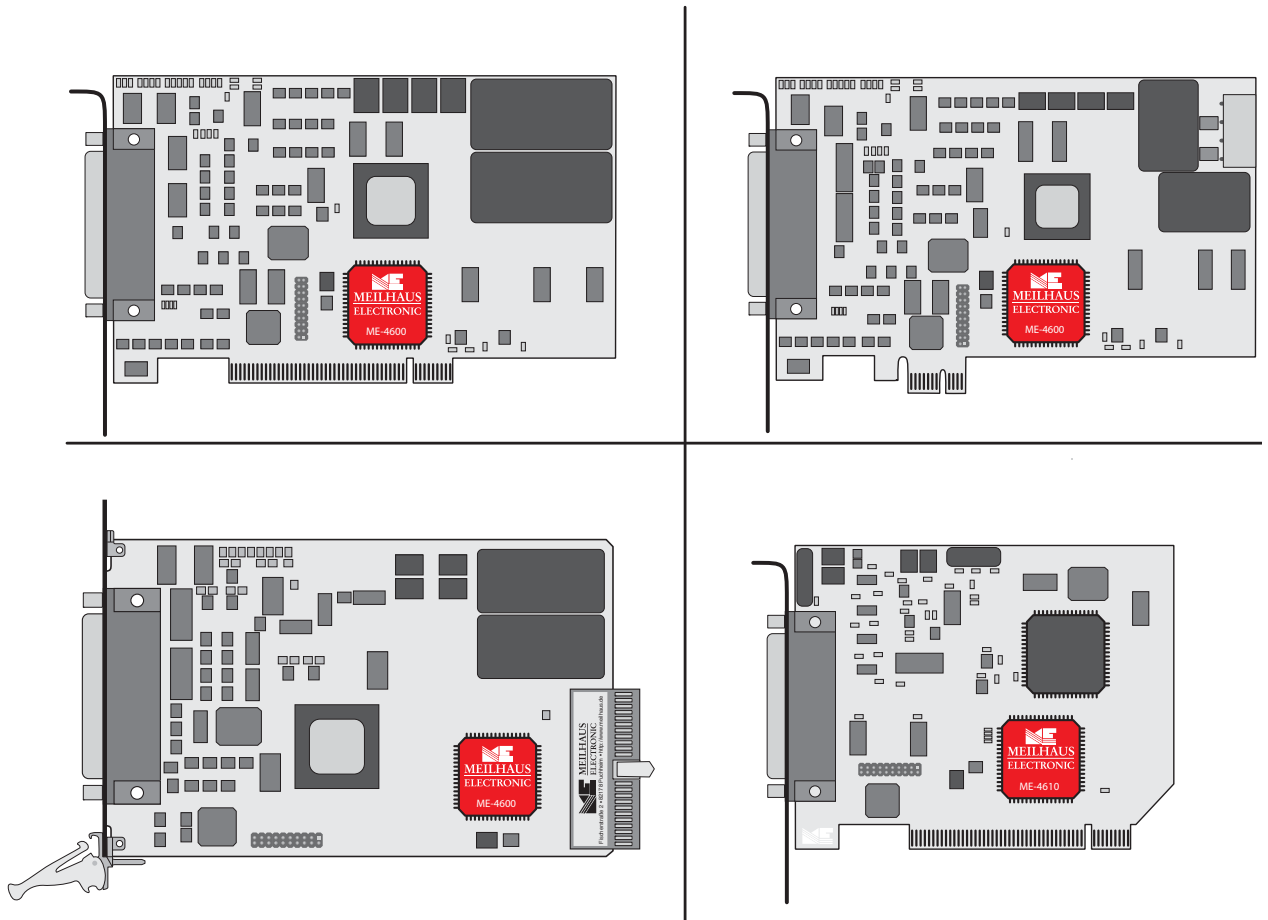


Meilhaus Electronic Manual

ME-4600 Series 2.3E

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



16 bit Multifunction Board with up to 32 A/D and 4 D/A Channels
Optional: Opto Isolation, Sample & Hold and Frequency IO

Imprint

Manual ME-4600 Series

Revision 2.3E

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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.

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, contact us immediately.

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

The descriptions in this manual concern PCI, PCI-Express and CompactPCI versions of the ME-4600 series if not otherwise noted.

1.1 Important Notes

1.1.1 Use in Accordance with the Requirements

The PC boards of the ME-4600 series are designed for acquisition and output of analog and digital signals with a PC. Depending on type install the models of the ME-4600 series into:

... a free PCI slot (ME-46x0 PCI) or

... a free PCI-Express slot (ME-46x0 PCIe) or

... a free CompactPCI slot (ME-46x0 cPCI)

For installing a plug-in board please read the manual of your PC.

Please follow the notes and the specifications from page 51 on:

- Ensure a sufficient heat conductance from the board in 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.
- Basically 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 when handling the board or when 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 the both screws, otherwise proper operation of the board can not 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 of the USB models only an authorized power adapter may be used.

Make sure, that not any contact with voltage-carrying parts can happen by the external wiring of the device. Basically all connections should only be made or removed in a powered down state.

1.1.3 Unforeseeable Misapplication

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

1.2 Package Contents

We take great care to make sure that the package is complete in every way. We do ask that you take the time to examine the content of the box. Your box should consist of:

- Multifunction board of the ME-4600 series for PCI, PCI-Express resp. CompactPCI bus.
- Manual in PDF format on CD/DVD.
(optional as printed version)
- Driver software on CD/DVD.
- 78pin D-Sub male connector
- Additional mounting bracket ME-AK-D25F/S (cPCI) for PCI, PCI-Express resp. CompactPCI slot.
- 25pin D-Sub male connector

1.3 Features

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

* Note: not all theoretical variations are available as standard models for immediate delivery (see our website for more details: www.meilhaus.com/me-foxx).

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&D and „FIO“ option)

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 500 kHz A/D converter. With exception of the ME-4610 the following input ranges are available: 0...2.5 V, 0...10 V, ±2.5 V and ±10 V. The input voltage range of the ME-4610 is fixed to ±10 V.

All models without opto-isolation have **2 bi-directional 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 bi-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 **four**

channels for 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 ± 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 & Hold**” option.

1.4 System Requirements

The ME-4600 can be installed into any PC with a free standard PCI, PCI-Express resp. CompactPCI slot (32 bit, 33MHz, 5V). The board is supported by the Meilhaus Intelligent Driver System (ME-iDS) under Windows 2000 or higher and Linux kernel 2.6 or higher.

1.5 Software Support

The ME-4600 is supported by the Meilhaus 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 as well as Linux systems with kernel 2.6 and contains an 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 read also the notes in the appropriate read-me files.

2 Starting up

Please read your computer manual instructions 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 un-pack the software **before installing the board**. First choose a directory on your computer (e. g. C:\Temp\Meilhaus\ME-iDS).

Use the Meilhaus 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.

- **Installation under Linux**

Note the installation instructions included with archive file of the appropriate driver.

2.2 Power Supply for PCI-Express Models

Because of the PCI-Express slot drives not sufficient 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)

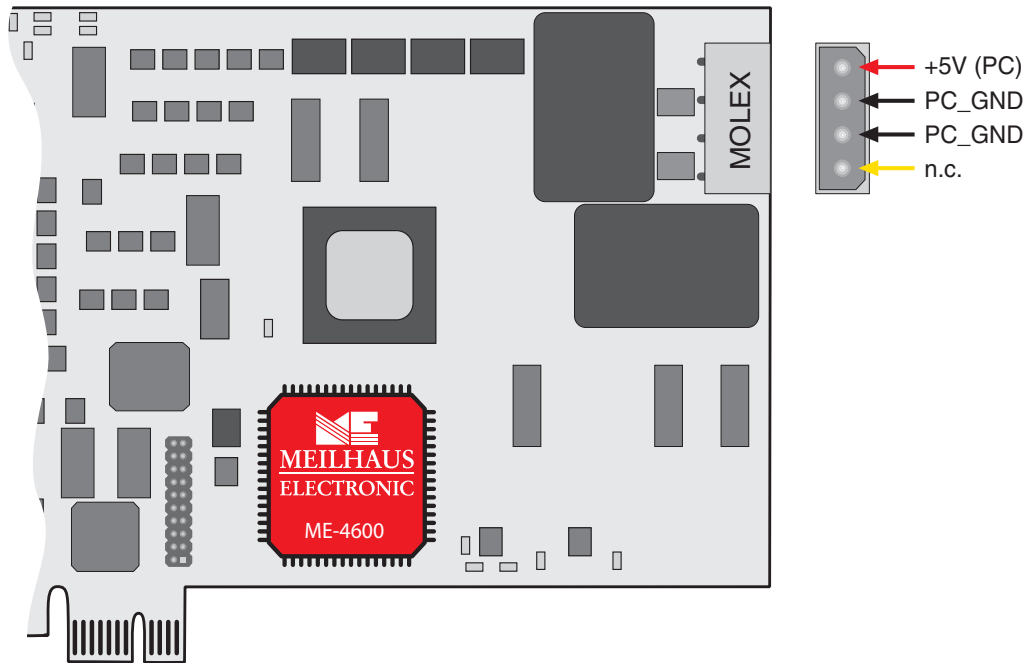


Diagram 1: Additional supply PCI-Express models

2.3 Test Program

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

3 Hardware

3.1 Block Diagrams

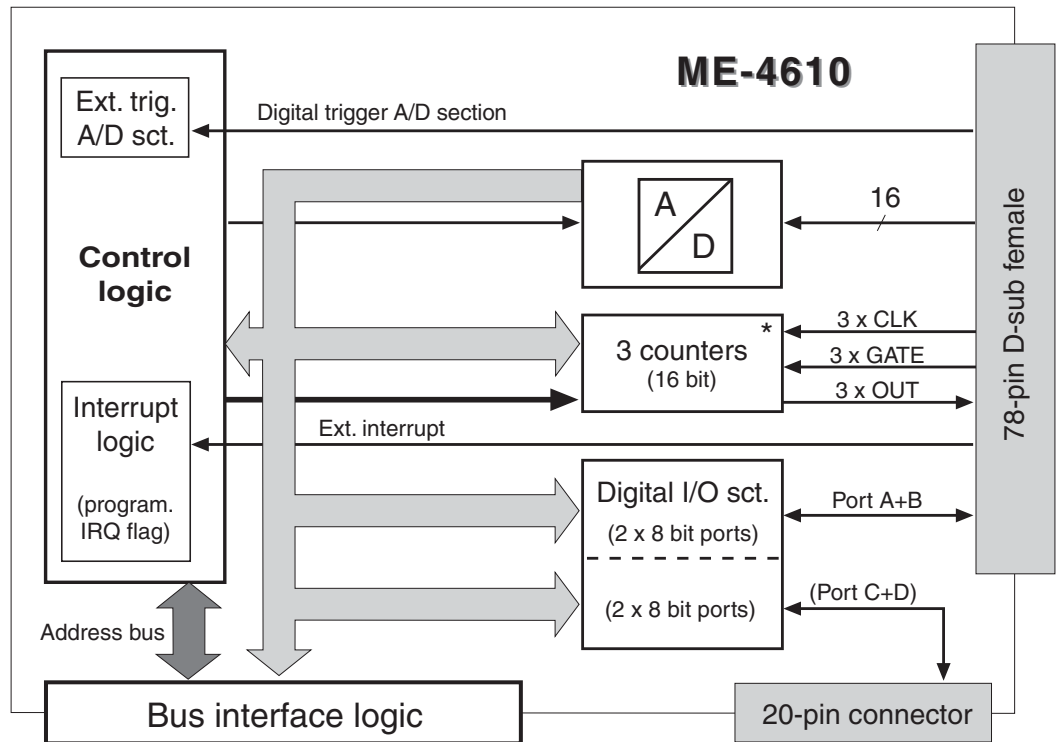


Diagram 2: Block diagram of ME-4610

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

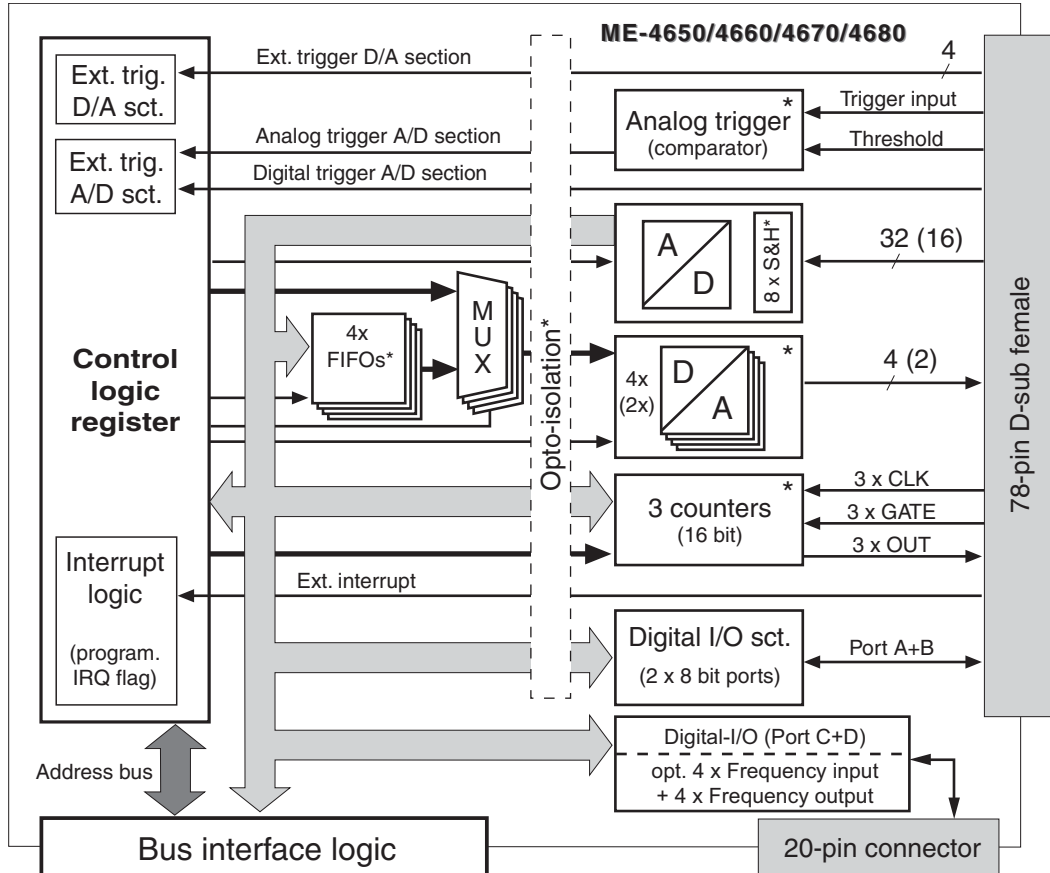


Diagram 3: Block diagram of ME-4650/60/70/80

*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 78pin D-Sub connector is shown in Appendix B on page 59.

The following chapters describe the wiring and connections of the different functional groups. For programming please read the chapter 4 (from page 35 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 isolated 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 & 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 & 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 $-10\text{V} \dots (+10\text{V} - 1\text{LSB})$.

The following (ideal) characteristic curves are valid:

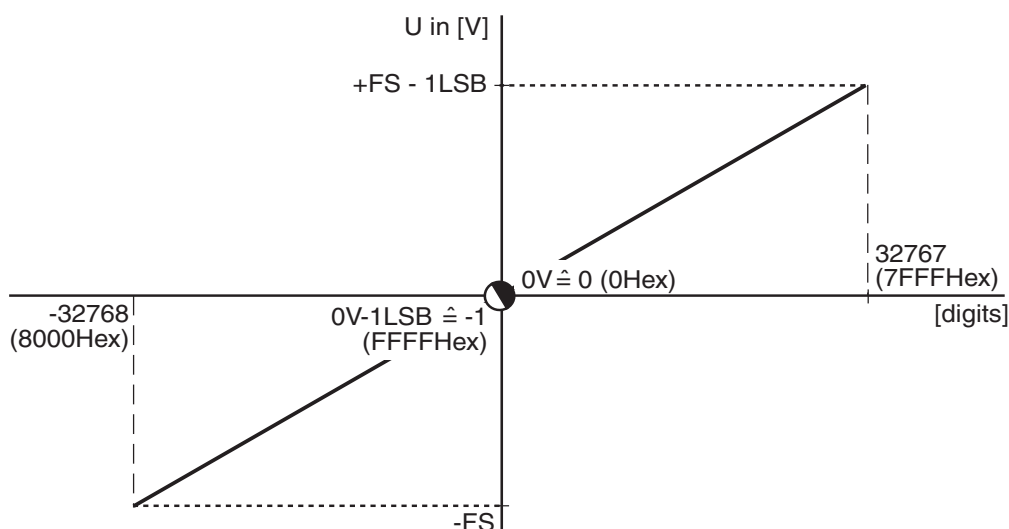


Diagram 4: Characteristic of bipolar input ranges

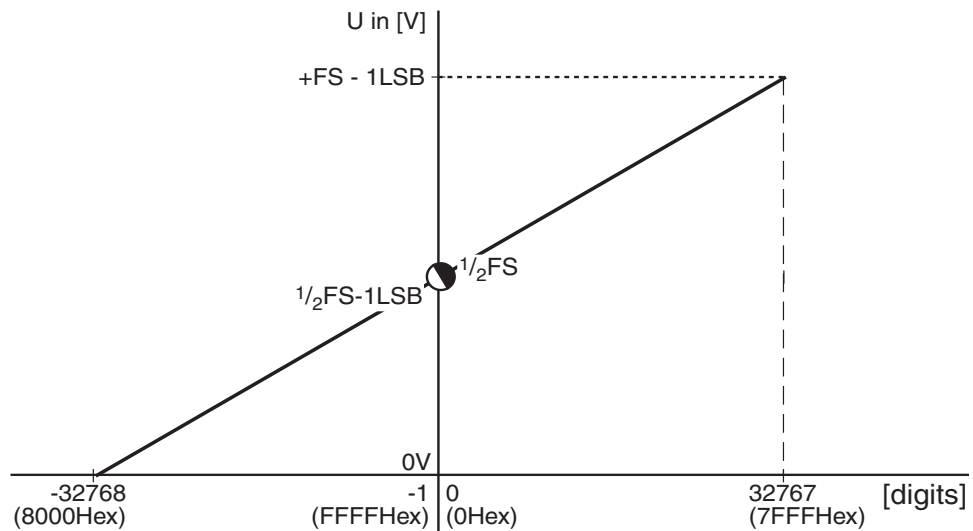


Diagram 5: Characteristic of unipolar input ranges

(„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 51).

Timer controlled A/D conversion can be achieved using the 32 bit chan and 36 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 (ME-4610/4650/ME-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).

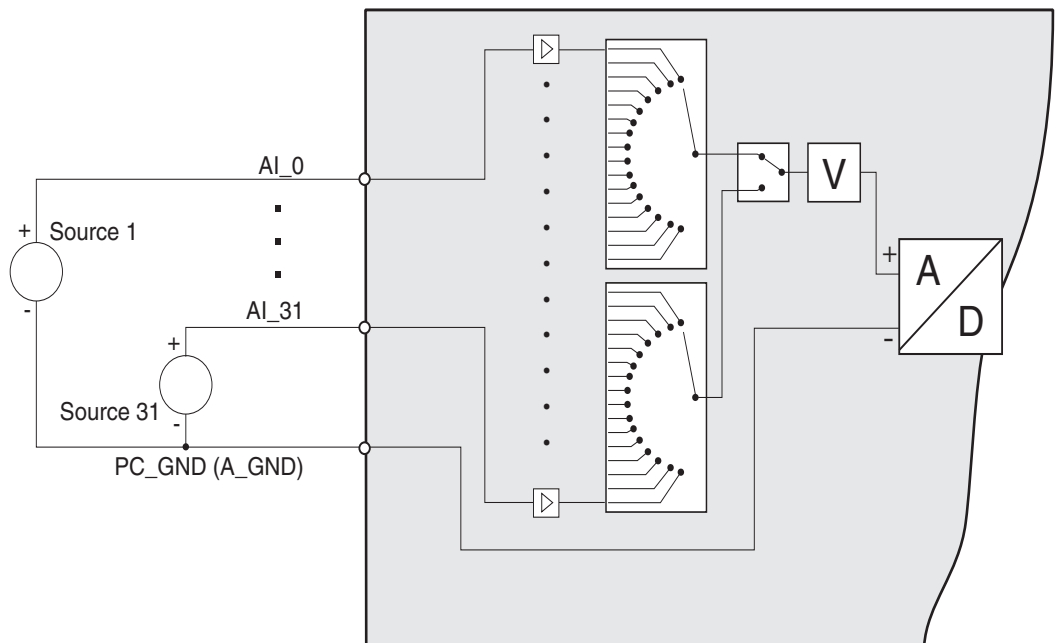


Diagram 6: Wiring in single ended operation

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 ($\pm 2.5V$ and $\pm 10V$). Each input channel requires a 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 organised:

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 kΩ).

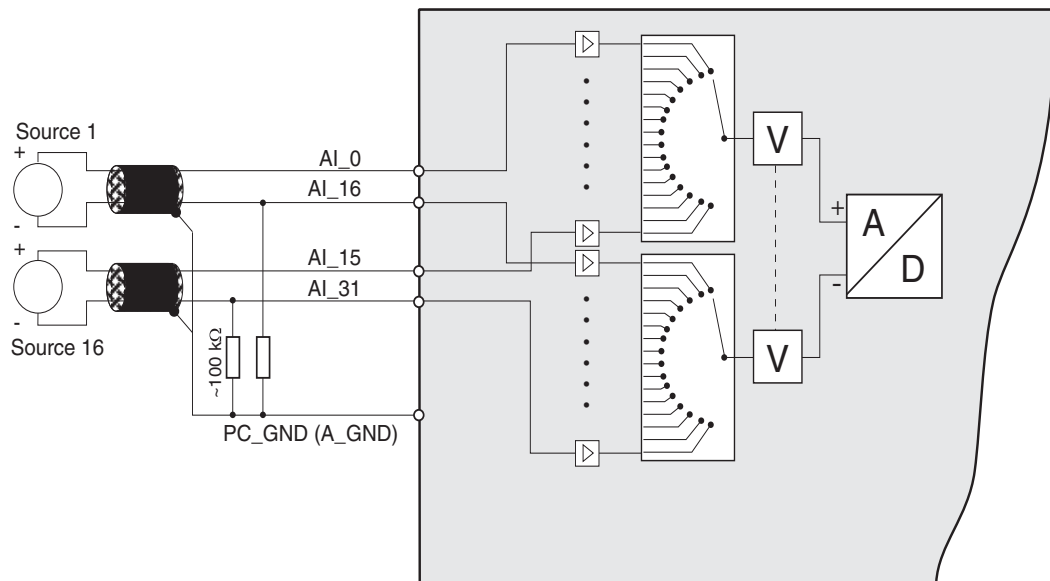


Diagram 7: Wiring in differential operation

3.2.3 Sample & Hold Option

Boards with the Sample & Hold option („s“-versions) allow a 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 & hold option is used or not.

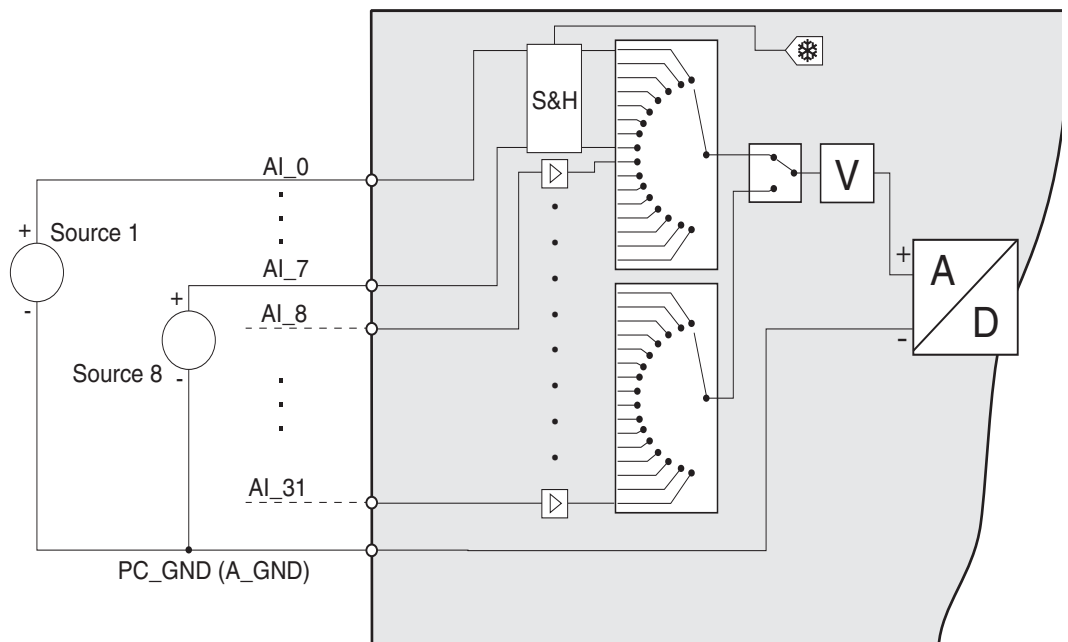


Diagram 8: Wiring in simultaneous operation

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 be used for simultaneous operation, otherwise the „frozen“ voltage value will “melt” at a rate of $\text{typ. } 0.08\mu\text{V}/\mu\text{S}$.

- 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:

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

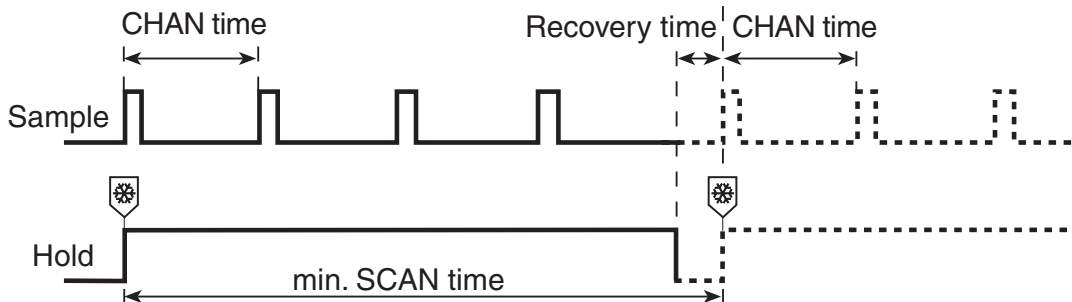


Diagram 9: Sample and Hold timing

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 **AD_TRIG_A+** (pin 50) and the **AD_TRIG_A-** (pin 69) inputs.

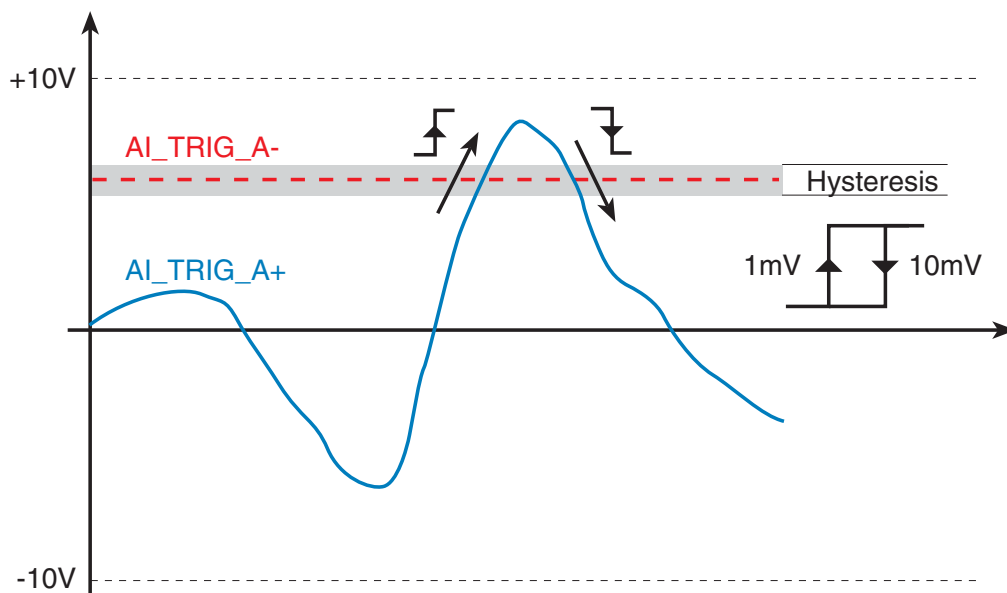


Diagram 11: Analog Trigger

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 500 kHz at ± 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).

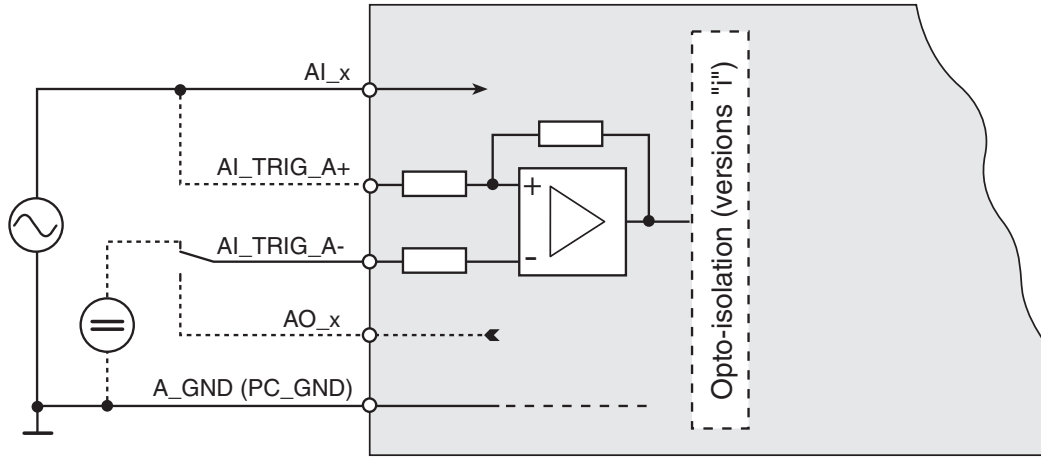


Diagram 12: Wiring analog trigger

3.2.4.2 Digital Trigger A/D Section

The digital trigger input (AD_TRIG_D) requires a high level of +5V. 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).

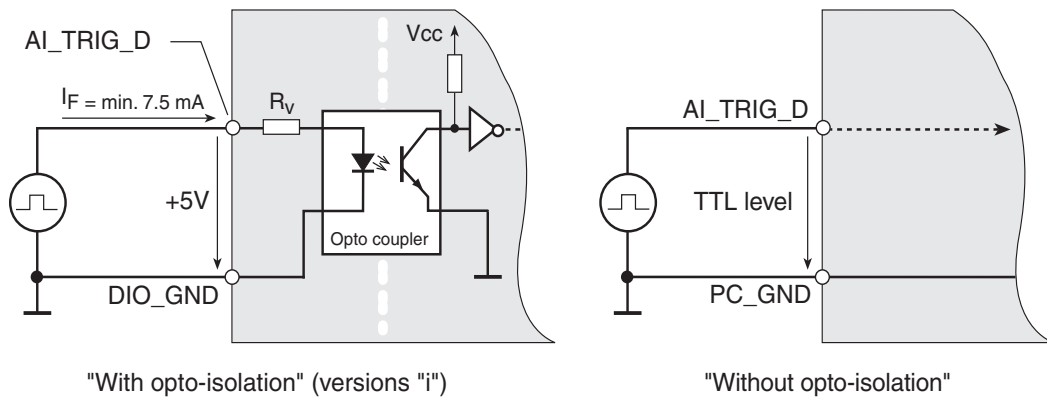


Diagram 13: Wiring digital trigger

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 serial 16 bit D/A converter and converts up to 500 kS/s. The output voltage range for each channel is from -10V to +10V-1LSB.

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.

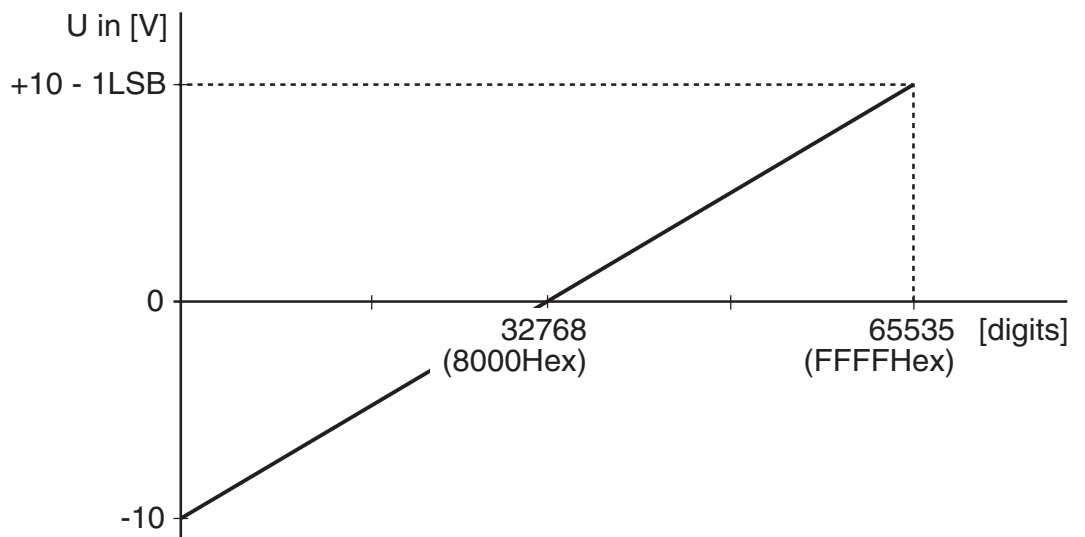


Diagram 14: Characteristic of the D/A channels

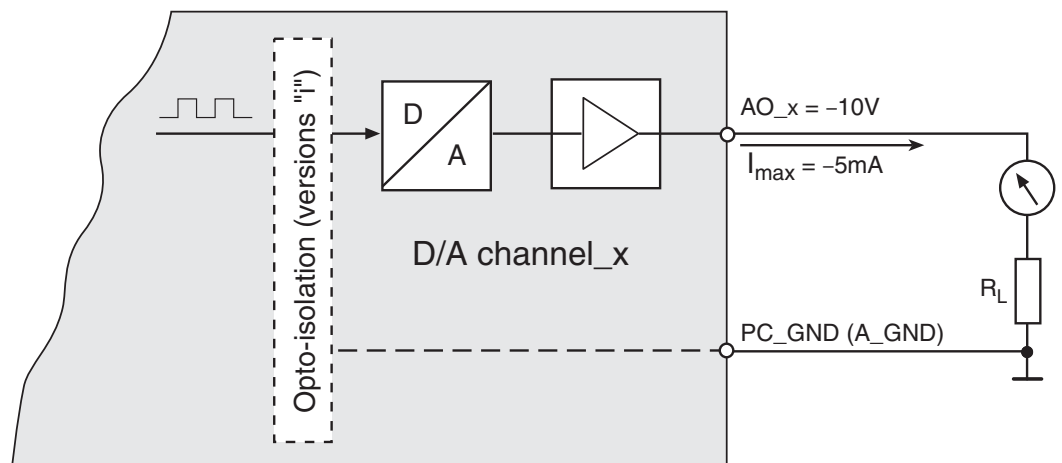


Diagram 15: Wiring of the analog outputs

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

The optically isolated models (“i” versions) have D/A channels which are isolated from the 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 be within the specified limits (see specifications on page 51) 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 trigger inputs is set for a high level of +5V at $I_F = 7.5$ mA. For not opto-isolated inputs TTL level is valid.

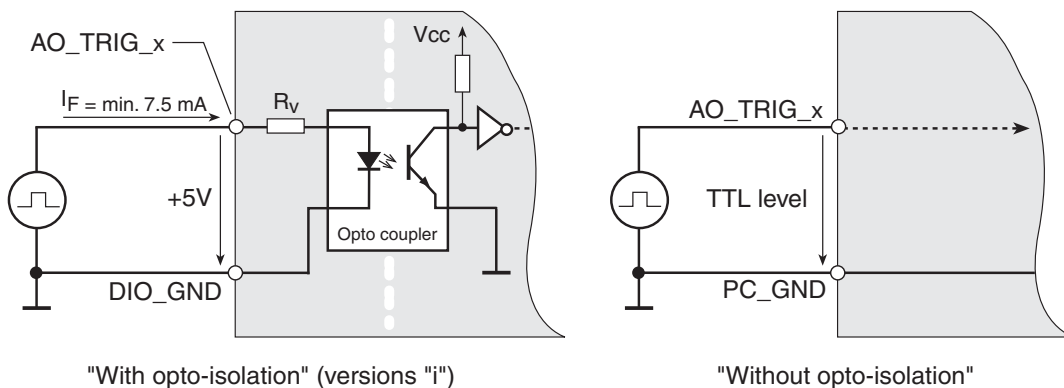


Diagram 17: Wiring of the D/A trigger inputs

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 20pin 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 41.

3.4.1 Digital Inputs

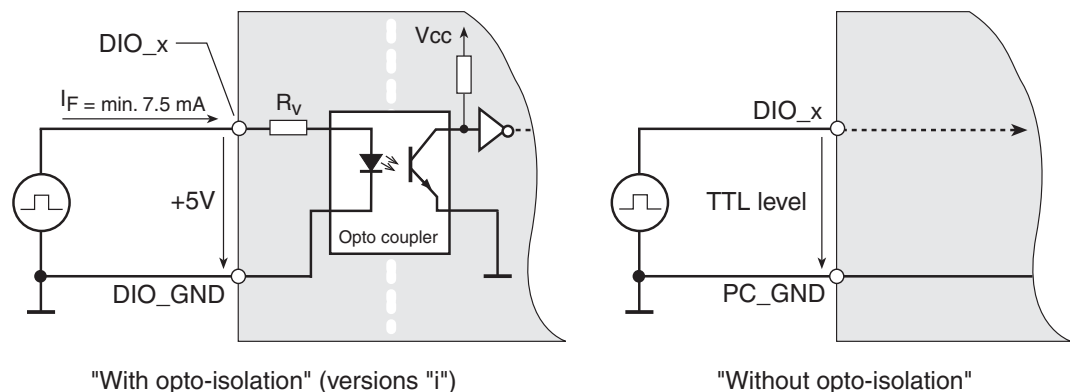


Diagram 18: Wiring of the digital inputs

It is important that the voltage levels of the digital input wiring be within the specified limits (see specifications on page 51) 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 +5V at $I_F = 7.5$ mA. For not opto-isolated inputs TTL level is valid.

3.4.2 Digital Outputs

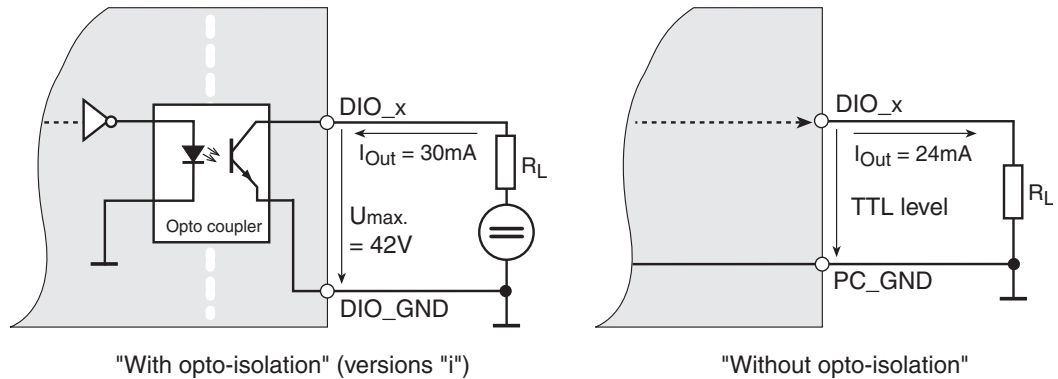


Diagram 19: Wiring of the digital outputs

It is important that the voltage levels of the digital output wiring be within the specified limits (see specifications on page 51) and that a reference to PC ground (PC_GND) resp. digital ground (DIO_GND) for the "i" versions be 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_{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 „after-market 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-Ausgänge for output of a periodic rectangular signal up to 5.5 MHz with variable duty cycle

The according pins can be applied by the 20pin 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 63.

The frequency counter and pulse generators are configured by software. For programming the frequency input/output, refer to chapter 4.4 on page 44.

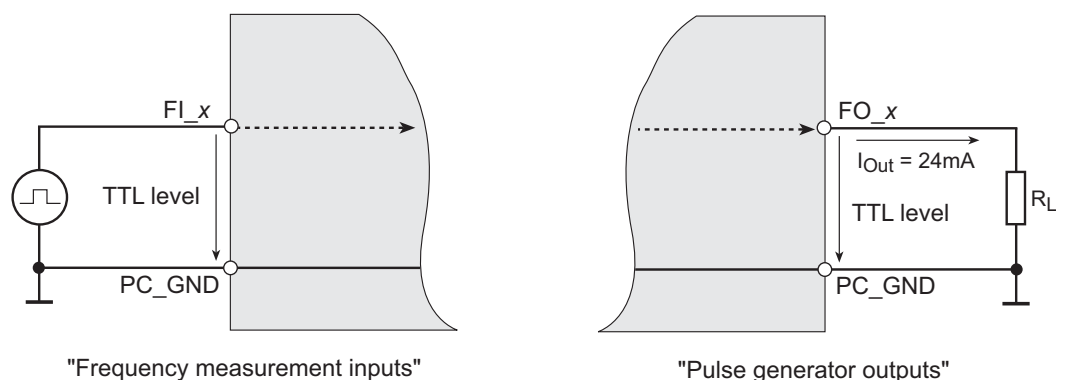


Diagram 20: Wiring of the „FIO“ option

It is important that the voltage level of the frequency inputs and outputs meets the TTL level (see specifications on page 55) 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 (not ME-4650) use the 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: 5V, Opto: 0V) 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 10MHz. The counters can be cascaded by making the 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 $I_{OH} = 6\text{mA}$.

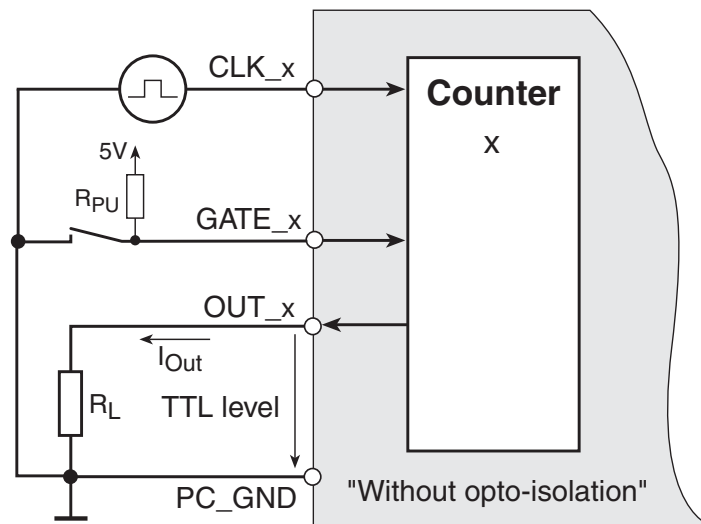


Diagram 21: Wiring of counters without opto-isolation

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 +5V/30mA 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.

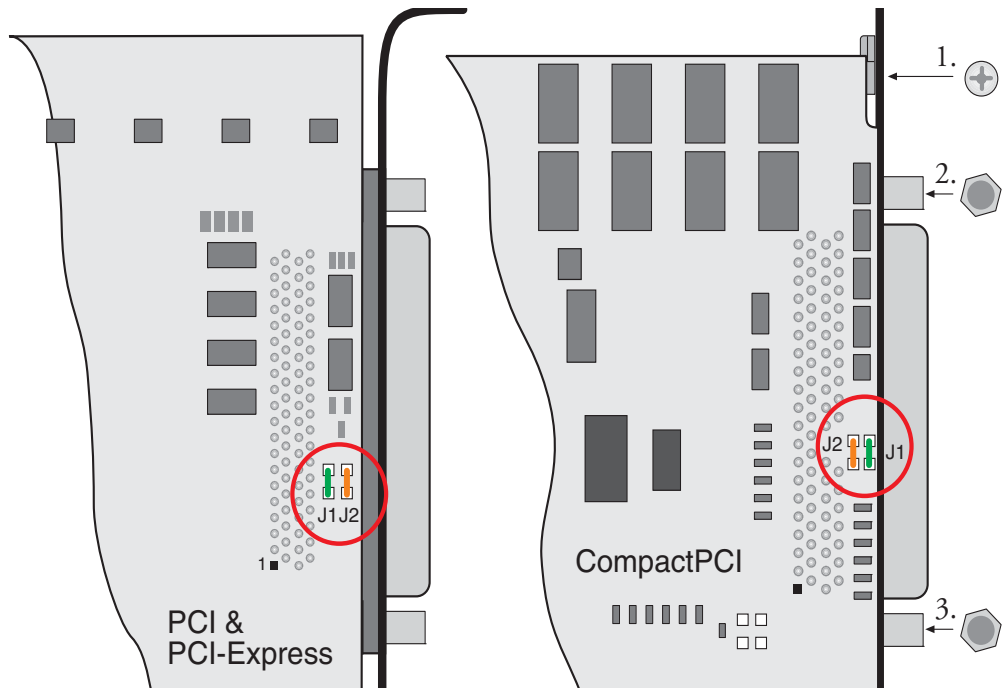


Diagram 22: Rear view (J1, J2)

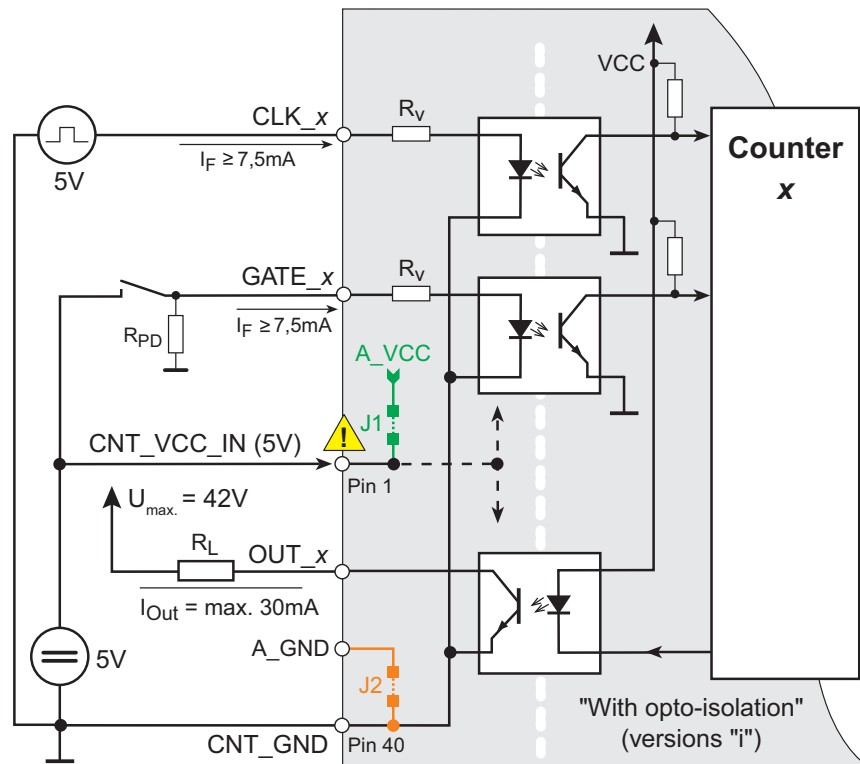


Diagram 23: Wiring of the counters with opto-isolation

- ! **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 driving (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 +5V. It applies for I_F : $7.5\text{mA} \leq I_F \leq 10\text{mA}$.

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

For programming the counters please read chapter 4.5.

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_{OUT_2} :

$$f_{OUT_2} = \frac{\text{Base clock}}{\langle \text{Prescaler} \rangle \cdot 100} \quad (\text{with } \langle \text{Prescaler} \rangle = 2 \dots (2^{16} - 1))$$

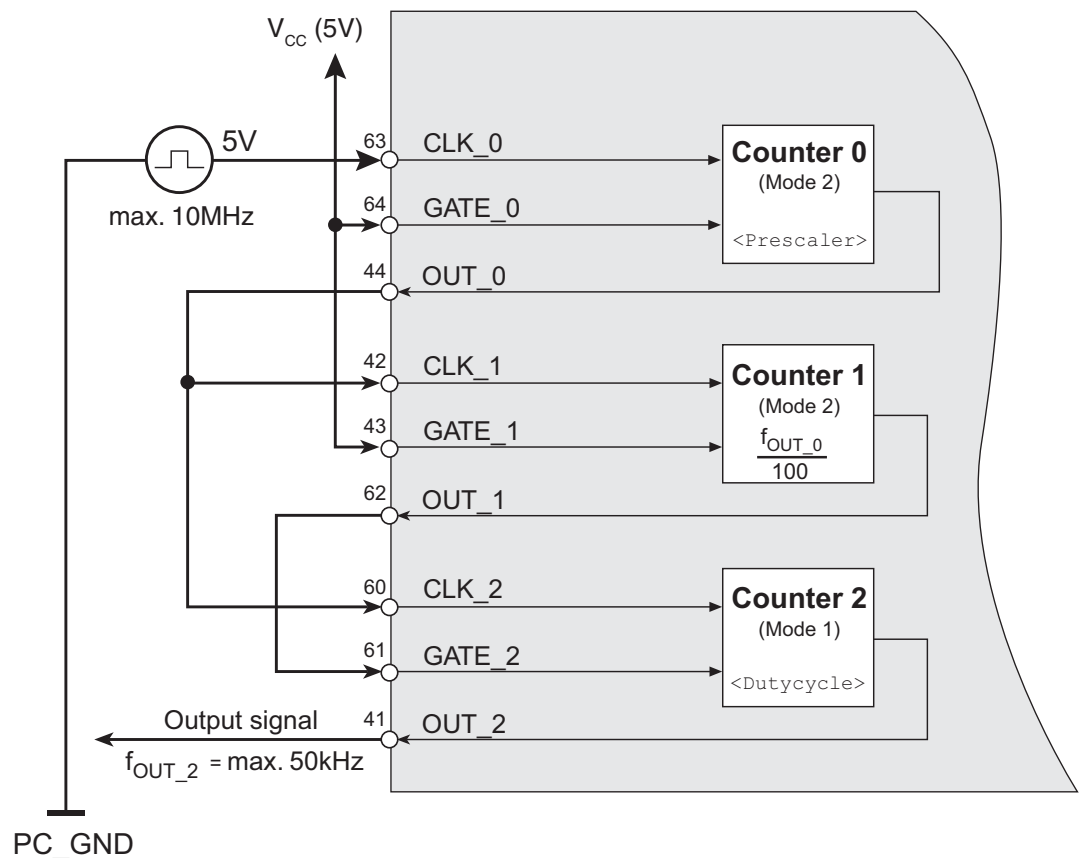


Diagram 24: PWM wiring without opto-isolation

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 $R_{1/2/3}$ is an example for $U_{\text{ext.}} = 24\text{V}$.

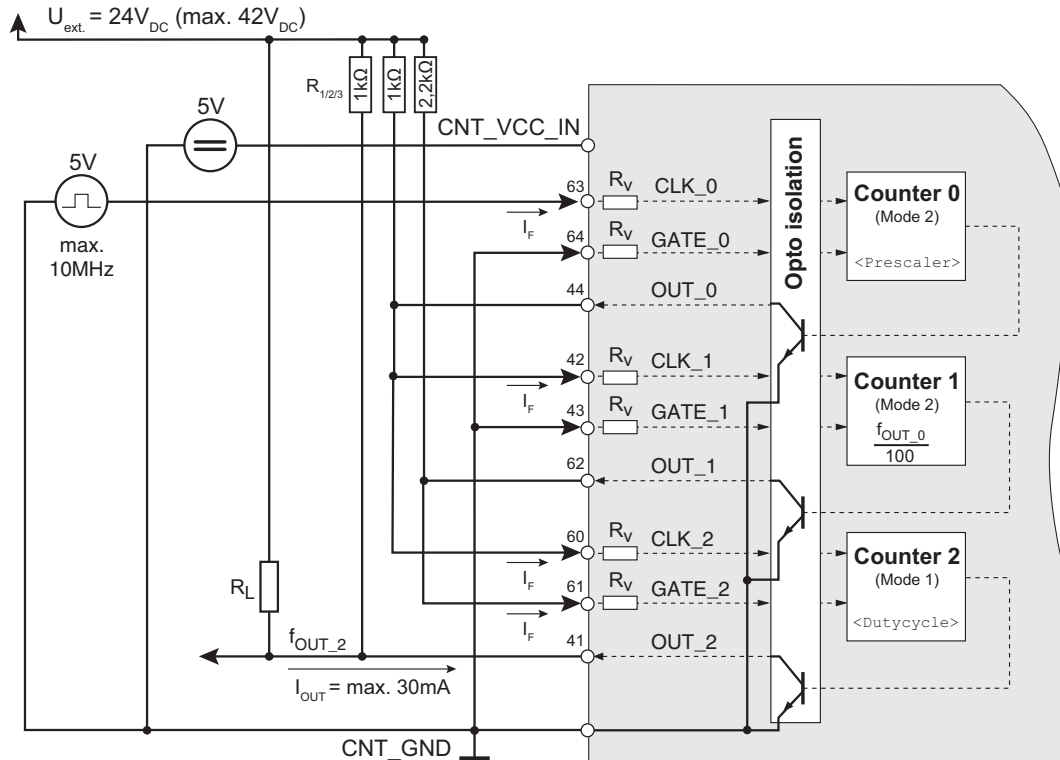


Diagram 25: PWM wiring with opto-isolation

! **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 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.

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_{max} must not exceed 42V! The maximum output current I_{Out} of the optically isolated versions must not exceed 30mA.

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()`.

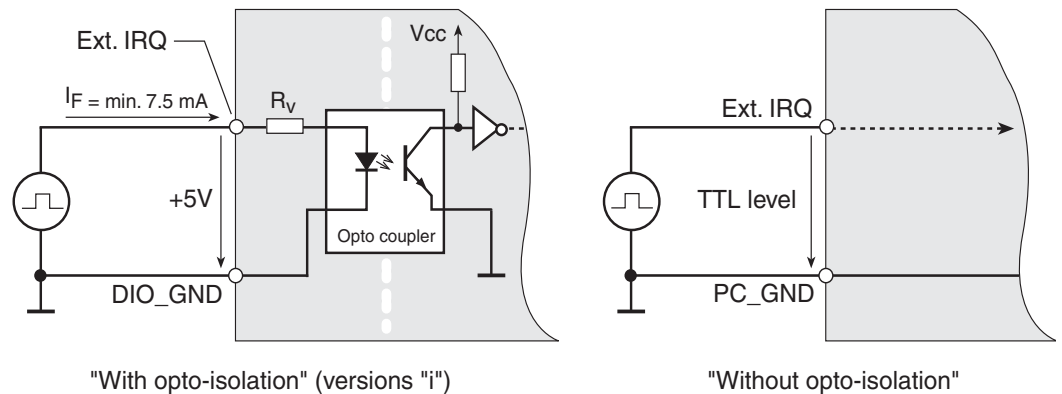


Diagram 26: Wiring of external interrupt input

For programming the external Interrupt please read chapter 4.6 on page 49.

4 Programming

For programming the device you find the Meilhaus Intelligent Driver System (ME-iDS) included with your package. The ME-iDS is a unique driver system covering different devices and operating systems. It supports Windows 2000 and higher as well as Linux systems with kernel 2.6 and higher and contains an 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 under: www.meilhaus.com/download). Further details regarding to 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 called 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 don't want to program your board with the ME-iDS you find the last revision of the old function reference in the ME-4600 manual Rev. 1.8 (see: www.meilhaus.com). 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	ME-4670	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, subtype 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...2.5V; 0...10V; $\pm 2.5V$; $\pm 10V$; ME-4610: $\pm 10V$ (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 & 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	ME-4670	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, subtype 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...2.5V; 0...10V; ±2.5V; ±10V; ME-4610: ±10V (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 & 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 36 bit SCAN timer. A 33MHz time base is used by both timers. This allows a period time of $30.\overline{30}$ ns, this is the smallest possible time unit and is defined as “one tick” from now on. For convenient conversion, the functions *meIOStreamFrequencyToTicks* and *meIOStreamTimeToTicks* 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 μs...130 s can be set (PCI-Express: 4 μs...130 s according to a max. sample rate of 250 kHz).

- The SCAN timer (<i>iScanStartTicks...</i>) 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 30.3 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	ME-4670	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, subtype 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: $\pm 10\text{V}$; „U-Plus“ channel ME-6200/6300 (subdevice 10): 0...50V.
- 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	ME-4670	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, subtype 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: $\pm 10V$.
- 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 33MHz base frequency. This results in a period of $30.30ns$, 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 bi-directional 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 25.

The following operation modes are possible:

4.3.1 Simple Input/Output

ME-4610	ME-4650	ME-4660	ME-4670	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, subtype 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	ME-4670	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 can not 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 subtype 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_CONFIG_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 33MHz base frequency. This results in a period of 30.30ns, 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.

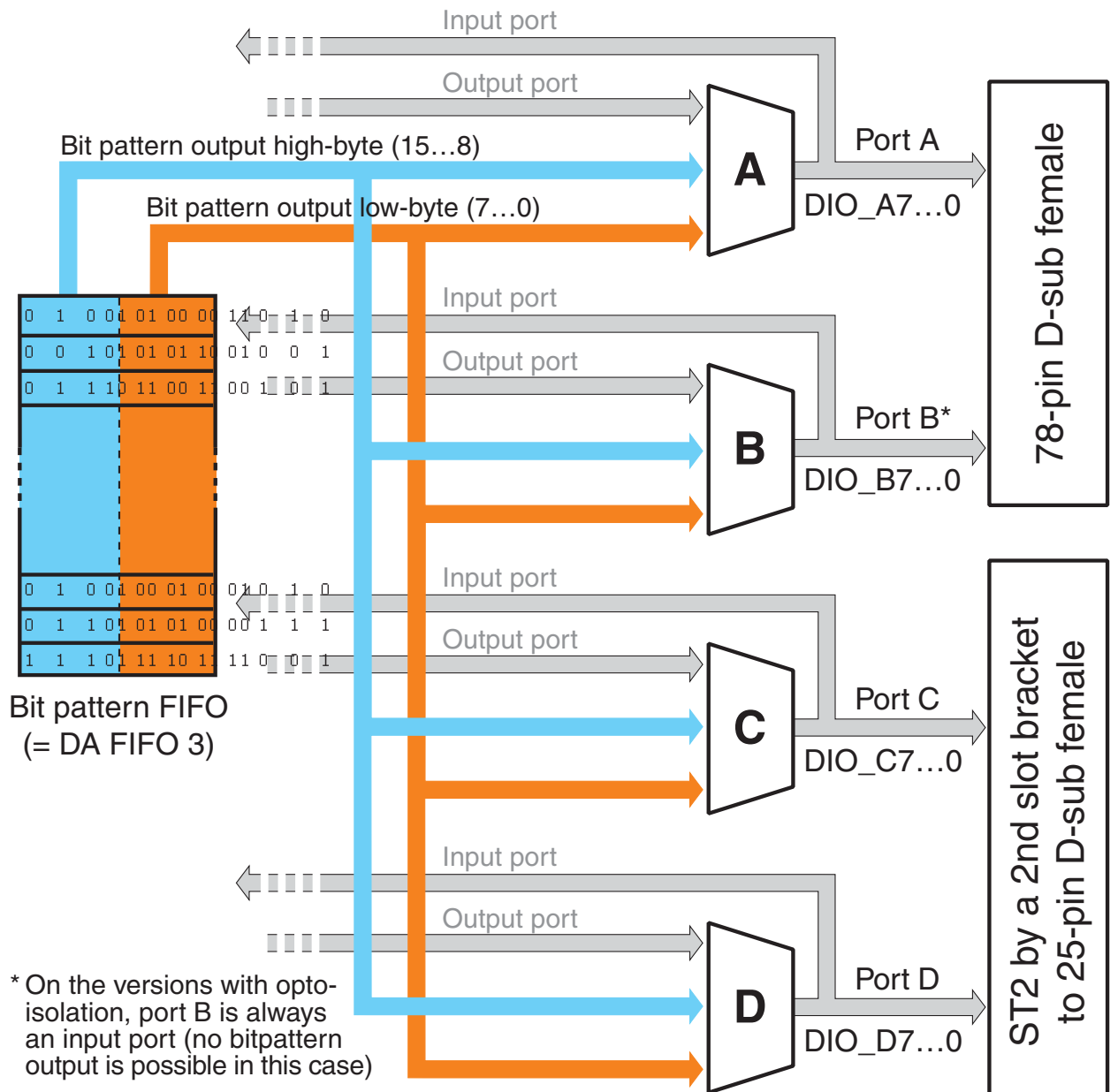


Diagram 27: Port mapping

4.4 Frequency Input/Output

Each channel for frequency measurement (input) resp. pulse output (pulse generator) is considered as an independent sub-device of sub-type „Single“ in the Meilhaus Intelligent Driver System (ME-iDS). Each sub-device 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 one value defines the period T and the other 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“.

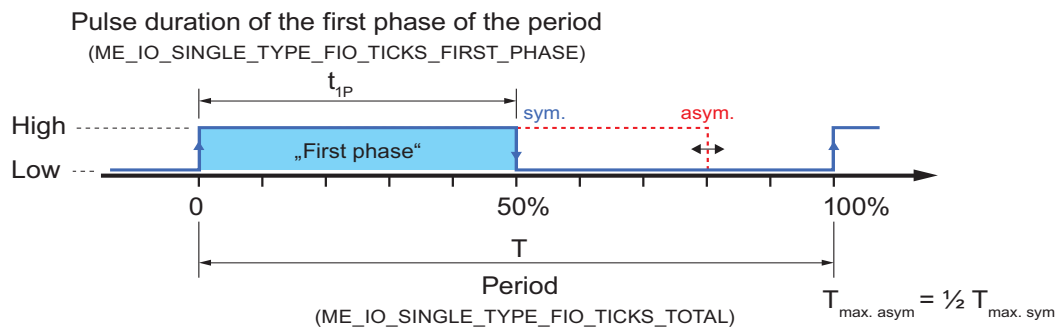


Diagram 28: Signal definition

A 33 MHz counter serves as time reference configured by the function `meIOSingleConfig()`. This results in a period of 30.30ns, which is the smallest time unit available and is defined as “1 Tick”. The resolution of T and t_{1P} is 1 Tick (see also specifications on page 55).

Note that the value for the maximum period $T_{\max.}$ is differing in dependency of the duty-cycle. There is an 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: $T_{\max. \text{ asym.}} = 32,5\text{s}$ (0,03Hz); $T_{\max. \text{ sym.}} = 65\text{s}$ (0,015Hz).

For wiring the digital ports please read chapter 3.5 on page 27.

The following operation modes are possible:

4.4.1 Frequency Measurement

ME-4610	ME-4650	ME-4660	ME-4670	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 = 30.3 ns. Each frequency measurement channel (FI_0...3) is accessed as independent sub-device 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 *meIOSingleConfig()*, *meIOSingle()* und *meIOSingleTicksToTime()* are relevant:

- Configuration of the sub-device by the function *meIOSingleConfig()*:
 - One channel per sub-device: `<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 *meIOSingle()*.
- To read the period and the duration of the first phase of the period you have to call the function *meIOSingle()* 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 *meIOSingleTicksToTime()*. 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 *meIOSingle()*.

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	ME-4670	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 sub-device of type ME_TYPE_FO, sub-type 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 `meIOSingleConfig()`, `meIOSingle()` and `meIOSingleTimeToTicks()` are relevant:

- Configuration of the sub-device by the function `meIOSingleConfig()`:
 - One channel per sub-device: `<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 `meIOSingleTimeToTicks()` 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	ME-4670	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, 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).

4.5.1 Standard Operation Modes

The counters can be configured independently of each another by the function *meIOSingleConfig()* 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

4.5.2 Pulse Width Modulation

With the wiring shown in diagram 24 resp. 25 from page 31 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	ME-4670	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 *meIOIrq...* functions. The Interrupt is considered to be a independent subdevice of type ME_TYPE_EXT_IRQ. After enabling the external interrupt by the function *meIOIrqStart()* 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“.

Appendix

A Specifications

(Ambient temperature 25°C)

PC Interface

PCI bus	32 bit, 33 MHz, 5 V, PCI Local Bus Specification Version 2.1
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	fully supported

Voltage Inputs

Measurand/criterion	Condition/annotation	Value
Number of A/D-channels	ME-4610/4650/4660	16 single ended
	ME-4670/4680	32 single ended/16 differential
„Sample&Hold“ channels	opt.	8 single ended simultaneously sampling
A/D converter		500 kHz, 16 bit
Input ranges	ME-4610	-10V...(±10V-1LSB) (1LSB = 305µV)
	ME-4650/4660/4670/4680	0V...(±2.5V-1LSB) (1LSB=38µV); 0V...(±10V-1LSB) (1LSB=152µV); -2.5V...(±2.5V-1LSB) (1LSB=76µV); -10V...(±10V-1LSB) (1LSB=305µV)
Full Scale Error	unipolar	0V+10LSB, +FS-10LSB
	bipolar	-FS+10LSB, +FS-10LSB
Inputs protected up to		±15 V
Input impedance	without Sample & Hold	$R_{IN} = \text{typ. } 600 \text{ M}\Omega$; $C_{IN} = \text{typ. } 3 \text{ pF}$
	Kanäle mit Sample & Hold-Option:	$R_{IN} = \text{typ. } 1 \text{ M}\Omega$; $C_{IN} = \text{typ. } 5 \text{ pF}$
Total accuracy	fullscale in input range ±10 V	typ. ±4 LSB, max. ±10 LSB
A/D-FIFO		2048 Werte-FIFO
Channel list		max. 1024 entries (channel number, gain, uni/bipolar, single ended/differential)
Smallest time unit for CHAN and SCAN timer		1 Tick $\hat{=}$ 30.30 ns $\hat{=}$ 33 MHz
CHAN-time (time between two consecutive channel list entries)	PCI, cPCI:	2µs up to ~130s (in steps of 30.30ns)
	PCIe	4µs bis ~130s (in steps of 30.30ns)

Measurand/criterion	Condition/annotation	Value
SCAN-time (time between two consecutive channel list processings)	PCI, cPCI	4µs bis ~30 minutes (in steps of 30.30ns)
	PCIe (at least 2 channels)	8µs bis ~30 minutes (in steps of 30.30ns)
Total sampling rate*	Single operation (dependent of system)	max. 500 kHz (cPCI, PCI) max. 250 kHz (PCIe)
	Streaming operation	max. 500 kHz (cPCI, PCI) max. 250 kHz (PCIe)
	Sample & Hold	Number of channel list entries (min. 2) x CHAN-time + 1.5 µs (relaxation time)
Relaxation time	Sample & Hold	1.5 µs
Operation modes		„Single“, „Streaming“, optional: „Sample & Hold“
Trigger modes	all models	software start, external digital trigger
	only ME-4670/4680	external analog trigger
Ext. trigger edges		rising, falling, any
Opto-isolation	„i“-versions	bis 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 don't 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}	$V_{CC}=4.5V$	max. 0.9V
U_{IH}	$V_{CC}=4.5V$	min. 3.15V
Delay time		max. 30ns

External Trigger with Opto-isolation

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

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		$\pm 10V$
Output current	per channel	max. 5mA
Settling time (DAC)	Full scale ($-10V \rightarrow +10V$)	max. 2 μ s
Total accuracy		max. $\pm 10mV$
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. 500V
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 each another	0...3
D/A FIFOs	per channel	4096 values
Sample rate		max. 500kS/s
D/A timer	programmable in steps of 30.30ns	2 μ s...130s

External Trigger without Opto-isolation

Measurand/criterion	Condition/annotation	Value
Reference to ground		PC ground (PC_GND)
Input level U_{IL}	$V_{CC} = 4.5V$	max. 0,9V
U_{IH}	$V_{CC} = 4.5V$	min. 3.15V
Delay time		max. 30ns

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. 5V
Delay time		typ. 80ns

Digital-I/Os

Number of ports	4 x 8 bit
-----------------	-----------

...without opto-isolation

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

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

Measurand/criterion	Condition/annotation	Value
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	42V (depends on external supply)
I_{Out}	Port A, B	max. 30mA
Input level I_F	Port A, B	$7.5\text{mA} \leq I_F \leq 10\text{mA}$
U_{IL}	Port A, B	max. 0.8V
U_{IH}	Port A, B	min. 4.5V, max. 5V*
Sample rate		max. 172kS/s (5.8 μ 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	(shared with D/A FIFO 3)	4k values
Sample rate	TTL port	max. 500kS/s (2 μ s)
	Opto-isolated port	max. 172kS/s (5.8 μ s)
Bit pattern timer	programmable in steps of 30.30ns	2 μ s...130s
External trigger input	Type: digital	AO_TRIG_3
Input level		see external trigger D/A section
Delay time	without opto-isolation	max. 30ns
	with opto-isolation	typ. 80ns
Trigger modes		Software start, ext. digital trigger
External trigger edges		rising, falling, any

Frequency Input/Output

Availability	„f“ option for ME-4660/4670/4680
Signal curve	Rectangular

Frequency Measurement Channels

Measurand/criterion	Condition/annotation	Value
Reference to ground		PC ground (PC_GND)
Number of channels	(FI_0...3)	4 inputs (TTL)
Input level	U_{IL} at $V_{CC} = 5V$	max. 0.8V
	U_{IH} at $V_{CC} = 5V$	min. 2V
Input current		$\pm 1\mu A$
Period (T)	$T_{min.} = T_{min. asym.} = T_{min. sym.}$	181.81ns (5.5MHz)
	$T_{max. asym.}$	32.5s (0.03Hz)
	$T_{max. sym.}$	65s (0.015Hz)
Duty-cycle	variable in dependency of T	adjustable in steps of 1 Tick
Resolution	1 Tick	30.30ns
Accuracy		$\pm 30.30ns$
Operation modes		„single“

Pulse Generator Channels

Measurand/criterion	Condition/annotation	Value
Reference to ground		PC ground (PC_GND)
Number of channels	(FO_0...3)	4 outputs (TTL)
Output level	U_{OL} at 24mA	max. 0.5V
	U_{OH} at -24mA	min. 2.4V
Period (T)	$T_{min.} = T_{min. asym.} = T_{min. sym.}$ $T_{max. asym.}$ $T_{max. sym.}$	121.21ns (5.5MHz) 32.5s (0.03Hz) 65s (0.015Hz)
Duty-cycle	variable in dependency of T	adjustable in steps of 1 Tick
Resolution	1 Tick	30.30ns
Accuracy		$\pm 30.30ns$
Operation modes		„single“

Counter

Number	3 x 16 bit (1 x 82C54)
Clock source	extern up to 10 MHz

...without opto-isolation

Measurand/criterion	Condition/annotation	Value
Reference to ground		PC ground (PC_GND)
Level for counter output (OUT_x)		
U_{OL}	$I_{OL} = +7.8mA$	max. +0.45V
U_{OH}	$I_{OH} = -6mA$	min. +2.4V
Level for counter inputs (CLK_x, GATE_x)		
U_{IL}	$I_{ILmax} = \pm 10\mu A$	-0.5V...+0.8V
U_{IH}	$I_{IHmax} = \pm 10\mu A$	+2.2V...+6V

...with opto-isolation („i“-versions)

Measurand/criterion	Condition/annotation	Value
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	+5V/30mA
Level for counter outputs (OUT_x)		
	U_{\max}	42V
	I_{Out} :	max. 30mA
Level for counter inputs (CLK_x, GATE_x)		
	I_F	$7.5\text{mA} \leq I_F \leq 10\text{mA}$
	U_{IL}	max. 0.8V
	U_{IH}	min. 4.5V, max. 5V*

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

Optional: Supplying the opto-couplers with VCC from analog section (A_VCC). Note that 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	±5V und ±15 V (2 x 3W)
Power consumption	without external load	typ. 2.8A
Load for VCC_OUT		max. 200mA
Physical size (without mounting bracket and connector)	ME-4610 PCI	136mm x 107mm
	ME-4650/4660/4670/4680 PCI	175mm x 107mm
	PCI-Express versions	167,65mm x 111,15mm
	CompactPCI versions	3 HE CompactPCI board
Connectors	ST1	78pin D-Sub female connector
	ST2	20pin IDC connector
Operating temperature		0...70 °C
Storage temperature		-40...100 °C
Relative humidity		20...55% (non condensing)

CE Certification

EMC Directive	89/336/EMC
Emission	EN 55022
Noise immunity	EN 50082-2

B Pinout

Legend for pinouts:

AD _x	Analog input channels
AD_TRIG_D	Digital trigger input for A/D section
AD_TRIG_A+	Analog trigger input for A/D section (positive comparator input)
AD_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_A _x	Digital-I/O port A
DIO_B _x	Digital-I/O port B
DIO_C _x	Digital-I/O port C
DIO_D _x	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	<i>ST1 not-optoisolated</i> models: Common ground of all functional groups (= PC ground); <i>ST2</i> : PC ground
VCC_OUT	<i>ST1 not-optoisolated</i> models: V _{CC} output (+5V from PC); <i>ST2</i> : +5V from PC; total load max. 200mA
n.c.	Pin not connected

Valid for optoisolated models:

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 (+5V±10%) for the optocouplers of the counters.
A_VCC	Optional (see diagram 23 on page 29): Sourcing the optocouplers of the counters by the analog section (A_VCC). No external wiring to pin 1!

B1 78pin D-Sub Connector (ST1)

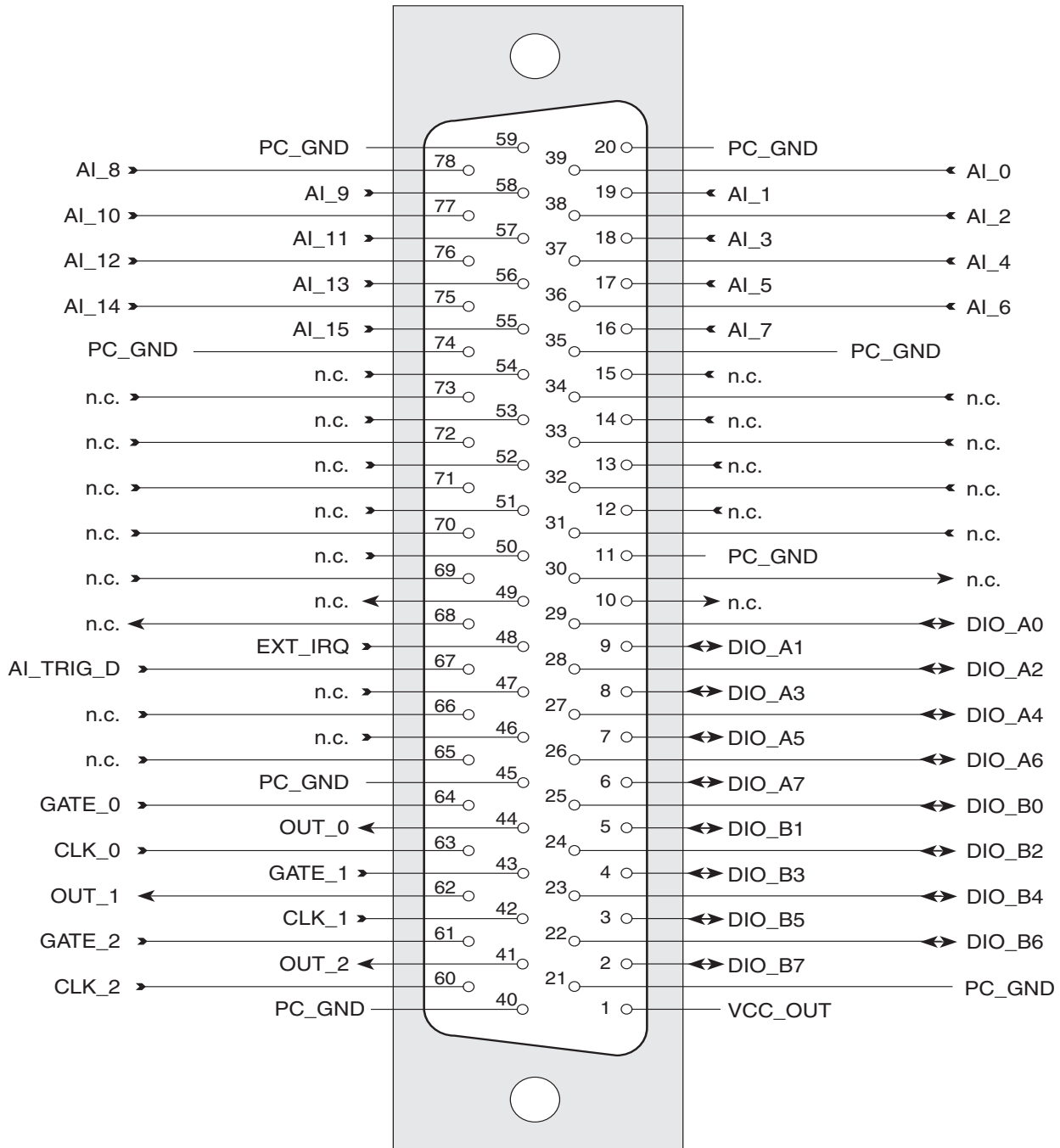


Diagram 29: 78pin D-Sub female connector ME-4610 (ST1)

B2 78pin D-Sub Connector (ST1)

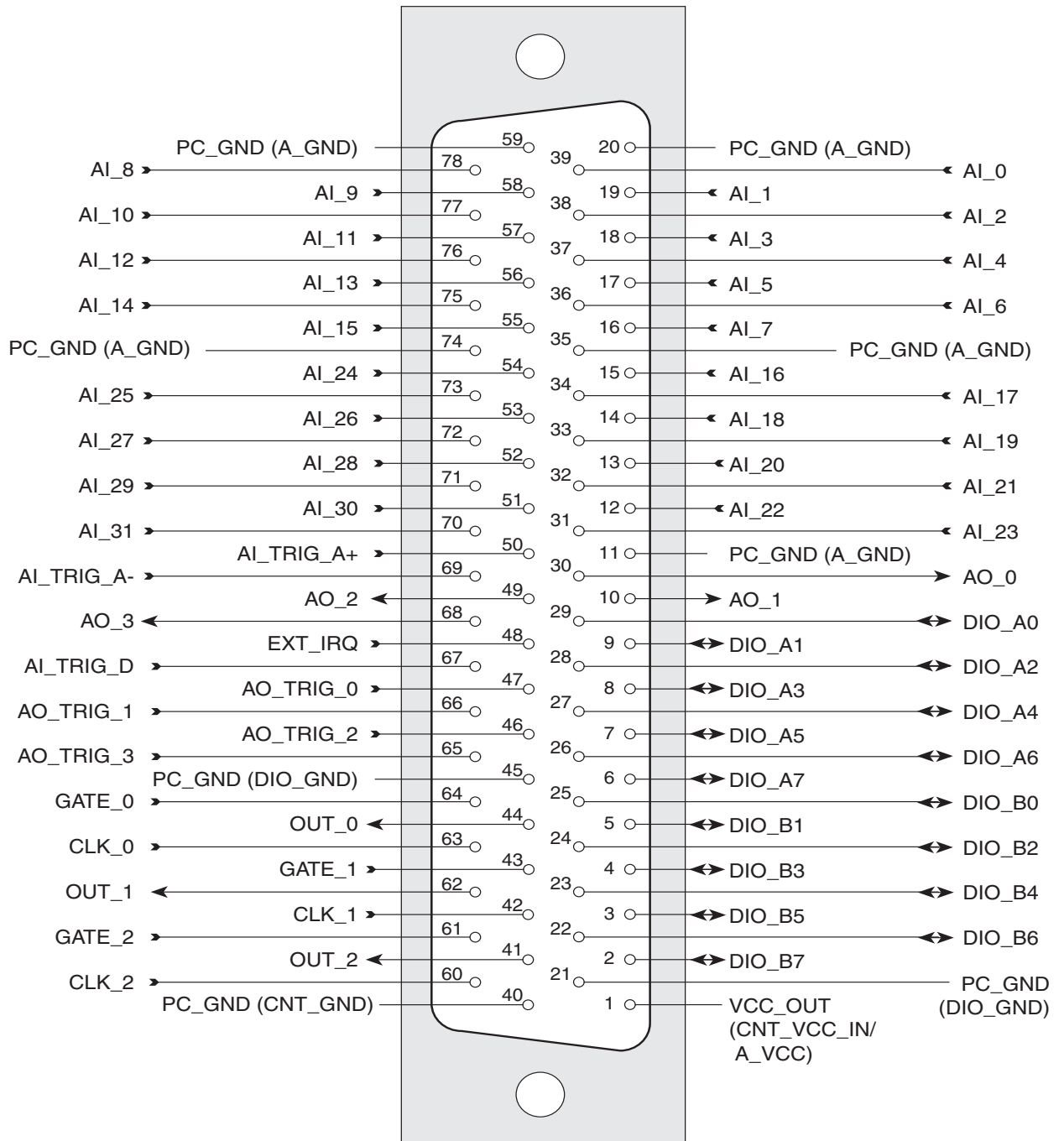


Diagram 30: 78pin D-Sub female connector ME-4650/4660/4670/4680 (ST1)

Depending on the model not all pins of the 78pin 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-D25F/S (cPCI)) from 20pin IDC connector to mounting bracket with 25pin D-Sub female connector (comes with the board).

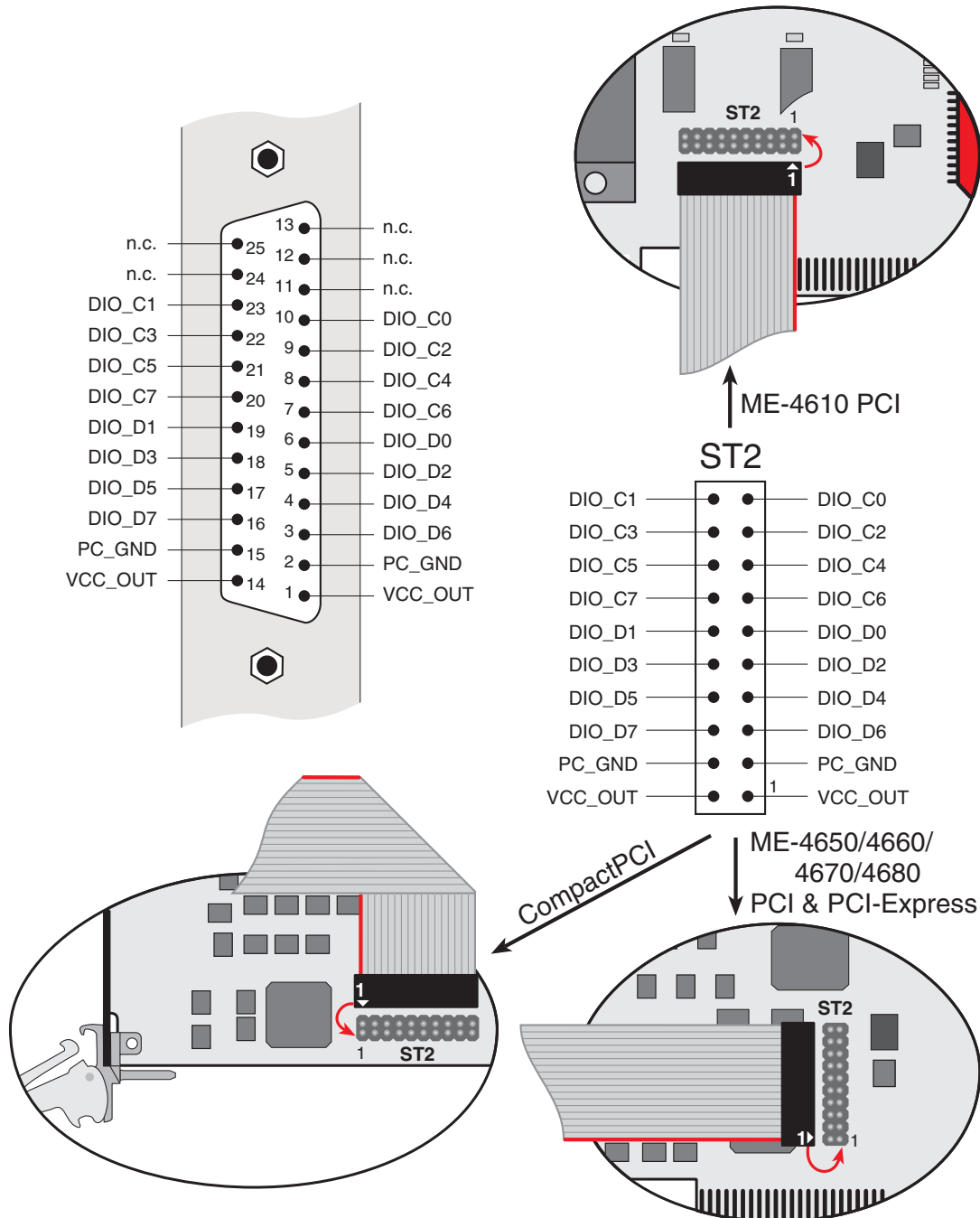


Diagram 31: Auxiliary connector „DIO“ for ME-4600 (top view)

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 ST2 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.

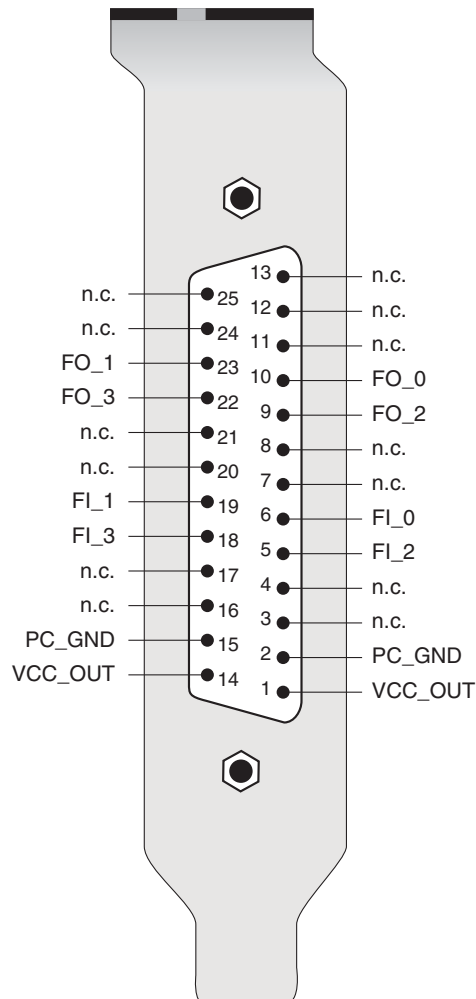


Diagram 32: Auxiliary connector „FIO“ for ME-4600 (top view)

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. Else the board can be irreversible 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.

ME-AK-D78/x

Standard connector cable (1:1) from 78pin D-Sub male connector to 78pin D-Sub female connector, different lengths.

ME AK-D78/HQ/x

High quality cable with different lengths. 2 cable bundles, line diameter $40 \times 0.25 \text{ mm}^2$. Max. current load 1.4 A per line; load on 20 lines: 2 A. 78-pin D-sub male to female, 1:1 contacted.

ME AK-D78/HQ-OE/1

1 m high quality cable. 78-pin D-sub male to open ends.

ME AK-D25/HQ/x

High quality cable with different lengths. 25-pin D-sub male to female, 1:1 contacted. With metal housing, line diameter $40 \times 0.25 \text{ mm}^2$. Max. current load 1.4 A per line; load on 20 lines: 2 A.

ME-AB-D78M

78pin D-Sub connector block (male connector)

ME-MultiSig System

Extended multiplex and signal conditioning system:

- Analog multiplexing up to 8192 channels (timer controlled up to 256 channels)
- Analog demultiplexing up to 32 channels
- Signal conditioning (voltage, current, RTDs...)

ME-63Xtend Series

External relay and digital I/O boards (DIN rail mounting possible). Connection by ST2 with additional mounting bracket ME AK-D25F/S (cPCI) and special connection cable ME AK-D2578/4000.

ME-UB Series

Desktop relay and digital I/O boxes. Connection by ST2 with additional mounting bracket ME AK-D25F/S (cPCI) and special connection cable ME AK-D2515/4000.

For further accessories please refer to the current Meilhaus catalog and the internet under: www.meilhaus.com.

D Technical Questions

D1 Hotline

If you should have any technical questions or problems that can be put down to your Meilhaus device, please send a fax to our hotline:

Fax hotline: + 49 (0) 89/89 01 66 28

eMail: support@meilhaus.de

Please give a full description of the problems and as much information as possible, including operating system information.

D2 Service address

If a technical error should occur with your device please contact us at the following address:

Meilhaus Electronic GmbH

Service Department

Fischerstraße 2

D-82178 Puchheim/Germany

If you want to send back a device to be repaired it is strictly necessary to request for a RMA number and to follow the notes to deal with the RMA process. Please attach a detailed error description of the problem, including information about operating system and application software!

D3 Driver Update

The current driver versions for Meilhaus devices and our manuals in PDF format are available under www.meilhaus.com.

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