                     1,
                                     0
                                     APCI1710_SINGLE,
                                     APCI1710_DISABLE);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong.
-2: The selected module is wrong.
-3: The module is no TOR module
-4: The selected TOR counter is wrong
-5: TOR counter not initialised. See function "i_APCI1710_InitTorCounter"
-6: The selected TOR input signal is wrong
-7: The selected mode fort he external gate signal is wrong
-8: The selected acquistion mode of the TOR counter is wrong.
-9: Interrupt parameter is wrong
-10: Interrupt function not initialised.
See function "i_APCI1710_SetBoardIntRoutineX"

### 3) i_APCI1710_DisableTorCounter (...)

**Syntax:**
<Return Wert> = i_APCI1710_DisableTorCounter
(BYTE b_BoardHandle,
BYTE b_ModulNbr,
BYTE b_TorCounter)

**Parameters:**
**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board APCI-1710 |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1). |

**- Output:**
There is no output..

**Task:**
Disables the TOR counter (*b_TorCounter*) of the selected module (*b_ModulNbr*). The status register will be deleted, if the TOR counter is deactivated after a cycle has started and if the TOR counter starts again with the function "i_APCI1710_EnableTorCounter"

**Calling convention:**

```
ANSI C :
int                 i_ReturnValue;
unsigned char       b_BoardHandle;

i_ReturnValue = i_APCI1710_DisableTorCounter
                                    (b_BoardHandle,
                                     0,
                                     0);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong
-2: The selected module is wrong
-3: The module is no TOR module
-4: The selected TOR counter is wrong
-5: TOR counter is not initialised. See function: "i_APCI1710_InitTorCounter"
-6: TOR counter is not released.
See function "i_APCI1710_EnableTorCounter"

## 4) i_APCI1710_GetTorCounterInitialisation (...)

**Syntax:**

```
<Return Wert> =  i_APCI1710_GetTorCounterInitialisation
                                    (BYTE     b_BoardHandle,
                                     BYTE     b_ModulNbr,
                                     BYTE     b_TorCounter,
                                     PBYTE    pb_TimingUnit,
                                     PULONG pul_TimingInterval,
                                     PBYTE     pb_InputMode,
                                     PBYTE     pb_ExternGate,
                                     PBYTE     pb_CycleMode,
                                     PBYTE     pb_Enable,
                                     PBYTE     pb_InterruptEnable)
```

**Parameter:**

**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1) |

**- Output:**

| | | |
|---|---|---|
| PBYTE | pb_TimingUnit | Base time unit (0 to 4)<br>0: ns<br>1: µs<br>2: ms<br>3: s<br>4: mn |
| PULONG | pul_TimingInterval | Base time value. See table. |
| PBYTE | pb_InputMode | Selection of the input signal level<br>0: TOR counts at each "Low" level<br>1: TOR counts at each "High" level |
| PBYTE | pb_ExternGate | Selected action for the external gate<br>0: External gate signal not used<br>1: External gate signal is used.. |
| PBYTE | pb_CycleMode | Cycle type of the TOR acquisition<br>APCI1710_SINGLE: Single cycle-MODE.<br>The TOR counter counts only one cycle<br>The function is to be called at each cycle.<br>APCI1710_CONTINUOUS: Each time cycle starts a new counting process. |
| PBYTE | pb_Enable | Indicates if the TOR counter is released or not.<br>0: TOR counter disabled<br>1: TOR counter enabled |
| PBYTE | pb_InterruptEnable | Selection of the TOR nterrupt.<br>APCI1710_ENABLE: TOR Interrupt enabled.<br>APCI1710_DISABLE: TOR Interrupt disabled |

**Task:**
Returns the TOR (*b_TorCounter*) initialisation of the selected module (*b_ModulNbr*). You must call up the "i_APCI1710_InitTorCounter" function before calling up this function

**Calling convention:**

```
ANSI C :
int             i_ReturnValue;
unsigned char   b_BoardHandle;
unsigned char   b_TimingUnit;
unsigned char   b_InputMode;
unsigned char   b_CycleMode;
unsigned char   b_InterruptEnable;
unsigned long   ul_TimingInterval;

i_ReturnValue = i_APCI1710_GetTorCounterInitialisation
                                    (b_BoardHandle,
                                     0,
                                     0,
                                     &b_TimingUnity,
                                    &ul_TimingInterval,
                                     &b_InputMode,
                                     &b_CycleMode,
                                     &b_InterruptEnable);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong
-2: The selected module is wrong
-3: The module is no TOR module
-4: The selected TOR counter is wrong
-5: TOR is not initialised. See function: "i_APCI1710_InitTorCounter"

# 3.4 Read TOR counter

### 1) i_APCI1710_GetTorCounterProgressStatus (...)

**Syntax:**
<Return Wert> = i_APCI1710_GetTorCounterProgressStatus
(BYTE b_BoardHandle,
BYTE b_ModulNbr,
BYTE b_TorCounter,
PBYTE pb_TorCounterStatus)

**Parameter:**
**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1) |

**-Output:**

| | | |
|---|---|---|
| PBYTE | pb_TorCounterStatus | Returns the TOR status<br>0: Counting cycle not started. Software gate not set.<br>1: Counting cycle is started. Software gate is set<br>2: Counting cycle stopped and ended.<br>3: Time is run out. Base time must be changed with the function "i_APCI1710_InitTorCounter" |

**Task:**
Returns the status of the selected TOR counter (*b_TorCounter*) in the selected module (*b_ModulNbr*).

**Calling convention:**
ANSI C :

```
int             i_ReturnValue;
unsigned char   b_BoardHandle;
unsigned char   b_TorCounterStatus;

i_ReturnValue = i_APCI1710_GetTorCounterProgressStatus
                                    (b_BoardHandle,
                                     0,
                                     0,
                                     &pb_TorCounterStatus);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong
-2: The selected module is wrong
-3: The module is no TOR module

-4: The selected TOR counter is wrong
-5: TOR is not initialised. See function "i_APCI1710_InitTorCounter"
-6: TOR is not released. See function: "i_APCI1710_EnableTorCounter"

## 2) i_APCI1710_ReadTorCounterValue (...)

**Syntax:**

```
<Return Wert> = i_APCI1710_ReadTorCounterValue
                                (BYTE    b_BoardHandle,
                                 BYTE    b_ModulNbr,
                                 BYTE    b_TorCounter,
                                 UINT    ui_TimeOut,
                                 PBYTE   pb_TorCounterStatus,
                                 PULONG  pul_TorCounterValue)
```

**Parameter:**

**-Input:**

| | | |
|---|---|---|
| BYTE | b_BoardHandle | Handle of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1) |
| UINT | ui_TimeOut | Selection of the sequence time (0 to 65535)<br>0: No time sequence used.<br>The function returns the TOR status and checks if the counter cycle has stopped the measured counting value.<br>1 to 65535: Determines the time sequence in ms. The function will be returned after Timeout or counting cycle stop. |

**- Output:**

| | | |
|---|---|---|
| PBYTE | pb_TorCounterStatus | Returns the TOR status<br>0: Counting cycle not started. Software gate is not set.<br>1: Counting cycle is started Software gate I set.<br>2: Counting cycle is stopped. The counting cycle will be ended<br>3: An overflow has occurred. The time base must be changed with the function "i_APCI1710_InitTorCounter"<br>4: Timeout is occurred. |
| PULONG | pul_TorCounterValue | TOR counting value. |

**Task:**

Returns the status (*pb_TorCounterStatus*) of the TOR counter (*b_TorCounter*) and the counting value (*pul_TorCounterValue*) of the selected module (*b_ModulNbr*) after a counting cycle is stopped.

**Calling convention:**
ANSI C :

```
int             i_ReturnValue;
unsigned char   b_BoardHandle;
unsigned char   b_TorCounterStatus;
unsigned long   ul_TorCounterValue;

i_ReturnValue = i_APCI1710_ReadTorCounterValue
                                    (b_BoardHandle,
                                    0,
                                    0,
                                    0,
                                    &pb_TorCounterStatus,
                                    &ul_TorCounterValue);
```

**Return value:**
0: No error
-1: The handle parameter of the board is wrong
-2: The selected module is wrong
-3: The module is no TOR module
-4: The selected TOR counter is wrong
-5: TOR is not initialised. See function "i_APCI1710_InitTorCounter"
-6: TOR is not released. See function "i_APCI1710_EnableTorCounter"
-7: Timeout parameter is wrong (0 to 65535)

## 3.5 Interrupt kernel functions for Windows NT/95

**IMPORTANT!**
These functions are only available for Windows NT and Windows 95 user interrupt routine in the synchronous mode. See function "i_APCI1710_SetBoardIntRoutineWin32"

### 1) i_APCI1710_KRNL_GetTorCounterProgressStatus (...)

**Syntax:**
<Return Wert> = i_APCI1710_KRNL_GetTorCounterProgressStatus
(UINT ui_BaseAddress,
BYTE b_ModulNbr,
BYTE b_TorCounter,
PBYTE pb_TorCounterStatus)

**Parameter:**
**-Input:**

| | | |
|---|---|---|
| UINT | ui_BaseAddress | Base address of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selektierter TOR Zähler (0 oder 1) |

**- Ausgabe:**

| | | |
|---|---|---|
| PBYTE | pb_TorCounterStatus | Returns the TOR status<br>0: Counting cycle is not started. Software gate is not set.<br>1: Counting cycle is started. Software gate is set<br>2: Counting cycle is stopped. The counting cycle is stopped.<br>3: an overflow occurred. The time base must be changed with the function "i_APCI1710_InitTorCounter"<br>4: Timeout occurred |

**Task:**
Returns the TOR status (*pb_TorCounterStatus*) of the selected TOR module (*b_ModulNbr*).

**Calling convention:**
ANSI C :

```
int             i_ReturnValue;
unsigned int    ui_BaseAddress;
unsigned char   b_TorCounterStatus;
i_ReturnValue = i_APCI1710_KRNL_GetTorCounterProgressStatus
                (ui_BaseAddress,
                 0,
                 0,
                 &pb_TorCounterStatus);
```

**Return value:**
0: No error
-1: The selected module is wrong
-2: The module is no TOR module
-3: The selected TOR counter is wrong
-4: TOR is not initialised. See function "i_APCI1710_InitTorCounter"
-5: TOR is not released. See function "i_APCI1710_EnableTorCounter"

## 2) i_APCI1710_KRNL_ReadTorCounterValue (...)

**Syntax:**

```
<Return Wert> = i_APCI1710_KRNL_ReadTorCounterValue
                                    (UINT     ui_BaseAddress,
                                     BYTE     b_ModulNbr,
                                     BYTE     b_TorCounter,
                                     PBYTE    pb_TorCounterStatus,
                                     PULONG   pul_TorCounterValue)
```

**Parameter:**

**-Input:**

| | | |
|---|---|---|
| UINT | ui_BaseAddress | Base address of the board **APCI-1710** |
| BYTE | b_ModulNbr | Number of the module to be configured (0 to 3) |
| BYTE | b_TorCounter | Selected TOR counter (0 or 1) |

**-Output:**

| | | |
|---|---|---|
| PBYTE | pb_TorCounterStatus | Returns the TOR status<br>0: Counting cycle is not started. Software gate is not set.<br>1: Counting cycle is started. Software gate is set.<br>2: Counting cycle is stopped. The counting cycle will be ended<br>3: An overflow occurred. The time base must be changed with the function "i_APCI1710_InitTorCounter"<br>4: Timeout occurred. |
| PULONG | pul_TorCounterValue | TOR counter value. |

**Task:**

Returns the TOR status (*pb_TorCounterStatus*) and the TOR counter value (*pul_TorCounterValue*) of the selected TOR module (*b_ModulNbr*) after a counting cycle stopped.

**Calling convention:**

ANSI C :

```
int             i_ReturnValue;
unsigned int    ui_BaseAddress;
unsigned char   b_TorCounterStatus;
unsigned long   ul_TorCounterValue;
i_ReturnValue = i_APCI1710_KRNL_ReadTorCounterValue
                                    (ui_BaseAddress,
                                     0,
                                     0,
                                     &pb_TorCounterStatus,
                                     &ul_TorCounterValue);
```

**Return value:**
0: No error
-1: The selected module is wrong
-2: The module is no TOR module
-3: The selected TOR counter is wrong
-4: TOR is not initialised. See function "i_APCI1710_InitTorCounter"
-5: TOR is not released. See function: "i_APCI1710_EnableTorCounter"