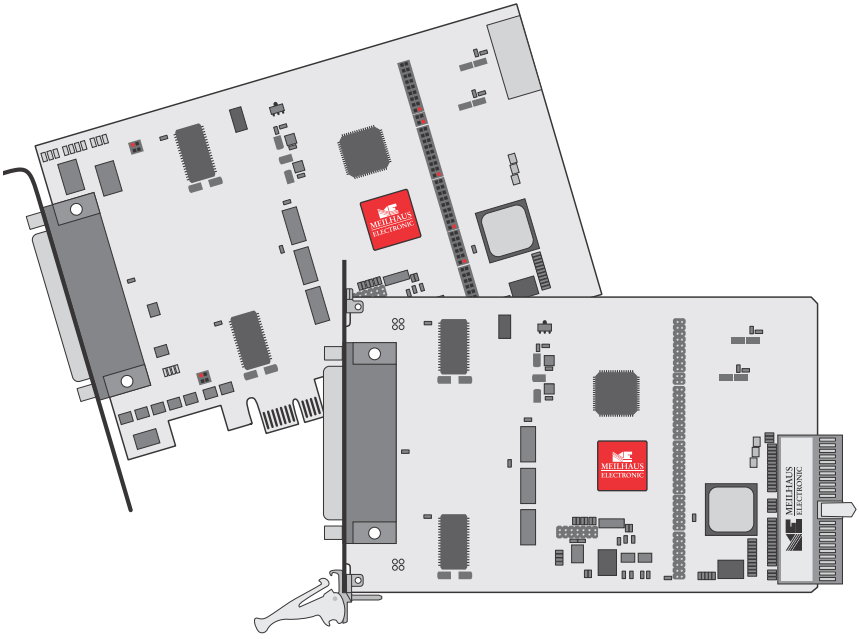
Meilhaus Electronic Manual

ME-5100 1.4E



32-channel high-speed digital I/O board

(alternatively: Frequency measurement and pulse generator)

Imprint

ME-5100 Manual

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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 apply equally to the PCI-Express and the CompactPCI versions of the ME-5100 series, except where differences are explicitly mentioned.

1.1 Important Notes

1.1.1 Intended Use

The PC plug-in boards of the ME-5000 series are used to acquire and output both analog and digital signals using a PC. The models of the ME-5000 series are for fitting:

- … in a free PCI Express slot (PCIe) or
- … in a free CompactPCI slot (cPCI),

according to the type. Please first read the instructions for use of your PC for the procedure to follow when fitting a plug-in board.

Observe the following notes and specifications starting on page 35:

- Make sure that heat can be dissipated from the board well enough inside the PC housing.
- Unused inputs must always be connected to the reference ground of their function group, in order to avoid crosstalk between the input channels.
- The partially opto-isolated inputs and outputs provide electrical isolation of the device of up to 500 V with respect to the PC ground.

- Note that the computer must be switched on first before any voltage is applied to the board through external circuitry.
- Connecting or disconnecting any of the the board's connectors must always be done when all the components are powered down.
- Make sure that when touching the board, or when plugging in the connecting cable, it is not possible for static discharges to pass through the board.
- Ensure that the connecting cable is securely seated. The plug must be fully inserted into the D-sub socket, and secured using both screws. Only in this way can the board be expected to function properly.

1.1.2 Improper Use

PC plug-in boards for the PCI Express or CompactPCI bus must never be operated outside the PC. Never connect the devices to electrically live parts, and particularly not to any that carry mains voltage.

Make sure that the external circuitry connected to the device cannot come into contact with electrically live parts. Connecting or disconnecting any of the the connectors must always be done when powered down.

1.1.3 Unforeseeable Misuse

The device is not suitable for use as a child's toy, for domestic purposes or under adverse ambient conditions (such as in the open air). The user must take appropriate precautions to avoid unforeseeable misuse.

1.2 Scope of Supply

We do, of course, endeavour to supply you a complete product package. Nevertheless, to make entirely sure that your supply is complete, you can check the contents of your package with the help of the following list.

Your package should contain the following parts:

- Digital I/O board of type ME-5100 for the PCI Express or Compact-PCI bus
- Manual in PDF format on CD/DVD
  (optionally available in printed form)
- Driver software on CD/DVD
- 78-pin D-sub mating connector

1.3 Features

The **ME-5100** is a fast digital I/O board for the PCI Express and CompactPCI systems. The base board can optionally be extended with plug-on boards (see Table 2 on page 10).

Overview:

	DIO	FIO*	3.3 V/5 V	Termination
ME-5100 (Subdevice 0)	16 bit DIO	4 FI channels	✔	✔
(Subdevice 1)	16 bit DIO	4 FO channels	✔	✔

Table 1: Overview of the ME-5100

*Alternative configuration can be activated via ME-iDC.

- **High speed digital I/O ports**: The ME-5100 has two 16-bit digital I/O ports and a number of control lines. When operating in single mode, the two ports can be configured, independently of one another, as input or output. The direction of the ports is defined in software. Immediately after powering up, all the ports are configured as inputs. When operating in streaming mode, the direction of the ports is specified by hardware: port A is the input port, while port B is the output port.
- **Frequency counter:** The concept of the "configurable subdevices" allows subdevice 0 to be employed as a frequency counter. Four independent channels are available for measuring the frequency and duty cycle of rectangular signals (max. 5.5 MHz).
- **Pulse generator:** The concept of the "configurable subdevices" allows subdevice 1 to be employed as a rectangular wave generator. Four independent channels are available for the output of a periodic, rectangular signal at up to 5.5 MHz with a variable duty cycle.
- **Signal level 3.3 /5 V**: The signal level of all the digital inputs/outputs and of the control lines can be switched together between 3.3 V and 5 V, depending on the external circuitry. The changeover is made for all the ports of the base board at once using software.

- For optimum signal matching, you are able to activate, via software, an **active** 110 **Ω termination** at the digital inputs/outputs of each port.
- The DATA_VALID and L_CLK signals are available for **synchronisation** with the external circuitry. The DATA_VALID pin indicates the validity of the data during output in streaming mode operation, while the 66 MHz system clock can be accessed at the L_CLK pin.
- **Bit-pattern detection**: The bit-pattern at the digital inputs can be monitored if required. Depending on the configuration, an interrupt can be triggered in response to a change in the bit-pattern. In streaming mode operation, the bit-pattern detection can also be used to control the input/output operation, depending on the selected operating mode (not using interrupts).

Thanks to the DMA architecture, the data can be transferred very quickly between the PC's working memory and the board. In streaming mode, an input/output rate of up to 30 MS/s, in which all the ports must participate, is possible. (See also Table 3 on page 25.) The actual transmission rate will depend on the operating mode and the configuration of your computer.

Depending on requirements, you can select from the following **operating modes**:

- **Single:** In this operating mode, a single value can be read or written under software control (see chapter 4.1.1 on page 27).
- **Streaming:** Data is read in/output in this operating mode via a FIFO. It is possible to choose between a timer and/or external trigger signals for timing control. A large number of **trigger options**, with which you can define start and stop conditions, are available. Port A is specified as a 16 bit input port, and Port B as a16 bit output port (see chapter 4.2 on page 31).
- **Interrupt:** For interrupt handling in the "bit-pattern change" and "bit-pattern comparison" modes (see chapter 4.3 on page 33).

Customer-specific versions of the firmware are available on request.

Model	ME-5100	ME-5001	ME-5004
PC interface	cPCI/PCIe	–	–
Board type	Base board	Plug-on board	Plug-on board
DIO channels	2 x 16 bit DIO	2 x 8 bit DIO + 4 x 8 bit DIO*	1 x 16 bit DI 1 x 16 bit DO
Streaming channels	1 x 16 bit DI, 1 x 16 bit DO	–	–
DI/DO I/O rate	30 MS/s / 30 MS/s	–	–
FI/FO frequency	5.5 MHz/5.5 MHz	5.5MHz/5.5MHz	300kHz/3kHz
External trigger for streaming	✔	–	–
Software start/Stop for streaming mode operation	✔	–	–
Frequency measurement	4 channels	8 channels	8 channels
Pulse generator	4 channels	8 channels	8 channels
Bit-pattern change	✔	✔	✔
Bit-pattern compare	–	–	✔
DI/FI level	3.3 V/5 V (TTL)	3.3 V/5 V (4 x 8 bit**)	3…60 V
DO/FO level	3.3 V/5 V (TTL)	3.3 V/5 V (4 x 8 bit**)	15…30V
Active termination	✔	4 x 8 bit**	–
Opto-isolation	–	–	✔
Sink/source selection	–	–	✔
Temperature monitoring	–	–	✔
External wiring	78-pin D-sub socket	25-pin D-sub socket	37pin D-sub sock.
Configurable firmware	✔	✔	✔
Configurable subdevices	✔	✔	✔

Table 2: ME-5100 and plug-on boards in overview

*opt. via ME-AK-D25F/S(cPCI) **only for subdevices 0..3

1.4 System Requirements

The ME-5000 series requires a PC with an Intel® Pentium® processor, or compatible computer, with a free PCI Express or CompactPCI slot (see also the specifications on page 35). The board is supported by the Meilhaus Intelligent Driver System (ME-iDS) from Windows 2000 upwards (Linux under development).

1.5 Software Support

The ME-5000 series is supported by the Meilhaus Intelligent Driver System (ME-iDS). The ME-iDS is a unified driver system usable across devices and operating systems. It supports Windows 8/7/Vista/XP/2000 (Linux under development) and contains a universal function library (API) for programming.

You will find a detailed description of the functions in the ME-iDS manual, a copy of which is on the CD/DVD supplied.

Please also observe the notes in the appropriate README files.

2 Initial Operation

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.

Linux under development!

2.2 Test Program

- **ME-PowerLab^3**: Run the program from the Windows Start menu. This will allow you to test all the important functions of the hardware.
- You will find **simple test programs** in the SDK of the ME-iDS, in the "Test Executables32" or "Test Executables64" subfolders.

2.3 Fitting the Plug-on Boards

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

Observe the following procedure:

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

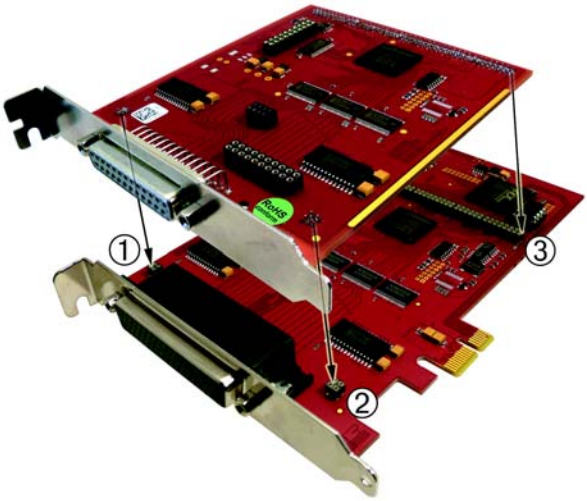

Diagram 1: Fitting the plug-on boards

2.4 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). **Else the board can be irreverseable damaged!**

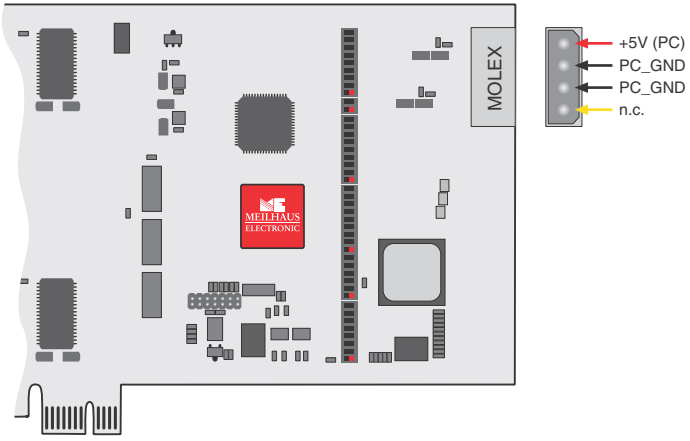

Diagram 2: Additional power to the PCI Express models

3 Hardware

3.1 Block Diagram

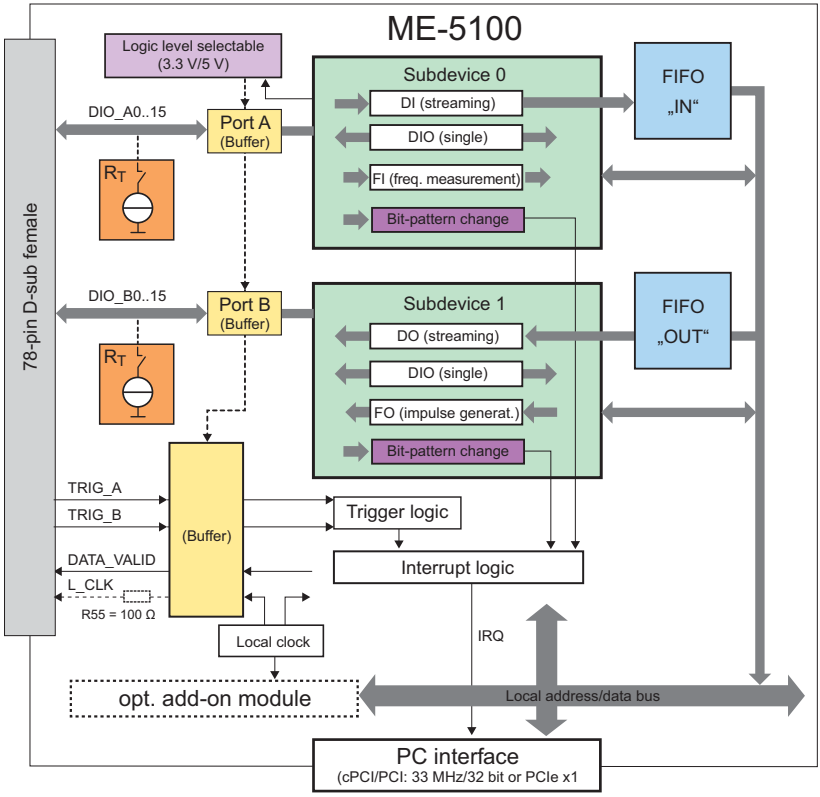

Diagram 3: Block diagram of the ME-5100

- **Subdevice 0 (port A):** Single mode operation: bidirectional, specified as an **input port** for operation in streaming mode.
- **Subdevice 1 (port B):** Single mode operation: bidirectional, specified as an **output port** for operation in streaming mode.

* SPI: "Serial Programming Interface"

The pin assignment for the 78-pin D-sub socket can be found in the appendix (see "Pinout" on page 39).

You will find a description of the circuitry of the individual function groups in the following sections. Please read the chapter 4 from page 25 for operating modes and programming.

3.2 ME-5100 cPCI

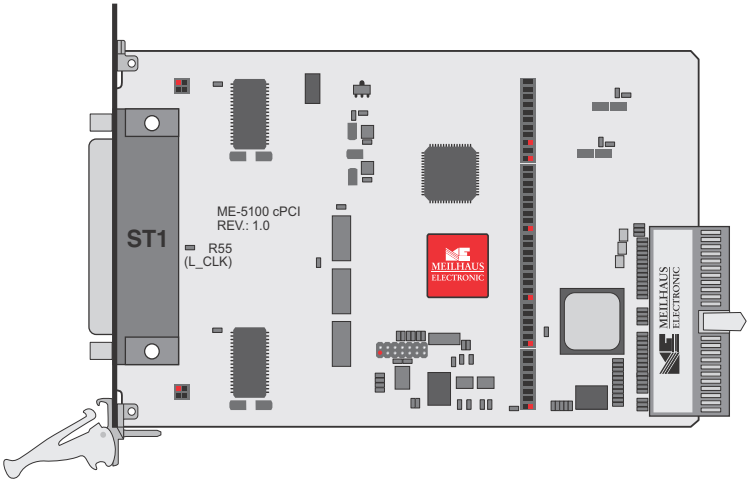

Diagram 4: ME-5100 cPCI

3.3 ME-5100 PCIe

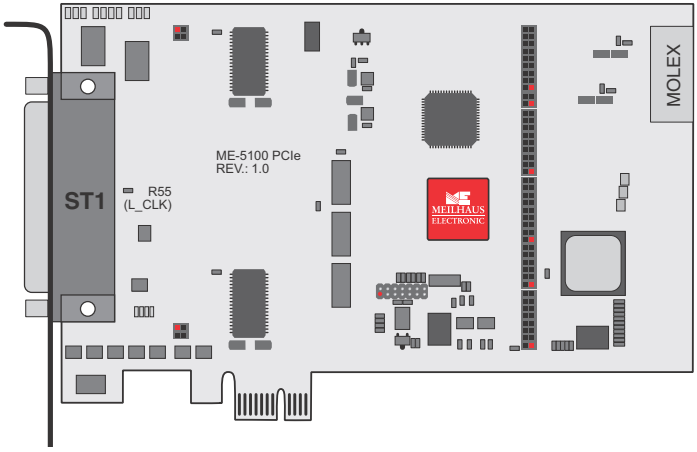

Diagram 5: ME-5100 PCIe

3.4 Digital Input/Output

The ME-5100 has two 16 bit digital I/O ports and a number of control lines. When operating in single mode, the two ports can be configured, independently of one another, as input or output. The direction of the ports is defined in software. Immediately after powering up, all the ports are configured as inputs. When operating in streaming mode, the direction of the ports is specified by hardware: port A is the input port, while port B is the output port.

In streaming mode, ports A and B must share the bandwidth for the data transfer between the board and the PC. This depends on the configuration of your computer – a total data throughput of up to 30 MS/s is realistic (see also table 4 on page 26).

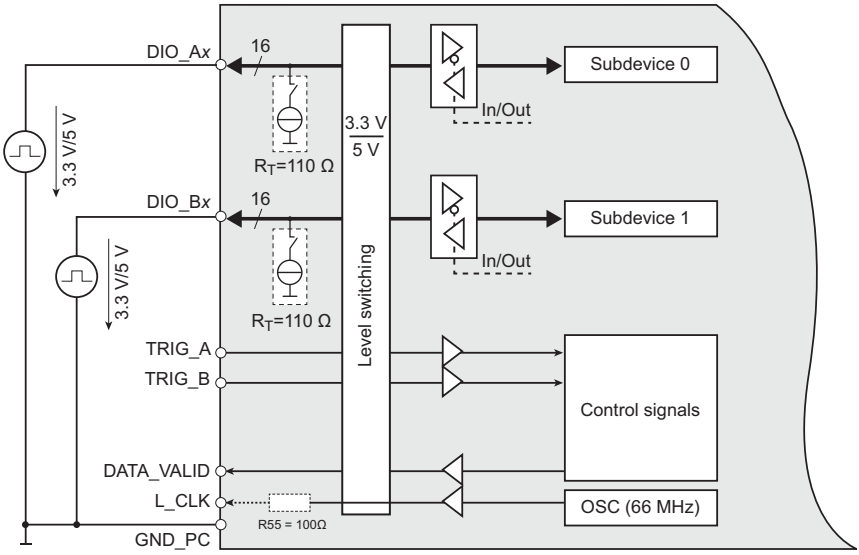

Diagram 6: Wiring of digital inputs/outputs

Please read chapter 4.1.1 from page 27 for programming the different operating modes.

3.4.1 Digital Inputs

When wiring the inputs, note that the voltage level must be observed (see the specifications on page 35) and that a reference to the PC ground (GND_PC) must be established (see diagram 6).

3.4.2 Digital Outputs

When wiring the outputs, note that the voltage level must be observed (see the specifications on page 35) and that a reference to the PC ground (GND_PC) must be established (see diagram 6). $I_{Out} = I_{OL} = I_{OH} =$ 24 mA per pin.

3.4.3 External Trigger

3.4.3.1 External Trigger Inputs

In addition to the trigger inputs TRIG_A and TRIG_B, any of the digital inputs can also be used as a trigger input. You can therefore configure the trigger conditions for starting and stopping a timer-controlled input/output (streaming mode operation) very flexibly. See also diagram 7 on page 20, and the trigger matrix, diagram 12 on page 32.

The specifications for the digital inputs apply to the wiring of the trigger inputs TRIG_A and TRIG_B.

Note: The input/output cannot be externally triggered in single mode operation. Compare here chapter 3.6 "External Interrupt"on page 22.

3.4.3.2 Edge Detection

You can specify, both for the trigger inputs TRIG_A and TRIG_B and for all the usable digital inputs, whether the operation is to be started by a rising edge, falling edge, or by any edge (i.e. equally by rising or falling edges).

Diagram 7: Trigger edges

3.5 Frequency Input/Output

The concept of the "configurable subdevices" of the ME-5000 series gives you the option of using individual subdevices with an alternative functionality. The associated configuration is carried out with the ME-iDC configuration tool before your application is called.

The following channels are available:

- **Frequency counter** (FI= "Frequency Input"):
  4 independent inputs for measuring the frequency and duty cycle of rectangular signals (max. 5.5 MHz).
- **Pulse generator** (FO= "Frequency Output"):
  4 independent outputs for the output of a periodic rectangular signal at up to 5.5 MHz with a variable duty cycle

The associated pins are identified as FI_A0..3 and FO_B0..3 in the terminal assignment on page 15. Immediately after powering up, the pins FI_A0..3 and FO_B0..3 are configured as inputs. In this configuration, the remaining inputs/outputs of the digital ports cannot be used.

Please note: In the "pulse generator" (FO) configuration, the unused pins DIO_B4..15 are connected to ground!

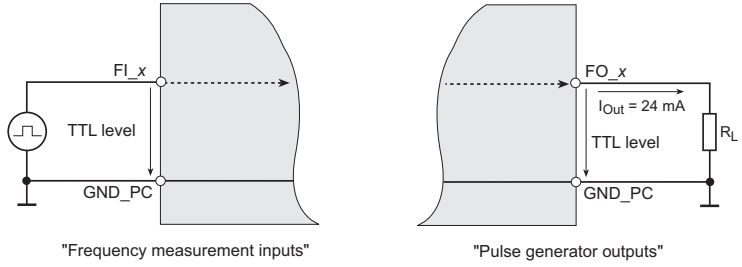

Diagram 8: Wiring the frequency inputs/outputs

The specifications for the digital I/O ports apply to the wiring of the inputs and outputs. A reference to the PC ground (PC_GND) must always be established. The maximum output current is $I_{Out} = I_{OL} = I_{OH} = 24$ mA.

The frequency counters and pulse generators are configured by software. Please read chapter 4.3 on page 33 for programming the frequency input/output.

3.6 External Interrupt

If required, you can also monitor the bit-pattern of a digital input port. The "bit-pattern change" mode is available on the ME-5100. As soon as the specified event occurs, an interrupt is issued and passed directly to the PC.

The digital inputs/outputs are programmed in the single operating mode. The interrupt handling is carried out with the *meIOIrq…* functions; see also chapter 4.3 on page 33.

3.7 Additional Functions

You can make the following settings for adapting to your application regardless of the operating mode.

3.7.1 System Clock Output

If required, you can output the 66 MHz system clock (L_CLK) at pin 29 of the 78-pin D-sub connector. A 100 Ω resistor must be fitted at R55 for this purpose. You can find the position of R55 with the aid of Figs. 4 and 5 (page 18).

Note: Remember that crosstalk between the clock and the signal lines can easily happen in the external wiring. We recommend use of the optional ME AB-D78/IDC adapter board, where a ground line is included between each signal line. Used together with a suitable ribbon cable, you can minimise the crosstalk in this way.

3.7.2 Termination

For optimum signal matching, you can enable via software, an **active 110 Ω termination** at the digital inputs/outputs of each port.

The termination circuits are effectively protected against overload by the combination of current limiting and thermal shutdown (with automatic return to service).

3.7.3 Logic Level Matching

The **signal level** of all the digital inputs/outputs and of the control lines can be switched together between **3.3 V and 5 V**, depending on the external circuitry. The changeover is made for all the ports of the base board at once using software.

3.7.4 "DATA_VALID" Pin

A high level at the DATA_VALID output indicates the validity of the data at output port B in streaming mode operation.

4 Programming

The Meilhaus Intelligent Driver System (ME-iDS) is included with the device for programming purposes. The ME-iDS is a unified driver system usable across devices and operating systems. It supports Windows 2000 and above, as well as Linux systems (in preparation) with Kernel 2.6 and above, and contains a universal function library (API) for all common programming languages. (You can find the scope of the current software support in the readme files of the ME-iDS.)

A detailed description of the functions can be found in the ME-iDS manual (see the CD/DVD included with the board, or online under: www.meilhaus.com/download). Other details, such as the assignment of the subdevices and device-specific arguments, may be found in the help file (in the help file format under Windows, *.chm), which you can open via the "ME-iDS Control Center" in the information area of the taskbar (usually at the bottom right of the screen), or through the Windows Start menu.

The ME-5100 base board is a device with two "subdevices", beginning with the index "0". When a plug-on board (e.g. the ME-5001) is used, further subdevices (starting with the index "0") are added. The functionality of the subdevices can be specified by the user through selecting a pre-defined configuration. The desired configuration is loaded into the board by the ME-iDC configuration tool before your application starts. Using the standard configuration, (ID 0), the board is ready to operate immediately. You will find an overview of the currently available configurations in the following table:

Subdevice of type…	…subtype	I/Os	ID of the configuration
Subdevice 0 (DIO, DI, FI)			
Digital input (DI)	Streaming	16 bit port	0*
Digital input/output (DIO)	Single	16 bit port	1
Frequency input (FI)	Single	4 channels	2

Table 3: Subdevice configurations of the ME-5100

Subdevice of type…	…subtype	I/Os	ID of the configuration
Subdevice 1 (DIO, DO, FO)			
Digital output (DO)	Streaming	16 bit port	0*
Digital input/output (DIO)	Single	16 bit port	1
Frequency output (FO)	Single	4 channels	2

Table 3: Subdevice configurations of the ME-5100

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

Depending on requirements, you can select from the following **operating modes**:

- **Single:** Individual values can be read or written in this operating mode.
- **Streaming:** Data is read in/output in this operating mode via a FIFO. It is possible to choose between a timer and/or external trigger signals for timing control. A large number of **trigger options**, with which you can define start and stop conditions, are available. See chapter 4.2 starting on page 31.
- **Interrupt:** For the interrupt handling in the bit-pattern change mode (see chapter 4.3.1 starting on page 33).

Operation mode	Speed	Trigger
Single	Single value	Input/output via software
Stream timer …with "wraparound" option	up to 30 MS/s ** (depending on the computer)	Start/stop by software or by external trigger
Stream trigger sample	up to 30 MS/s ** (depending on the computer)	Start/stop by software or by external trigger
Interrupt (Bit-pattern detection)	$f_{IRQmax.}$ = 10 kHz	Ext. trigger signal at a digital input/output port

Table 4: Operation modes summary

Comprehensive timing diagrams will be found in the ME-iDS manual.

**see chapter 4.2 starting on page 31.

4.1 Single Operation Mode

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

Notes:

- In the single operating mode, the ports of the ME-5100 can be used bidirectionally.
- Immediately after powering up, the bidirectional ports are configured as inputs.
- In streaming mode, port A is specified as input and port B as output.
- A port that is configured as an output can also be read back!

4.1.1 Digital Input/Output

ME-5100	ME-5001	ME-5004		
✔	✔	✔		

The input/output of individual digital values is carried out in the **single** operating mode. Each digital port is addressed as a function group of type ME_TYPE_DIO, subtype ME_SUBTYPE_SINGLE. Ports A and B can optionally be configured as 16-bit input or output ports.

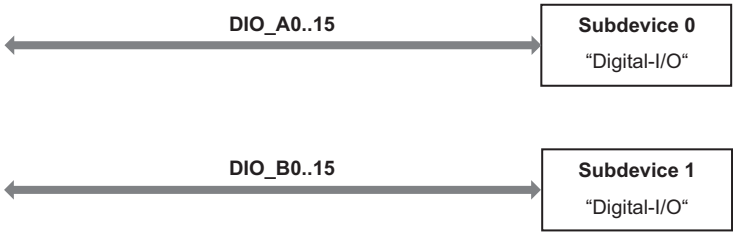

Diagram 9: Digital input/output in single operating mode

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

Please read chapter 3.4 on page 19 for the wiring of the digital ports.

4.1.2 Frequency Input/Output

ME-5100	ME-5001	ME-5004		
✔	✔	✔		

Before you can use the "Frequency measurement" or "Pulse generator" modes, it is necessary, before opening your application, to run the ME-iDC configuration tool in order to specify the configuration for the corresponding subdevice (see also Table 3 on page 25).

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

Diagram 10: Frequency input/output in single operating mode

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

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

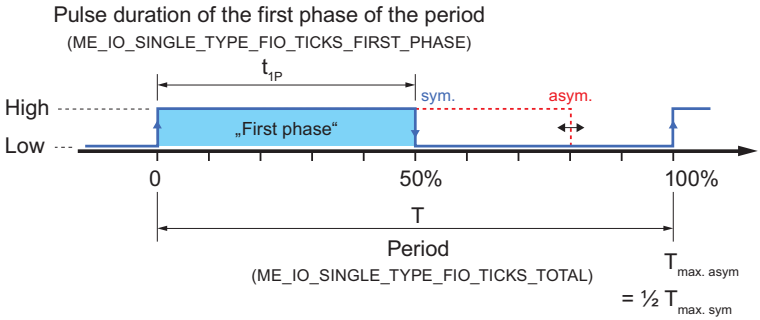

Diagram 11: Signal definition

The time reference is provided by a 66 MHz counter. It is configured using the *meIOSingleConfig()* function. A period of 15.$\overline{15}$ns follows from this, and is defined as the smallest unit of time. It is referred to below as "1 tick". The resolution for T and t_{1P} is therefore 1 tick (see also the specifications on page 37).

Note that the value of the maximum period $T_{max.}$ depends on the duty cycle. A distinction is drawn between rectangular signals with an asymmetrical duty cycle $T_{max.\ asym.}$ and a symmetrical duty cycle $T_{max.\ sym.}$. The figures for the ME-5100 are:

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

The wiring of the frequency inputs/outputs can be found in chapter 3.5 on page 21.

4.1.2.1 Frequency Measurement

With the frequency measurement operating mode (FI= "Frequency Input") you can determine the period or frequency, and the duty cycle of rectangular signals up to about 5.5 MHz. The resolution is 1 tick = 15.15 ns. The measurement always starts at a rising edge. On the ME-5100, all 4 frequency measuring channels (FI_A0…3) are addressed as subdevices of type ME_TYPE_FI, subtype ME_SUBTYPE_ SINGLE. Each channel can be programmed independently.

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

Frequency [Hz] = 1/period [s]

Duty cycle [%] = ("duration of the first phase of the period" [s] / period [s]) × 100

4.1.2.2 Pulse Generator

In the pulse generator operating mode (FO = "Frequency Output") you can output rectangular signals with a variable duty cycle at frequencies of up to 5.5 MHz and with a resolution of 1 tick. On the ME-5100, all 4 pulse generator channels (FO_B0…3) are addressed as subdevices of type ME_TYPE_FO, subtype ME_SUBTYPE_ SINGLE. Each channel can be programmed independently.

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

Note: An output channel can also be read back!

4.2 Streaming Operation Mode

4.2.1 Digital Input/Output

ME-5100	ME-5001	ME-5004		
✔	--	--		

The programming of the timer-controlled input/output via FIFO is carried out in the **streaming** operating modes. The 16 pins of subdevice 0 are specified as inputs (subdevice of type ME_TYPE_DI), while the 16 pins of subdevice 1 are specified as outputs (subdevice of type ME_TYPE_DO), all of these having the subtype ME_SUBTYPE_ STREAMING.

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

4.2.1.1 Stream Timer

In this operating mode the values are acquired or output under the control of a timer. A continuous transfer bandwidth between the PC and the ME-5100 of up to 30 MHz is available. This must be divided between all the subdevices (measured with a dual core computer running under Windows 7 – it will depend on your computer configuration).

4.2.1.2 Stream Trigger Sample

In this operating mode individual values can be acquired or output under the control of one or more external trigger signals. A continuous transfer bandwidth between the PC and the ME-5100 of up to 30 MHz is available. This must be divided between all the subdevices (measured with a dual core computer running under Windows 7 – it will depend on your computer configuration).

4.2.1.3 Burst Mode

In what is known as the "burst mode" you can read a maximum of 8192 data words from subdevice 0, or output them on subdevice 1, at a guaranteed rate of 33 MS/s. The transfer to and from the PC is carried out at a maximum of 30 MHz.

4.2.1.4 Wraparound Mode

This option is used for the repeated output of one and the same data buffer on subdevice 1.

Note: When no more than 8192 values are to be output for an indefinitely long period at an output rate of at most 7.4 MS/s (at least 9 ticks), this is done on firmware level of the ME-5100 without loading the host computer.

4.2.1.5 External Trigger

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

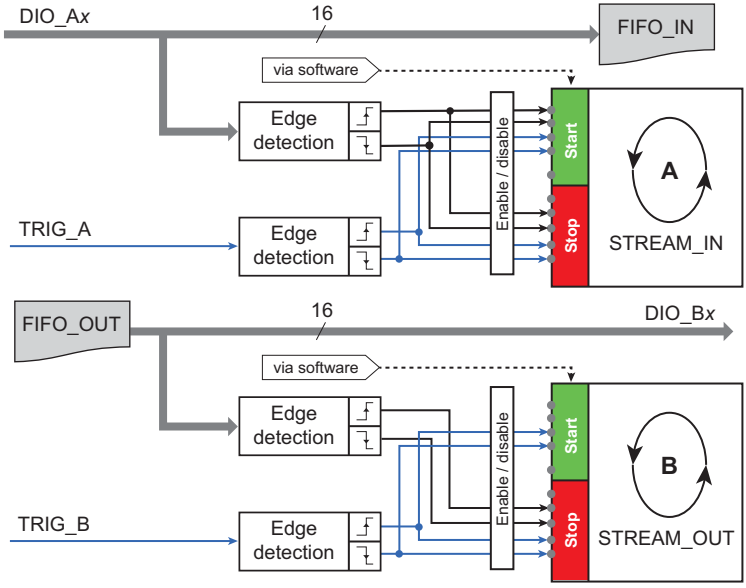

Diagram 12: Trigger in streaming mode

Trigger signals from TRIG_A or the inputs DIO_A0..15 can be used for subdevice 0, while for subdevice 1 the trigger signals from TRIG_B and any of the inputs DIO_B0..15 can be used (see diagram 12 on page 32).

4.3 Interrupt Operation

ME-5100	ME-5001	ME-5004		
✔	--	✔		

On the ME-5100 you can monitor the bit-pattern of a digital I/O port configured as an input for changes in one or more masked bits. As soon as the first edge that meets the trigger condition arrives, an interrupt is generated and passed directly to the PC. A digital port used for bit-pattern detection must be of type ME_TYPE_DIO or ME_TYPE_DI.

The programming is carried out in the single operating mode.

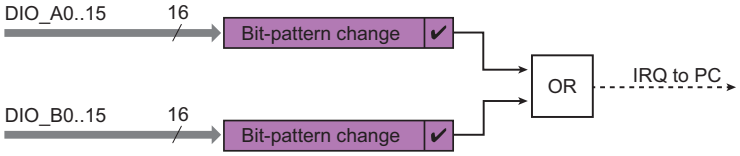

Diagram 13: Interrupt options

Note: TRIG_A and TRIG_B can also be used as interrupt inputs with the aid of the property functions (see the ME-iDS help file).

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

4.3.1 Bit-pattern Change

In the bit-pattern change mode, one or more bits that are to be monitored for a change of state can be defined (masked). A 32-bit wide argument per subdevice contains the mask. For each input pin both one bit for rising edge and one bit for falling edge is available. If the state of at least one bit masked with a "1" changes (0 → 1 or 1 → 0), an interrupt is issued (see diagram 14 on page 34).

In what is known as the "extended format" of interrupt handling (see the ME-iDS manual), two bits are available for the interrupt status of each pin. One is for the rising edge, and one for the falling edge. The bits for the falling edges are assigned to the bit b15…0, while the bits for the rising edges are assigned to the bits b31…16.

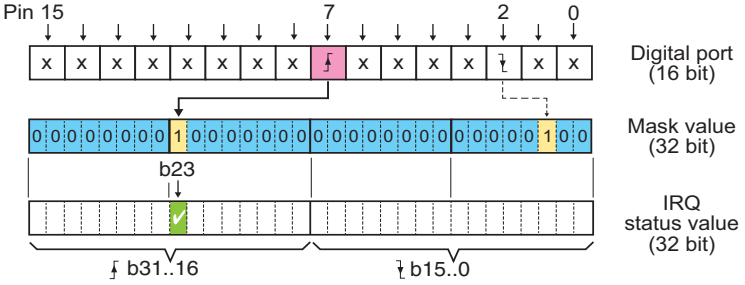

Diagram 14: Bit-pattern change

Example (see diagram 14):
By writing the value 00800004Hex as a mask value (see parameter `<iIrqArg>` of the function *meIOIrqStart()*), bit 2 is monitored for a falling edge, and bit 7 for a rising edge. A rising edge now is to arrive at bit 7, so that an interrupt is issued and in the interrupt status value bit b23 returns "1". Any edges that might arrive at pins labelled with an "X" are ignored. Only the change in state of a pin whose edge is set to "1" in the parameter `<iIrqArg>` can issue an interrupt.

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

Appendix

A Specifications

(Ambient temperature 25 °C)

PC Interface

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

Digital Input/Output

Measured quantity/criterion	**Condition/explanation**	**Value**
Ports	Subdevice 0 single mode operation	16 bit bidirectional
	Subdevice 0 streaming mode operation	16 bit input port
	Subdevice 1 single mode operation	16 bit bidirectional
	Subdevice 1 streaming mode operation	16 bit output port
Operating modes	Single	Software-triggered reading/writing
	Stream timer	Timer-controlled reading/writing of the values via FIFO
	Stream trigger sample	Trigger-controlled reading/writing of the values via FIFO
	Interrupt	Monitoring the digital ports for a change in the bit-pattern
FIFO size	FIFO_IN	8192 values (16 bits wide)
	FIFO_OUT	8192 values (16 bits wide)
Transfer rate in streaming mode	between the ME-5100 and PC	max. 25 MHz (cPCI) resp. 30 MHz (PCIe) (system-dependent)

Measured quantity/criterion		Condition/explanation	Value
Input/output rate in streaming mode		continuous (total for both ports)	max. 25 MS/s (cPCI) resp. 30 MS/s (PCIe) (system-dependent)
		"Burst" option (input/output of up to 8192 values)	max. 33 MS/s per channel, transfer: see transfer rate
		"Wraparound" option (total for both ports) ...if $f_{max.}$ < 7.4 MS/s and the number of values ≤ 8192, and the number of repetitions is "infinite"	max. 25 MS/s (cPCI) or 30 MS/s (PCIe) (system-dependent)
			max. 7.4 MS/s (without loading the host PC)
Timer (CHAN time)*		programmable in steps of 15.$\overline{15}$ ns (1 tick)	30,$\overline{30}$ ns…65 s (2..FFFFFFFFHex ticks)
External trigger inputs			TRIG_A, TRIG_B, DIO_Ax, DIO_Bx
External trigger edges			rising, falling, any
Output level	U_{OL}	at I_{OUT} = 24 mA	max. 0.5 V
	$U_{OH\ 3.3\ V}$	at I_{OUT} = -24mA	min. 2.4 V
	$U_{OH\ 5V}$	at I_{OUT} = -24 mA	min. 2.4 V
Input level	U_{IL}	at Vcc = 3.3 V or 5 V	max. 0.8 V
	$U_{IH\ 3.3\ V}$	at Vcc = 3.3 V	min. 2 V
	$U_{IH\ 5V}$	at Vcc = 5 V	min. 2 V
Input current	I_{IN}		±1 µA
Output current	I_{OUT}	per pin	max. 24 mA
Reference ground			PC ground (GND_PC)

* Due to the nature of the system, boards that are not fitted into the ME Synapse do not reach the full sampling rate. The sampling rate that can actually be achieved depends heavily on the capacity of your computer and on the number of USB devices connected.

Frequency input/output

Availability	Alternative subdevice configuration via ME-iDC
Signal form	Rectangular

Frequency measuring channels

Measured quantity/criterion	Condition/explanation	Value
Reference ground		PC ground (GND_PC)
Number of channels	(FI_A0…3)	4 inputs (TTL)
Input level		see digital I/O
Input current		see digital I/O
Period (T)	$T_{min.} = T_{min.\ asym.} = T_{min.\ sym.}$ $T_{max.\ asym.}$ $T_{max.\ sym.}$	181,$\overline{81}$ ns (5.5 MHz) 32.5 s (0.03 Hz) 65 s (0.015 Hz)
Duty cycle	Variable, depending on T	Measurable in steps of 1 tick
Resolution	1 tick	15,$\overline{15}$ ns
Accuracy		±15,$\overline{15}$ ns
Operating modes		Single

Pulse generator channels

Measured quantity/criterion	Condition/explanation	Value
Reference ground		PC ground (GND_PC)
Number of channels	(FO_B0…3)	4 outputs (TTL)
Output level		see digital I/O
Period (T)	$T_{min.} = T_{min.\ asym.} = T_{min.\ sym.}$ $T_{max.\ asym.}$ $T_{max.\ sym.}$	181,$\overline{81}$ ns (5.5 MHz) 32.5 s (0.03 Hz) 65 s (0.015 Hz)
Duty cycle	Variable, depending on T	Adjustable in steps of 1 tick
Resolution	1 tick	15,$\overline{15}$ ns
Accuracy		±15,$\overline{15}$ ns
Operating modes		Single

Interrupt

Measured quantity/criterion	Condition/explanation	Value
Interrupt sources	Passed directly to the PC	Bit-pattern change

General Data

Measured quantity/criterion	Condition/explanation	Value
Power supply	CompactPCI	+5 V (via PCI bus)
	PCI Express	+3.3 V (via PCIe bus), +5 V (via Molex plug from PC power supply unit)
Current consumption	CompactPCI	0.8…1.2 A (full load)
	PCI Express	0.8…1.2 A (full load)
Board dimensions (without mounting bracket and connector)	CompactPCI	3 U CompactPCI board
	PCI Express	162 mm x 98 mm
Connections	ST1	78-pin D-sub female socket
		IDC connectors for plug-on board
Operating temperature		0…70 °C
Storage temperature		-40…100 °C
Air humidity		20…55% (non-condensing)

CE Certification

EU directive	89/336/EMC
Emission	EN 55022
Immunity	EN 50082-2

B Pinout

Legend for pinouts

DIO_A0..15	Digital input/output (subdevice 0)
DIO_B0..15	Digital input/output (subdevice 1)
TRIG_A	Digital trigger input for subdevice 0
TRIG_B	Digital trigger input for subdevice 1
DATA_VALID	Output indicating the validity of the data at outputs DIO_B0..15 in streaming mode
L_CLK	Local clock output (66 MHz). Not connected by default – if necessary, can be brought to the connector (ST1) by fitting R55 (see page 18 for the position of R55).
FI_A0..3	Frequency measuring inputs (alternative configuration)
FO_B0..3	Pulse generator outputs (alternative configuration)
GND_PC	Common ground (= PC ground)
"reserved"	Pin reserved for extensions. ***These pins must not be connected. Otherwise the board may be irreversibly damaged!***

B1 78-pin D-Sub (ST1) – ME-5100

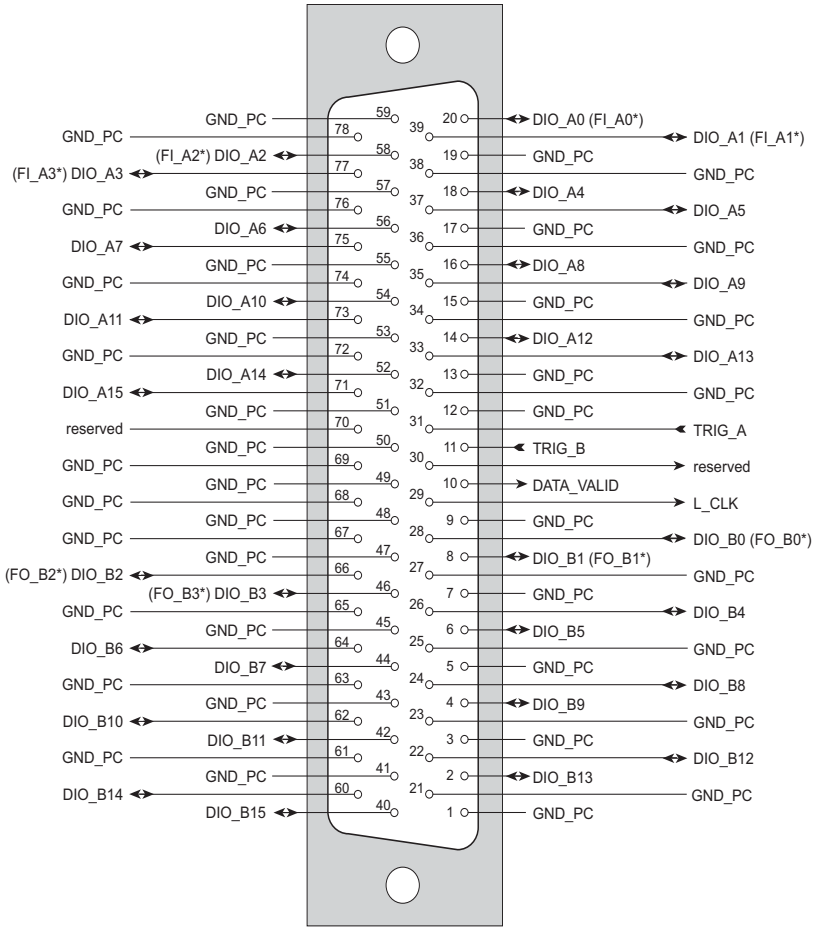

Diagram 15: 78-pin D-sub socket ME-5100 (ST1)

*Use as a frequency measuring input or pulse generator output is only possible after appropriate configuration using ME-iDC. The other pins of the relevant digital port (DIO_A4..15 or DIO_B4..15) can then no longer be used for digital input/output.

Note that the unused pins DIO_B4..15 are connected to ground for frequency output (FO)!

B2 Adapter Board – ME AB-D78/IDC

The optional ME AB-D78/IDC adapter board (78-pin D-sub connector to male connector) carries a ground line between every signal line. Used together with ribbon cables, you can thus minimise the crosstalk.

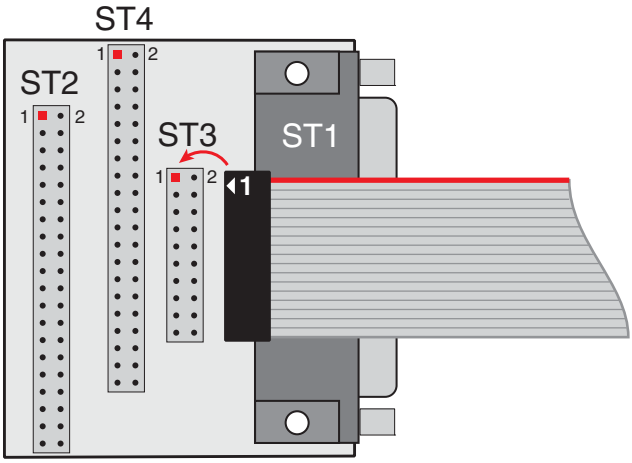

Diagram 16: Adapter board – ME AB-D78/IDC (plan view)

The pin-assignment of the 78-pin D-sub connector ST1 corresponds to ST1 on the ME-5100 (see diagram 15).

Additional signals (ST3)

ST3 pin	Name (ST1 pin)	ST3 pin	Name (ST1 pin)
1	**TRIG_A** (31)	2	GND_PC
3	**TRIG_B** (11)	4	GND_PC
5	reserved (30)	6	GND_PC
7	**DATA_VALID** (10)	8	GND_PC
9	**L_CLK** (29)	10	GND_PC
11	reserved (70)	12	GND_PC
13	GND_PC	14	GND_PC
15	GND_PC	16	GND_PC
17	GND_PC	18	GND_PC
19	GND_PC	20	GND_PC

Table 5: Control line pin assignments (ST3)

Subdevice 0 (ST4)

ST4 pin	Name (ST1 pin)	ST4 pin	Name (ST1 pin)
1	**DIO_A0**/FI_A0 (20)	2	GND_PC
3	**DIO_A1**/FI_A1 (39)	4	GND_PC
5	**DIO_A2**/FI_A2 (58)	6	GND_PC
7	**DIO_A3**/FI_A3 (77)	8	GND_PC
9	**DIO_A4** (18)	10	GND_PC
11	**DIO_A5** (37)	12	GND_PC
13	**DIO_A6** (56)	14	GND_PC
15	**DIO_A7** (75)	16	GND_PC
17	**DIO_A8** (16)	18	GND_PC
19	**DIO_A9** (35)	20	GND_PC
21	**DIO_A10** (54)	22	GND_PC
23	**DIO_A11** (73)	24	GND_PC
25	**DIO_A12** (14)	26	GND_PC
27	**DIO_A13** (33)	28	GND_PC
29	**DIO_A14** (52)	30	GND_PC
31	**DIO_A15** (71)	32	GND_PC
33	GND_PC	34	GND_PC
35	GND_PC	36	GND_PC
37	GND_PC	38	GND_PC
39	GND_PC	40	GND_PC

Table 6: ST4 pin assignments

Subdevice 1 (ST2)

ST2 pin	Name (ST1 pin)	ST2 pin	Name (ST1 pin)
1	**DIO_B0** (FO_B0)	2	GND_PC
3	**DIO_B1** (FO_B1)	4	GND_PC
5	**DIO_B2** (FO_B2)	6	GND_PC
7	**DIO_B3** (FO_B3)	8	GND_PC
9	**DIO_B4**	10	GND_PC
11	**DIO_B5**	12	GND_PC
13	**DIO_B6**	14	GND_PC
15	**DIO_B7**	16	GND_PC
17	**DIO_B8**	18	GND_PC
19	**DIO_B9**	20	GND_PC
21	**DIO_B10**	22	GND_PC
23	**DIO_B11**	24	GND_PC
25	**DIO_B12**	26	GND_PC
27	**DIO_B13**	28	GND_PC
29	**DIO_B14**	30	GND_PC
31	**DIO_B15**	32	GND_PC
33	GND_PC	34	GND_PC
35	GND_PC	36	GND_PC
37	GND_PC	38	GND_PC
39	GND_PC	40	GND_PC

Table 7: ST2 pin assignments

C Accessories

We recommend the use of high-quality connecting cables with separate shielding of each channel.

ME-AB-D78/IDC

Adapter board from a 78-pin D-sub connector to two 40-pin IDC connectors and one 20-pin IDC connector, for connecting suitable ribbon cables.

ME-AK-D78/*x*

Standard connecting cable from 78-pin D-sub connector to 78-pin D-sub socket, various lengths.

ME-AB-D78M

Terminal blcok with 78-pin D-sub male connector

ME-63Xtend series

External relay and digital I/O boards (suitable for DIN rail mounting). Can be connected via the plug-on board ME-5001.

ME-UB series

Desktop relays and digital I/O boxes. Can be connected via the plug-on board ME-5001.

Further accessories can be found in the current Meilhaus Electronic catalogue, or on the Internet under www.meilhaus.de

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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