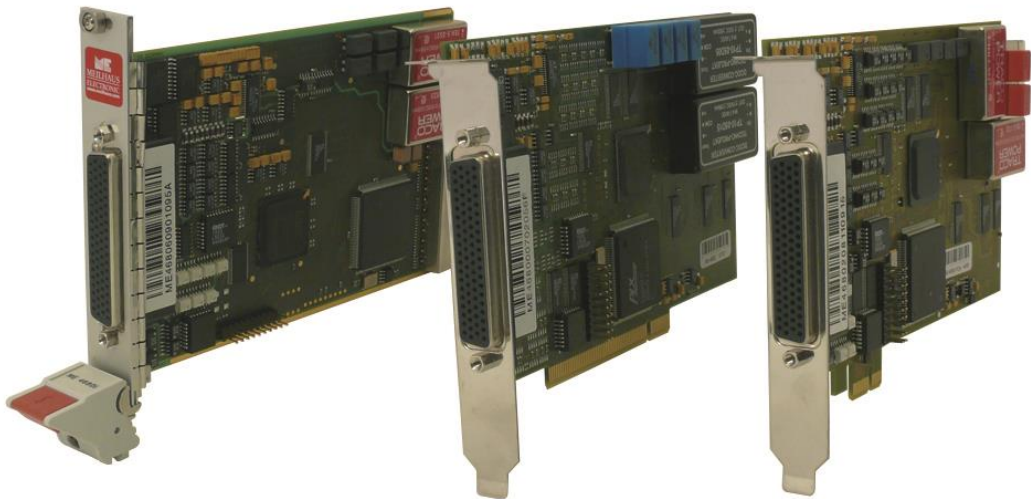


## Meilhaus Electronic Manual

# ME-4600 Series

(ME-4610/4650/4660/4670/4680)



16-bit Multifunction Board with up to 32 A/D-  
and 4 D/A-Channels

Optionals: Opto-Isolation, Sample & Hold, Frequency I/O

# Imprint

## Manual ME-4600 Series

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# 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 with a PC. Depending on type install the models of the ME-series into:

- a free PCI slot (PCI versions) or
- 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 or connect a USB device, please read the manual of your PC.

Please note the instructions and specifications as presented in this manual (Appendix A, Specifications):

- 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 to 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:

- Multifunction board of the ME-4600 series for PCI-, PCI-Express resp. CompactPCI-bus.
- Manual in PDF format on CD/DVD.
- Driver software on CD/DVD.
- 78-pin D-Sub male connector.
- Additional mounting bracket ME-AK-D25F/S (cPCI) for PCI-, PCI-Express- resp. CompactPCI-Slot for TTL DIO ports C and D.
- 25-pin D-Sub male connector.

## 1.3 Features

Overview	16-bit A/D channels single-ended/differential	Analog-Trigger for A/D section	Sample-and-hold („s“-version) 3)	16-bit D/A channels	D/A channels with FIFOs	Digital I/Os <sup>1)</sup> (without/with „f“-version)	Frequency input/output („f“-version)	Counters (8254)	Opto-isolation of the board <sup>2)</sup> („i“-version)
<b>ME-4610*</b>	16/-	-	-	-	-	32/-	-/-	3	-
<b>ME-4650*</b>	16/-		-	-	-	32/-	-/-	-	-
<b>ME-4660*</b>	16/-		8	2	-	32/16	4/4	3	4
<b>ME-4670*</b>	32/16	4	8	4	-	32/16	4/4	3	4
<b>ME-4680*</b>	32/16	4	8	4	4	32/16	4/4	3	4

\* **Note:** not all theoretical variations are available as standard models for immediate delivery (see our website for more details: [www.meilhaus.com](http://www.meilhaus.com)).

- 1) Digital ports A and B are available on the standard D-Sub 78 female connector, ports C&D are available by an optional mounting bracket with a D-Sub 25 female connector.
- 2) Only for the "i"-versions: Optical isolation of the A/D- and D/A-sections, counters and digital ports A and B (not digital ports C and D and „FIO“-or “f“-version).
- 3) Optionally available with 8 sample-and-hold channels („s“-versions).

**The analog input channels** are routed through a high-impedance input stage to a 16-bit 300-kHz A/D converter (PC-specific). With exception of the ME-4610 the following input ranges are available 0...2.5 V, 0...10 V,  $\pm 2.5$  V and  $\pm 10$  V. The input voltage range of the ME-4610 is fixed to  $\pm 10$  V.

All models without opto-isolation have **2 bidirectional, 8-bit-wide digital-I/O Ports (A/B)**. If you have chosen the option „opto-isolation“ port A is fixed as output and port B as input. Additionally, all boards without the option „frequency input/output“ provide **2-bit-directional 8-bit-wide TTL ports (C/D)**, which are basically not opto-isolated. These two ports are available on a flat IDC 20-pin connector. They can also be routed to a D-Sub 25 connector on a separate mounting bracket. In combination with the **option “frequency input/output”** (“FIO“-or “f“-version) the digital-I/O ports C and D are not applied. Instead of that **four TTL channels for frequency measurement** (up to 5.5 MHz) and for channels **four putting out a TTL rectangular-signal** (5.5 MHz max.) are available.

With exception of the ME-4650 there are 3 free programmable **16-bit counters** (1 x 8254) available.

The model **ME-4660** has 2 and the models **ME-4670** and **ME-4680** have 4 high accuracy **16-bit D/A channels**. The output voltage range is  $\pm 10$  V.

The high-end model **ME-4680** additionally provides 4 **FIFOs** on the D/A channels. The maximum output rate per channel of the D/A output channels is 500 kS/s. In the operation mode „Streaming“ values can be output periodically or reloaded when the output is still running.

The **opto-isolated** board versions („i“-versions) allow a complete isolation of all function groups from the PC ground (exception: ports C and D and „FIO“-option). This can be very helpful in preventing ground loops and in electrically “noisy” environments.



For simultaneous data acquisition, 8 A/D channels on the „s“-versions are equipped with a “**Sample-and-hold**”-option.

## 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 Starting up

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 Power Supply for PCI-Express Models

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

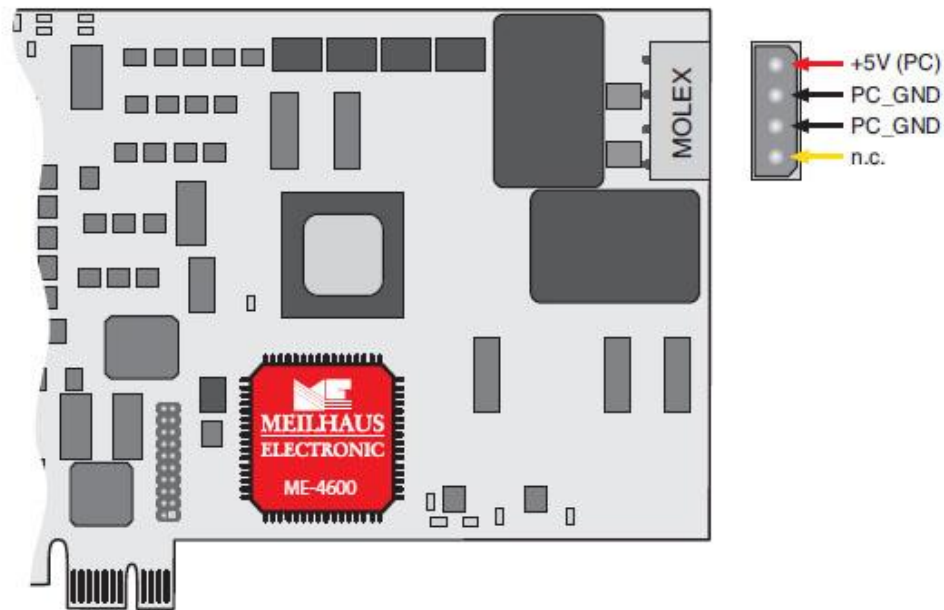


Diagram 1: Additional supply PCI-Express models

## 2.3 Test Program

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

# 3 Hardware

## 3.1 Block Diagrams

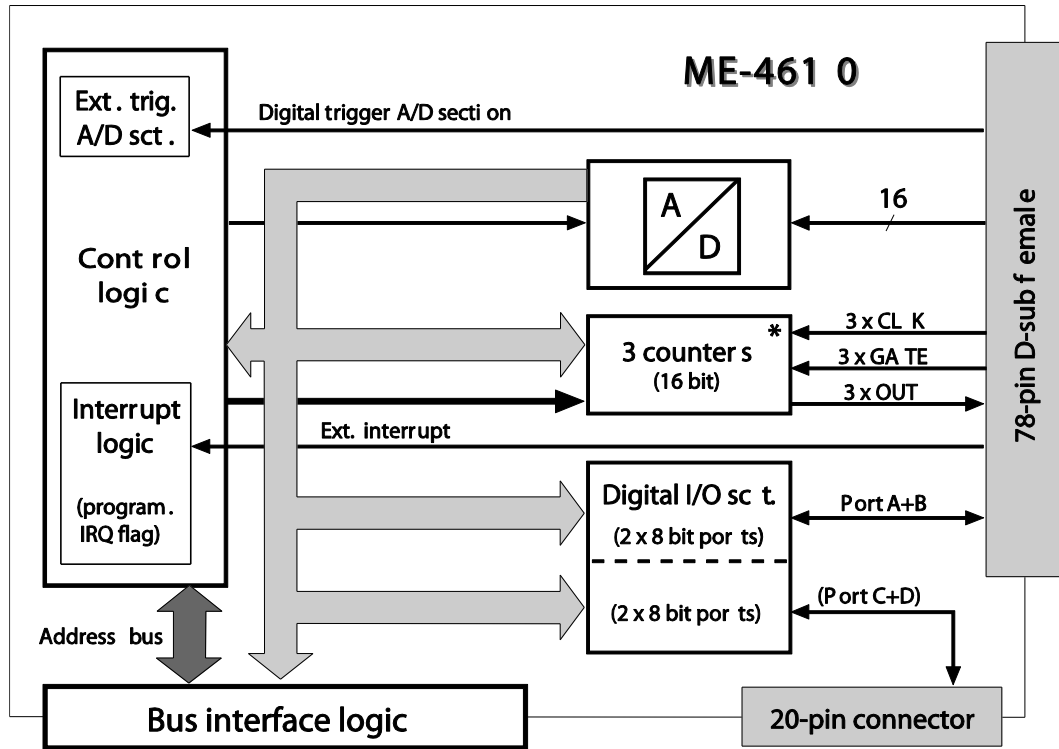


Diagram 2: Block diagram of ME-4610

**ME-4610:** 16 A/D channels, 32 DIOs, 3 counters

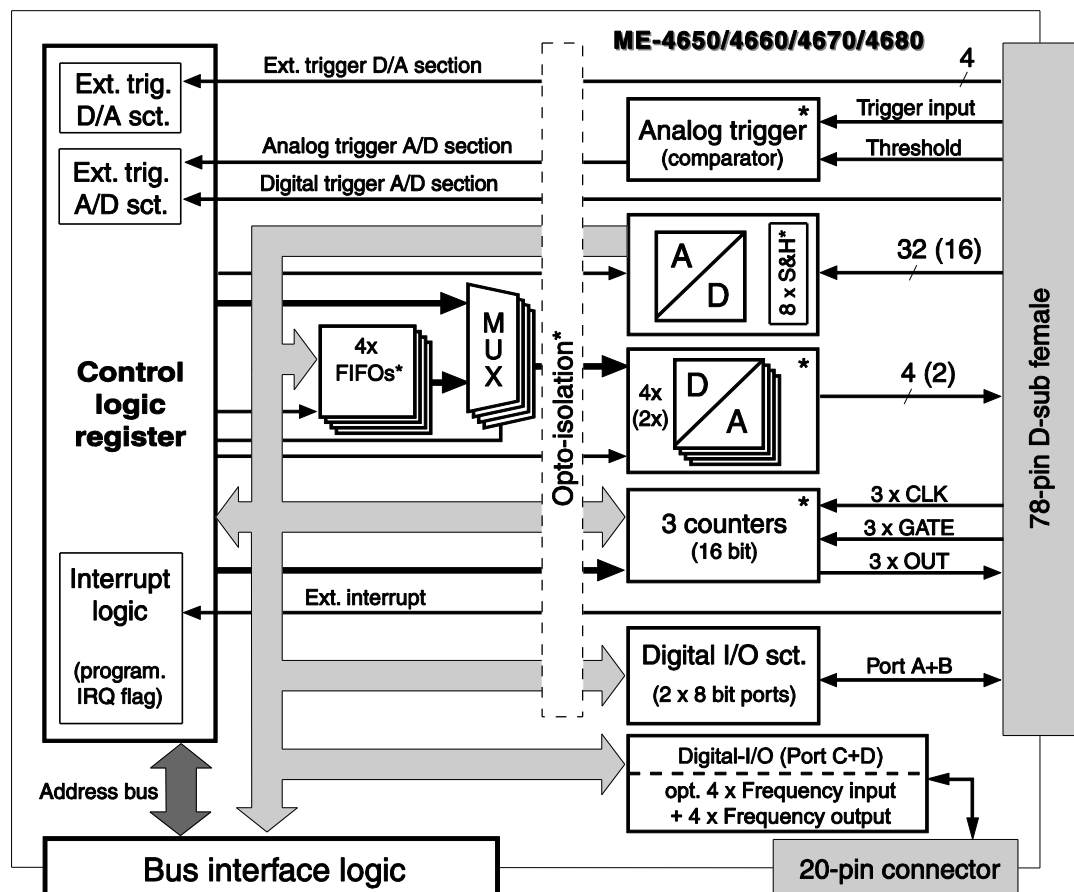


Diagram 3: Block diagram of ME-4650/60/70/80

\*Depending on the model, not all functional groups shown in the diagram above are available:

**ME-4650:** 16 A/D channels, 32 DIOs

**ME-4660:** 16 A/D channels, 2 D/A channels, 32 DIOs, 3 counters

**ME-4670:** 32 A/D channels, analog trigger, 4 D/A channels, 32 DIOs, 3 counters

**ME-4680:** 32 A/D channels, analog trigger, 4 D/A channels with FIFO, 32 DIOs, 3 counters

**„f“-Option:** with frequency input/output

**„i“-Option:** with opto-isolation

**„s“-Option:** with 8 sample-and-hold channels

The pinout of the 78-pin D-Sub connector is shown in Appendix B on page 54.

The following chapters describe the wiring and connections of the different functional groups. For programming please read the chapter 4 (from page 34 on) and the ME-iDS manual.

## 3.2 A/D Section

The models ME-4610, ME-4650 and ME-4660 have 16 single-ended channels, the models ME-4670 and ME-4680 have 32 single-ended resp. 16 differential input channels. All channels are equipped with a high-impedance input stage:

- Input impedance:  $R_{IN} = \text{typ. } 600 \text{ M}\Omega$ ,  $C_{IN} = \text{typ. } 3 \text{ pF}$

Boards with sample-and-hold option (see also chapter 3.2.3) the input impedance of the first 8 channels (AD\_0...7) is:

- $R_{IN} = \text{typ. } 1 \text{ M}\Omega$ ,  $C_{IN} = \text{typ. } 5 \text{ pF}$  (valid independently whether the sample-and-hold option is used or not).

**The input voltage applied to the analog inputs must not exceed  $\pm 15 \text{ V}$ .**

With exception of the ME-4610 the user can choose between the unipolar input voltage ranges  $0 \dots (2.5 \text{ V} - 1 \text{ LSB})$  and  $0 \dots (10 \text{ V} - 1 \text{ LSB})$  and the bipolar input voltage ranges  $-2.5 \text{ V} \dots (+2.5 \text{ V} - 1 \text{ LSB})$  and  $-10 \text{ V} \dots (+10 \text{ V} - 1 \text{ LSB})$ . The ME-4610 only provides the input range  $-10 \dots (+10 \text{ V} - 1 \text{ LSB})$ .

The following (ideal) characteristic curves are valid:

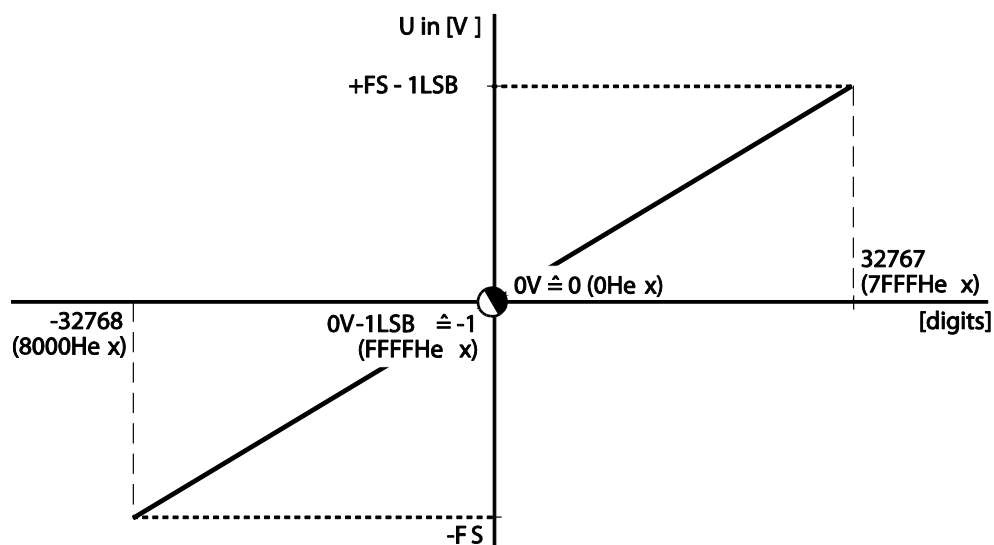


Diagram 4: Characteristic of bipolar input ranges

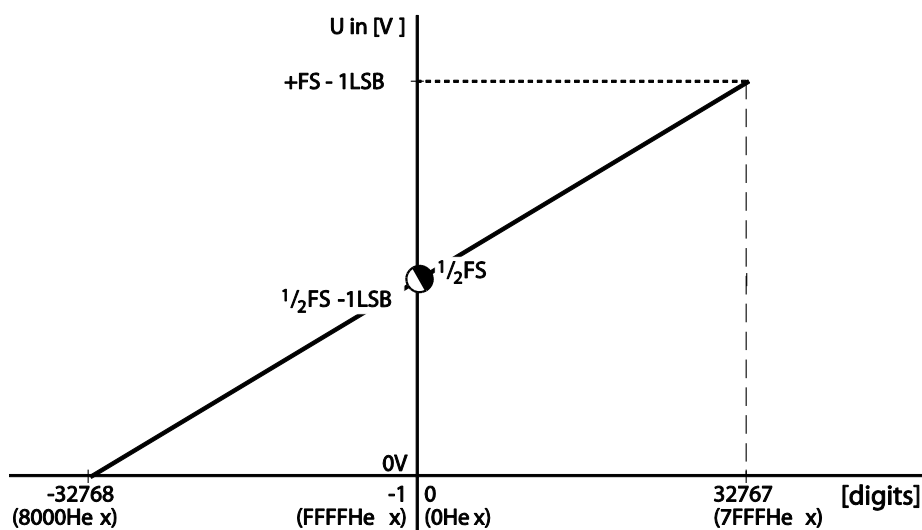


Diagram 5: Characteristic of unipolar input ranges

(„FS“ means „Full Scale“ in the appropriate measuring range; „LSB“ means „Least Significant Bit“ of the 16-bit A/D conversion).

**Note:** the theoretical value for full-scale in the appropriate measuring range is only met approximately as a rule (see also specifications on page 43)

Timer controlled A/D conversion can be achieved using the 32-bit chan and 40-bit scan timers. The configuration of the A/D section in „Streaming“-mode is done using the function `meIOStreamConfig()`. The input voltage range for the appropriate channel will be written to a so called channel list with max. 1024 entries. The conversion process can be started (depending on programming) by software or by one of the numerous external triggering options.

### 3.2.1 Single-ended Operation

Depending on model in single-ended operation 16 input channels (ME4610/4650/4660) resp. 32 input channels (ME-4670/4680) are available. The measurement signal is connected to the desired input channel `AD_x`. Each input channel requires a low-resistance connection to the ground of the A/D section (`A_GND`). It is important that all minus (-) lines have the same potential to avoid cross currents (and therefore measurement errors).

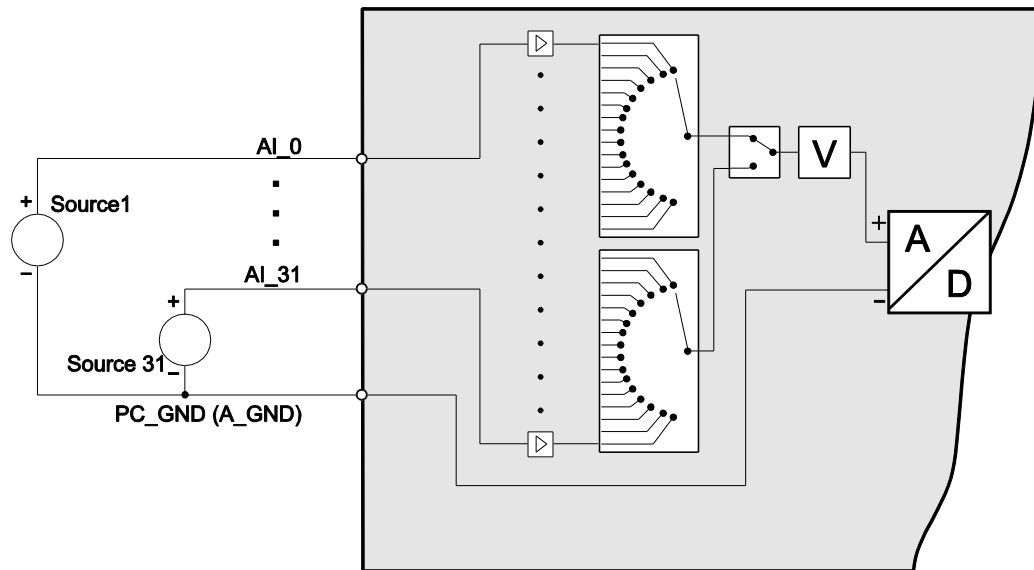


Diagram 6: Wiring in single-ended operation

### 3.2.2 Differential Operation

The advantage of differential operation is that common mode noise is greatly suppressed. You can use up to 16 differential channels operating in the bipolar ranges ( $\pm 2.5$  V und  $\pm 10$  V). Each input channel has its own positive and negative input line.

**Note:** ME-4610/4650/4660 provide only single-ended operation!

The following table shows how the differential pin connections are organized:

Pos. Signal		Neg. Signal		Pos. Signal		Neg. Signal	
Channel	Pin	Channel	Pin	Channel	Pin	Channel	Pin
AD_0	39	AD_16	15	AD_8	78	AD_24	54
AD_1	19	AD_17	34	AD_9	58	AD_25	73
AD_2	38	AD_18	14	AD_10	77	AD_26	53
AD_3	18	AD_19	33	AD_11	57	AD_27	72
AD_4	37	AD_20	13	AD_12	76	AD_28	52
AD_5	17	AD_21	32	AD_13	56	AD_29	71
AD_6	36	AD_22	12	AD_14	75	AD_30	51
AD_7	16	AD_23	31	AD_15	55	AD_31	70

Table 1: Channel assignment in differential operation



**Please note** that also in differential mode a connection to the analog ground is required. This is achieved by connecting the negative (-) input to the ground of the A/D section (A\_GND) via a resistor (approx. 100 k $\Omega$ ).

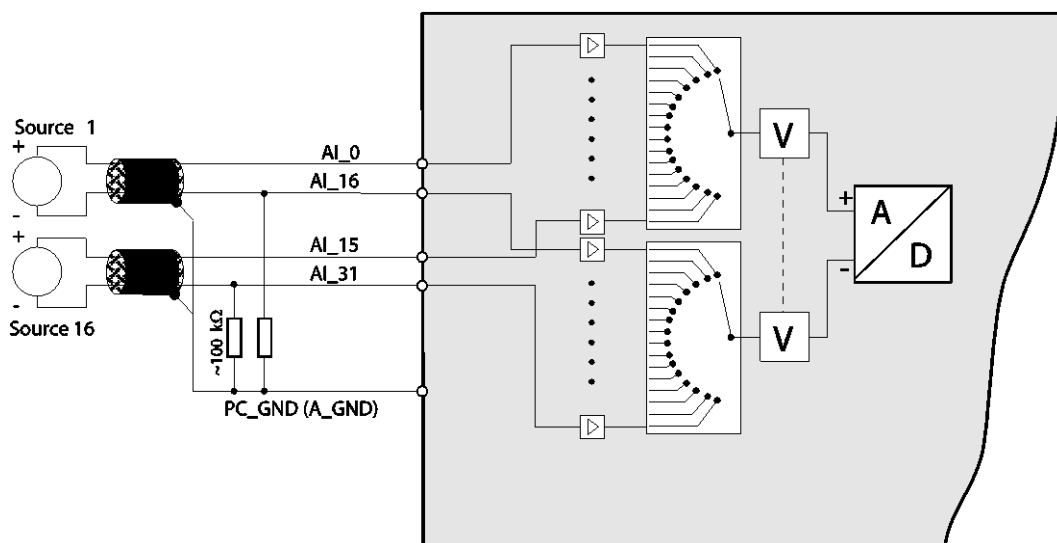


Diagram 7: Wiring in differential operation

### 3.2.3 Sample-and-hold Option

Boards with the sample-and-hold option („s“-versions) allow simultaneous data acquisition using the first 8 channels to be controlled by software. The input impedance of the sample-and-hold channels is as follows:  $R_{IN} = \text{typ. } 1 \text{ M}\Omega$ ,  $C_{IN} = \text{typ. } 5 \text{ pF}$ . Valid independently whether the sample-and-hold option is used or not.

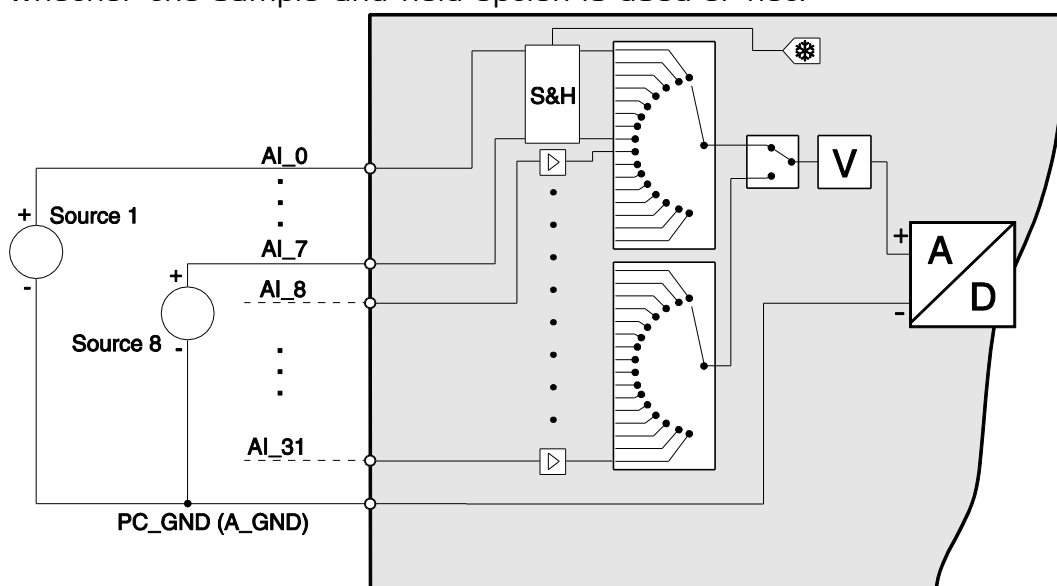


Diagram 8: Wiring in simultaneous operation

The signals applied to the channels AD\_0...7 are “frozen” when a signal from the state machine occurs. The “frozen” values are read in sequentially. The following points should be noted:

Only single-ended mode is possible for the simultaneous operation (for all channel list entries).

- Each sample-and-hold channel can only be sampled once per channel list processing. This means that channels 0...7 can only appear once in the channel list.
- Useful values for the number of channel list entries are 2...8.
- It is recommended to use the maximum sample rate (2  $\mu\text{s}$ ) always for simultaneous operation, otherwise the „frozen“ voltage value will decrease at a rate of typ. 0.08  $\mu\text{V}/\mu\text{s}$ .
- The minimum time between 2 simultaneous measurements depends on the number of channels being sampled and the recovery time. This must be considered when calculating the SCAN time. The minimum SCAN time can be calculated as follows:

$$\text{Min. SCAN time} = (\text{Number of channel list entries} \times \text{CHAN time}) + \text{recovery time}$$

**Note** that after the channel list processing is done, a recovery time of at least 1.5  $\mu\text{s}$  is required!

In the following example 4 channels are to be sampled simultaneously. The values should be read as quickly as possible,

i.e. the minimum CHAN time should be used (2  $\mu\text{s}$ ). The following calculation is valid (2  $\mu\text{s}$ ).

$$\text{min. SCAN time} = (4 \times 2 \mu\text{s}) + 1.5 \mu\text{s} = 9.5 \mu\text{s}$$

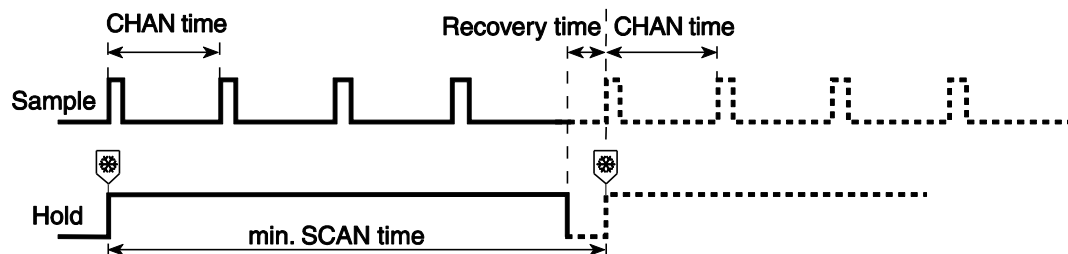


Diagram 9: Sample-and-hold timing

### 3.2.4 External Trigger A/D Section

All ME-4600 models have a digital-A/D trigger input. The models ME-4670 and ME-4680 have an additional analog trigger unit. Depending on the selected option the A/D conversion will be started on the matching edge.



Diagram 10: Trigger edges

#### 3.2.4.1 Analog-Trigger A/D Section

The analog A/D trigger unit uses a comparator to compare the voltage levels on the **AI\_TRIG\_A+** (pin 50) and the **AI\_TRIG-A-** (pin 69) inputs.

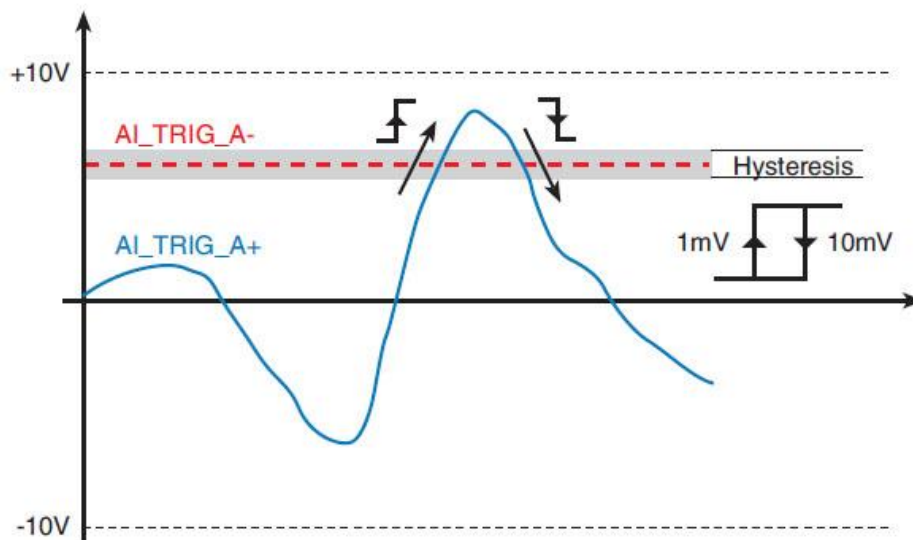


Diagram 11: Analog trigger

We recommend applying a „Threshold voltage“-level on the minus input. This can be done using one of the D/A channels or an external voltage source. The voltage value which serves as the trigger is applied to the positive input. This could be an A/D channel which is connected to the positive input for example (see also diagram 12). When the voltage level on the positive input becomes higher (more positive) than the threshold voltage on the minus input a rising edge is met. The inverse direction is considered as falling edge.

Dynamic signals of up to 300 kHz at  $\pm 10$  V can be applied. The ground reference of the trigger inputs must be considered. For boards without optical isolation, this is the PC ground (PC\_GND). For optically isolated boards, the analog trigger requires a reference to the analog ground (A\_GND)

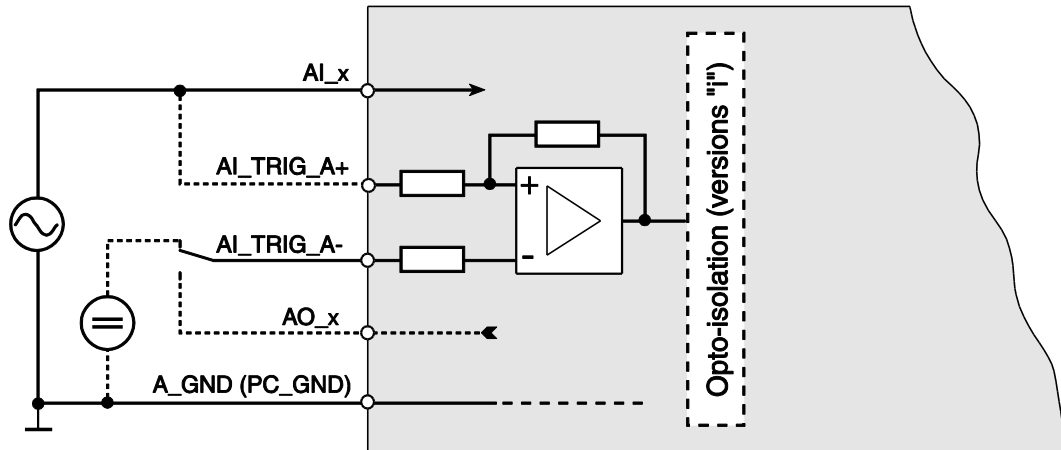


Diagram 12: Wiring analogical trigger

### 3.2.4.2 Digital Trigger A/D section

The digital trigger input (AD\_TRIG\_D) requires a high level of + 5 V. Board versions with optical isolation require a minimum  $I_F$  of 7.5 mA to be supplied. The trigger signal requires a reference to ground (PC\_GND or DIO\_GND).

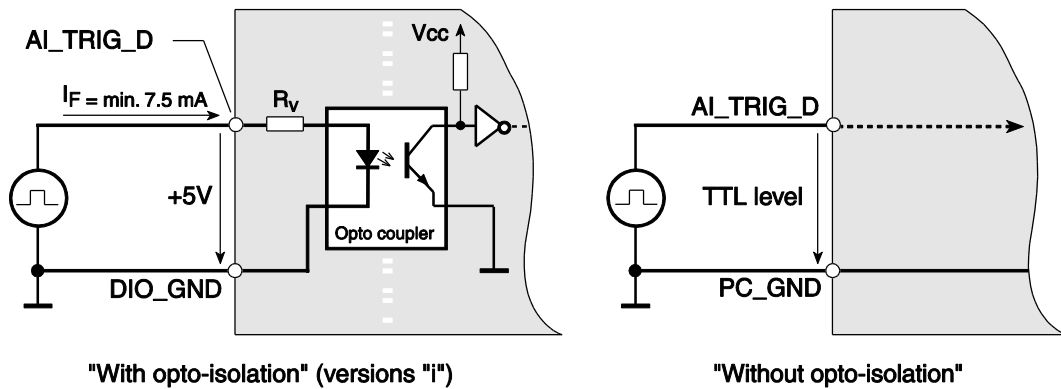


Diagram 13: Wiring digital trigger

### 3.3 D/A Section

The ME-4660 provides 2 and the ME-4670 and ME-4680 provides 4 analog output channels. Each channel has its own 16-bit D/A converter and converts up to 500 kS/s. The output voltage range for each channel is from -10 V to +10 V-1 LSB.

#### Attention:

After power-up, the D/A channels output -10 V. After starting the driver, the outputs are set to 0 V. To guarantee a defined power-up condition please start your host computer first and do not power-up your external wiring until the driver started.

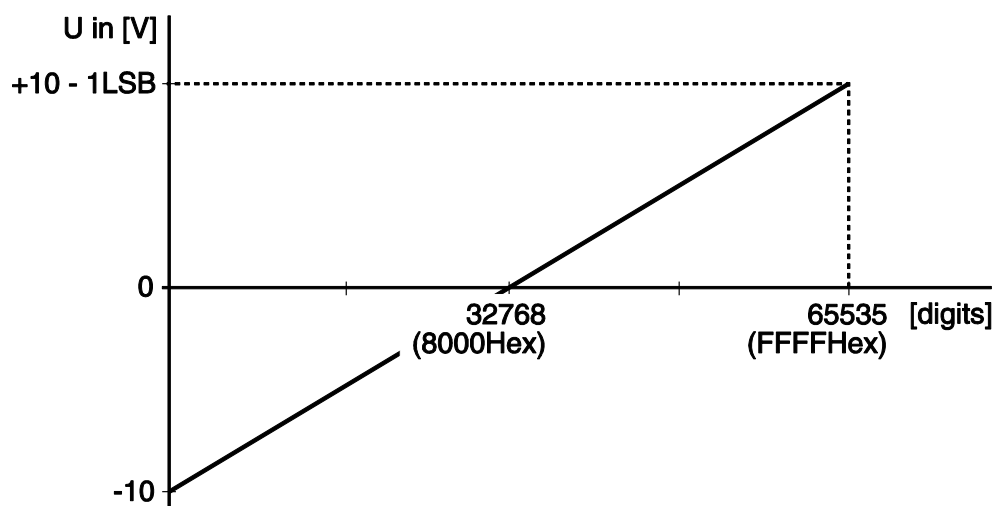


Diagram 14: Characteristic of the D/A channels

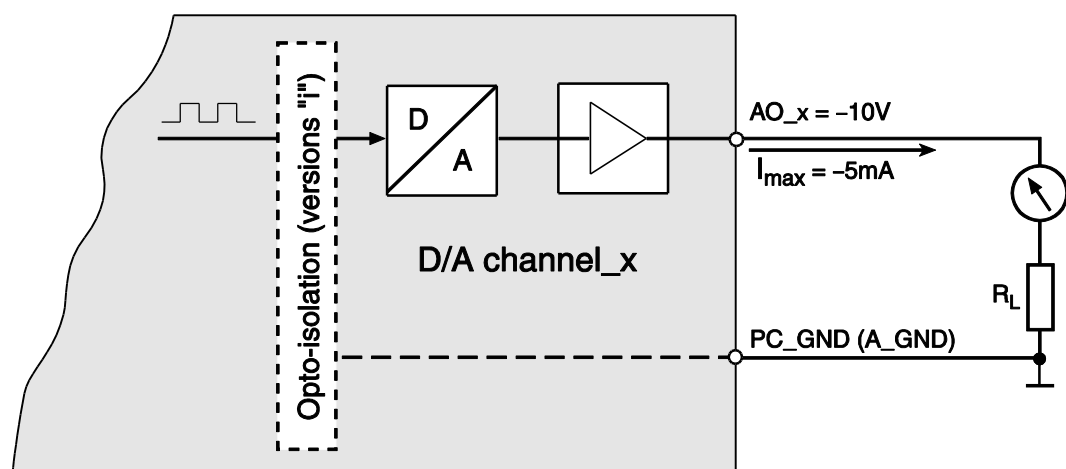


Diagram 15: Wiring of the analogical outputs

**Note:**  $I_{\max} = \pm 5\text{ mA}$  per channel must not be exceeded!

The optically isolated models („i“-versions) have D/A channels which are isolated from PC ground and are all referenced to the analog ground (A\_GND).

### 3.3.1 External Trigger D/A Section

Each D/A channel has its own external trigger input (AO\_TRIG\_x). Depending on the selected option the conversion will be started on the matching edge.

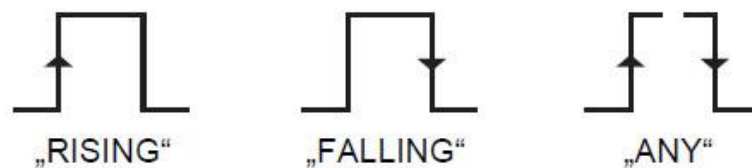


Diagram 16: Trigger edges

It is important that the voltage levels of the external trigger input wiring are within the specified limits (see specifications on page 52) and that a reference to PC ground (PC\_GND) resp. digital ground (DIO\_GND) for the “i“-board versions is made. The resistor  $R_V$  of the opto-isolated trigger inputs is set for a high level of +5 V at  $I_F = 7.5$  mA. For non opto-isolated inputs TTL level is valid.

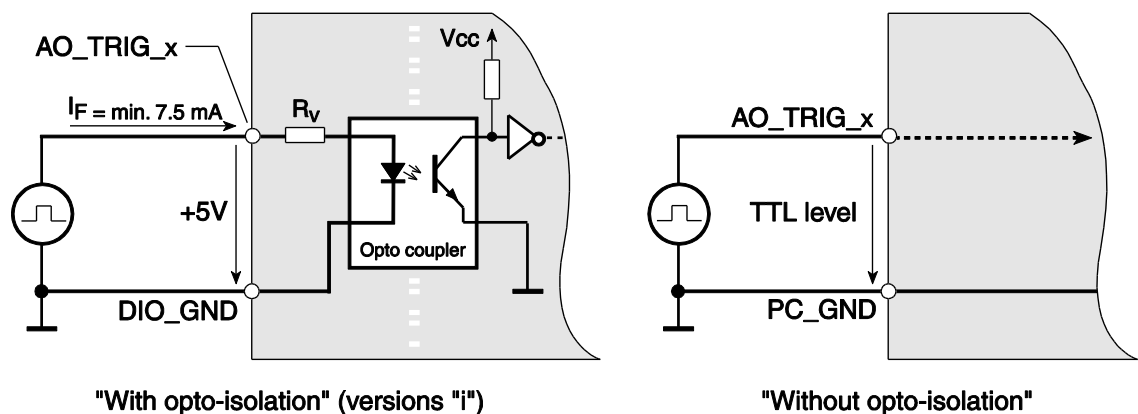


Diagram 17: Wiring of the D/A trigger inputs

## 3.4 Digital Input/Output

The ME-4600 series boards have four digital ports each 8-bits-wide. If your board is not optically isolated, each port can be configured independently as input or output. Models with optical isolation ("i" versions) are fixed with port A as output and port B as input.

Port C and D are available on the 20-pin flat connector ST2 and can be routed to an external mounting bracket (ME-AK-D25F/S) with a D-Sub 25 female connector. Port C and D are not isolated, even on the "i"-versions.

The port direction is set by the software. After power-up, all ports are set to input with the exception of port A (output) on the optically isolated models ("i"-versions).

For programming of the digital-I/O section, refer to chapter 4.3 on page 35.

### 3.4.1 Digital Inputs

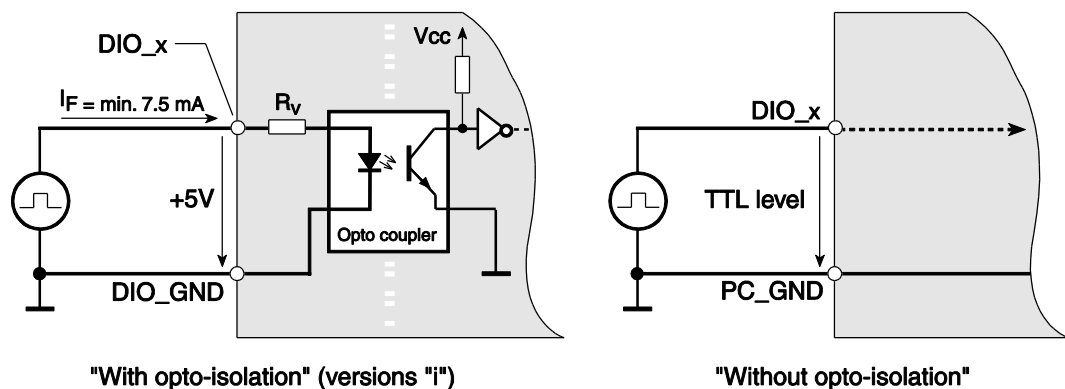


Diagram 18: Wiring of the digital inputs

It is important that the voltage levels of the digital input wiring be within the specified limits (see specifications on page 43) and that a reference to PC ground (PC\_GND) resp. digital ground (DIO\_GND) for the "i"-board versions be made. The resistor  $R_V$  of the opto-isolated inputs is set for a high level of + 5 V at  $I_F = 7.5$  mA. For non opto-isolated inputs TTL level is valid.

### 3.4.2 Digital Outputs

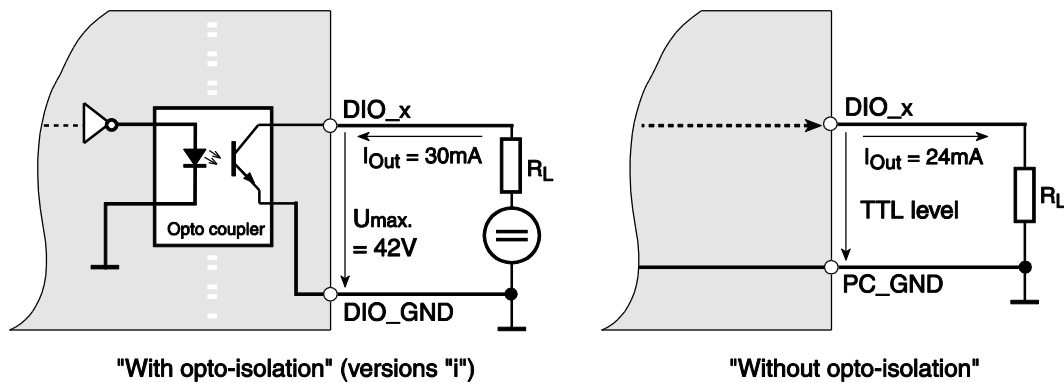


Diagram 19: Wiring of the digital outputs

It is important that the voltage levels of the digital output wiring are within the specified limits (see specifications on page 39) and that a reference to PC ground (PC\_GND) resp. digital ground (DIO\_GND) for the “i”-versions is made. The opto-isolated board versions allow wiring of signals up to  $U_{\max} = 42\text{ V}$ . The maximum output current for TTL versions is  $I_{\text{Out}} = I_{\text{OL}} = I_{\text{OH}} = 24\text{ mA}$ . The opto-isolated versions provide an  $I_{\text{Out}}$  of maximum 30 mA.

## 3.5 Frequency Input/Output

Specific models of the ME-4600 series can be combined with the option „frequency input/output“ (also named „FIO“- or „f“-option). An „aftermarket equipment“ is not possible.

The following channels are available:

- **Frequency Counter:** 4 independent TTL inputs for measurement of frequency and duty cycle with periodic rectangular signals (max. 5,5 MHz)
- **Pulse Generator:** 4 independent TTL outputs of a periodic rectangular signal up to 5.5 MHz with variable duty cycle

The according pins can be applied by the 20-pin flat connector ST2 and the external mounting bracket (ME-AK-D25F/S) with a D-Sub 25 female connector. The digital ports C and D are omitted without replacement.

**Please** note, after power-up, the pins FO\_0...3 are set to input. The pinout can be found in the appendix on page 56.



The frequency counter and pulse generators are configured by software. For programming the frequency input/output, refer to chapter 4.4 on page 38.

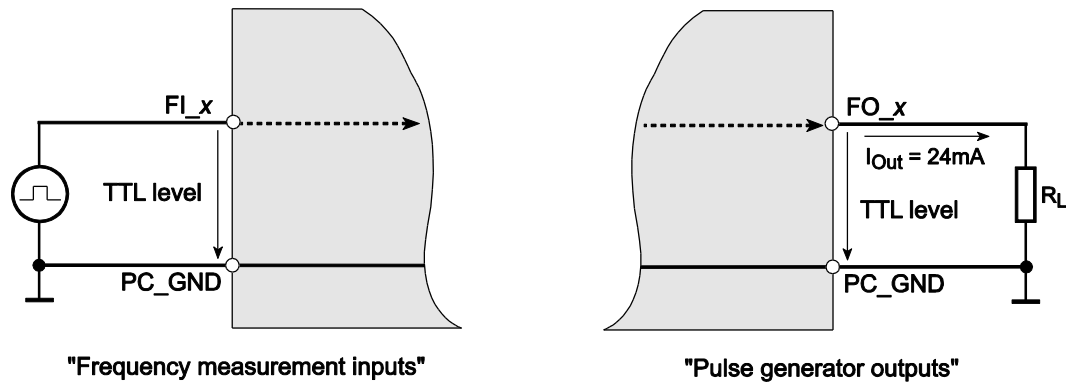


Diagram 20: Diagram 20: Wiring of the "FIO"-option

It is important that the voltage level of the frequency inputs and outputs meets the TTL level (see specifications on page 43) and that a reference to PC ground (PC\_GND) must be made. The maximum output current is  $I_{Out} = I_{OL} = I_{OH} = 24 \text{ mA}$ .

## 3.6 Counter

### 3.6.1 Counter Chip

The **ME-4600 series boards** (except ME-4650) use a standard counter chip of type 82C54. This flexible component has 3 independent 16-bit (down) counters. All counter signals are available on the external D-Sub connector. After the GATE signal has been properly set (TTL: 5 V, Opto: 0 V) the counter counts down on every falling edge. The clock (CLK) sourcing the counter must be supplied externally and can have a maximum frequency of 10 MHz. The counters can be cascaded by making proper external connections.

The counter signals of the non-optically isolated boards work with TTL level (see Appendix A "Specifications") and require a reference to ground (PC\_GND). The maximum output current for low-level is  $I_{OL} = 7.8 \text{ mA}$  and for high level  $I_{OH} = 6 \text{ mA}$ .

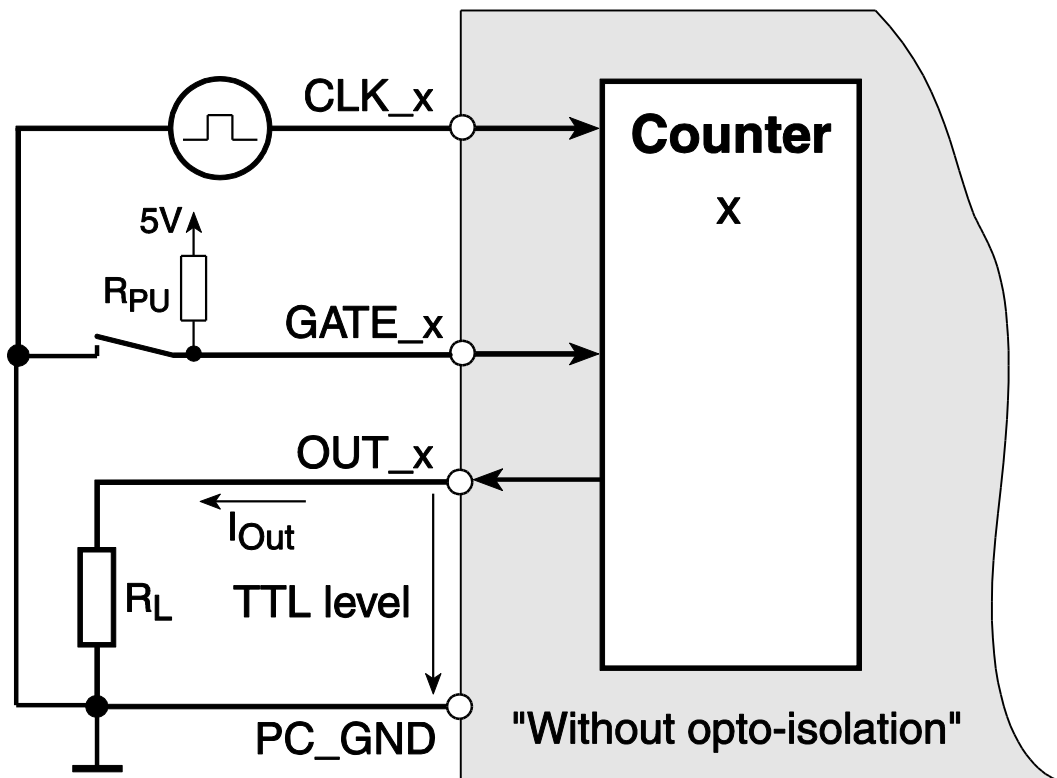


Diagram 21: Wiring of counters without opto-isolation

On opto-isolated boards you can choose whether the opto-couplers should be supplied by an external power supply or via the analog section of the board. In the first case you must source pin 1 (CNT\_VCC\_IN) with +5 V/30 mA and a ground reference by pin 40 (CNT\_GND) must be done. J1 and J2 must not be bridged (default). If the second case is used the power supply is done internally via the analog section of the board (A\_VCC) with a ground reference to A\_GND J1 and J2 must be bridged. Therefore the front panel must be unscrewed on CompactPCI models. See diagram 22 right hand.

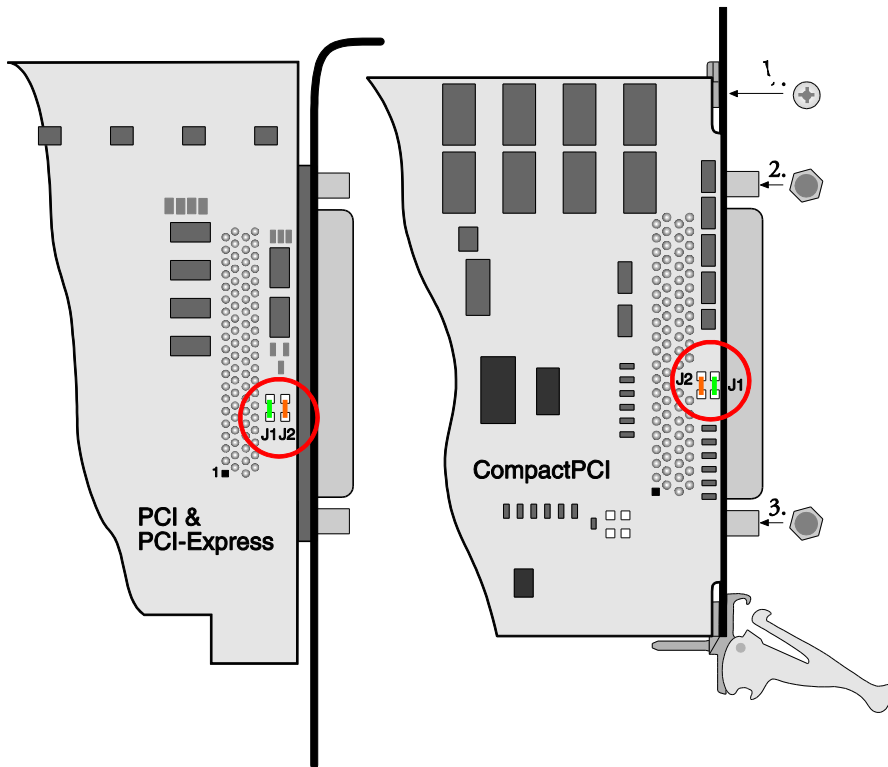


Diagram 22: Rear view (J1, J2)

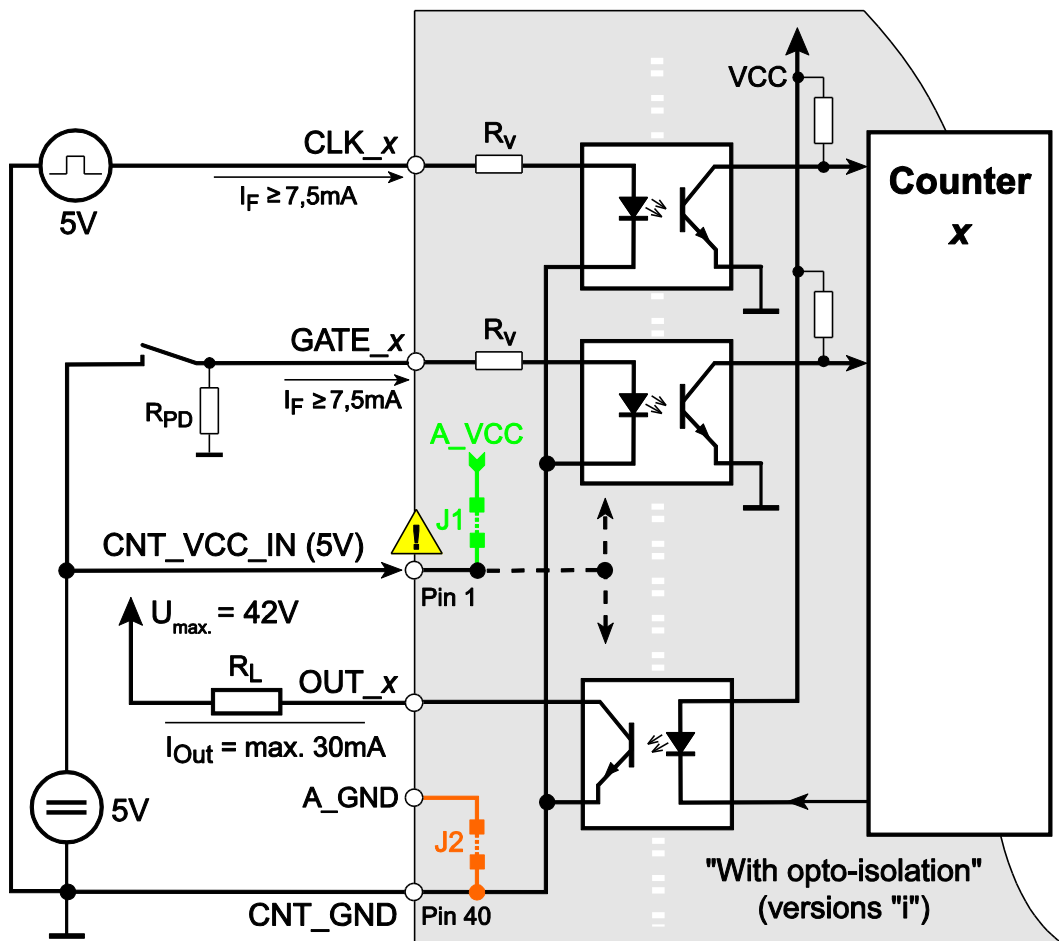


Diagram 23: Wiring of the counters with opto-isolation

**Note** that in case of internal supply of the opto-couplers (J1 and J2 are bridged) the isolation between the analog ground (A\_GND) and the counter ground (CNT\_GND) is removed. With that pin 1 becomes an output and may be not connected!

On opto-isolated boards the output OUT\_2 is an open collector output. This means as soon as the output is set (logical „1“) the load  $R_L$  will be switched against ground (CNT\_GND). Logical „0“ means the output is in a high impedance state.

On the opto-isolated versions the polarity of the input signals (CLK\_x and GATE\_x) is inverted by the opto-coupler circuitry. All counter signals require a reference to counter ground (CNT\_GND).

The inputs CLK\_x and GATE\_x are dimensioned for a voltage level of +5 V. It applies for  $I_F$  :  $7,5 \text{ mA} \leq I_F \leq 10 \text{ mA}$ .

The voltage  $U_{\max}$  must not exceed 42 V! The maximum output current  $I_{\text{Out}}$  of the optically isolated versions must not exceed 30 mA.

For programming the counters please read chapter 4.5 on page 41.

### 3.6.2 Pulse Width Modulation

With proper external wiring the counters 0...2 can be used together to create an output signal with a variable duty cycle. The duty cycle can be set between 1...99 % in 1 % steps. The prescaler must be sourced by an external base clock of maximum 10 MHz. This results in an output signal of maximum 50 kHz. By using the connections shown in the diagram below, the functions *meUtilityPWMStart/Stop* can be used which greatly simplifies programming (see also ME-iDS manual).

Use the following formula to calculate the frequency  $f_{\text{OUT}_2}$ :

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

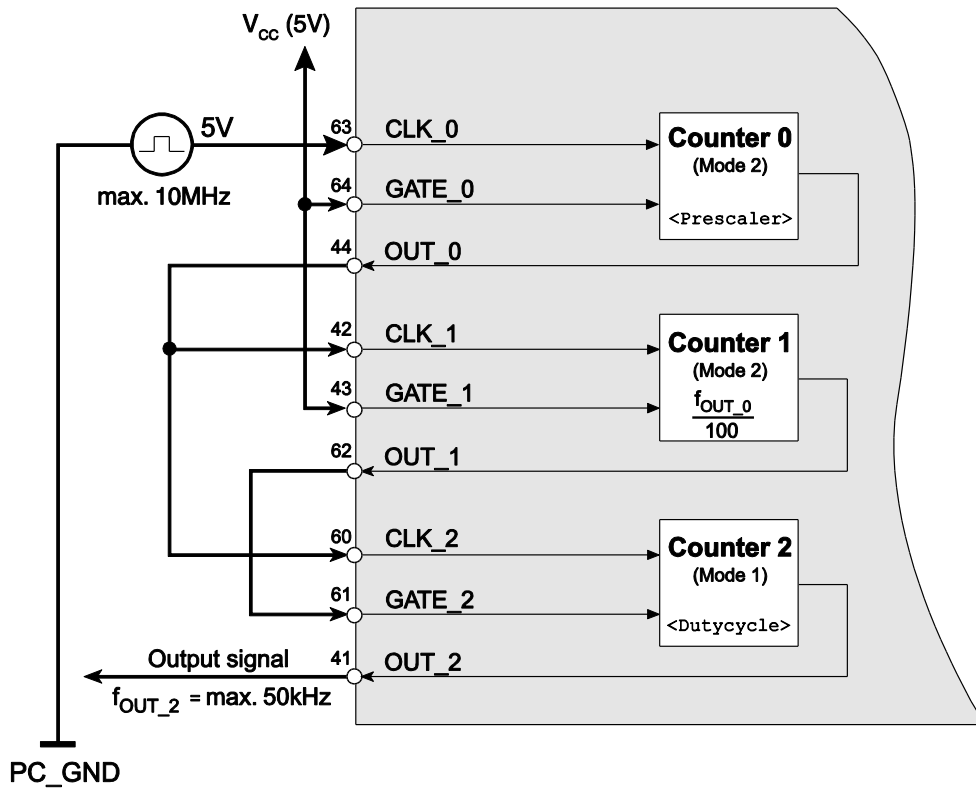


Diagram 24: PWM wiring without opto-isolation

The following diagram shows the external wiring of the counters for opto-isolated models of the ME-4600 series. The calculation of the pull-up resistors  $R_{123}$  is an example for  $U_{ext.} = 24\text{ V}$ .

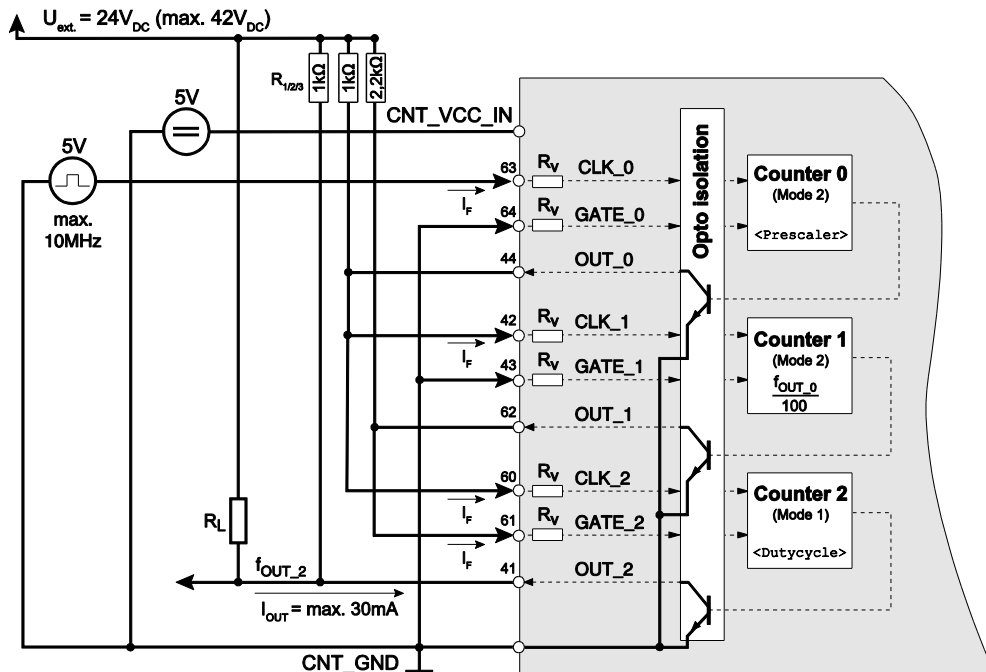


Diagram 25: PWM wiring with opto-isolation

**Note:** on opto-isolated boards the output OUT\_2 is an open collector output. This means as soon as the output is driving (logical „1“) the load RL will be switched against ground (CNT\_GND). Logical „0“ means the output is in a high-impedance state.

On the opto-isolated versions the polarity of the input signals (CLK\_x and GATE\_x) is inverted by the opto-coupler circuitry.

The inputs CLK\_x and GATE\_x are dimensioned for a voltage level of + 5V. It applies for  $I_F$ :  $7.5 \text{ mA} \leq I_F \leq 10 \text{ mA}$ .

The voltage  $U_{\text{max}}$  must not exceed 42 V! The maximum output current  $I_{\text{Out}}$  of the optically isolated versions must not exceed 30 mA.

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

### 3.7. External Interrupt

The external interrupt input (EXT\_IRQ, pin 48) requires a high level of +5 V. On boards with optical isolation a minimum  $I_F$  of 7.5 mA must be supplied. The interrupt signal requires a reference to ground (PC\_GND or DIO\_GND).

Depending on the configuration you can trigger an interrupt by a rising, falling or any edge, which is sent to the PCI bus directly. Condition is to enable the external interrupt by calling the function `meIOIrqStart()`.

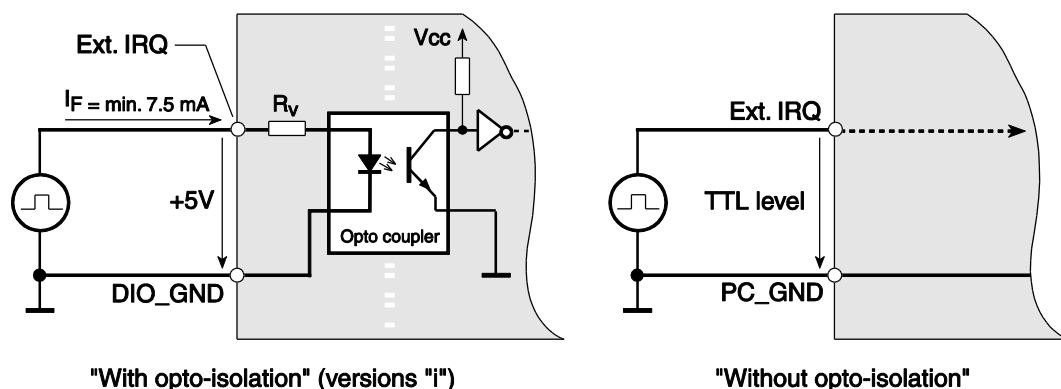


Diagram 26: Wiring of external interrupt input

For programming the external Interrupt see chapter 4.6 on page 42.

## 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](http://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.

If you do not want to program your board with the ME-iDS but with the legacy driver you can find the last revision of the old function reference in the ME-630 manual Rev. 2.3 (see: [www.meilhaus.com/download/ME-4600](http://www.meilhaus.com/download/ME-4600)). Please note, that we cannot support this driver anymore.

### 4.1 A/D Section

#### 4.1.1 Single Value Acquisition

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
✓	✓	✓	✓	✓

Acquisition of a single value from the chosen channel is done in operation mode „Single“. The A/D section is accessed as a subdevice of type ME\_TYPE\_AI, sub-type ME\_SUBTYPE\_SINGLE. **Note** the order of operation as described in the ME-iDS manual. The following parameters can be configured by the functions *meIOSingleConfig()* and *meIO\_Single()*:

- Determine subdevice with *meQuery...* functions.
- Channel number 0...31 (ME-4610/4650/4660: 0...15)

Input voltage range (except ME-4610): 0...2.5 V; 0...10 V;  $\pm 2.5$  V;  $\pm 10$  V; ME-4610:  $\pm 10$  V (**Note**: for differential mode, only the bipolar ranges can be used).

- Operation mode can be single-ended or differential (ME-4610/4650/4660: single-ended only).  
Trigger channel: optional simultaneous acquisition of the channels 0...7 (only for „s“-versions with sample-and-hold option, see also chapter 3.2.3).
- Trigger type: per software, external digital trigger, or external analog trigger (ME-4670/4680 only).
- Trigger edge: trigger event on falling, rising or any edge.
- Time out: in case the external trigger signal does not occur.

No channel list is required.

## 4.1.2 Timer Controlled Acquisition

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
✓	✓	✓	✓	✓

Programming of timer controlled acquisition is done in operation mode „**Streaming**“. The A/D section is accessed as a subdevice of type ME\_TYPE\_AI, sub-type ME\_SUBTYPE\_STREAMING. Note the order of operation as described in the ME-iDS manual. The following parameters can be configured by the functions *meIOStreamConfig()*:

- Subdevice: capable for streaming operation (see chm-file).
- Channel number 0...31 (ME-4610/4650/4660: 0...15)  
Input voltage range (except ME-4610): 0...2.5 V; 0...10 V;  $\pm 2.5$  V;  $\pm 10$  V; ME-4610:  $\pm 10$  V (**Note**: for differential mode, only the bipolar ranges can be used).
- Operation mode can be single-ended or differential (ME-4610/4650/4660: single-ended only).  
Trigger channel: optional simultaneous acquisition of the channels 0...7 (only for „s“-versions with sample-and-hold option, see also chapter 3.2.3).
- Trigger type: per software, external digital trigger, or external analog trigger (ME-4670/4680 only)
- Trigger edge: trigger event on falling, rising or any edge.
- Two programmable counters serve as timers which are configured by the trigger structure *meIOStreamTrigger*. There is a 32-bit CHAN timer and a 40-bit SCAN timer. A 33-MHz time



base is used by both timers. This allows a period time of 30.30 ns, this is the smallest possible time unit and is defined as “one tick” from now on. For convenient conversion, the functions *melOStreamFrequencyToTicks* and *melOStreamTimeToTicks* can be used.

- The CHAN timer (<i>ConvStartTicks...>) determines the sample rate within the channel list (time between two consecutive conversions within the channel list). CHAN times between 2  $\mu$ s... 130 s can be set (PCI-Express: 4  $\mu$ s... 130 s according to a max. sample rate of 250 kHz)
- The SCAN timer (<i>ScanStartTicks...>) determines the time between two consecutive channel list processings. Use of this timer is optional. SCAN times of up to 30 minutes are possible. The SCAN time can be calculated as follows:

(number of channel list entries x CHAN time) + „pause“

The “pause” and therefore the SCAN time, can be set in increments of 30.30 ns (1 tick). The pause time must be minimum 1 tick.

## 4.2 D/A Section

### 4.2.1 Single Value Output

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
-	-	✓	✓	✓

The output of a single value is done in operation mode „Single“. Each D/A channel is accessed as a subdevice of type ME\_TYPE\_AO, sub-type ME\_SUBTYPE\_SINGLE. Note the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center). The following parameters can be configured by the functions *meIOSingleConfig()* and *meIOSingle()*:

- Determine Subdevice with *meQuery...* functions.
- Channel number: always „0“.
- Output voltage range:  $\pm 10$  V.
- Trigger channel: optional synchronous start of several channels.
- Trigger type: per software or external digital trigger.
- Trigger edge: trigger event on falling, rising or any edge.
- Time out: in case the external trigger signal does not occur.

### 4.2.2 Timer Controlled Output

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
-	--	-	-	✓

Programming of timer controlled output is done in operation mode „**Streaming**“. Each D/A channel is accessed as a subdevice of type ME\_TYPE\_AO, sub-type ME\_SUBTYPE\_STREAMING. Note the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center). The following parameters can be configured by the functions *meIOStreamConfig()*:

- Determine subdevice with *meQuery...* functions (capable for streaming operation).
- Channel number: always „0“.
- Output voltage range:  $\pm 10$  V.
- Trigger channel: optional synchronous start of several channels.
- Trigger type: per software or external digital trigger.
- Trigger edge: trigger event on falling, rising or any edge.

- A programmable counter serves as timer which is configured by the trigger structure `meIOStreamTrigger`. The 32-bit counter uses a 33 MHz base frequency. This results in a period of 30.30 ns, which is the smallest time unit available. This will be referred to as “1 Tick” in the following sections.
- The functions `meIOStreamFrequencyToTicks()` and `meIOStreamTimeToTicks()` offer a convenient way to convert the frequency resp. the period in ticks to program the timer. Sample rates between 500 kS/s and 0.5 samples per minute can be set.

## 4.3 Digital Input/Output

Each of the four digital ports of the ME-4600 series is considered as an independent subdevice. On opto-isolated boards port A is fixed as output (type: DO) and port B fixed as input (type: DI). Ports C and D are basically bidirectional and not opto-isolated.

The assignment of the ports to the subdevices can be found in the ME-iDS help file (see ME-iDS Control Center).

For wiring the digital ports please read chapter 3.4 on page 23. The following operation modes are possible:

### 4.3.1 Simple Input/Output

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
✓	✓	✓	✓	✓

The input/output of single digital values is done in operation mode „Single“. Each digital port is accessed as a subdevice of type `ME_TYPE_DIO`, `ME_TYPE_DI`, `ME_TYPE_DO`, sub-type `ME_SUBTYPE_SINGLE`. Note the order of operation as described in the ME-iDS manual. The following parameters can be configured by the functions `meIOSingleConfig()` and `meIOSingle()`:

- Determine Subdevice with `meQuery...` functions.
- Port direction: input or output, if not fixed by opto-isolation.
- Port width: bit or byte operation (8 bit).

**Note:** Ports defined as output can also be read back!

### 4.3.2. Bit-Pattern Output

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
-	-	-	--	✓

A special feature of the ME-4680 is the timer controlled bit pattern output. The FIFO from D/A channel 3 serves a special purpose for doing this. Separated into low byte and high byte, the 16-bit-wide FIFO values (= bit patterns) can be assigned by byte to the 8-bit-wide digital ports (A, B, C and D). See also diagram 27. A port used for the bit pattern output is automatically configured as output. The input port B on opto-isolated board versions cannot be used for bit pattern output.

Programming is done in operation mode „**Streaming**“. A digital port used for bit pattern output must be a subdevice of type `ME_TYPE_DO` or `ME_TYPE_DIO` and is accessed to as sub-type `ME_SUBTYPE_STREAMING`. The following parameters can be configured by the functions `meIOSingleConfig()` and `meIOStreamConfig()`.

- Configure one or several digital output ports for the timer-controlled bit pattern output with the constant `ME_SINGLE_ONFIG_DIO_BIT_PATTERN` in parameter `<iSingleConfig>` of function `meIOSingleConfig()`.
- Assignment of low-byte and high-byte of the 16-bit-wide FIFO values to the specified digital port with the constants `ME_REF_FIFO_LOW` resp. `ME_REF_FIFO_HIGH` in parameter `<iRef>` of function `meIOSingleConfig()`.
- The subdevice of AO channel 3 (subdevice with index 11 of type `ME_TYPE_AO`) is configured for bit-pattern output with the constant `ME_IO_STREAM_CONFIG_BIT_PATTERN` in parameter `<iFlags>` of the function `meIOStreamConfig()`.
- As a reference the constant `ME_REF_AO_GROUND` must be used in parameter `<iRef>` of the function `meIOStreamConfig()`. However use the ground pins of the digital-I/O section (`PC_GND` resp. `DIO_GND`) for ground reference (not the AO-section's ground).
- Trigger channel, trigger type and trigger edge are defined by the trigger structure `meIOStreamTrigger` of the function `meIOStreamConfig()`.
- A programmable counter serves as timer which is configured by the trigger structure `meIOStreamTrigger`. The 32-bit counter uses a 33 MHz base frequency. This results in a period of

30.30 ns, which is the smallest time unit available. This will be referred to as “1 Tick” in the following sections. The functions *meIOStreamFrequencyToTicks()* and *meIOStreamTimeToTicks()* offer a convenient way to convert the frequency resp. the period in ticks to program the timer.

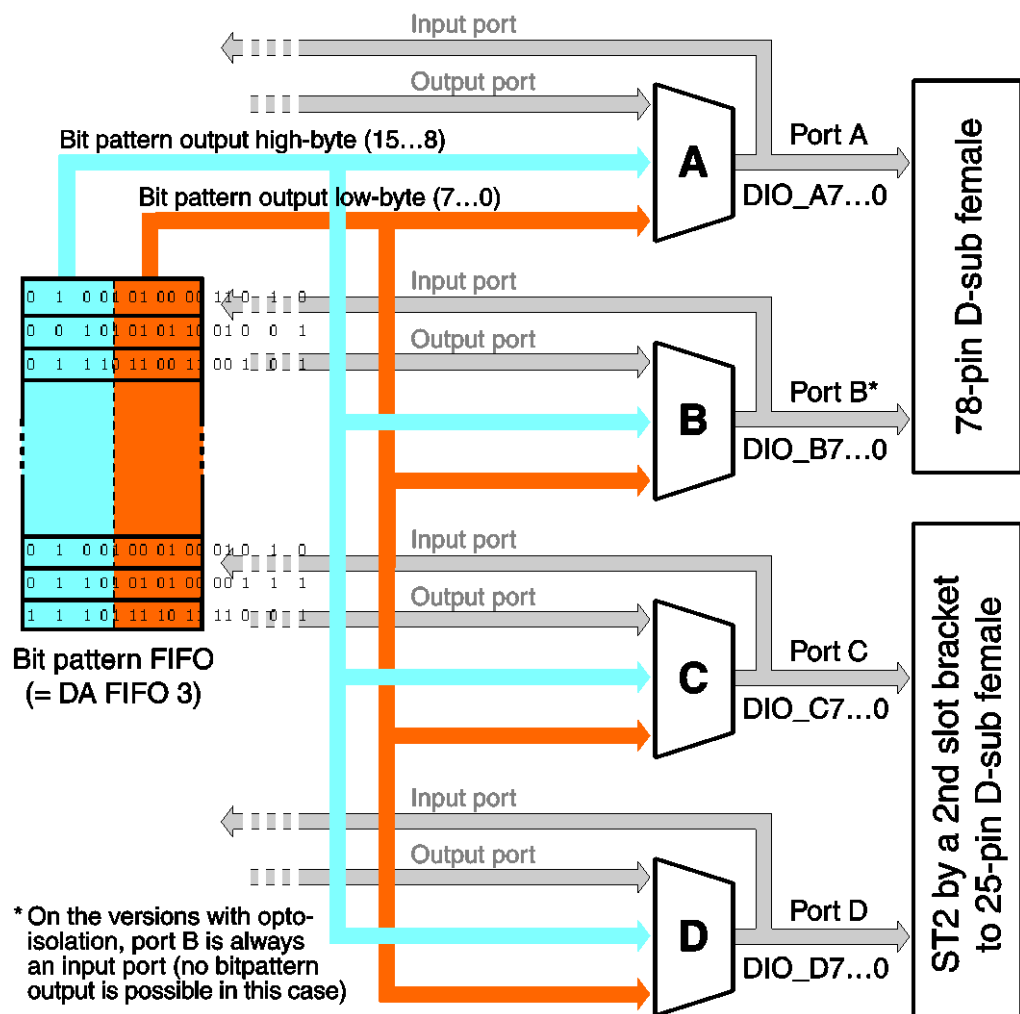


Diagram 27: Port mapping

## 4.4 Frequency Input/Output

Each channel for frequency measurement (input) resp. pulse output (pulse generator) is considered as an independent subdevice of sub-type „Single“ in the Meilhaus Electronic Intelligent Driver System (ME-iDS). Each subdevice represents one frequency I/O channel. The assignment of the channels (FI\_0...3 and FO\_0...3) to the sub-devices can be found in the ME-iDS help file (see ME-iDS Control Center).

To describe the rectangular signal two variables have been introduced, which apply for input and output likewise. The first value defines the period  $T$  and the second value the pulse duration of the „first phase of the period“  $t_{1P}$ . When measuring frequency the measurement starts on the first positive edge and ends with the consecutive positive edge. The negative edge between defines the end of the „first phase“. In pulse generator operation the output starts with a high level and toggles to low after the end of the „first phase“.

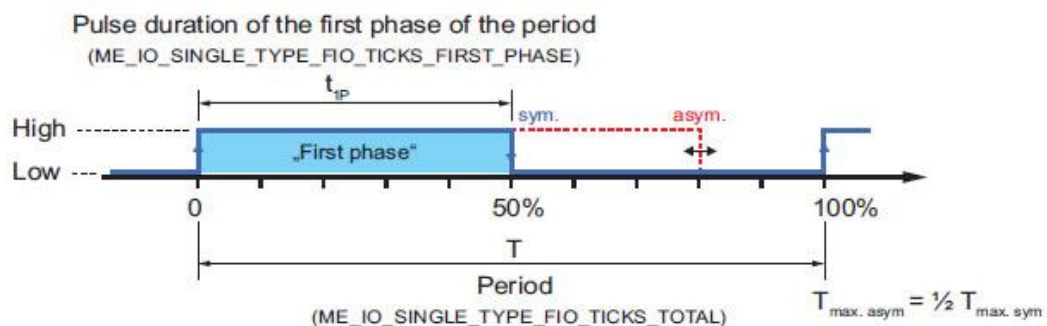


Diagram 28: Signal definition

A 33 MHz counter serves as time reference configured by the function `meIOSingleConfig()`. This results in a period of 30.30 ns, which is the smallest time unit available and is defined as “1 Tick”. The resolution of  $T$  and  $t_{1P}$  is 1 Tick (see specifications on page 54).

**Note** that the value for the maximum period  $T_{\max.}$  is differing in dependency of the duty-cycle. There is a difference between rectangular signals with asymmetrical duty-cycle  $T_{\max. \text{ asym}}$  and symmetrical duty-cycle  $T_{\max. \text{ sym}}$ . For the ME-4600 applies:

$$T_{\max. \text{ asym.}} = 32.5 \text{ s (0.03 Hz)}; T_{\max. \text{ sym.}} = 65 \text{ s (0.015 Hz)}.$$

For wiring the digital ports please read chapter 3.5 on page 24. The following operation modes are possible:

## 4.4.1 Frequency Measurement

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
-	-	"f"-Option	"f"-Option	"f"-Option

Using the operation mode frequency measurement (FI="Frequency Input") you can determine the period resp. frequency and duty-cycle of rectangular signals up to 5.5 MHz. The resolution is 1 Tick = 30.30 ns. Each frequency measurement channel (FI\_0...3) is accessed as independent subdevice of type ME\_TYPE\_FI, sub-type ME\_SUBTYPE\_SINGLE.

**Note** the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center). The following parameters of the functions *melOSingleConfig()*, *melOSingle()* und *melOSingleTicksToTime()* are relevant.

- Configuration of the subdevice by the function *melOSingleConfig()*:
  - One channel per subdevice: `<iChannel>` must always be „0“.
  - Configuration for frequency measurement with ME\_SINGLE\_CONFIG\_FIO\_INPUT in `<iSingleConfig>`.
  - There are no external trigger options available. Pass ME\_VALUE\_NOT\_USED to `<iRef>`, `<iTrigChan>`, `<iTrigType>` and `<iTrigEdge>`.
  - With parameter `<iFlags>` we recommend the option ME\_IO\_SINGLE\_CONFIG\_FI\_SINGLE\_MODE (measurement is carried out once) in combination with the flag ME\_IO\_SINGLE\_TYPE\_NONBLOCKING in *melOSingle()*
- To read the period and the duration of the first phase of the period you have to call the function *melOSingle()* twice. Depending on the option in parameter `<iFlags>` either the total period (in ticks) or the duration of the first phase of the period (in ticks) will be returned in parameter `<iValue>`.
- For easy conversion of ticks into seconds you can use the function *melOSingleTicksToTime()*. You have to call the function separately for period and duration of the first phase of the period. Note that the option for `<iTimer>` corresponds with `<iFlags>` in the function *melOSingle()*.

**Note:** If you need the dimensions frequency and duty-cycle they can be easily calculated by the return values of `<pdTime>`. It applies:

$$\text{Frequency [Hz]} = 1/\text{period [s]}$$

$$\text{Duty-cycle [\%]} = (\text{„Duration of the first phase of the period“ [s]} / \text{period [s]}) \times 100$$

## 4.4.2 Pulse-Generator

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
-	-	“f”-Option	“f”-Option	“f”-Option

Using the operation mode pulse generator (FO=“Frequency Output”) you can output rectangular signals with variable duty-cycle up to 5.5 MHz by a resolution of 1 tick. Each pulse generator channel (FO\_0...3) will be accessed as subdevice of type ME\_TYPE\_FO, subtype ME\_SUBTYPE\_SINGLE.

**Note:** An output channel can also be read back!

Note the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center). The following parameters of the functions *melOSingleConfig()*, *melOSingle()* and *melOSingleTimeToTicks()* are relevant:

- Configuration of the subdevice by the function *melOSingleConfig()*:
  - One channel per subdevice: `<iChannel>` must always be „0“.
  - Configuration for frequency measurement with ME\_SINGLE\_CONFIG\_FIO\_OUTPUT in `<iSingleConfig>`.
  - By parameter `<iTrigChan>` you can choose whether the output operation should start independently or synchronously with other channels.
  - There are no external trigger options available. Pass ME\_VALUE\_NOT\_USED to `<iRef>`, `<iTrigType>` and `<iTrigEdge>`.
- For easy conversion of the signal to be output from seconds into ticks the function *melOSingleTimeToTicks()* is useful. You have to call the function separately for period and duration of the first phase of the period.



- To pass the period and the duration of the first phase of the period you must call the function *meIOSingle()* twice.
- Define the direction by ME\_DIR\_OUTPUT in parameter <iDir>. Use ME\_DIR\_INPUT for readback operation.
- In parameter <iValue> the ticks are passed. **Note** that function *meIOSingle()* must be called twice and that the value corresponds with <iFlags>.
- Starting the output operation can be controlled by appropriate combination of the flags in parameter <iFlags>. E.g. synchronous start or signal negation (by default the output starts with high level).

## 4.5 Counter Operation Modes

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
✓	-	✓	✓	✓

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, sub-type 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).

### 4.5.1 Standard Operation Modes

The counters can be configured independently of one another by the function *meIO-SingleConfig()* for the following 6 operation modes (a 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.

**Note** the different wiring of the counters with opto-isolation and without opto-isolation (see also chapter 3.6 page 25).

## 4.5.2 Pulse Width Modulation

With the wiring shown in diagram 24 resp. 25 from page 28 you can simplify programming considerably using the functions *meUtility-PWMStart/Stop* for this operation mode (see also ME-iDS manual and ME-iDS help file (see ME-iDS Control Center)).

## 4.6 External Interrupt

ME-4610	ME-4650	ME-4660	ME4670	ME-4680
✓	✓	✓	✓	✓

At the external interrupt input (EXT\_IRQ, pin 48) you can initiate an interrupt by a proper edge, which is sent to the PCI bus directly.

Programming is done by the *meOIrq...* functions. The Interrupt is considered to be a independent subdevice of type ME\_TYPE\_EXT\_IRQ. After enabling the external interrupt by the function *meOIrqStart()* an interrupt can be triggered by a rising, falling or any edge (depending on configuration). **Note** the order of operation as described in the ME-iDS manual and in the ME-iDS help file (see ME-iDS Control Center).

## 4.7 ME-MultiSig Control

To understand the ME-MultiSig system it is strongly recommended to fully read the ME-MultiSig manual!

Using the ME-iDS you can program all operation modes as described in the ME-MultiSig manual „on foot“.

## 5 Appendix

### A Specifications (Ambient temperature 25 °C)

#### PC Interface

<b>PCI bus</b>	32 bit, 33 MHz, 5 V, PCI Local-Bus-Specification Version 2.1
<b>PCI Express bus</b>	32 bit, 33 MHz, 3.3 V, PCI Express x1 Specification Version 2.0
<b>CompactPCI bus</b>	32 bit, 33 MHz, 5 V, Specification PICMG 2.0 R3.0
<b>Plug&amp;Play</b>	fully supported

#### Voltage Inputs

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Number A/D channels	ME-4610/4650/4660	16 single-ended
	ME-4670/4680	32 single-ended/ 16 differential
„Sample-and-hold“ channels	opt.	8 single-ended simultane- ously sampling
A/D converter		300 kHz (PC-specific), 16 bit
Input ranges	ME-4610	-10 V...( +10 V-1 LSB) (1 LSB = 305 µV)
	ME-4650/4660/ 4670/4680	0V...( +2.5 V-1 LSB) (1 LSB=38 µV); 0V...( +10 V-1 LSB) (1 LSB=152 µV); -2.5 V...( +2.5 V-1 LSB) (1 LSB=76 µV); -10 V...( +10 V-1 LSB) (1 LSB=305 µV)
Full-scale-error	unipolar	0 V+10 LSB, +FS-10 LSB
	bipolar	-FS+10 LSB, +FS-10 LSB
Inputs protected up to		±15 V

Measurand/ Criterion	Condition/ Annotation	Value
Input impedance	without sample-and-hold	$R_{IN} = \text{typ. } 600 \text{ M}\Omega$ ; $C_{IN} = \text{typ. } 3 \text{ pF}$
	channels with sample-and-hold option:	$R_{IN} = \text{typ. } 1 \text{ M}\Omega$ ; $C_{IN} = \text{typ. } 5 \text{ pF}$
Total accuracy	full-scale in input range $\pm 10 \text{ V}$	typ. $\pm 4 \text{ LSB}$ , max. $\pm 10 \text{ LSB}$
A/D FIFO		2048 values FIFO
Channel list		max. 1024 entries (channel number, gain, uni-/bipolar, single-ended/differential)
Smallest time unit for CHAN and SCAN timer		$1 \text{ Tick} \triangleq 30.30 \text{ ns} \triangleq 33 \text{ MHz}$
CHAN time (time between two consecutive channel list entries)	PCI, cPCI:	$2 \mu\text{s}$ bis $\sim 130 \text{ s}$ (in steps of $30.30 \text{ ns}$ )
	PCIe	$4 \mu\text{s}$ bis $\sim 130 \text{ s}$ (in steps of $30.30 \text{ ns}$ )
SCAN time (time between two consecutive channel list processings)	PCI, cPCI	$4 \mu\text{s}$ to $\sim 30 \text{ minutes}$ (in steps of $30.30 \text{ ns}$ )
	PCIe (at least 2 channels)	$8 \mu\text{s}$ to $\sim 30 \text{ minutes}$ (in steps of $30.30 \text{ ns}$ )
Total sampling rate*	single operation (dependent of system)	max. $300 \text{ kHz}$ (cPCI, PCI, PC-specific) max. $250 \text{ kHz}$ (PCIe)
	Streaming operation	max. $300 \text{ kHz}$ (cPCI, PCI, PC-specific) max. $250 \text{ kHz}$ (PCIe)
	sample-and-hold	number of channel list entries (min. 2) x CHAN time + $1.5 \mu\text{s}$ (relaxation time)
Relaxation time	sample-and-hold	$1.5 \mu\text{s}$
Operation modes		„single“, „streaming“, optional: „sample-and-hold“
Trigger modes	all models	software start, external digital trigger
	only ME-4670/4680	external analog-trigger

Measurand/ Criterion	Condition/ Annotation	Value
Ext. Trigger edges		rising, falling, any
Opto-isolation	„i“-versions	to 500 V
Reference to ground	„i“-versions – A/D and D/A section with common ground, isolated from PC ground and the rest of the board	A_GND

\*System-related, boards installed into a ME-Synapse do not achieve the full sample rate. The actual achievable sample rate heavily depends on the performance of your computer and the number of USB-devices connected.

#### External Trigger without Opto-isolation

Measurand/ Criterion	Condition/ Annotation	Value
Reference to ground		PC ground (PC_GND)
Input Level $U_{IL}$	$V_{CC} = 4.5 \text{ V}$	max. 0.9 V
$U_{IH}$	$V_{CC} = 4.5 \text{ V}$	min. 3.15 V
Delay time		max. 30 ns

#### External Trigger with Opto-isolation

Measurand/ Criterion	Condition/ Annotation	Value
Reference to ground		Digital-I/O ground (DIO_GND)
Input current $I_F$		$7.5 \text{ mA} \leq I_F \leq 10 \text{ mA}$
Voltage level		typ. 5 V
Delay time		typ. 80 ns

#### Voltage Outputs (ME-4660, ME-4670, ME-4680)

Measurand/ Criterion	Condition/ Annotation	Value
Number of D/A channels	ME-4660	2
	ME-4670/4680	4

D/A converter		1 serial converter per channel
Resolution		16 bit
Output range		$\pm 10$ V
Output-current	per channel	max. 5 mA
Settling time (DAC)	full-scale(-10 V...+10 V)	max. 2 $\mu$ s
Total accuracy		max. $\pm 10$ mV
Operation modes		„single“, „streaming“
Trigger modes		software start, ext. digital trigger synchronous start (software/external)
External trigger edges		rising, falling any
Opto-isolation	„i“-versions	max. 500 V
Reference to ground	„i“-versions – A/D and D/A section with common ground, isolated from PC ground and the rest of the board	A_GND

#### Timer controlled Output (only ME-4680)

Measurand/ Criterion	Condition/ Annotation	Value
Channel no. (subdevice)	independent of one another	0...3
D/A FIFOs	per channel	4096 values
Sample rate		max. 500 kS/s
D/A timer	programmable in steps of 30.30 ns	2 $\mu$ s...130 s

#### External Trigger without Opto-isolation

Measurand/ Criterion	Condition/ Annotation	Value
Reference to ground		PC ground (PC_GND)
Input level $U_{IL}$	$V_{CC} = 4.5$ V	max. 0.9 V
$U_{IH}$	$V_{CC} = 4.5$ V	min. 3.15 V
Delay-time		max. 30 ns

**External Trigger with Opto-isolation**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground		digital-I/O ground (DIO_GND)
Input current $I_F$		$7.5 \text{ mA} \leq I_F \leq 10 \text{ mA}$
Voltage level		typ. 5 V
Delay time		typ. 80 ns

**Digital I/Os**

<b>Number of ports</b>	4 x 8 bit
------------------------	-----------

**...without Opto-Isolation**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground		PC ground (PC_GND)
Port-type		bi-directional TTL ports
Output level $U_{OL}$	at 24 mA	max 0.5 V
$U_{OH}$	at -24 mA	min. 2.4 V
Input level $U_{IL}$	at $V_{CC} = 5 \text{ V}$	max. 0.8 V
$U_{IH}$	at $V_{CC} = 5 \text{ V}$	min. 2 V
Input current		$\pm 1 \mu\text{A}$
Sample rate		max. 500 kS/s (2 $\mu\text{s}$ )

**...with Opto-Isolation („i“-versions):**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground	„i“-versions – digital-I/O ground, isolated from PC ground and the rest of the board	DIO_GND
Port type	Port A	output port
	Port B	input port
	Port C, D	bi-directional TTL ports (refer to the levels „without opto-isolation“)

Output level $U_{\max}$	Port A, B	42 V (depends on external supply)
$I_{\text{OUT}}$	Port A, B	max. 30 mA
Input level $I_F$	Port A, B	$7.5 \text{ mA} \leq I_F \leq 10 \text{ mA}$
$U_{\text{IL}}$	Port A, B	max. 0,8 V
$U_{\text{IH}}$	Port A, B	min. 4.5 V, max. 5 V
Sample rate		max. 172 kS/s (5.8 $\mu$ s)

\*optional higher input voltages possible – please contact our support division.

### Bit-Pattern Output

Measurand/ Criterion	Condition/ Annotation	Value
Ports	flexible port mapping to all digital output ports	A, B, C, D
Operation modes		„Streaming“
Bit-pattern FIFO	(shares with D/A FIFO 3)	4 k values
Sample rate	TTL port	max. 500 kS/s (2 $\mu$ s)
	opto-isolated port	max. 172 kS/s (5.8 $\mu$ s)
Bit-pattern timer	programmable in steps of 30.30 ns	2 $\mu$ s... 130 s
External trigger input	Type: digital	AO_TRIG_3
Input level		see external trigger D/A section
Delay time	without opto-isolation	max. 30 ns
	with opto-isolation	typ. 80 ns
Trigger modes		software start, ext. digital trigger
External trigger edges		rising, falling, any

### Frequency Input/Output

<b>Availability</b>	„f“-option for ME-4660/4670/4680
<b>Signal curve</b>	rectangular



**Frequency Measurement Channels**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground		PC ground (PC_GND)
Number of channels	(FI_0...3)	4 inputs (TTL)
Input level	$U_{IL}$ bei $V_{CC} = 5\text{ V}$	max. 0.8 V
	$U_{IH}$ bei $V_{CC} = 5\text{ V}$	min. 2 V
Input current		$\pm 1\ \mu\text{A}$
Period (T)	$T_{min.} = T_{min. asym.} = T_{min sym.}$ $T_{max. asym.}$ $T_{max. sym.}$	$181.81\ \overline{\text{ns}}$ (5.5 MHz) 32.5 s (0.03 Hz) 65 s (0.015 Hz)
Duty-cycle	variable independency of T	adjustable in steps of 1 Tick
Resolution	1 Tick	$30,30\ \overline{\text{ns}}$
Accuracy		$\pm 30,30\ \overline{\text{ns}}$
Operation modes		„Single“

**Pulse Generator Channels**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground		PC ground (PC_GND)
Number of channels	(FO_0...3)	4 outputs (TTL)
Output level	$U_{OL}$ at $I_{OUT} = 24\ \text{mA}$	max. 0,5 V
	$U_{OH}$ at $I_{OUT} = 24\ \text{mA}$	min. 2.4 V
Period (T)	$T_{min.} = T_{min. asym.} = T_{min sym.}$ $T_{max. asym.}$ $T_{max. sym.}$	$181.81\ \overline{\text{ns}}$ (5.5 MHz) 32.5 s (0.03 Hz) 65 s (0.015 Hz)
Duty-cycle	variable in dependency of T	adjustable in steps 1 Tick
Resolution	1 Tick	$30,30\ \overline{\text{ns}}$
Accuracy		$\pm 30,30\ \overline{\text{ns}}$
Operation modes		„Single“

**Counter**

<b>Number</b>	3x16 bit (1x82C54)
<b>Clock source</b>	ext. up to max. 10 MHz

**...without opto-isolation**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground		PC ground (PC_GND)
Level for counter output (OUT x)		
$U_{OL}$	$I_{OL} = +7.8 \text{ mA}$	max. +0.45 V
$U_{OH}$	$I_{OH} = -6 \text{ mA}$	min. +2.4 V
Level for counter inputs (CLK x, GATE x)		
$U_{IL}$	$I_{ILmax} = \pm 10 \mu\text{A}$	-0.5 V...+0.8 V
$U_{IH}$	$I_{IHmax} = \pm 10 \mu\text{A}$	+2.2 V...+6 V

**...with opto-isolation („i“-versions)**

<b>Measurand/ Criterion</b>	<b>Condition/ Annotation</b>	<b>Value</b>
Reference to ground	„i“-versions – counter ground, isolated from PC ground and the rest of the board	CNT_GND
External supply for opto-couplers	CNT_VCC_IN	+5 V/30 mA
Level for counter outputs (OUT x)		
$U_{max}$		42 V
$I_{OUT}$		max. 30 mA
Level for counter inputs (CLK x, GATE x)		
$I_F$		$7.5 \text{ mA} \leq I_F \leq 10 \text{ mA}$
$U_{IL}$		max. 0.8 V
$U_{IH}$		min. 4.5 V, max. 5 V*

\*optional higher input voltages possible – please contact our support division.

**Optional:** Supplying opto-couplers with VCC from analog section (A\_VCC). Note: the electrical isolation between analog and counter section will be removed (CNT\_GND = A\_GND), see Diagram 23.

### External Interrupt

Measurand/ Criterion	Condition/ Annotation	Value
Ext. interrupt input	directly sent to the system	EXT_IRQ
Input level		see digital I/Os
Reference to ground	„TTL“	PC ground(PC_GND)
	„Opto“	digital-I/O ground (DIO_GND)

### General Information

Measurand/ Criterion	Condition/ Annotation	Value
Supply A/D section	2 DC/DC converter	$\pm 5$ V und $\pm 15$ V (2 x 3 W)
Power consumption	without external load	typ. 2.8 A
Load for VCC_OUT		max. 200 mA
Physical size (without mounting bracket and connector)	ME-4610 PCI	136 mm x 107 mm
	ME-4650/4660/4670/4680 PCI	175 mm x 107 mm
	PCI Express versions	167.65 mm x 111.15 mm
	CompactPCI versions	3 HE CompactPCI board
Connectors	ST1	78-pin D-Sub female connector
	ST2	20-pin IDC-connector
Operating temperature		0...70 °C
Storage temperature		-40... 100 °C
Relative humidity		20...55 % (non-condensing)

Certification	CE
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## B Pinout

Pin-name	Function
AI X	analog input channels
AI_TRIG_D	digital trigger input for A/D section
AI_TRIG_A+	analog trigger input for A/D section (positive comparator)
AI_TRIG_A-	analog trigger input for A/D section (negative comparator input)
AO X	analog output channels
AO_TRIG x	digital trigger input separately for each D/A channel
DIO_Ax	digital-I/O port A
DIO_Bx	digital-I/O port B
DIO_Cx	digital-I/O port C
DIO Dx	digital-I/O port D
EXT_IRQ	external interrupt input
CLK_x	clock input for counter
GATE_x	gate input for counter
OUT_x	counter output
PC_GND	<b>ST1 not opto-isolated models:</b> Common ground of all functional groups (=PC ground; ST2: PC ground
VCC_OUT	<b>ST1 not opto-isolated models:</b> VCC-output (+5 V from PC); ST2: +5 V from PC; total load max. 200 mA
n.c.	Pin not connected
<b>Valid for opto-isolated models</b>	
A_GND	Ground for A/D and D/A section
DIO_GND	Ground for digital-I/O section
CNT_GND	Ground for counter section
CNT_VCC_IN	Default: Input for external power supply (+5 V ± 10 %) for the opto-couplers of the counters.
A_VCC	Optional (see diagram 23 on page 25): Sourcing the opto-couplers of the counters by the analog section (A_VCC) <b>No external wiring to pin 1!</b>

# B1 78-pin D-Sub Connector (ST1) ME-4610

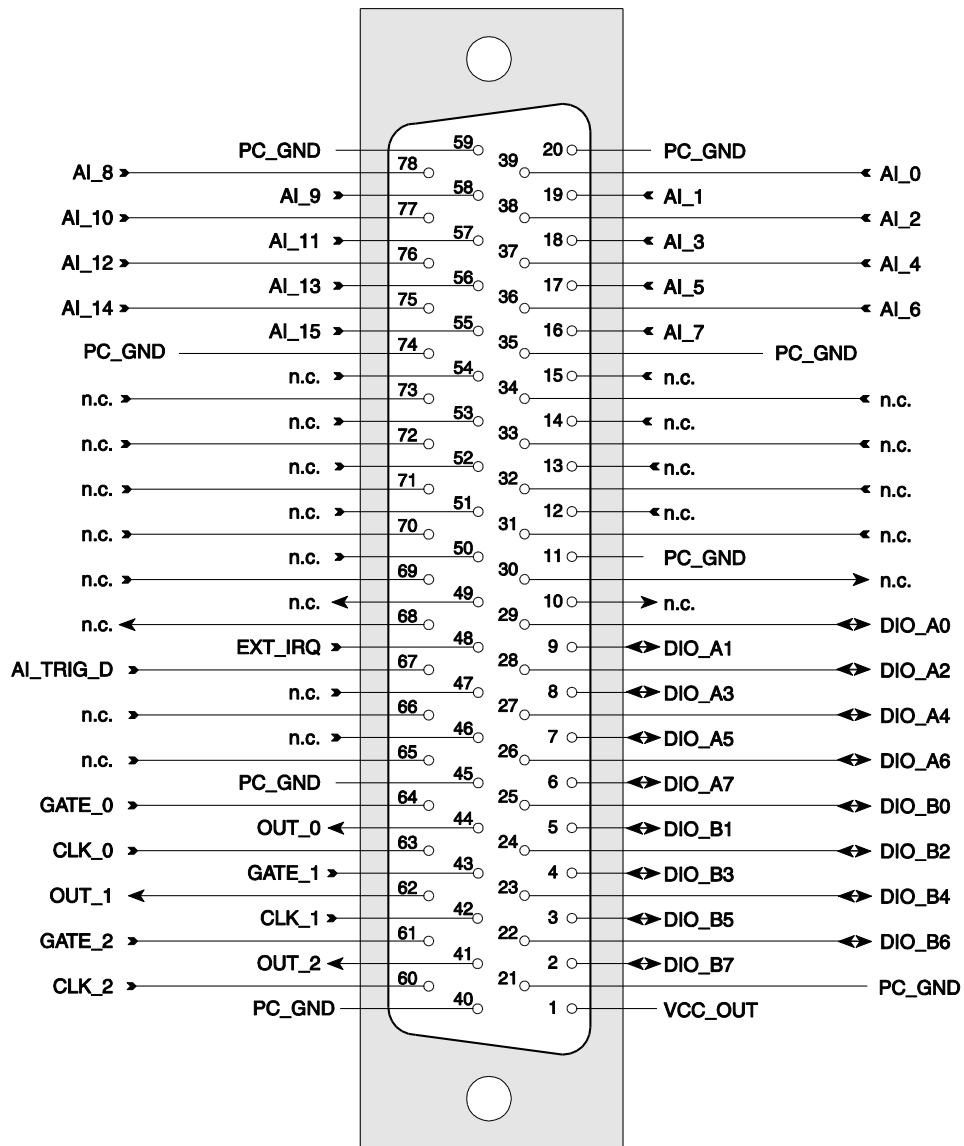


Diagram 29: 78-pin D-Sub female connector ME-4610 (ST1)

# B2 78-pin D-Sub Connector (ST1) ME-4650/4660/4670/4680

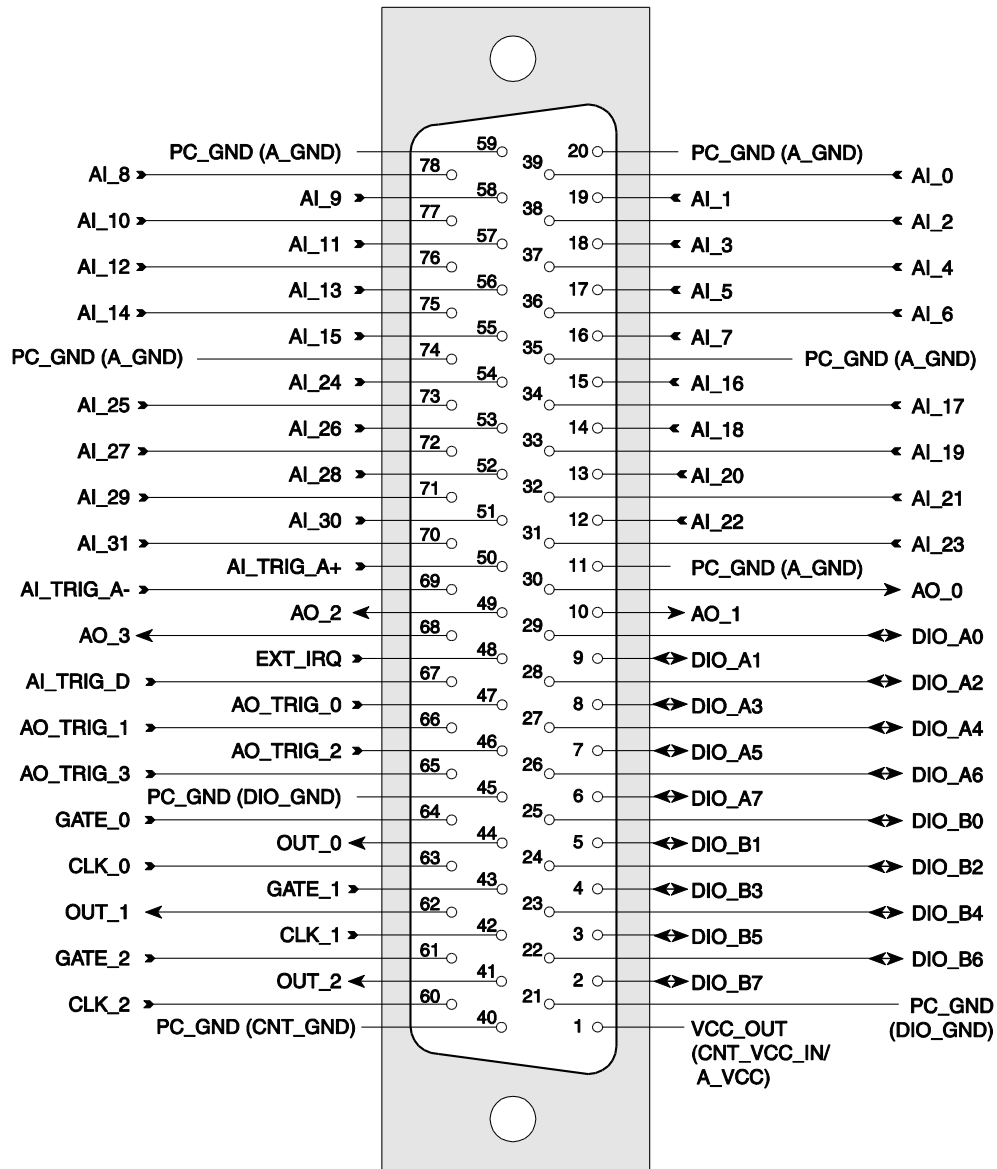


Diagram 30: 78-pin D-Sub female connector  
ME-4650/4660/4670/4680 (ST1)

Depending on the model not all pins of the 78-pin D-Sub connector are connected. The labels in brackets concern the opto-isolated versions ("I"-versions).

## B3 Auxiliary Connector „DIO“ (ST2)

Adapter cable (ME-AK-D 25F/S (cPCI)) from 20-pin IDC-connector to mounting bracket with 25-pin D-Sub female connector (comes with the board).

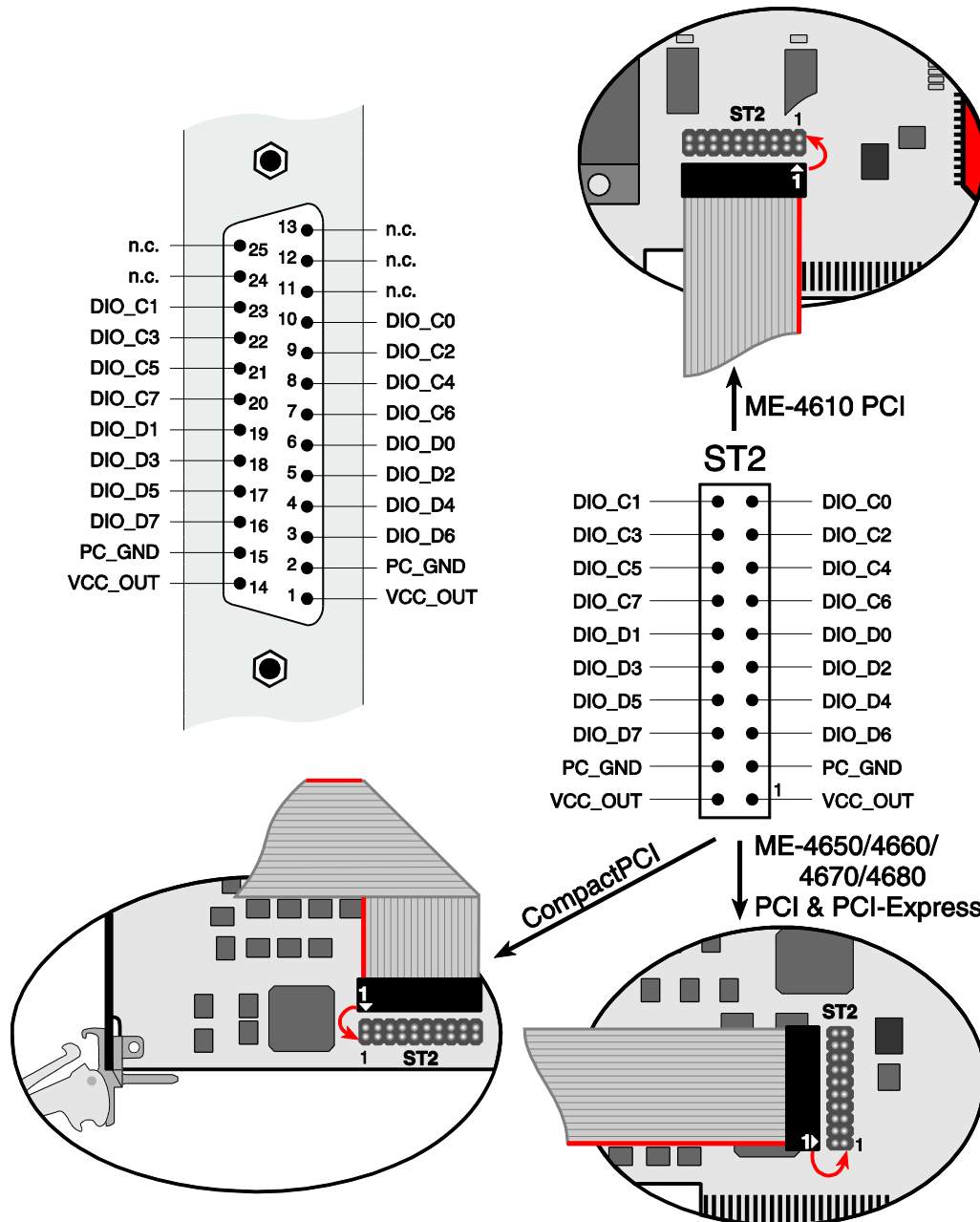


Diagram 31: Auxiliary connector "DIO" for ME-4600 (top view)

**Note:** Connect the mounting bracket pin 1 of the flat ribbon cable (red marked line) as shown above to the IDC-connector ST2.

## B4 Auxiliary Connector „FIO“ (ST2)

Diagram 32 shows the pinout of ST 2 in combination with „FIO“-option. Four pulse generator outputs and four frequency measurement inputs are available instead of the digital-I/O ports C and D.

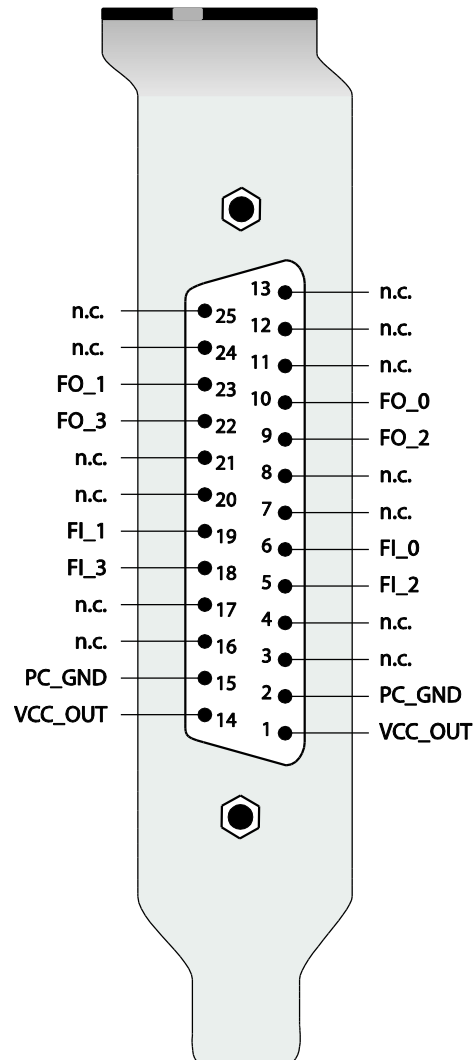


Diagram 32: Auxiliary connector "FIO" for ME-4600 (top view)

### Additional legend:

FI\_x Frequency measurement input („FIO“-Option)

FO\_x Pulse generator output („FIO“-Option)

**Attention!** Pins labeled with „n.c.“ may not be connected by your external switching. Otherwise the board can be irreversibly damaged!

**Note:** See Diagram 31 for connecting the adapter cable ME-AK-D25F/S (cPCI).



## **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/](http://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:

**Meilhaus Electronic GmbH**

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Am Sonnenlicht 2  
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**Sales:**

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**Support:**

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Fax: (08141) 52 71 – 169

eMail: [support@meilhaus.de](mailto:support@meilhaus.de)

**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](http://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](http://www.meilhaus.de/en/infos/service/rma.htm).

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