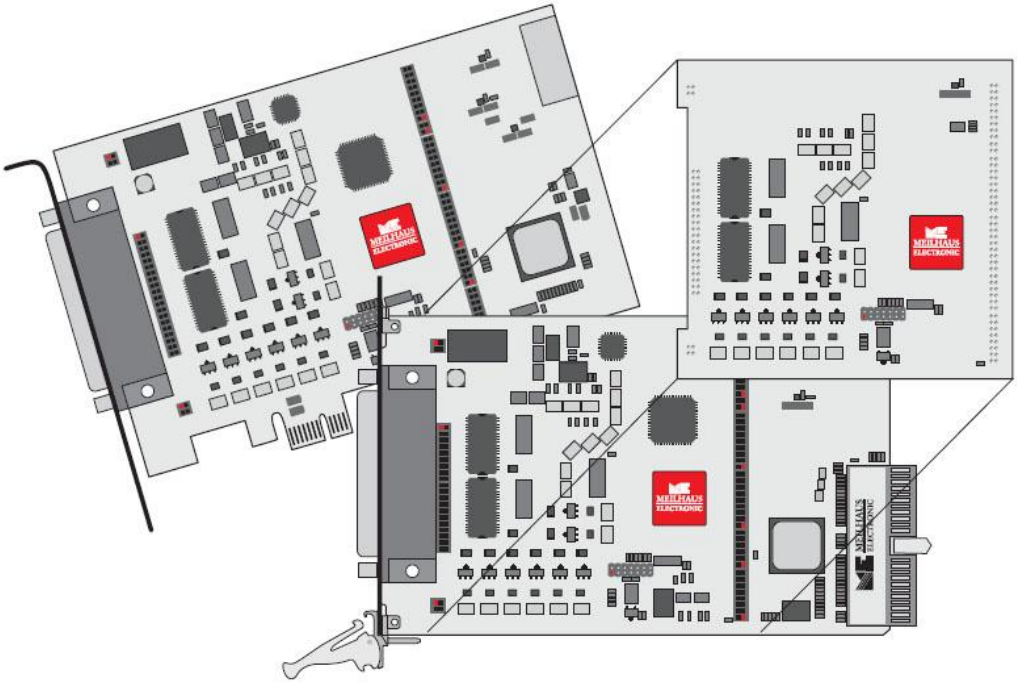
MEILHAUS ELECTRONIC

Meilhaus Electronic Manual

ME-5810 Series



Opto-Isolated Digital-I/O Board

with Bit-Pattern Detection, 3 x 16-bit Counters (8254)
(alternatively: Frequency Measurement and Pulse Generator)

Imprint

Manual ME-5810 Series

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Content

1 Introduction

Valued customer,

Thank you for purchasing this device from Meilhaus Electronic. You have chosen an innovative high-technology product that left our premises in a fully functional and new condition.

Please take the time to carefully examine the contents of the package for any loss or damage that may have occurred during shipping. If there are any items missing or if an item is damaged, please contact us immediately.

Before installing the board in your computer, we recommend you read this manual carefully, especially the chapter describing board installation.

1.1 Important Notes

1.1.1 Use in Accordance with the Requirements

The PC boards of the ME-series are designed for acquisition and output of analog and digital signals using a PC. Depending on type, install the models of the ME-series into:

a free PCI-Express slot (PCIe versions) or

a free CompactPCI slot (3 HE cPCI versions)

For information on how to install a plug-in board, read the manual of your PC.

Please note the instructions and specifications as presented in this manual (Appendix, from page 38 on):

- Please ensure sufficient heat dissipation for the board within the PC housing.
- All unused inputs should be connected to the ground reference of the appropriate functional section. This avoids cross talk between the input lines.
- The opto-isolated inputs and outputs achieve an electrical isolation of the application relative to PC ground.
- Note that the computer must be powered up, prior connecting signals by the external wiring of the board.

- As a basic principle, all connections to the board should only be made or removed in a powered-down state of all components.
- Ensure that no static discharge occurs while handling the board or while connecting/disconnecting the external cable.
- Ensure that the connection cable is properly connected. It must be seated firmly on the D-Sub connector and must be tightened with both screws, otherwise proper operation of the board cannot be guaranteed!

1.1.2 Improper Application

PC plug-in boards for the PCI-, PCI-Express- or CompactPCI-bus may not be taken into operation outside of the PC. Never connect the devices with voltage-carrying parts, especially not with mains voltage. As power supply for the USB models only an authorized power adaptor may be used.

Make sure that no contact with voltage-carrying parts can happen by the external wiring of the device. As a basic principle, all connections should only be made or removed in a powered-down state.

1.1.3 Unforeseeable Misapplications

The device is not suitable to be used as a children's toy, in the household or under unfavourable environmental conditions (e.g. in the open). Appropriate precautions to avoid any unforeseeable misapplication must be taken by the user.

1.2 Package Contents

We take great care to ensure your delivery is complete. Nonetheless, please check the list enclosed to verify the contents of your delivery. You should find included:

- Opto-isolated digital-I/O boards for the PCI-Express- or Compact-PCI-bus of type ME-5810A or ME-5810B (incl. ME-5002)
- Manual in PDF format on CD/DVD (optionally available in printed form).
- Driver software on CD/DVD.
- 78-pin D-sub mating connector.

1.3 Features

The ME-5810 series PC boards are opto-isolated digital-I/O boards with bit-pattern detection and counters for PCI-Express- and CompactPCI-systems. In this user manual “ME-5810” is used for all versions of the cards, whereas “ME-5810A” or “ME-5810B” is used to describe special features of these versions.

If required, certain subdevices can alternatively be configured for frequency measurement or for pulse generation (see chapter 4 from page 26). As an option, the base-board can be extended with add-on boards (see table 2 on page 10).

Model overview:

Model	Opto-Dio	Opto-FIO*	Counter
ME-5810A	1 x 16 bit DI 1 x 16 bit DO	4 FI channels 4 FO channels	3 x 16 bit
ME-5810A/S …with streaming operation	1 x 16 bit DI 1 x 16 bit DO	4 FI channels 4 FO channels	3 x 16 bit
ME-5810B** (ME-5810A + ME-5002)	2 x 16 bit DI 2 x 16 bit DO	4 + 4FI channels 4 + 4 FO channels	3 x 16 bit
ME-5810B/S** (ME-5810A/S with streaming operation + ME-5002)	2 x 16 bit DI 2 x 16 bit DO	4 + 4FI channels 4 + 4FO channels	3 x 16 bit

Table 1: Model overview ME-5810 series

* Alternative configuration can be selected with ME-iDC.

** ME-5810A(/S) is always registered in the Windows device manager.

- **Opto-isolated digital-inputs**: The ME-5810 has 16 opto-isolated inputs. Further 16 opto-isolated inputs can be added using the plug-on board ME-5002. The inputs run with a voltage high level of 3…60 V (specifications see page 38).
- **Opto-isolated digital outputs**: Die ME-5810 has 16 opto-isolated outputs. Further 16 opto-isolated outputs can be added using the plug-on board ME-5002. The source-driver can drive up to 370 mA per pin (all 16 outputs active). The detailed specifications of the sink and/or source drivers can be found on page 38. The source drivers are short-circuit-proof and are equipped

with a current limiting per channel. If required, the output driver can send an interrupt on overload to the PC.
A suitable external source is required to supply the output drivers.

- **Frequency measurement:** With the concept of "configurable subdevices" the subdevice 0 can also be used as a frequency counter. Four independent channels are available to measure the frequency and duty cycle of periodic rectangular signals (max. 5.5 MHz). 4 further channels can be added using the plug-on board ME-5002.
- **Pulse generator:** With the concept of "configurable subdevices" the subdevice 1 can also be used as a rectangular signal generator. Four independent channels are available to output a periodic rectangular signal up to 5.5 MHz with selectable duty cycle. 4 further channels can be added using the plug-on board ME-5002.
- **Sink/source selection:** You can switch the output ports over from sink to source drivers or high impedance by software for an optimal adaption in industrial applications. "High impedance" means that the voltage level at the output pin depends on your external application.
- **Bit-pattern detection:** If required, the bit-pattern at the digital input port can be monitored. Depending on the mode an interrupt can be generated, if the bit-pattern changes or is equal/not equal to a given bit-pattern. In streaming mode bit-pattern detection can be used to control the input/output operation depending on the selected operating mode (no interrupt operation).
- The isolation voltage between the opto-isolated inputs/outputs and PC-ground is 1 $kVAC_{RMS}$.
- The opto-isolated digital inputs of the ME-5810 and ME-5002 are equipped with an overvoltage protection diode that can discharge voltage pulses to ground for a short period of time.

Depending on your application you can select between these operating modes:

- **Single:** In this mode a single value can be read or written under software control (see chapter 4.1.1 on page 29).
- **Streaming** ("S"-versions only): In this mode data I/O makes use of the FIFO, either under timer control and/or controlled by external trigger signals. Various trigger options are available that can be defined as start and stop conditions. Subdevice 0 is defined as a 16-bit input port and subdevice 1 as a 16-bit output port (see chapter 2.1 on page 11).

- **Interrupt**: Used for interrupt processing in bit-pattern change and bit-pattern compare mode (see chapter 4.3 on page 35).

Custom specific firmware versions are available on request.

Model	ME-5810 A	ME-5001	ME-5002	ME-5004
PC-Interface	cPCI/PCIe	–	–	–
Board type	base board	plug-on board	plug-on board	plug-on board
DIO-channels	1 x 16-bit DI, 1 x 16-bit DO	2 x 8-bit DIO+ 4 x 8-bit DIO**	1 x 16-bit DI, 1 x 16-bit DO	1 x 16-bit DI, 1 x 16-bit DO
Streaming channels*	1 x 16-bit DI, 1 x 16-bit DO	–	–	–
I/O rate DI/DO	30 MS/s / 30 MS/s	–	–	–
Frequency FI/FO	300 kHz/ 3 kHz	5.5 MHz/ 5.5 MHz	300 kHz/ 3 kHz	300 kHz/ 3 kHz
Ext. trigger for streaming*	✓	–	–	–
Software-start/-stop for streaming*	✓	–	–	–
Frequency measurement	4 channels	4 channels	4 channels	4 channels
Pulse generator	4 channels	4 channels	4 channels	4 channels
Counter (8254)	3 x 16 bit	–	–	–
Bit-pattern change	✓	–	✓	✓
Bit-pattern compare	✓	–	✓	✓
DI/FI level	3…60 V	3.3 V/5 V (4 x 8 bit***)	3…60 V	3…60 V
DO/FO level	15…30 V	3.3 V/5 V (4 x 8 bit***)	15…30 V	15…30 V
Active termination	–	4 x 8 bit***	–	–

Opto-isolation	✓	–	✓	✓
Sink/Source selection	✓	–	✓	✓
Temperature monitoring	source driver	–	source driver	source driver
Field wiring	78-pin D-Sub female socket	25-pin D-Sub female socket	via 78-pin D-Sub of base board	37-pin D-Sub female socket
Configurable firmware	✓	✓	✓	✓
Configurable subdevices	✓	✓	✓	✓

Table 2: ME-5810 and plug-on boards in overview

* Streaming mode only for "S"-versions
** opt. via ME-AK-D25F/S (cPCI)
*** only for subdevice 0...3.

1.4 System Requirements

The ME-series may be installed into any PC (Intel® Pentium® processor) with a free standard PCI-, PCI-Express- resp. CompactPCI-slot (32 bit, 33 MHz, 5 V). The board is supported by the Meilhaus Electronic Intelligent Driver System (ME-iDS).

1.5 Software Support

The ME-series is supported by the Meilhaus Electronic Intelligent Driver System (ME-iDS). The ME-iDS is a unique driver system covering different devices and operating systems. It supports Windows 2000/XP/Vista and Windows 7, 8.1, 10 and contains a universal function library (API) for all common programming languages.

A detailed description of the functions can be found in the ME-iDS manual on the CD/DVD enclosed.

Please also note the corresponding README-files.

2 Initial Operation

Please read your computer's instruction manual on how to install new hardware components **before installing the board**.

2.1 Software Installation

- Installation under Windows

The following basic procedure should be used:

If you have received the driver software as an archive file, please unpack the software **before installing the board**. First choose a directory on your computer (e.g. C:\Temp\Meilhaus\ME-iDS).

Use the Meilhaus Electronic Intelligent Driver System (ME-iDS) for programming your new data acquisition hardware. For installation and operation of the driver system, please follow the documentation in electronic form included with the software package.

2.2 Test Program

For simple testing of the board use the corresponding test program provided with the ME-iDS.

ME-PowerLab[3]. Run the program from the Windows Start menu. This will allow you to text all the important functions of the hardware.

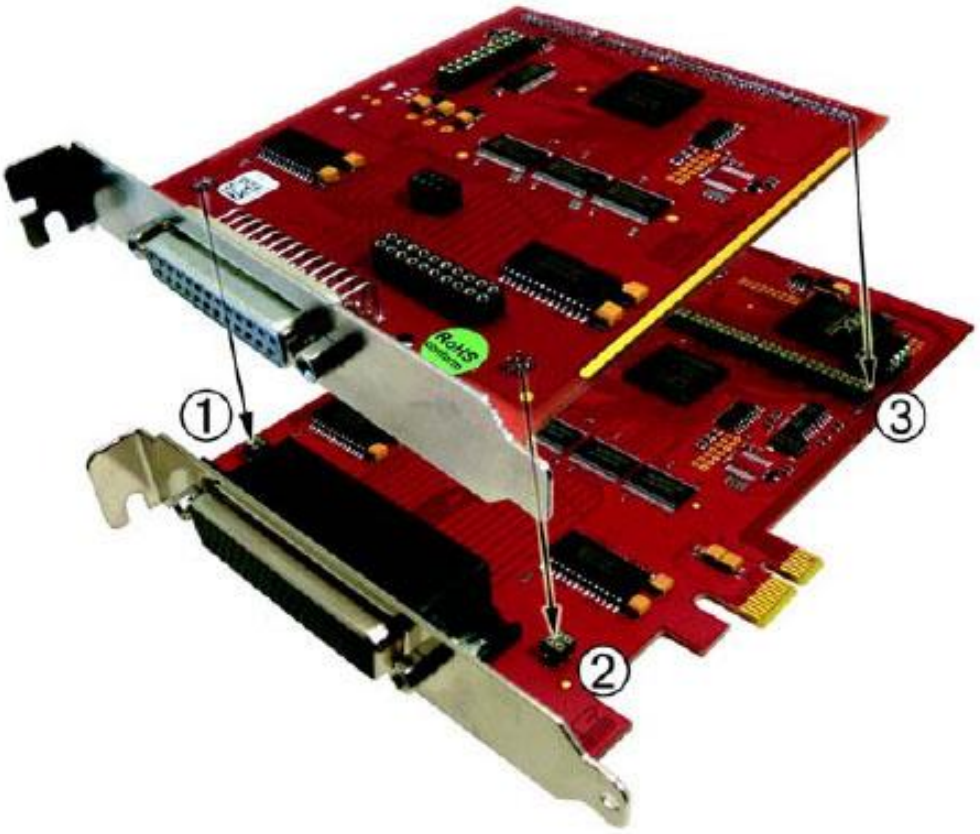
- You will find simple test programs in the SDK of the ME-iDS, in the "Test Executables32" or "Test Executables64" subfolders.

2.3 Fitting the Plug-on Boards

The boards should be handled with care in order to make sure that the device is not damaged by electrostatic discharge (ESD), mechanical stress or unsuitable current surges. Precautions should also be taken to avoid an electric shock. Ensure that standard ESD safety precautions are taken. At least one hand should be grounded in order to dissipate any electrostatic charge.

Observe the following procedure:

1. If the base board is installed, you must first remove it in order to be able to insert the plug-on board. Here you should observe the procedure as described in the manual for your PC system.
2. Make sure that electrostatic discharges cannot take place through the plug-on board or the base board as you plug it in. Follow the standard ESD safety precautions.
3. Push the plug-on board carefully, and with only a little force, on to the male connector provided for it (see picture 1, items 1, 2 and 3). Check that the board is fully plugged in.
4. Choose two adjacent slots for the installation. If necessary, remove an additional blanking plate for the slot of the plug-on board.
5. Carefully plug the combination of the base and plug-on board into the computer.
6. Screw the two slot brackets down firmly.
7. Close the PC system again.

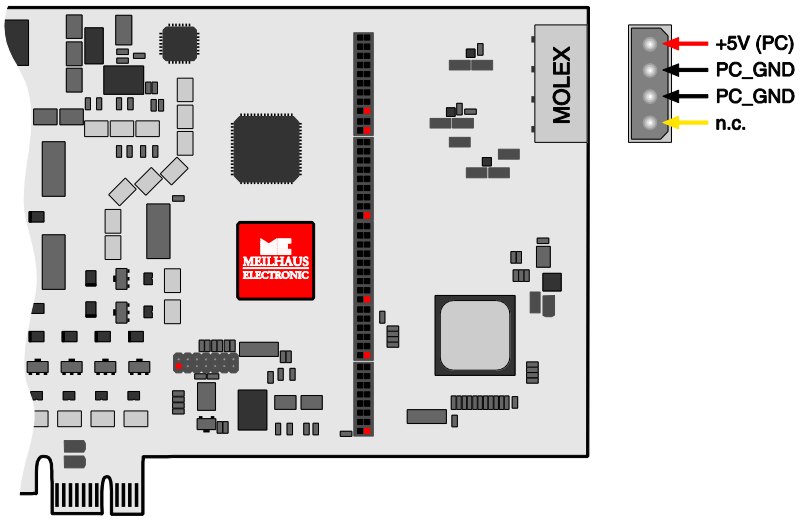


Picture 1: Fitting the plug-on boards

2.4 Power Supply for PCI-Express Models

Because of the PCI-Express slot drive's insufficient current for operating the board, an additional supply is required via the PC power supply. For that purpose connect a free "MOLEX" connector of the PC (as used for power supply of drives) with the appropriate terminal of the board (see the following diagram).

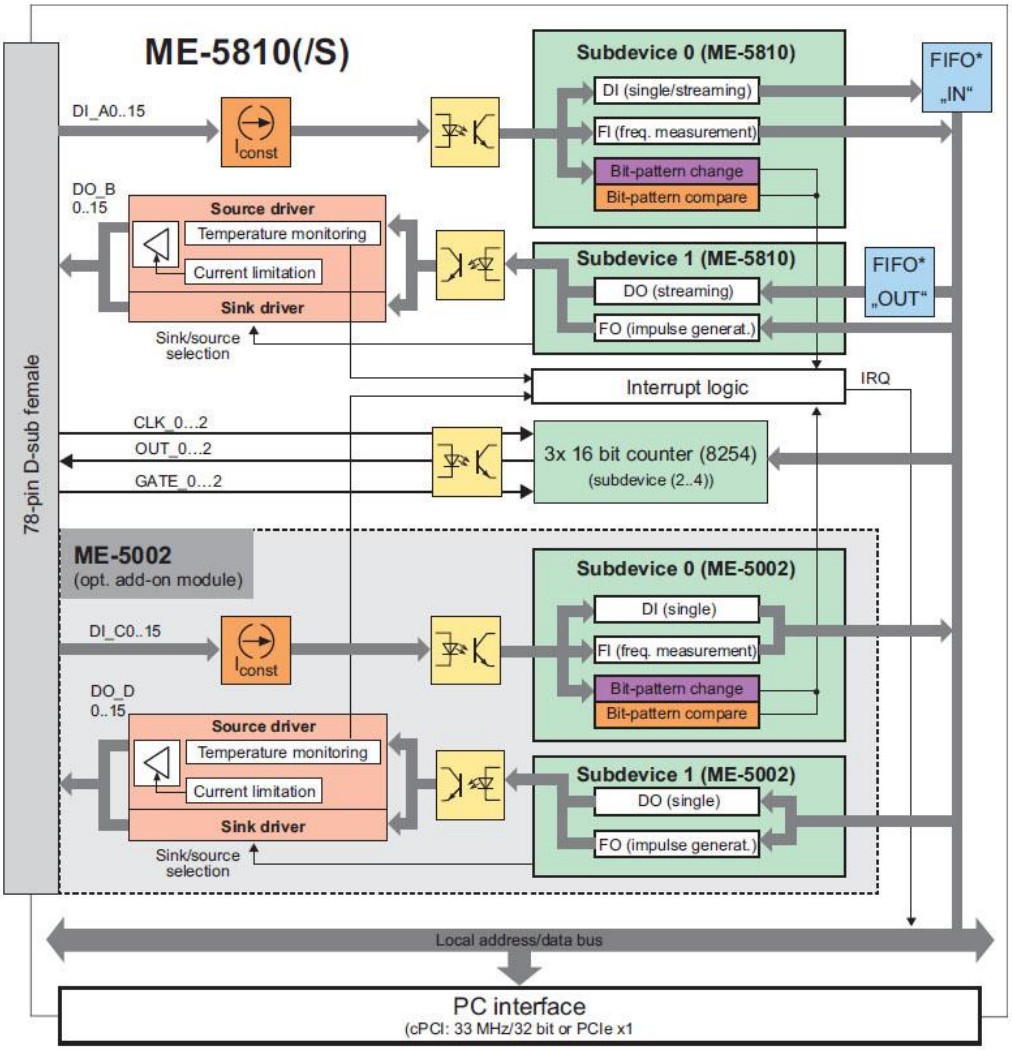
Otherwise the board may be irreversibly damaged!



Picture 2: Additional power to the PCI-Express models

3 Hardware

3.1 Block Picture



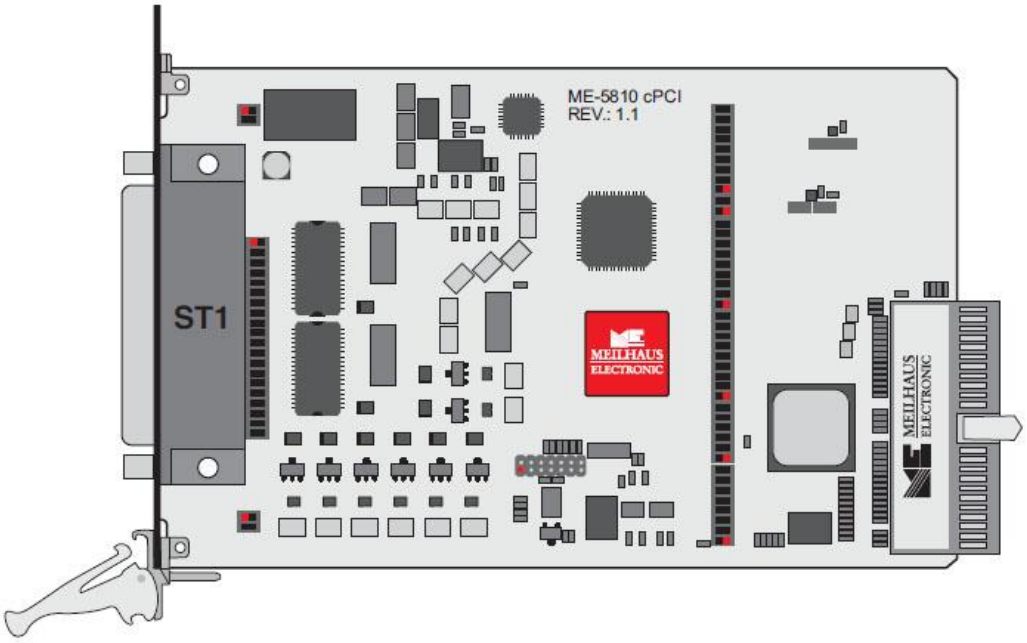
Picture 3: Block picture of ME-5810

***Note:** “FIFO IN” and “FIFO OUT” for streaming mode are only available on “S”-versions.

Pinout picture of the 78-pin D-sub female connector in the appendix (see “Pinout”page 46).

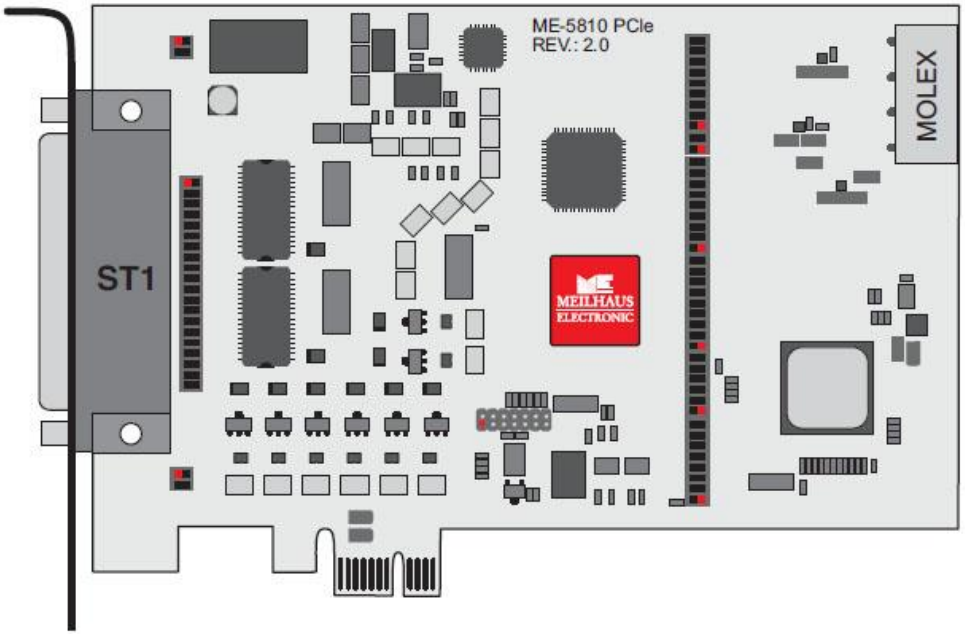
In the following chapters you will learn more about the external wiring of the functional sections. Chapter 4 from page 26 describes the operation modes and the programming.

3.2 ME-5810 cPCI



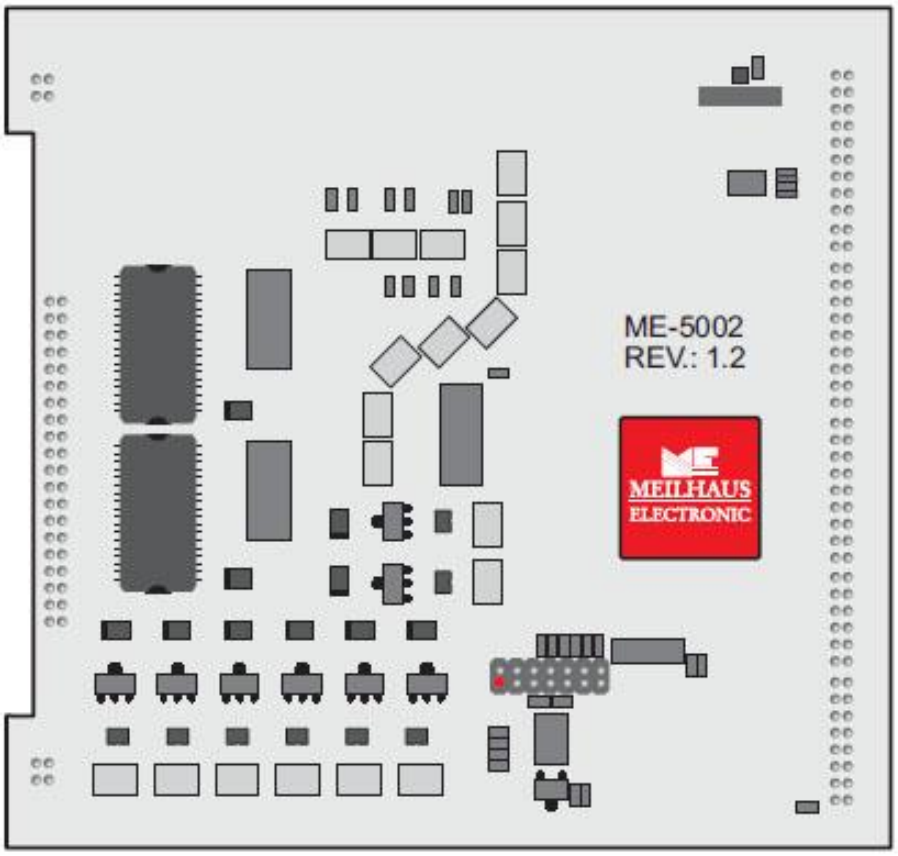
Picture 4: ME-5810 cPCI

3.3 ME-5810 PCIe



Picture 5: ME-5810 PCIe

3.4 ME-5002



Picture 6: ME-5002

3.5 Digital Input/Output

The ME-5810 series opto-isolated ports have been designed for applications in industrial control applications (typ. 24 V). An external power supply (pin: VCC_EXT) is required for the opto-isolated digital-I/O section. Depending on the application, the drivers of the output ports can be configured as sink or source or high impedance via software. The isolation voltage to PC-ground is 1000 VAC_{RMS}.

The ME-5810 series base board has 16 opto-isolated inputs (port A) and 16 opto-isolated outputs (port B). In combination with the plug-on board ME-5002, 16 further opto-isolated inputs (port C) and 16 opto-isolated outputs (port D) can be added. Due to the opto-isolation, the port direction is fixed.

In streaming mode ports A and B share the bandwidth for the data transfer between boards on PC. The bandwidth depends on the

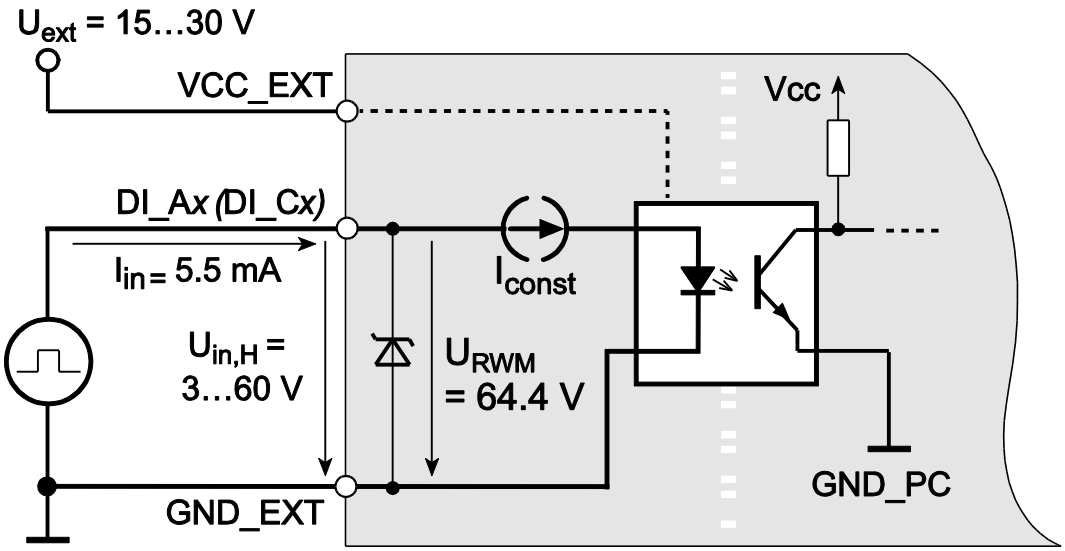
configuration of your PC – a total data throughput of up to 30 MS/s is realistic (see also table 6).

The programming of the various operating modes is described in chapter 4.1 from page 28.

3.5.1 Opto-Isolated Inputs

The ME-5810 has 16 opto-isolated inputs (port A). In combination with a plug-on board ME-5002, 16 further opto-isolated inputs (port C) can be added.

The inputs have been designed for an input high-level $U_{in,H}$ = 3…60 V. A reference to the ground of the external circuitry via GND_EXT (pins 9, 11, 59) has to be setup in any case. The input lines show logic "0" if not connected.



Picture 7: Inputs of the ME-5810

The opto-isolated digital-inputs of the ME-5810 and ME-5002 are protected from over-voltages with special Z-diodes, so called Transient Voltage Suppressor diodes (TVS diodes). These diodes can discharge short voltage pulses with U_{RWM} (Reverse Working Maximum) greater than 64.4 V to ground (max. 600 W pulse power at a pulse width of 1 ms).

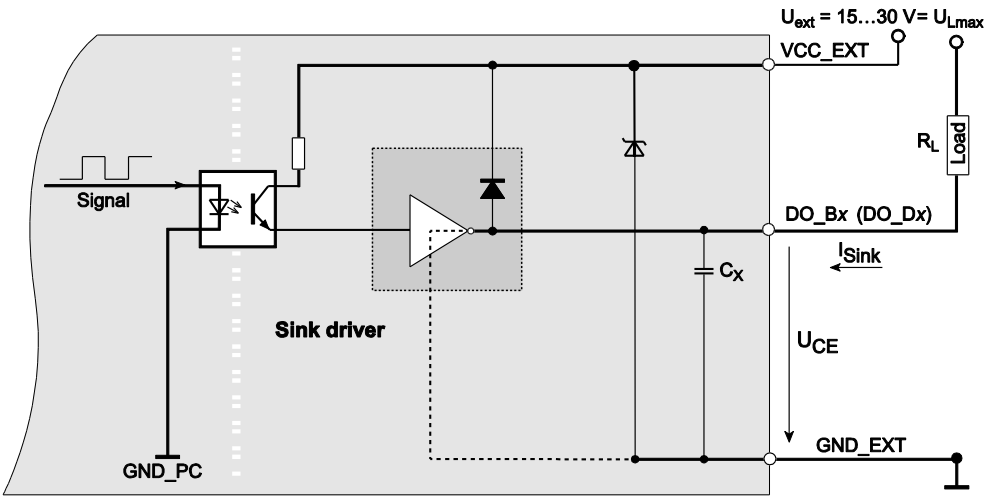
3.5.2 Opto-Isolated Outputs

The ME-5810 has 16 opto-isolated outputs (port B). In combination with a plug-on board ME-5002, further 16 opto-isolated outputs (port D) can be added.

The ME-5810 and ME-5002 output ports are equipped with special driver chips that allow a selection of sink and source via software. Depending on the application, the user can switch between low-active outputs (sink driver = standard setting) and high-active outputs (source driver) via software. Moreover, the output ports can be set to high impedance. A reference to the ground of the external wiring via GND_EXT (pins 9, 11, 59) has to be setup in any case.

3.5.2.1 Sink Driver

Each output is equipped with two sink driver chips of type ULN2803, detailed specifications see page 38.

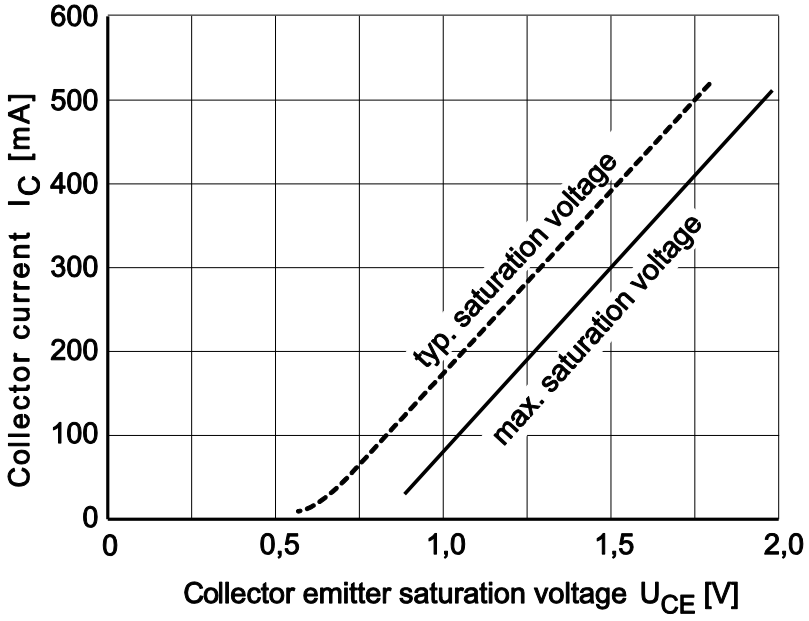


Picture 8: ME-5810 outputs with sink drivers

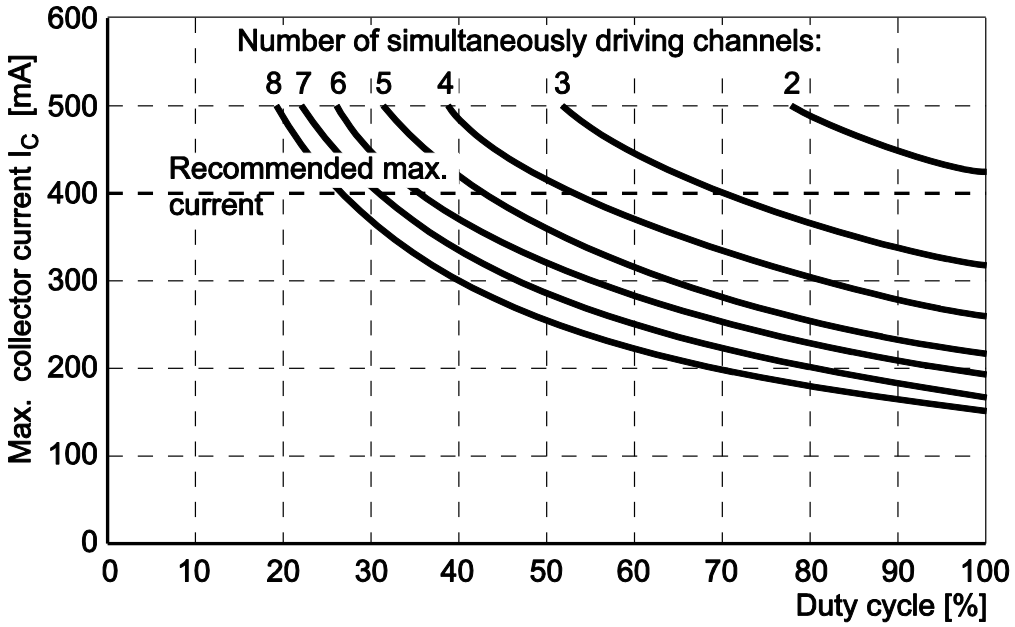
The maximum current per output ($I_C = I_{Sink}$) depends on the saturation voltage U_{CE} and is limited by the power loss of the sum of the channels on P_{tot} = 1 W per chip (DO_x 0...7 = chip 1, DO_x 8...15 = chip 2), see picture 9 and 10.

$P_{tot} = P_0 + \ldots + P_7 \leq$ 1 W (per chip bei 70 °C)

with $P_0 = I_{C0} \cdot U_{CE0}$



Picture 9: Collector current against saturation voltage



Picture 10: Collector current against duty cycle and number of active channels in use

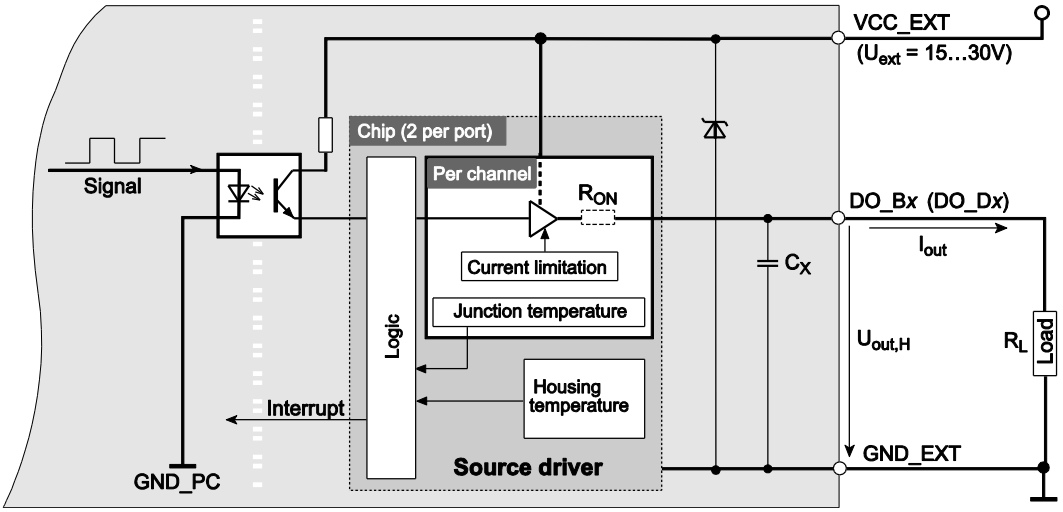
To supply the sink output drivers, an external power supply has to be connected to VCC_EXT (Pin 10, 20) with sufficient power (depending on the application). At full load this means min. 0.8 A for the ME-5810A and min. 1.6 A for the ME-5810B.

3.5.2.2 Source Driver

Each input port is equipped with two source driver chips of type ISO1H811G; detailed specifications see page 38.

The source output drivers are short-circuit-proof and are equipped with a current limiting per channel. The combination of current limiting, thermal shutdown, and automatic restart protects the circuitry against overload.

In the case of an overload condition (T_{TSD} = typ. 175 °C) the related channel will switch off and on again automatically, as soon as the junction temperature has fallen below the threshold of T_R = 135 °C. If a chip temperature of typ. 130 °C is still exceeded, the overloaded channel remains disabled and is only reactivated, if the temperature decreases below T_{CR} = 110 °C. Channels in standard (no overload) condition can be used at any time without restrictions. In the case of an overload condition the output driver (per port) can send an interrupt to the PC. A further security feature is a complete disabling of a port in case of a missing ground connection.



Picture 11: ME-5810 outputs with source drivers

The following table shows the maximum output current I_{Out} in dependency of the number of channels in use.

Number Of Channels Used	1	16	32
I_{OUT}[A]	0.625 A	0.370 A	0.180 A

Table 3: Max current of the source driver

To supply the source output drivers, an external power source has to be connected to VCC_EXT (pin 10, 20), with sufficient power (depending on the application). At full load this means minimum 6 A for the ME-5810A/B. The output voltage $U_{Out,H}$ can be calculated like this:

$$U_{out,\,H} = U_{ext} - (R_{ON} \cdot I_{out})$$

3.5.3 External Trigger

3.5.3.1 External Trigger Inputs

Each digital input can be used as a trigger input. The trigger conditions for start and stop of an I/O under timer control (streaming mode operation on "S"-versions) can be configured in a very flexible way. Also see picture 12 on page 21 as well as picture 19 on page 35.

Note: In single mode operation I/O cannot be triggered externally. See chapter 4.3 on page 35.

3.5.3.2 Edge Detection

Any digital input can be configured to start an operation on a rising, a falling or any edge (i.e. both rising/falling edge).

Picture 12: Trigger edges

3.6 Frequency Input/Output

With the concept of "configurable subdevices" on the ME-5000 series boards you can use certain subdevices with an alternative functionality. The configuration tool ME-iDC is used to change the configuration before the user application is started.

The following channels are available:

- Frequency measurement (FI = "Frequency Input"):

  4 independent inputs for measurement of frequency and duty cycle of periodic rectangular signals (max. 300 kHz). 4 further channels can be added using the plug-on board ME-5002.

- Pulse generator (FO = "Frequency Output"):
  4 independent outputs for a periodic rectangular signal up to 3 kHz with a selectable duty cycle. 4 further channels can be added using the plug-on board ME-5002.

The related pins are marked with FI_x and FO_x in the pinout picture on page 24. The remaining I/O-channels of the digital-ports cannot be used in this configuration.

Note: For the configuration "pulse generator" (FO) take care of the level at the unused pins DO_B4..15 (ME-5810) and DO_D4..15 (ME-5002). When used as sink drivers the channels are high impedance, when used as source drivers they are connected to ground!

The specifications of the digital-I/O ports also apply to the FI/FO lines. A reference to the ground of the external circuitry via GND_EXT (pins 9, 11, 59) has to be setup in any case.

The frequency counters and pulse generators are configured via software. Chapter 4.1 on page 28 describes the programming of the frequency-I/Os.

3.7 Counters

A standard counter chip of type 82C54 is used on the ME-5810 series boards. This versatile chip has 3 independent 16-bit (downward) counters. All counter signals are available at the D-sub female connector.

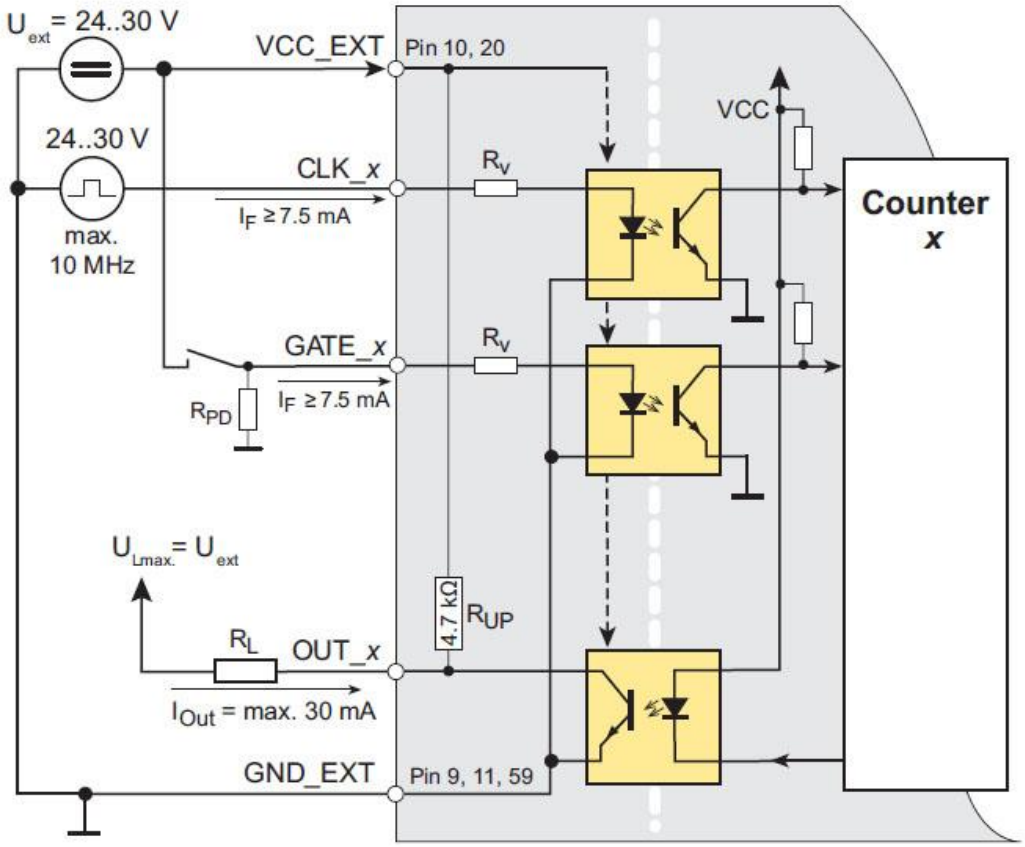
With a suitable enabling of the GATE input (0 V) the related counter will start downward-counting with negative edge control. The counter clock (CLK) has to be supplied externally and can be max. 10 MHz. With a suitable external wiring the counters also can be cascaded.

All counter signals (CLK, GATE, and OUT) are opto-isolated. The counter inputs have been designed for 24 V (R_v = 3 kΩ) as used in industrial control applications. When the counters are used, U_{ext}

has to be in the range of 24…30 V. The counter outputs are equipped with pull-up resistors (R_{UP} = 4.7 kΩ).

For programming the timers see chapter 4.1 on page 28.

3.7.1 Wiring of the Counters



Picture 13: Wiring of the counters

Notes:

- Output OUT_2 is designed as an "Open Collector" output, i.e. as soon as the output is conducting (logic "1"), the load R_L is connected to ground (GND_EXT). Logic "0" means that the output is in a high-impedance state.
- The polarity of the input signals (CLK_x and GATE_x) is inverted by the opto-couplers.
- All counter signals require a reference to external ground GND_EXT (pins 9, 11, 59).
- The inputs CLK_x and GATE_x have been designed for a voltage level of +24 V (R_v = 3 kΩ). Note for I_F: 7.5 mA ≤ I_F ≤ 10 mA.
- The max. output current of opto-isolated versions may not exceed I_{Out} = 30 mA.

3.7.2 Pulse Width Modulation

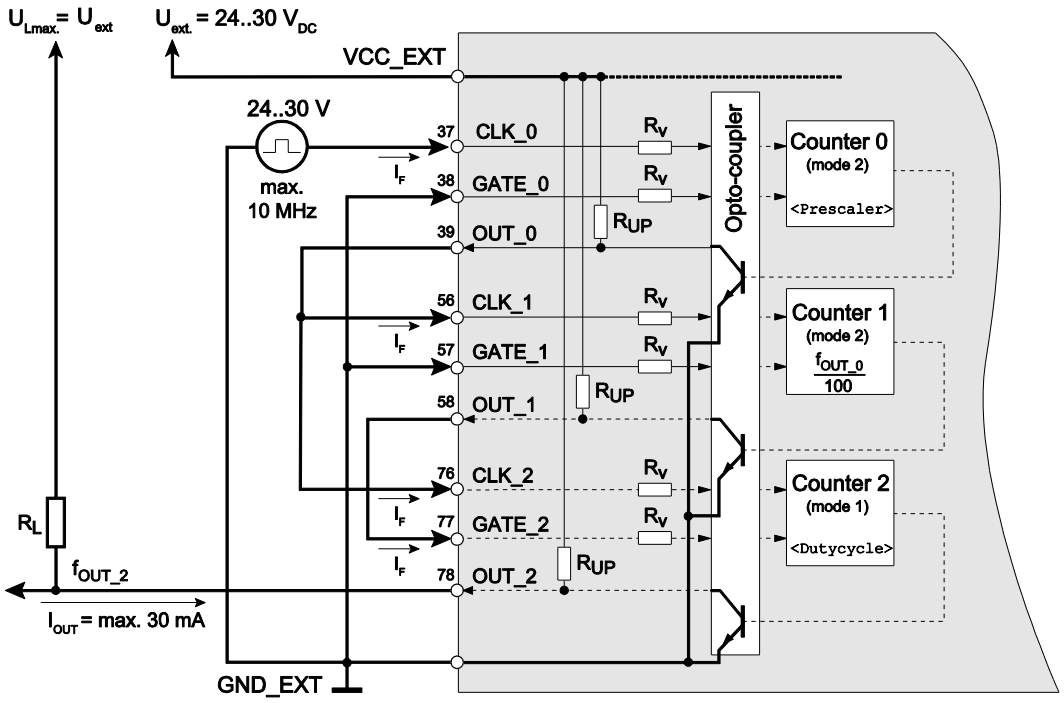
Pulse width modulation (PWM) is a special application of the counters. With a suitable external wiring a signal with variable duty cycle can be generated with the help of counters 0...2. The duty cycle can be varied in the range of 1...99 % in steps of 1.

The prescaler has to be sourced with an external base clock of max. 10 MHz. This results in a max. output signal frequency of 50 kHz. Picture 14 shows the external wiring to be used with the functions *meUtilityPWMStart/Stop* (see also ME-iDS manual).

$$f_{OUT\_2} = \frac{\text{Base clock}}{\text{<Prescaler>} \cdot 100} \quad \text{(with <Prescaler> = 2...(}2^{16} - 1\text{))}$$

The following picture shows the external wiring of the counters for the ME-5810.

For programming the PWM output please read the ME-iDS user manual and the ME-iDS help file (see ME-iDS Control Center).



Picture 14: PWM wiring ME-5810

3.8 External Interrupt

If required, you can also monitor the bit-pattern of a digital input port. You can select one of the modes “bit-pattern change” and “bit-pattern compare”. As soon as the specified event occurs, an interrupt is issued and passed directly to the PC.

The digital inputs/outputs are programmed in the single operating mode. The interrupt handling is carried out with the *meIOIrq...* functions; see also chapter 4.3 on page 35.

4 Programming

For programming the device please use the Meilhaus Electronic Intelligent Driver System (ME-iDS) included in your package. The ME-iDS is a unique driver system covering different devices and operating systems. It supports Windows 2000 and higher and contains a universal function library (API) for all common programming languages (the extent of the current software support can be found in the README-files of the ME-iDS).

A detailed description of the functions can be found in the ME-iDS manual (see CD/DVD enclosed or online:
www.meilhaus.de/download/ME-iDS.

Further details regarding the assignment of the subdevices and device specific arguments can be found in the help file (help file format under Windows, *.chm) which can be accessed via the „ME-iDS Control Center“ in the info area of the task bar (as a rule in the lower right corner of the screen) or via the Windows start menu.

The ME-5810 series base boards are devices with five subdevices, beginning with index “0”. When using plug-on boards (e.g. ME-5002) these appear as individual devices and subdevices, beginning with the index “0”. The functionality of the subdevices can be selected by the user from a list of predefined configurations. The desired configuration has to be selected with the configuration tool ME-iDC before the user application is started. With the standard configuration (ID 0) the board is ready to-use at once. The following tables show an overview of the configurations available:

Base boards ME-5810A(/S)

Subdevice of Type	...Subtype	I/Os	ID of the Configuration
Subdevice 0 (DI, FI)			
Digital input (DI) (ME-5810A)	single	16-bit port	0*
Digital input (DI) (ME-5810A/S)	streaming	16-bit port	0*
Frequency input (FI)	single	4 channels	1
Subdevice 1 (DO, FO)			
Digital output (DI) (ME-5810A)	single	16-bit port	0*
Digital output (DI) (ME-5810A/S)	streaming	16-bit port	0*
Frequency output (FI)	single	4 channels	1
Subdevice 2...4 (Counters, Type 8254)			
3 x Counter (CTR)	single	3 x 16 bit	0*

Table 4: Subdevice configuration ME-5810:

Plug-on board ME-5002 (included with ME-5810B(/S))

Subdevice of Type	...Subtype	I/Os	ID of the Configuration
Subdevice 0 (DI, FI)			
Digital input (DI)	single	16-bit port	0*
Frequency input (FI)	single	4 channels	1
Subdevice 1 (DO, FO)			
Digital output (DO)	single	16-bit port	0*
Frequency output (FO)	single	4 channels	1

Table 5: Subdevice configuration ME-5002

*Standard configuration at shipment. The most recently selected configuration in the ME-iDC is stored in a non-volatile memory on the board, and is automatically loaded after a restart.

Depending on your application you can choose one of the following operating modes:

- **Single:** In this mode single values can be read or written.
- **Streaming** (only for the versions "S"): In this mode data-I/O is done via FIFO. The timing can either be controlled by a timer and/or external trigger signals. Various trigger options are available which can be defined as start and stop conditions, see chapter 4.2.1 on page 33.
- **Interrupt:** For interrupt processing in the modes bit-pattern change and bit-pattern compare (see chapter 4.3.1 from page 36).

Operating Mode	Speed	Trigger
Single	Single value	Input/output by software
Stream-timer …with option "wraparound"	$f_{Input\ signal}$: to 300 kHz $f_{Output\ signal}$: to 3 kHz	Start/stop per software or ext. trigger
Stream-trigger-sample	$f_{Input\ signal}$: to 300 kHz $f_{Output\ signal}$: to 3 kHz	Start/stop per software or ext. trigger
Interrupt (Bit-pattern detection)	$f_{IRQmax.}$ = 10 kHz	Ext. trigger signal at a digital-I/O port

Table 6: Operating modes overview

Detailed timing pictures can be found in the ME-iDS manual.

4.1 Single Operation Mode

Individual values can be read or written in this operating mode.

Notes:

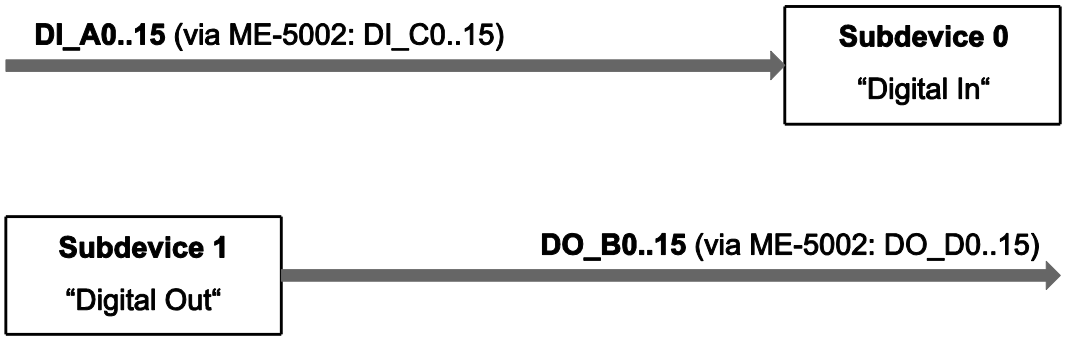
- The digital-I/O channels direction is determined by the ME-5810 series hardware (opto-couplers).
- In power-down state and after switching on the PC all outputs are in a high-impedance state. Only if "1" is written, the output changes to conductive.
- A port that is configured as an output can also be read back!

4.1.1 Digital Input/Output

ME-5810	ME-5001	ME-5002	ME-5004
✓	✓	✓	✓

For input/output of individual digital values the single operation mode is used. The subdevices are defined as follows: subdevice 0 of the ME-5810 always is of type ME_TYPE_DI and subdevice 1 of type ME_TYPE_DO. The subtype of the subdevice is ME_SUBTYPE_ STREAMING for the ME-5810/S, otherwise ME_SUBTYPE_ SINGLE.

If the plug-on board ME-5002 is used, its subdevice 0 is of type ME_TYPE_DI and subdevice 1 of type ME_TYPE_DO.



Picture 15: Digital input/output in single operation mode

Please observe the ME-iDS manual and the ME-iDS help file (*.chm) for the procedure. You can open both these documents through the “ME-iDS Control Center) or through the Windows Start menu.

Please read chapter 3.5 on page 16 for the wiring of the digital ports.

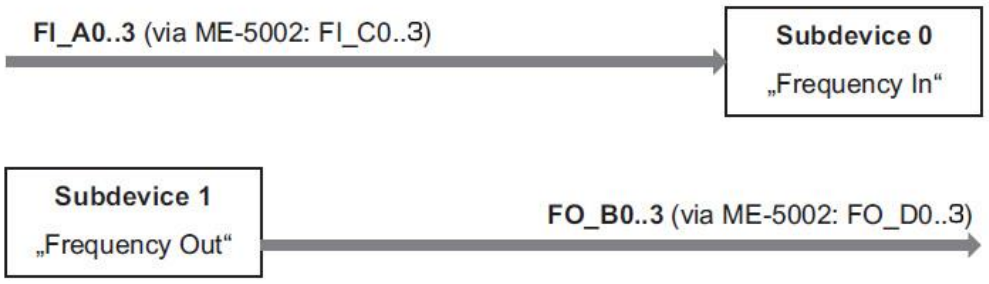
4.1.2 Frequency Input/Output

ME-5810	ME-5001	ME-5002	ME-5004
✓	✓	✓	✓

Before you can use the "Frequency measurement" or "Pulse generator" modes, it is necessary, before opening your application, to run

the ME-iDC configuration tool in order to specify the configuration for the corresponding subdevice (see also Table 4 on page 27).

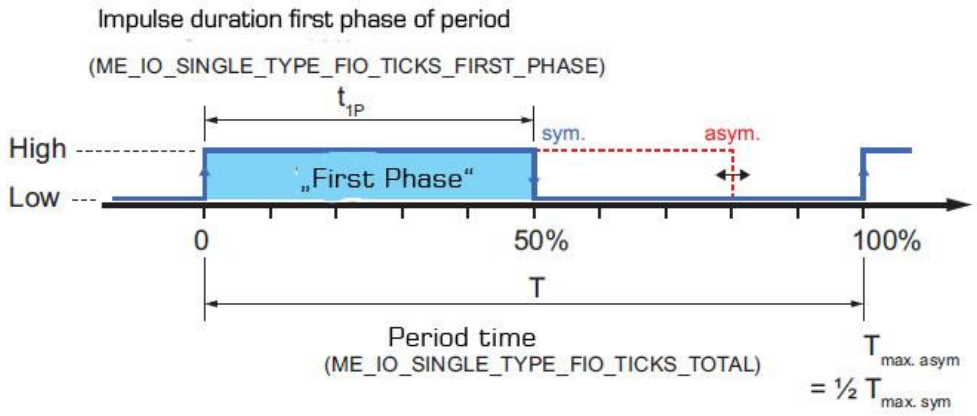
The programming of the frequency measurement and the pulse generator is always done in the single operation mode. The subtype of the subdevices is always ME_SUBTYPE_SINGLE.



Picture 16: Frequency input/output in single operation mode

Please read the ME-iDS manual and the ME-iDS help file (*.chm) carefully prior to programming. You can open both of these documents through the "ME-iDS Control Center" or through the Windows Start menu.

Two variables are introduced to describe the rectangular signal, and apply equally to input and output. One value indicates the period T, while the other value provides the duration of the pulse of the first phase of the period t_{1P}. For frequency measurement, the measurement starts with the first rising edge, and finishes with the next rising edge. The falling edge that lies between them defines the end of the first phase. In pulse generator mode, output normally starts with a high level, changing to the low level when the first phase has elapsed.



Picture 17: Signal definition

The time reference is provided by a 66 MHz counter. It is configured using the *meIOSingleConfig()* function. A period of $15.\overline{15}$ ns follows from this, and is defined as the smallest unit of time. It is referred to below as "1 tick". The resolution for T and t_{1P} is therefore 1 tick (see also the specifications on page 38).

Note that the value of the maximum period $T_{max.}$ depends on the duty cycle. A distinction is drawn between rectangular signals with an asymmetrical duty cycle $T_{max.\ asym.}$ and a symmetrical duty cycle $T_{max.\ sym.}$

The figures for the ME-5810 are:

$T_{max.\ asym.} = 16.25$ s (0.06 Hz); $T_{max.\ sym.} = 32.5$ s (0.03 Hz)

The wiring of the frequency inputs/outputs can be found in chapter 3.6 on page 21.

4.1.2.1 Frequency Measurement

With the frequency measurement operating mode (FI= "Frequency In-put") you can determine the period or frequency, and the duty cycle of rectangular signals up to 300 kHz. The resolution is 1 tick = $15.\overline{15}$ ns. The measurement always starts at a rising edge. On the ME-5810, all 4 frequency measuring channels (FI_A0...3) are addressed as subdevices of type ME_TYPE_FI, subtype ME_SUBTYPE_SINGLE. Each channel can be programmed independently.

In combination with the plug-on board ME-5002, 4 additional frequency measurement channels (FI_C0...3) are available which can be addressed as one subdevice.

Note: If the frequency and duty cycle are the magnitudes you want, these can easily be calculated from the values returned for `<pdTime>`. The formula is:

Frequency [Hz] = 1/period [s]

Duty cycle [%] = („duration of the first phase of the period“[s]/ period [s] x 100

4.1.2.2 Pulse Generator

In the pulse generator operating mode (FO = "Frequency Output") you can output rectangular signals with a variable duty cycle at frequencies of up to 3 kHz and with a resolution of 1 tick. On the ME-5810, all 4 pulse generator channels (FO_B0...3) are addressed as subdevices of type ME_TYPE_FO, subtype ME_SUBTYPE_SINGLE. Each channel can be programmed independently.

The first phase of the rectangular signal is "high" by default. By setting the ME_IO_SINGLE_TYPE_FO_START_LOW flag it is also possible to start the output with a "low" level.

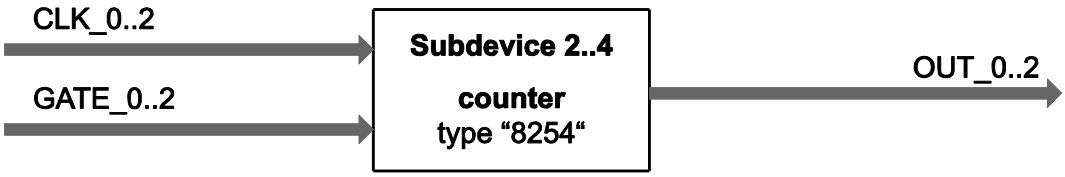
In combination with the plug-on board ME-5002, 4 additional pulse generators (FO_D0...3) are available, addressed as one subdevice.

Note: An output channel can also be read back!

4.1.3 Counters (8254)

ME-5810	ME-5001	ME-5002	ME-5004
✓	–	–	–

The programming of the counters is done in operation mode „Single“. A counter device of type 82C54 provides three 16-bit counters. Each counter is accessed as a subdevice of type ME_TYPE_CTR, subtype ME_SUBTYPE_CTR_8254. **Note** the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center).



Picture 18: Counter in Single

4.1.3.1 Standard Operation Modes

The counters can be configured independently of one another by the function *meIOSingleConfig()* for the following 6 operation modes (a detailed description of the modes can be found in the ME-iDS manual):

- Mode 0: Change state at zero
- Mode 1: Retriggerable „One Shot“
- Mode 2: Asymmetric divider
- Mode 3: Symmetric divider
- Mode 4: Counter start by software trigger
- Mode 5: Counter start by hardware trigger

Please read picture 13 on page 23 for the wiring of the opto-isolated counter signals.

4.1.3.2 Pulse Width Modulation

With the wiring shown in picture 14 on page 24 you can simplify programming considerably using the functions *meUtilityPWMStart!Stop* for this operation mode (see also ME-iDS manual and ME-iDS help file).

4.2 Streaming Operation Mode

4.2.1 Digital Input/Output

ME-5810	ME-5001	ME-5002	ME-5004
"S"-version	–	–	–

The programming of the timer controlled input/output via FIFO is carried out in the streaming operating modes. Port A is defined as 16-bit input port (subdevice 0 of type ME_TYPE_DI) and port B as 16-bit output port (subdevice 1 of type ME_TYPE_DO), each of subtype ME_SUBTYPE_STREAMING (only for versions "S").

Please observe the ME-iDS manual and the ME-iDS help file (*.chm) for the procedure. You can open both of these documents through the "ME-iDS Control Center" or through the Windows Start menu.

4.2.1.1 Stream Timer

In this operating mode the values are acquired or output under the control of a timer. A continuous transfer bandwidth between the PC and the ME-5810 of up to 30 MHz is available, shared among port A and B. You can sample a rectangular signal up to 300 kHz with up to 100 times oversampling. An output rate of up to 3 kHz is possible.

4.2.1.2 Stream Trigger Sample

In this operating mode individual values can be acquired or output under the control of one or more external trigger signals. A continuous transfer bandwidth between the PC and the ME-5810 of up to 30 MHz is available, shared among port A and B. You can sample a rectangular signal up to 300 kHz with up to 100 times oversampling. An output rate of up to 3 kHz is possible.

4.2.1.3 Wraparound Mode

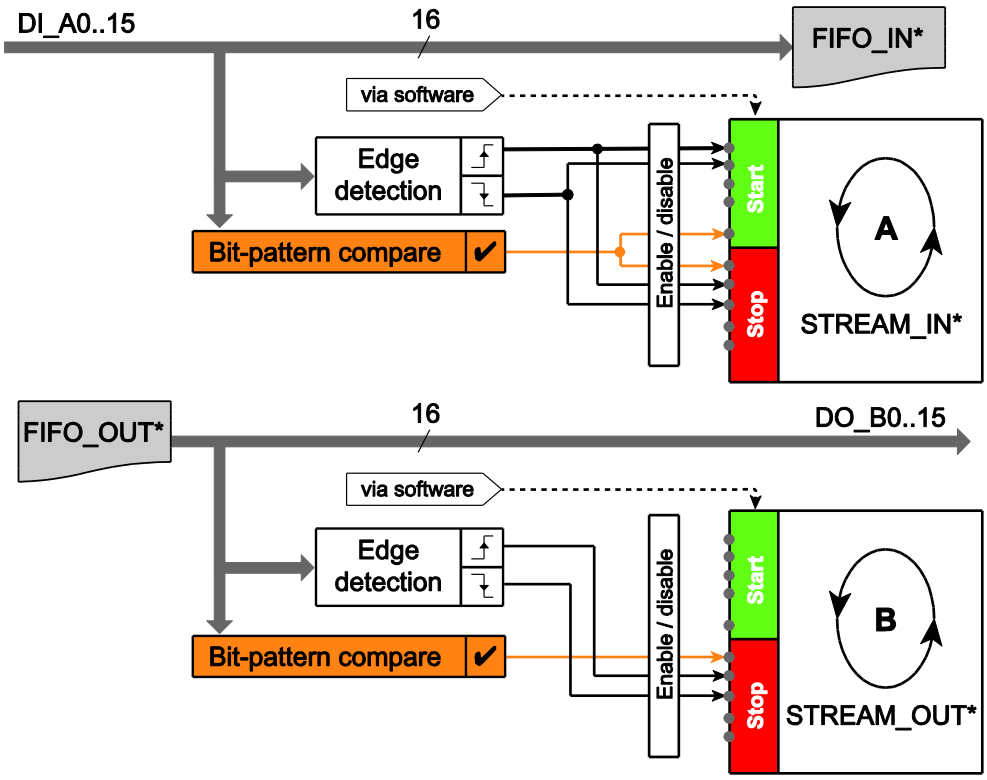
This option is used for repetitive output of the very same data buffer on port B.

Note: When no more than 8192 values are to be output for an indefinitely long period, this is done on firmware level of the ME-5810 without loading the host computer.

4.2.1.4 External Trigger

On the „S“-versions the trigger conditions for starting and stopping the streaming operation mode can be selected very flexibly. It is thus possible to enable one or more trigger inputs individually, with specification of the desired trigger edge (rising, falling, or any). All the enabled trigger inputs are logically ORed together. This means that the first edge to arrive that meets the trigger condition starts or stops the input/output operation, according to the selected operation mode (stream timer or stream trigger sample). In other words, any change of the bit-pattern can be used as a trigger event for the subdevice concerned.

For subdevice 0 all inputs of port A (DI_Ax) can be used and for subdevice 1 all outputs of port B (DO_Bx) can be used, as they can be read back (see picture 19).



Picture 19: Trigger in streaming operation mode

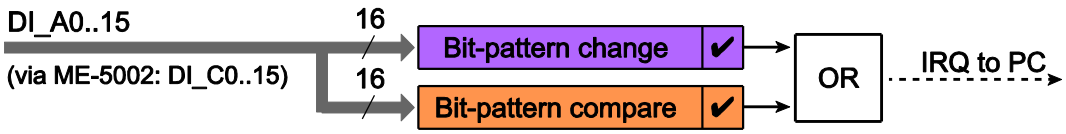
Note: “FIFO IN” and “FIFO OUT” only available on “S”-versions.

4.3 Interrupt Operation

ME-5810	ME-5001	ME-5002	ME-5004
✓	✓	✓	✓

On the board of the ME-5810 series you can monitor the bit-pattern of the 16-bit-wide input ports of subdevice 0 of the base-board ME-5810 (DI_A0..15) as well as subdevice 0 of the plug-on board ME-5002 (DI_C0..15). Depending on the application you can select one of the operating modes “bit-pattern compare” and “bit-pattern change”. As soon as the first edge that meets the trigger condition arrives, an interrupt is issued and passed directly to the PC.

Programming the digital input/output is carried out in the operation mode single. The subdevice must have the type ME_TYPE_DI. The interrupt processing is controlled with the functions *meIOIrq...*



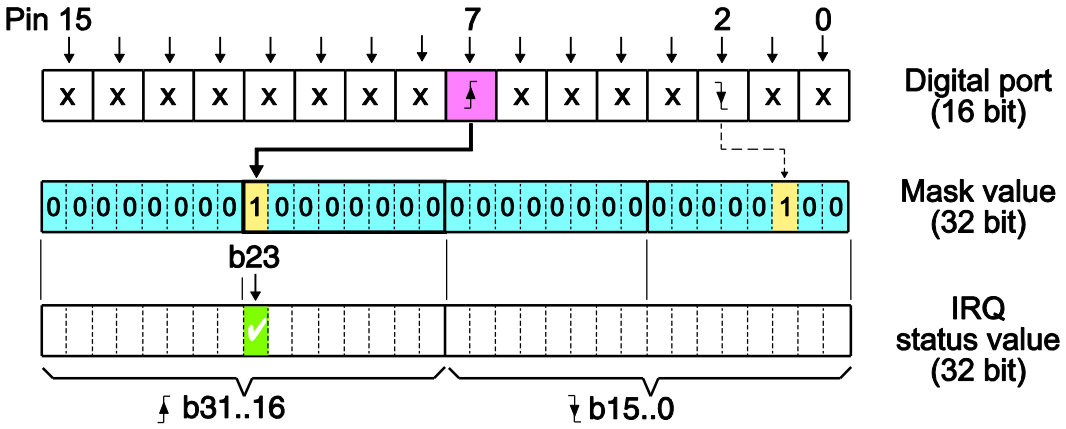
Picture 20: Interrupt options

Please observe the ME-iDS manual and the ME-iDS help file (*.chm) for the procedure. You can open both of these documents through the "ME-iDS Control Center" or through the Windows Start menu.

4.3.1 Bit-Pattern Change

In the bit-pattern change mode, one or more bits that are to be monito- red for a change of state can be defined (masked). A 32-bit-wide argument per subdevice contains the mask. For each input pin both one bit for rising edge and one bit for falling edge is available. If the state of at least one bit masked with a "1" changes (0 → 1 or 1 → 0), an interrupt is issued (see picture 21 on page 36).

In what is known as the "extended format" of interrupt handling (see the ME-iDS manual), two bits are available for the interrupt status of each pin. One is for the rising edge, and one for the falling edge. The bits for the falling edges are assigned to the bit b 15...0, while the bits for the rising edges are assigned to the bits b 31...16.



Picture 21: Bit-pattern change

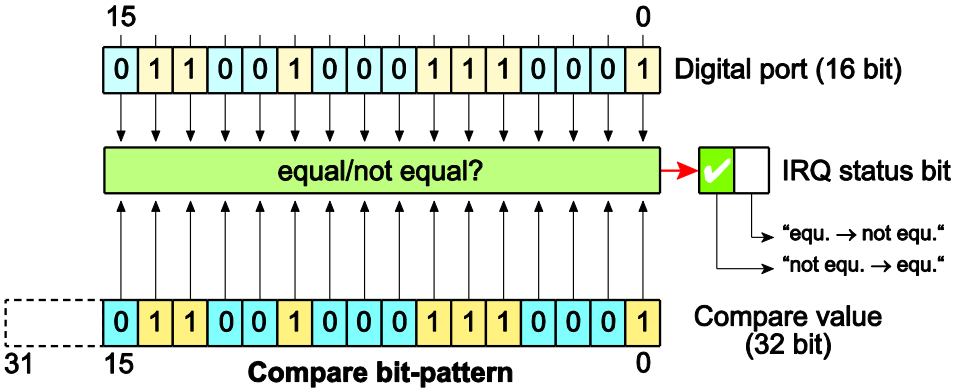
Example (see picture 21):

By writing the value 0x00800004 Hex as a mask value (see parameter <iIrqArg> of the function *meIOIrqStart()*), bit 2 is monitored for a falling edge, and bit 7 for a rising edge. A rising edge now is to arrive at bit 7, so that an interrupt is issued and in the interrupt status value bit b 23 returns "1". Any edges that might arrive at pins labelled with an "X" are ignored. Only the change in state of a pin whose edge is set to "1" in the parameter <iIrqArg> can issue an interrupt.

The interrupt event is evaluated with the function *meIOIrqWait()*. We recommend using what is known as the "extended format" to obtain detailed information about the triggering edge.

4.3.2 Bit-Pattern Compare

In the “bit-pattern compare” mode, the bit-pattern of digital inputs can be monitored for equality or inequality. The compare bit-pattern of the corresponding subdevice is used as reference. If the state changes from unequal to equal or from equal to unequal, an interrupt is generated (see picture 22 on page 37).



Picture 22: Bit-pattern compare

5 Appendix

A Specification

(Ambient temperature 25 °C)

PC Interface

PCI-Express Bus	32 bit, 33 MHz, 3.3 V, PCI-Express x1 specification version 2.0
CompactPCI Bus	32 bit, 33 MHz, 5 V, specification PICMG 2.0 R3.0
Plug&Play	is fully supported

Digital Input/Output (general)

Measured Quantity/Criterion	**Condition/Explanation**	**Value**
Ports ME-5810 (base board)	subdevice 0 (Single/Streaming)	16-bit input port opto-isolated
	subdevice 1 (Single/Streaming)	16-bit output port opto-isolated
Ports ME-5002 (plug-on board)	subdevice 0 (Single)	16-bit input port opto-isolated
	subdevice 1 (single)	16- bit output port opto-isolated
Operation modes	single	software triggered read/write
	stream timer	timer controlled read/write of values via FIFO
	stream trigger sample	timer controlled read/write of values via FIFO
	interrupt	bit-pattern change, bit-pattern compare
FIFO-size	FIFO_IN	8192 values (16-bit-wide)
	FIFO_OUT	8192 values (16-bit-wide)

Transfer rate in streaming mode	between ME-5810 and PC	max. 25 MHz (cPCI) resp. 30 MHz (PCIe) (system-dependent)
Frequency input signal	symmetrical rectangular signal	max. 300 kHz
Frequency output signal	symmetrical rectangular signal	max. 3 kHz
	option „wraparound“	max. 3 kHz, without load for the Host PCs
Timer (CHAN-time)	input	30.30 ns…65 s (2..FFFFFFFFHex Ticks)
	output	0.15 ms…65 s (11000..FFFFFFFF-Hex Ticks)
Timer resolution	programmable	15.15 ns (1 Tick)
Ext. trigger inputs	ME-5810	DI_Ax, DO_Bx
Ext. trigger edges		Rising, falling, any
Input level	see the following tables	
Isolation voltage	U_{ISO} (f = 60 Hz, t = 60 s)	max. 1000 VAC_{rms}
Reference ground	isolated from PC ground	GND_EXT

Opto-Isolated Inputs

Static values

Conditions: TA=25 °C

Measured Quantity	Test Criterion	MIN	Type	MAX	Unit
$U_{in,H}$		3		60	V
$U_{in,L}$		0		2.2	V
R_{in}	U_{in}=24 V		4.3		kΩ
I_{in}	U_{in}=24 V		5.5	6	mA

Limiting Values

Measured Quantity /Criterion	Condition/Explanation	Value
URWM over-voltage protection for inputs	max. 600 W pulse power at a pulse width of 1 ms	64.4 V

Opto-Isolated Outputs

Conditions: T_A=25 °C

Output-drivers	sink	2 x ULN2803 (ME-5810A)
		+ 2 x ULN2803 (ME-5002)
	source	2 x ISO1H811G (ME-5810A)
		+ 2 x ISO1H811G (ME-5002)
External supply	U_{ext}	15...30 V
	U_{Lmax}	U_{ext}

For further specifications see chapter sink driver resp. source driver

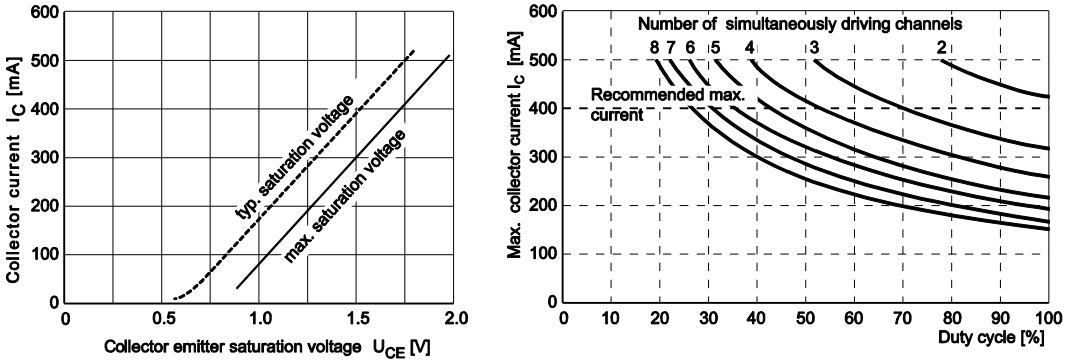
Sink Driver (UDN2803)

Measured Quantity	**Test Criterion**	**MIN**	**Type**	**MAX**	**Unit**
I_{OUT} =I_C (output current)	per channel			50	mA
	See also characteristics curves in picture 23				
I_{CEX} (output leckage current)	U_{CE}=50 V, T_A=25 °C U_{CE}=50 V, T_A=85 °C			50 100	µA
$U_{CE(SAT)}$((collector emitter saturation voltage)	I_{OUT}=350 mA I_{OUT}=200 mA I_{OUT}=100 mA		1.3 1.1 0.9	1.6 1.3 1.1	V
I_R (clamp diode reverse current)	U_R=50 V, T_A=25 °C U_R=50 V, T_A=85 °C			50 100	µA
U_F (clamp diode forward voltage)	I_F=350 mA			2.0	V
t_{on} (switch-on time)	R_L=125 Ω, U_{OUT}=50 V, C_L=15 pFina		0.1	1	µs
t_{off} (switch-off time)	R_L=125 Ω, U_{OUT}=50 V, C_L=15 pF		0.2	1	µs

Output current

The maximum current per output (I_C) depends of the saturation voltage U_{CE} and is limited by the power dissipation of the sum of the channels to P_{tot}=1 W per chip:

$P_{TOT}=P_0+...+P_7 \leq 1$ W (bei 70 °C)



Picture 23: Characteristic curves UDN2803

Source Driver (ISO1H811G)

(short-circuit proof with current limiting and temperature monitoring)

Voltage supply

Conditions: U_{ext}=15...30 V, TJ=-25...+125 °C

Measured Quantity	**Test Criterion**	**MIN**	**Type**	**MAX**	**Unit**
U_{OUT}	U_{ext}=24 V; 1 channel with I_{out}=0,625 A		23.8		V
I_{OUT}/channel	1 channel			625	mA
	16 channel			370	mA
	32 channel (with ME-5002)			180	mA
U_{USD} (undervoltage shutdown)		7		10.5	V
R_{ON} (resistance if output active)	I_{OUT}=0.5 A, TI=25 °C I_{OUT}=0.5 A, TJ=125 °C		150 270	200 320	mΩ mΩ
I_S (current consumption driver chip)	8 channels active per chip; without load		10	14	mA
$I_{L(off)}$ (output current in inactive state)	U_{in}=U_{OUT}=0 V,	0	5	30	µA

Switching Times

Measured Quantity	Test Criterion	MIN	Type	MAX	Unit
t_{on} (switch-on time)	RL=47 Ω, to 90 % U_{out}		64	120	µs
t_{off} (switch-off time)	RL=47 Ω, to 10 % U_{out}		89	120	µs
$dU_{out}/dt_{(on)}$ (slope on switch-on)	RL=47 Ω, up 10...30 % U_{out}, U_{ext}=15 V		1	2	V/ µs
$dU_{out}/dt_{(off)}$ (slope on switch-off)	RL=47 Ω, up 70...40 % U_{out}, U_{ext}=15 V		1	2	V/ µs

Limiting Values

Measured Quantity	Test Criterion	MIN	Type	MAX	Unit
T_{CSD} (housing switch-off temperature)		125	130	135	°C
T_{CR} (housing reset temperature)		110			°C
T_{TSD} (junction switch-off temperature)		150	175	200	°C
T_R (junction reset temperature)		135	1		°C
I_{lim} (DC-short-circuit current)	U_{ext} = 24 V, R_L=10 mΩ		1.1		A

Frequency Input/Output

Availability	alternative subdevice configuration via ME-iDC
Signal-form	rectangular

Frequency Measuring Channels

Measured Quantity/Criterion	Condition/Explanation	Value
Reference ground	isolated from PC ground	GND_EXT
Number of channels	ME-5810A (FI_A0...3)	4 inputs (opto-isolated)

	ME-5002 (FI_C0...3)	4 inputs (opto-isolated)
Input-level		see digital I/O
Input-current		see digital I/O
Period (T)	$T_{min.} = T_{min.asym.} = T_{min.sym.}$ $T_{max.asym}$ $T_{max.sym}$	3.3 µs (300 kHz) 16.25 s (0.06 Hz) 32.5 s (0.03 Hz)
Duty-cycle	variable, depending on T	measurable in steps of 1 tick
Resolution	1 tick	$15.\overline{15}$ ns
Accuracy		± 15.15 ns
Operating modes		single

Pulse Generator Channels

Measured Quantity/Criterion	**Condition/Explanation**	**Value**
Reference ground	isolated from PC ground	GND_EXT
Number of channels	ME-5810A (FI_A0...3)	4 outputs (opto-isolated)
	ME-5002 (FI_C0...3)	4 outputs (opto-isolated)
Output level	sink or source driver	see digital I/O
Period (T)	$T_{min.} = T_{min.asym.} = T_{min.sym.}$ $T_{max.asym}$ $T_{max.sym}$	$0.\overline{3}$ ms (300 kHz) 16.25 s (0.06 Hz) 32.5 s (0.03 Hz)
Duty-cycle	variable, depending on T	to be set in steps of 1 tick
Resolution	1 tick	$15.\overline{15}$ ns
Accuracy		± $15.\overline{15}$ ns
Operating modes		single

Counters

Number	3 x 16 bit (1 x 82C54)
Opto-isolation	yes (dimensioning of the I/O level for 24 V)
Counter-clock	up to 10 MHz by external source

...with Opto-Isolation

Measured Quantity/Criterion	**Condition/Explanation**	**Value**
Reference ground	isolated from PC ground	GND_EXT
External supply for opto-couplers	U_{ext}	24...30 V
Level for Counter Outputs (OUT_x)		
Type		"Open Collector"
U_{Lmax}		U_{ext}
I_{Out}		max. 30 mA
Level for Counter Inputs CLK_x, Gate_x)		
Logic level	inverted by opto-couplers	low-active
I_F		7.5 mA ≤ I_F ≤ 10 mA
U_{IL}		max. 0.8 V
U_{IH}		24..30 V, max. U_{ext}

Interrupt

Measured Quantity/Criterion	**Condition/Explanation**	**Value**
Interrupt sources	passed directly to the PC	bit-pattern change bit-pattern compare

General Data

Measured Quantity/Criterion	**Condition/Explanation**	**Value**
Power supply	CompactPCI	+5 V (via PCI-Bus)
	PCI-Express	+3.3 V (via PCIe-Bus), +5 V (via Molex plug from PC power supply unit)
Current consumption	CompactPCI	0.8...1.2 A (full-load)
	PCI-Express	0.8...1.2 A (full-load)
Board dimensions (without slot bracket and connector)	ComactPCI	3 U CompactPCI board
	PCI-Express	162 mm x 98 mm

Connections	ST1	78-pin D-sub female socket
	I/Os der ME-5002	via ST1 of base board
Operating temperature		0 °C…70 °C
Storage temperature		-40 °C…100 °C
Air humidity		20 %…55 % (non-condensing)
Certification	CE	

B Pinout

Note: „ME-5810“ represents all models of the ME-5810 series.

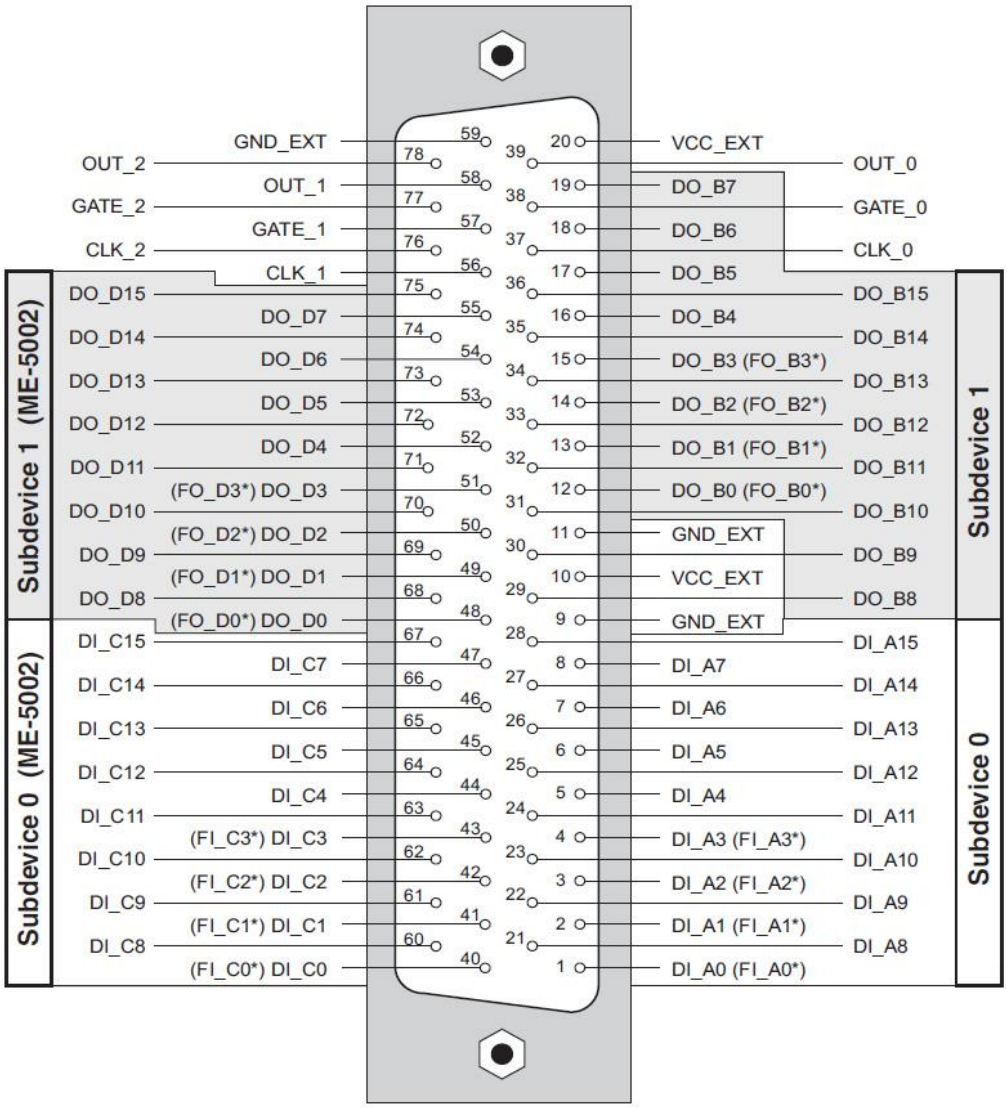
Legend for pinouts:

Name	Function
DI_A0..15	digital inputs of ME-5810 (subdevice 0)
DO_B0..15	digital outputs of ME-5810 (subdevice 1)
DI_C0..15*	digital inputs of ME-5002 (subdevice 0)
DO_D0..15*-	digital inputs of ME-5002 (subdevice 1)
CLK_0..2	clock inputs for counters
GATE_0..2	gate inputs for counters (low-active)
OUT_0..2	Counter outputs (type "Open-Collector")
FI_A0..3	frequency measurement inputs of ME-5810 (subdevice 0, alternative configuration)
FO_B0..3	pulse generator outputs of ME-5810 (subdevice 1, alternative configuration)
FI_C0..3*	frequency measurement input of ME-5002 (subdevice 0, alternative configuration)
FO_D0..3*	pulse generator output of ME-5002 (subdevice 1, alternative configuration)
VCC_EXT	VCC input for ext. power supply of isolated ports, U_{ext} typ. 24 VDC
GND_EXT	reference ground for isolated ports (isolated from PC ground)

Note: In the configuration “pulse generator” (FO) do not forget to take care of the unused pins DO_B4..15 (ME-5810) and DO_D4..15 (ME-5002). When used as sink drivers they are in high-impedance state, when used as source drivers they are connected to ground!

*These signals are only available in combination with the plug-on board ME-5002 (note: ME-5810B = ME-5810 + ME-5002)

B1 78-pin D-Sub (ST1) — ME-5810



Picture 24: 78-pin D-sub female connector ME-5810 (ST1)

*These pins can only be used as frequency measurement inputs (FI_x) resp. pulse generator outputs (FO_x) after appropriate configuration of the corresponding subdevice with the ME-iDC. The remaining pins of the digital ports cannot be used for digital-I/O.

C Accessories

We recommend to use high-quality connector cables with single-shielded lines per channel.

For further accessories please refer to the current Meilhaus Electronic catalog and the internet:
www.meilhaus.de/en/pc-boards/accessories/

D Technical Questions

D1 Hotline

Should you have questions or inquiries concerning your Meilhaus device, please contact us:

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Download-Server and Driver Update:
To download current driver versions for Meilhaus Electronic devices as well as manuals in PDF format, please go to:
www.meilhaus.org/driver

Service Department with RMA Process:
In case you need to return a board for repair purposes, we strongly ask you attach a detailed description of the error as well as information regarding your computer/system and the software used.
Please register online using our RMA process:
www.meilhaus.de/en/infos/service/rma.htm.

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