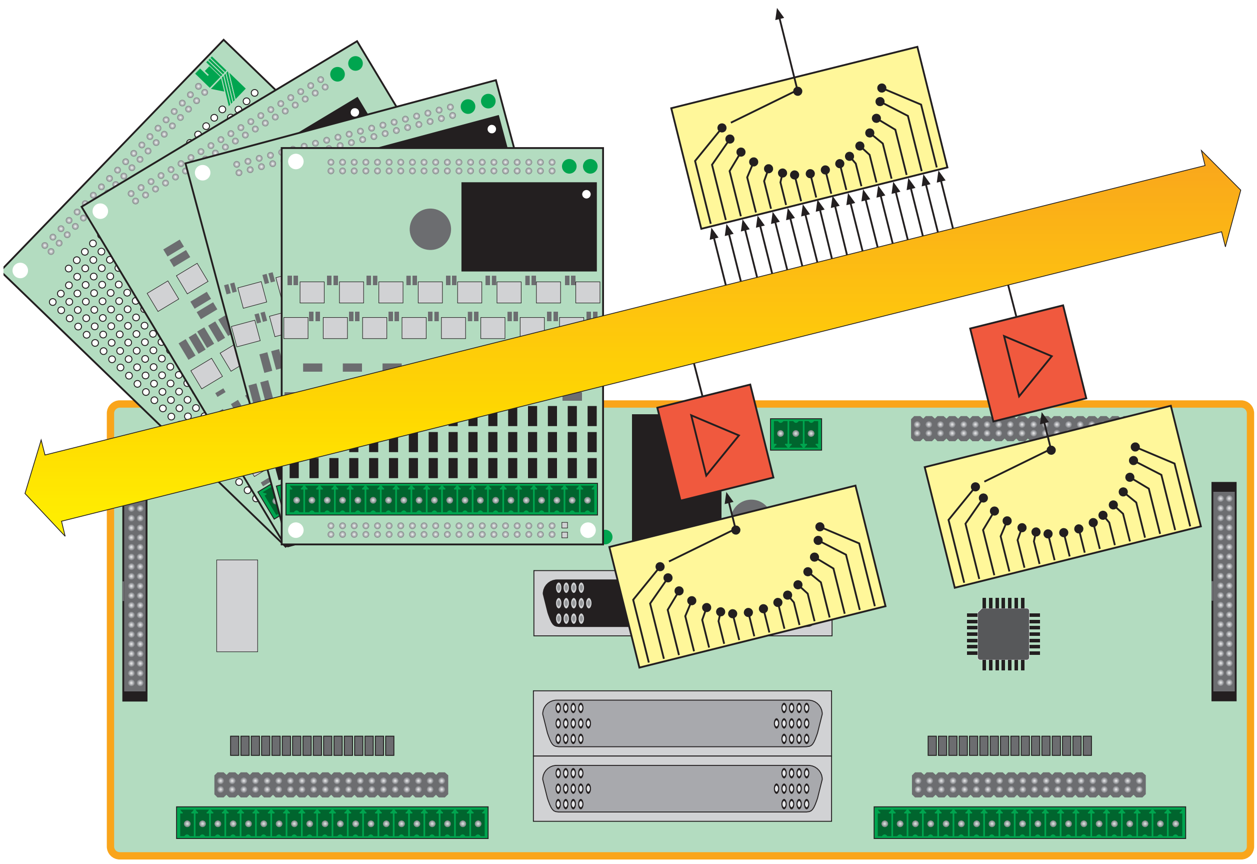
Meilhaus Electronic Manual

ME-MultiSig 1.5E

(ME-MUX32, ME-DEMUX32, ME-SIG32)



Analog Multiplexing/Demultiplexing System with optional Signal Conditioning Modules up to 8192 Channels

Imprint

Manual ME-MUX32, ME-DEMUX32, ME-SIG32

Revision 1.5E
Revised: 22. June 2005

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1 Introduction

Valued customer,

Thank you for purchasing an innovative high technology product that left our premises in a fully functional and new condition.

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

1.1 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 contents of the box. Your box should consist of:

- Base board(s) depending on model and level of expansion:
  - Analog multiplexer board(s) as master (ME-MUX32-M) and optional slave(s) (ME-MUX32-S),
  - or demultiplexer board (ME-DEMUX32),
  - or signal conditioning board (ME-SIG32).
- Two plug-on bridge modules per base board for operation without signal conditioning modules (except ME-SIG32).
- One 40-pin flat ribbon cable per slave board (for master-to-slave and/or slave-to-slave connection); 5 jumpers.
- Optional: Plug-On modules for signal conditioning.
- Screw terminal connectors for analog inputs and power supply.
- ME-Power-CD with user manual in PDF format for Acrobat Reader (optional printed manual).
- 78-pin D-sub connector for ST11 (not for ME-MUX32-S).

1.2 Features

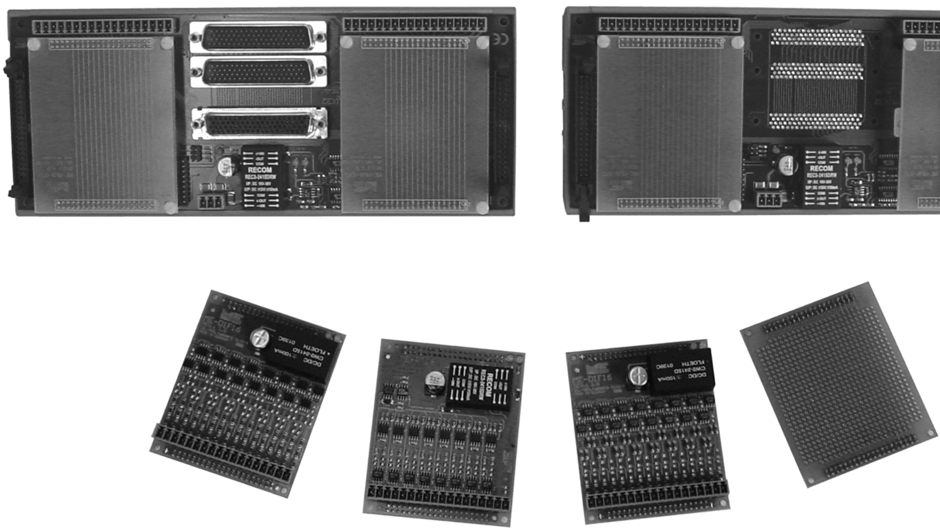


Diagram 1: Analog multiplexing system

The analog multiplexing and demultiplexing system expands your multifunctional PC I/O DAQ board, converting it into a versatile multi-channel DAQ system. The following models resp. expansion levels are available:

- Analog **multiplexing** up to 256 resp. 8192 channels with or without signalconditioning (also timer controlled*).
- Analog **demultiplexing** up to 32 channels.
- Pure **signal conditioning** (also timer controlled*).

The system consists of at least one master base board with 32 channels. You can expand the system on max. 256 channels, using up to 7 slave base boards. The multiplexer is controlled by the multi I/O PC board‘s digital I/O lines. Each base board has two groups of 16 measurement channels. Each channel group has variable gain, which can be configured via software for the gain factors 1, 10 and 100. The analog input channels can either be multiplexed into **one** A/D channel (”Single-MUX” mode) or can be multiplexed **per group** of 16 channels into the A/D channels 0…15 (”Multi-MUX” operation).

*in connection with matching multi-I/O boards. Ask our sales department!

Additional digital I/O boards and special cables are required for **full system expansion,** where up to 8192 channels can be multiplexed. For example you are using a digital I/O board with 64 outputs (e. g. ME-1000) for every set of 1024 channels an additional plug-in board is required.

Plug-On modules for signal conditioning can be added at any time. At the moment modules for differential acquisition of voltage or current, modules for resistance temperature detectors (RTDs) and a prototyping/breadboard module are available.

The base board ME-SIG32 is especially designed for **pure signal conditioning** on up to 16 or 32 channels (depending on the channel number of the multi I/O board). This model does not have multiplexing or programmable gain. The ME-SIG32 can also be used for data acquisition under timer control*. The same plug-on modules are used as for the ME-MUX boards (at least one plug-on module is required for operation. Plug-On modules are not included with the base board).

The model ME-DEMUX32 is designed to **demultiplex** one D/A channel into max. 32 output channels (you can build and add your own signal conditioning plug-on modules based on the prototyping module).

Each base board version (except the ME-SIG32) has its own power section with electrical isolation, which has to be externally supplied with **24 V** DC.

The system can be **mounted to DIN-rails**.

*in connection with matching multi-I/O boards. Ask our sales department!

1.3 Supported PC Boards

The following table shows the A/D, D/A and multi I/O boards supported by the analog (de-)multiplexing system (Note: depending on board type and channel number not all base boards are supported):

Board type	ST9/10	Remark
ME-2000	ST9	16 A/D channels, no demultiplexing
ME-2600/3000	ST9	16 A/D channels, demultiplexing supported
ME-4610	ST10	16 A/D channels, no demultiplexing
ME-4650	ST10	16 A/D channels, no demultiplexing
ME-4660(i)*	ST10	16 A/D channels, demultiplexing supported; notice the note for opto-isolated versions*!
ME-4670(i)*	ST10	32 A/D channels, demultiplexing supported; notice the note for opto-isolated versions*!
ME-4680(i/is)*	ST10	32 A/D channels, demultiplexing supported, multiplexing controlled by timer; notice the note for opto-isolated versions*!
* This **note** concerns the use of opto-isolated versions of the ME-4600 series („i“-versions) in combination with the base boards ME-MUX32-M and ME-MUX32-S. Because of the opto-isolation port B is fixed as an input port. This results in the following limitations: • the gain factor is preset to V=1 (V=10, V=100 not adjustable) • the reset bit can not be used • the address LED can not be controlled When using a „i“ version you can avoid these limitations in combination with an adapter board of type ME-AA4-3**i**.		

Table 1: Supported ME boards

Supported boards from other suppliers:

Board type	ST9/10	Remark
Eagle **PC30F/G**	ST9	16 A/D channels, no demultiplexing (special cable required)
Adlink **PCI-9111/9112**	ST9	16 A/D channels, demultiplexing possible; (set of adaptors and 2nd slot required)
Measurement Computing **CIO-DAS-08**	ST9	16 A/D channels, no demultiplexing; (set of adaptors and 2nd slot required)
Measurement Computing **CIO-DAS-1602/16**	ST9	16 A/D channels, demultiplexing possible; (set of adaptors and 2nd slot required)

Table 2: Supported boards from other suppliers

Board type	ST9/10	Remark
National Instruments **PCI-6025E**	ST9	16 A/D channels, demultiplexing possible; (special cable required)
UEI **PD2-MF-xxx**	ST9	16 A/D channels, demultiplexing possible; (set of adaptors and 2nd slot required)

Table 2: Supported boards from other suppliers

1.4 Model Overview

Model	Description
ME-MUX32-M	Multiplexer base board (master) with 32 inputs (with programmable gain)
ME-MUX32-S	Multiplexer base board (slave) with 32 inputs (with programmable gain)
ME-DEMUX32	Demultiplexer base board with 32 outputs (without gain)
ME-SIG32	Base board for signal conditioning on up to 32 inputs without multiplexing and gain
ME-DIFF16	Signal conditioning module with 16 differential voltage inputs; models available with the input ranges 10V, 20V, 50V (R_i = 3,75MΩ) or 50V (R_i = 50MΩ)
ME-Current16	Signal conditioning module with 16 current inputs (0..20mA)
ME-RTD8	Signal conditioning module for 8 RTDs with 2-, 3- or 4-wire connectivity; versions for: Pt100, Pt500 or Pt1000
ME-TE8	Signal conditioning module for 8 thermocouples of type J, K, T, E, R, S, B, N
ME-Proto	Prototyping/breadboard module for custom specific signal conditioning

Table 3: Hardware overview

2 Hardware

2.1 General Notes

Attention: Make sure that no contact with voltage carrying parts can happen by the wiring of the board. The external connections to the board should only be made or removed in a powered down state. Make sure to follow the guide lines for electrostatic sensitive devices.

If you do not use any signal conditioning modules, you have to plug on one bridge module per group between ST5 and 6 (group A) or ST7 and 8 (group B).

Inputs of the base boards and plug-on modules that are not used should always be connected to signal GND.

2.2 Pullup/Pulldown Resistors

After power-up the digital ports of most of the boards are configured as input ports i. e. tristate. To force the digital lines 0…11 into a defined state they are equipped with plugable pulldown (default) resp. pullup resistors (see also chap. 2.2 on page 10). This will set all base boards into their basic status (see chap. 3.4).

As a rule the digital ports are configured as inputs after power-up, i. e. the pins are tristate. However to get a defined state after power-up pullup resp. pulldown resistors are provided for the base boards ME-MUX32-M and ME-DEMUX32 (not necessary for ME-MUX32-S and ME-SIG32). They are realized as resistor arrays (RN1, RN2) with sockets. For a pulldown configuration the common pin of the array (marked with a dot as a rule) has to be plugged into the socket pin marked with a „-“ sign. For pullup configuration the common pin of the array has to be plugged into the socket pin marked with a „+“ sign (see diagram 2). Depending on the combination of PC DAQ board and base board the resistor arrays have to be plugged in the right way. Doing this take notice of the following table:

Board Type	Base Board	ST9/10	RN1	RN2
ME-2000/2600/3000	ME-MUX32-M	ST9	Pulldown	Pulldown
	ME-DEMUX32	ST9	Pulldown	--
ME-4600 Series (without opto-isolation)	ME-MUX32-M	ST10	Pulldown	Pulldown
	ME-DEMUX32	ST10	Pulldown	--
ME-4600i Series (with opto-isolation*)	ME-MUX32-M	ST10	Pullup	Pulldown
	ME-DEMUX32	ST10	Pullup	--
ME-4600i Series (with opto-isolation and ME-AA4-3**i***)	ME-MUX32-M	ST10	Pullup	Pullup
	ME-DEMUX32	ST10	Pullup	--
*see note in table 1 on page 8.				

Table 4: Resistor arrays

Positioning of the resistor arrays:

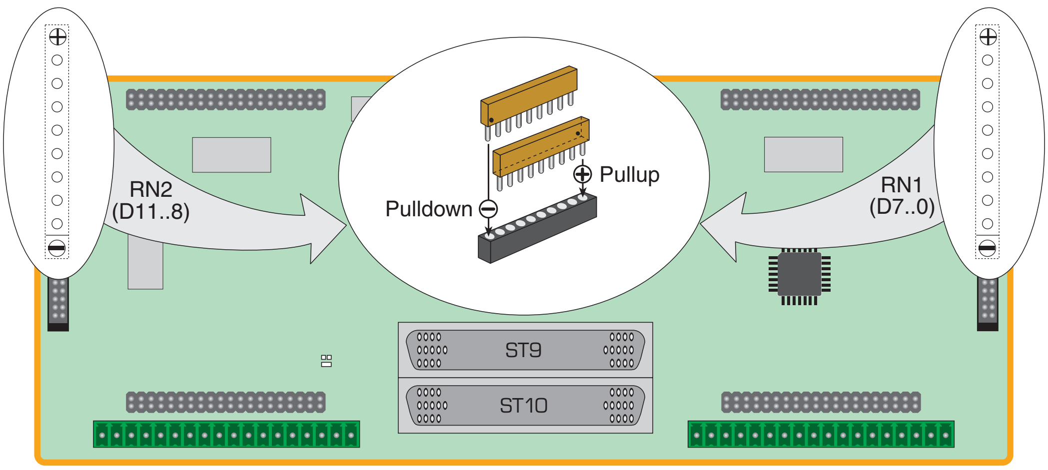


Diagram 2: Resistor arrays

2.3 Model "Multiplexer"

2.3.1 Multiplexer Master Board (ME-MUX32-M)

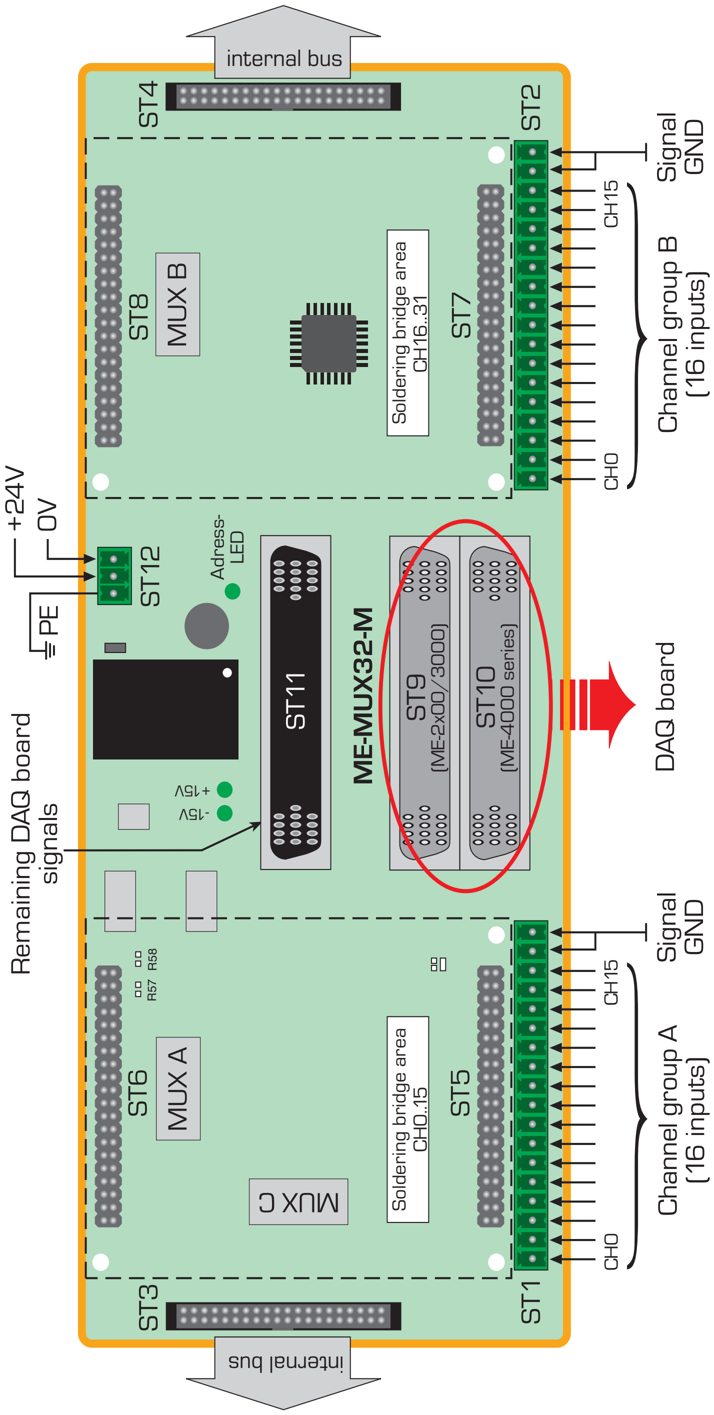


Diagram 3: Multiplexer master board (ME-MUX32-M)

2.3.2 Multiplexer Slave Board (ME-MUX32-S)

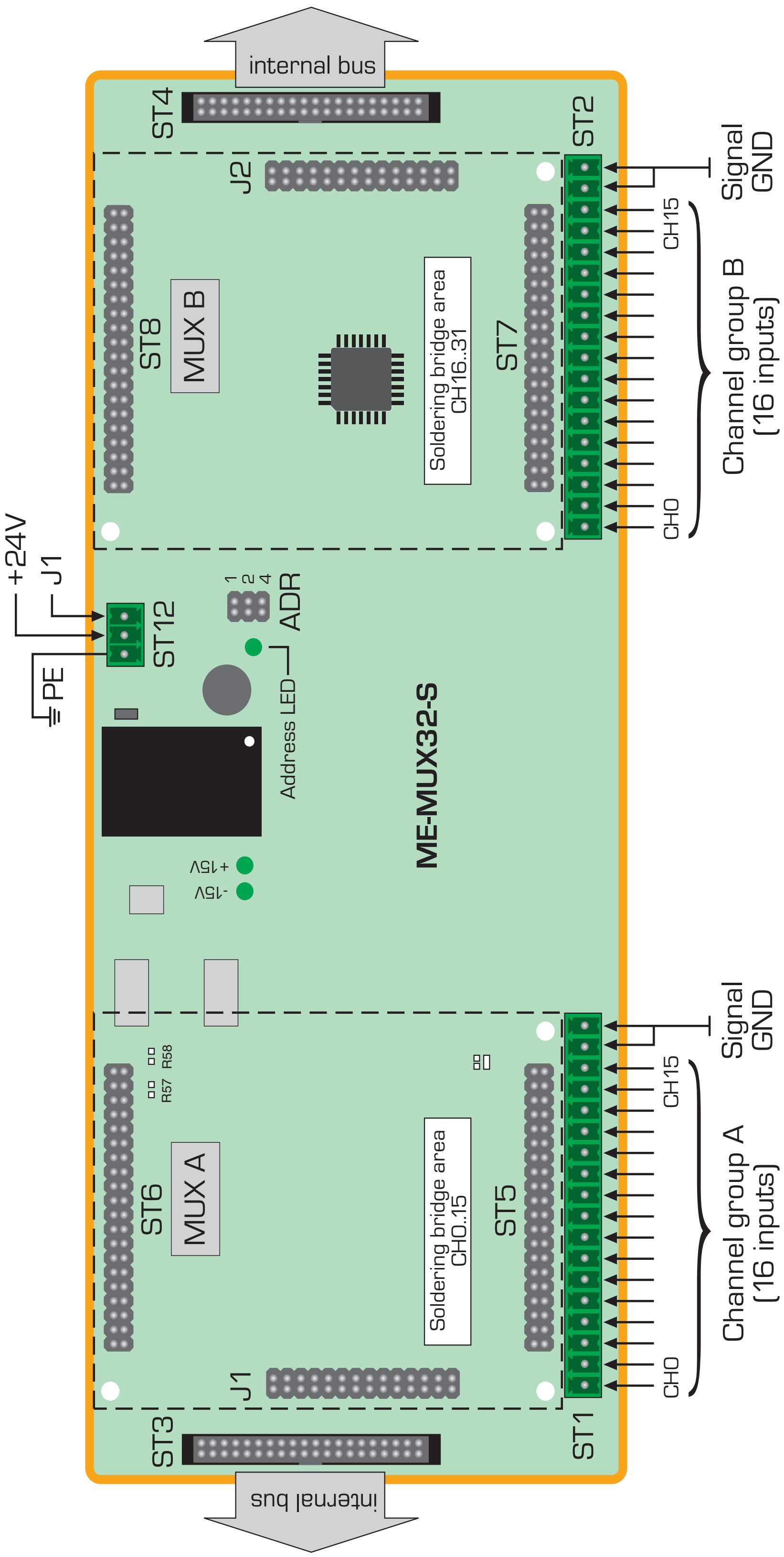


Diagram 4: Multiplexer slave board (ME-MUX32-S)

2.3.3 Standard System Expansion

Standard system expansion means, that one **master board** (ME-MUX32-M) is directly connected to one of the supported PC DAQ boards (see page 8). Connect your Meilhaus boards using a 1:1 cable (ME AK-D78) to ST9 (ME-2000/2600/3000) resp. ST10 (ME-4600 series*). If you use PC DAQ boards from other manufacturers special cables are required (see also table 2). You can connect up to 7 **slave boards** (ME-MUX32-S) with a 40-pin flat ribbon cable. Just connect the master board's ST4 with the first slave board's ST3 etc. Each slave board you add will expand your system with 32 channels. On the whole you can multiplex **256 channel** into one single-ended A/D channel (input range: ±10 V) of your DAQ board. The channel number can be selected by a soldering bridge, see chapter 2.3.8 and following. Every base board is divided into two groups (A, B) each with 16 input channel.

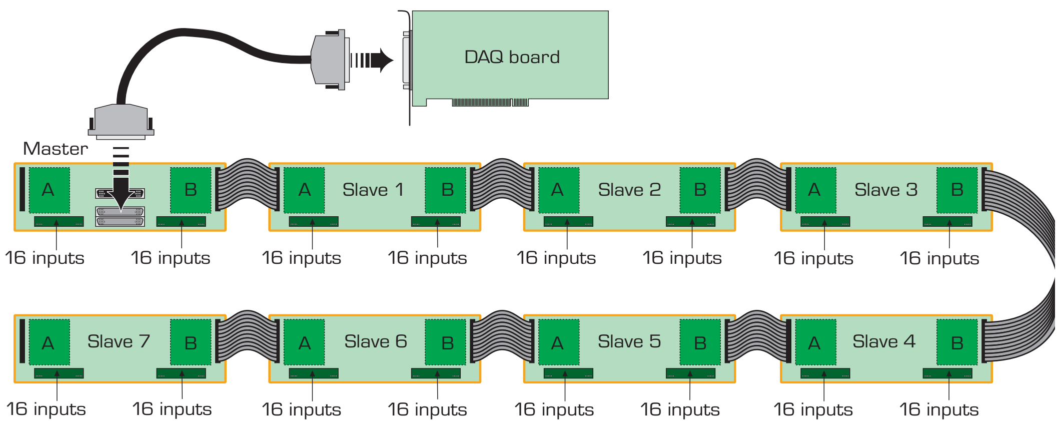


Diagram 5: ME-MUX standard system expansion with 7 slaves

As an option, each group can be "armed" with a **signal conditioning** module for differential measurement of voltage or current, for resistance temperature detectors (RTDs) or with a prototyping/breadboard module (detailed description see chapter "Plug-On Modules "on page 32). A 1:1 bridge module for each group is included.

*see note on page 8!

You can select the operation modes **"Single-MUX"** or **"Multi-MUX"** (see chapter 2.3.8 and following). Depending on the operating mode the master board's soldering bridge area has to be configured properly (standard setting is "Single-MUX"). If you are using slave boards, please also read chapter 2.3.5 Jumper Settings.

2.3.4 Full System Expansion

Full system expansion means, that up to 8192 analog inputs can be multiplexed into 32 single-ended A/D channels of a DAQ board (256 inputs each into one channel).

For control we recommend digital I/O boards of the type ME-1000 providing 64 digital I/Os. For every set of 1024 channels an additional ME-1000/64 is required. For 2048 channels you will need a ME-1001 additionally. For 3072 channels you will need an additional ME-1000/64 and for 4096 channels one more ME-1001 etc. Moreover you will need special cables (see diagram 6). Each MUX chain has one master board and up to 7 slave boards. The structure of a single chain is the same as for standard system expansion in "Single-MUX" mode.

Multiplexer Full System Expansion:

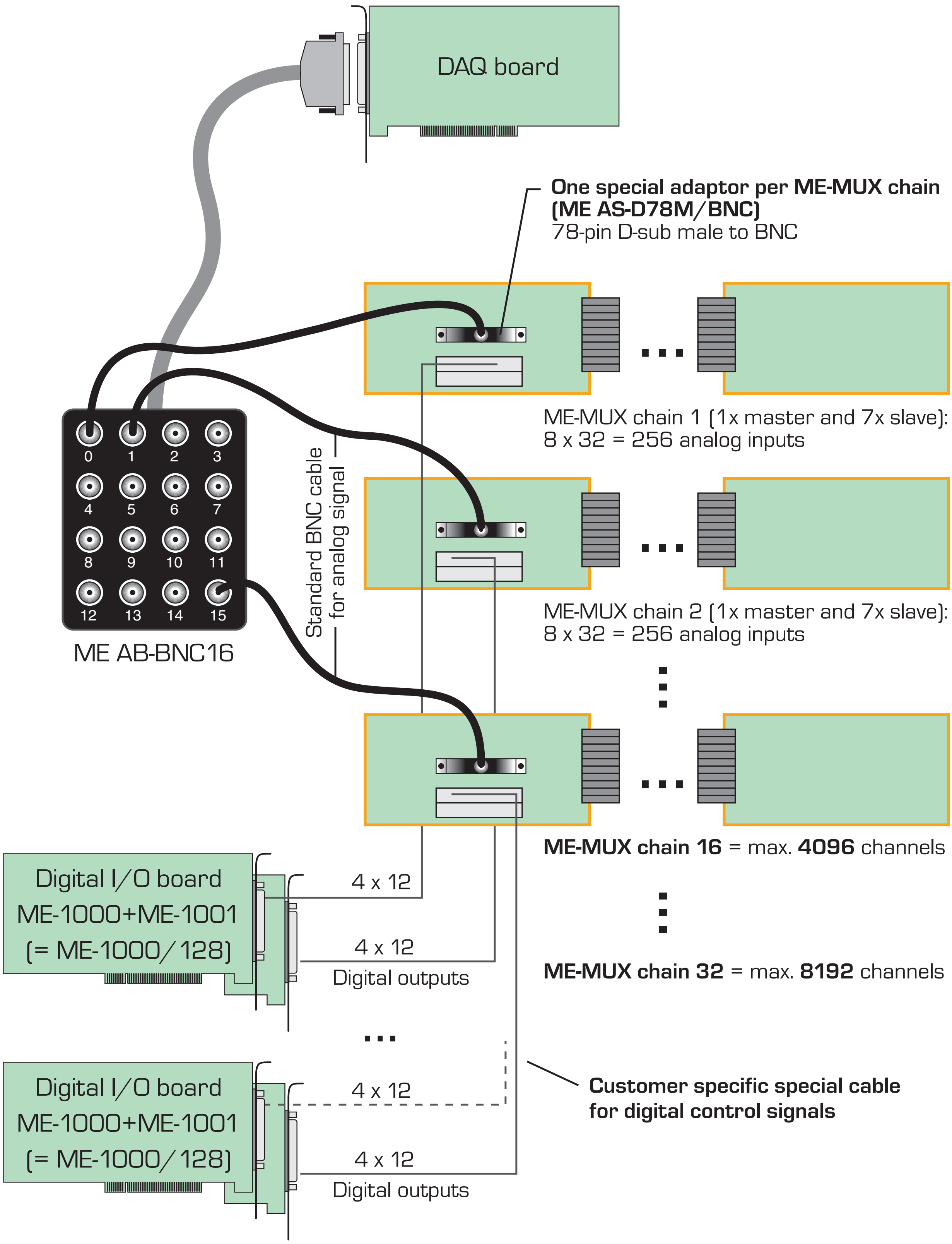


Diagram 6: Multiplexer full system expansion

2.3.5 Jumper Settings

An internal bus system connects the master board with up to 7 slave boards, using a 40-wire flat ribbon cable. A unique base address (1…7) has to be selected with the jumper ADR to address the individual slave boards. The jumpers J1 and J2 patch the analog channels of the slave boards to the internal bus. Always set the jumpers of the slave boards as shown in diagram 7 and 8.

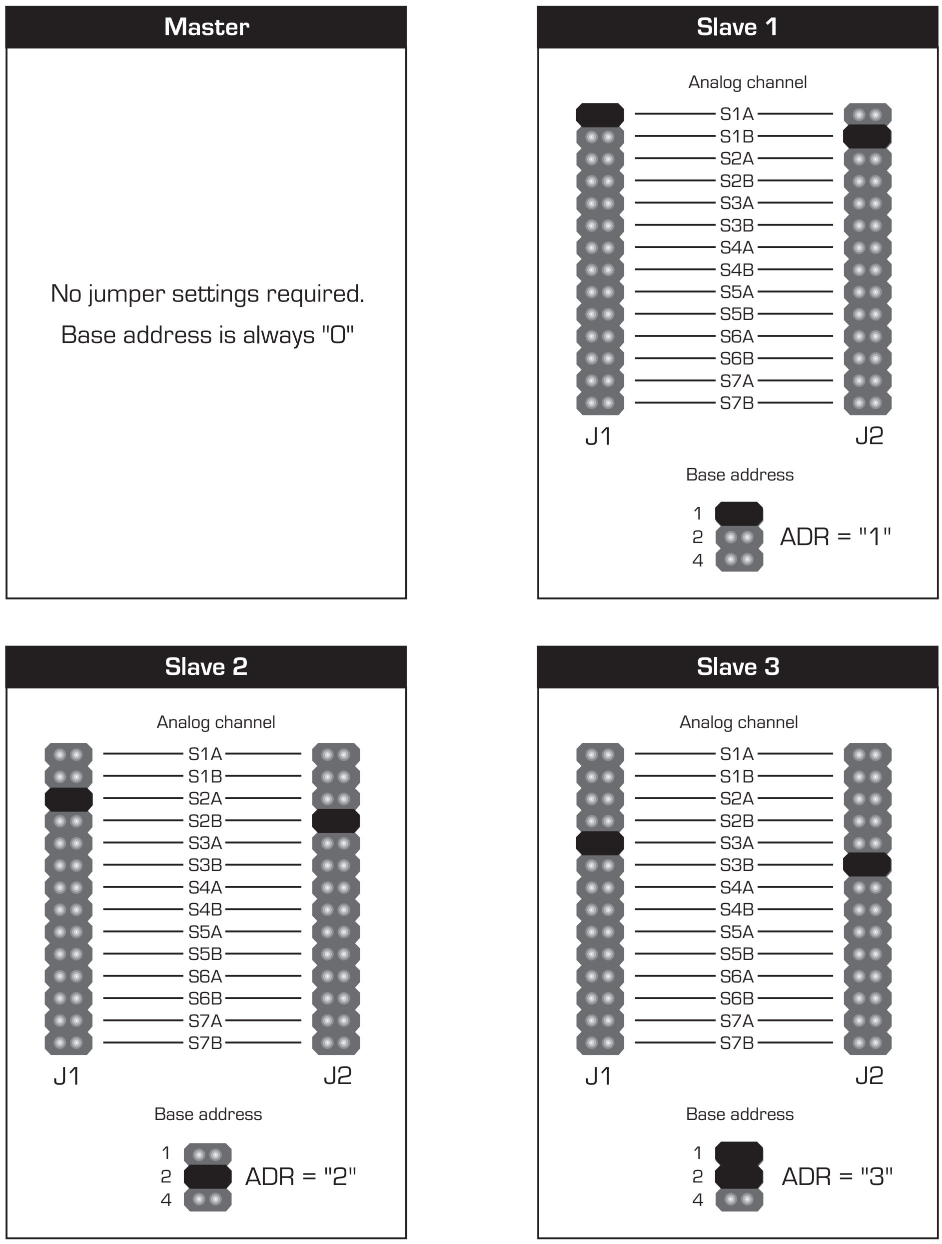


Diagram 7: Jumper settings (master, slave 1-3)

Jumper settings (continued)

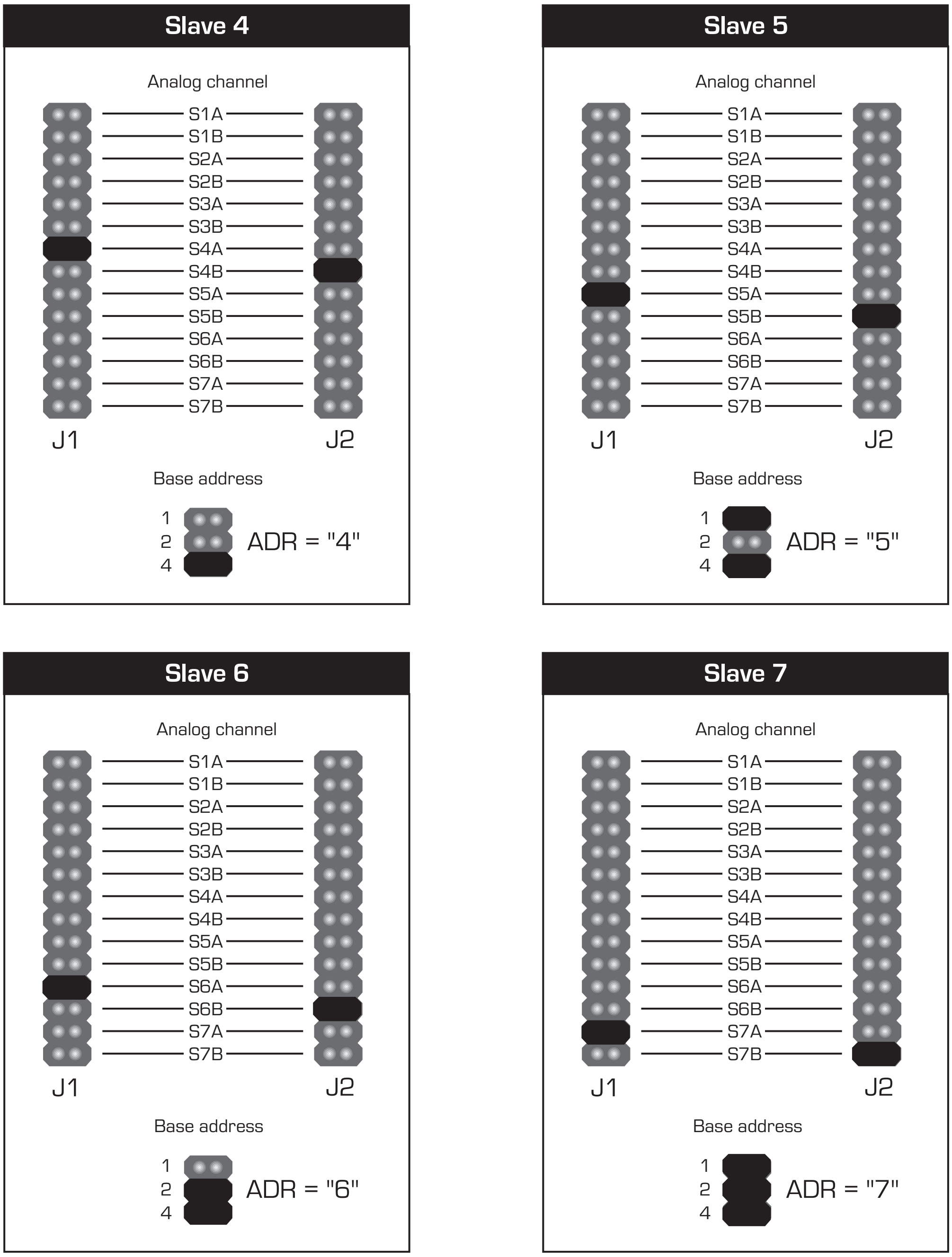


Diagram 8: Jumper settings (slave 4-8)

2.3.6 Gain

The base boards of type ME-MUX32-M and ME-MUX32-S offer a signal amplifier on the base board, which is independent from the DAQ PC board. The gain (V=1, V=10, V=100) can be programmed per group, using the digital control lines of your DAQ board. After power-up the gain is set to V=1. When setting the gain factor, please note, that the PC DAQ board's max. input range must not be exceeded (because of this always use V=1 in combination with signal conditioning modules). For further information on programming the gain factors see chapter. 3.2 on page 51.

2.3.7 Power Supply

Each base board has to be connected to a suitable DC power supply (18…36 V, typ. 24 V) via the connector ST12. You can calculate the power consumption of your system, depending on the number of base boards and plug-on modules (see appendix A Specifications). We recommend a star connection of all base boards to safety earth (PE) of your rack cabinet or PC.

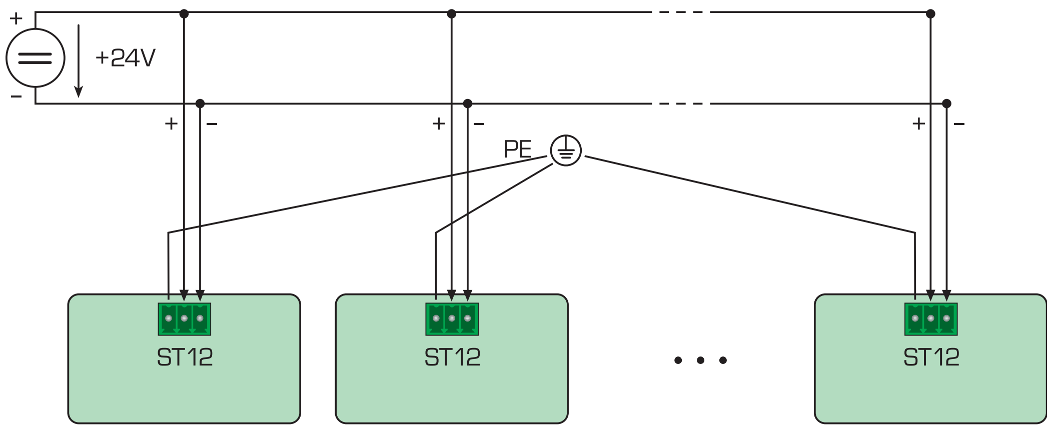
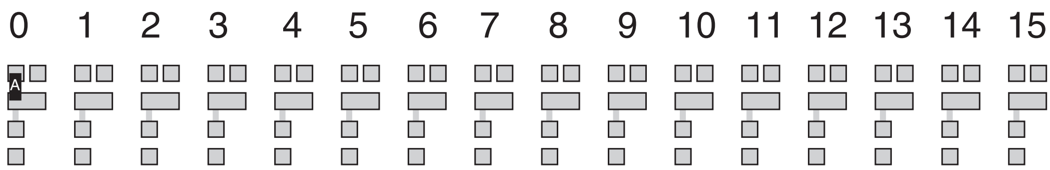


Diagram 9: Power supply

2.3.8 Operating Mode ”Single-MUX”

The operating mode ”Single-MUX” allows you to multiplex up to 256 channels into one A/D channel of your PC DAQ board. For this mode, you have to set the soldering bridge ”A” on the master board for the **one** DAQ board channel you would like to use. See also diagram 11 and 12.

Master board, Group A (A/D channel 0…15):



Master board, Group B (A/D channel 16…31):

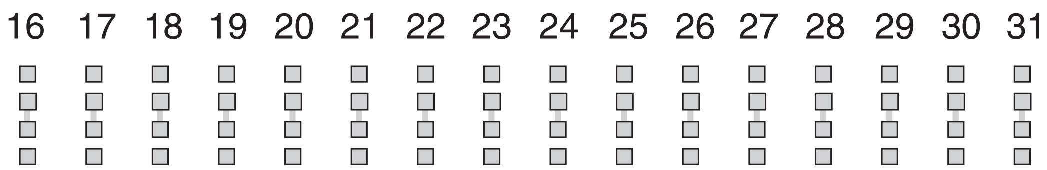


Diagram 10: Soldering bridges ”Single-MUX” (Default: Chan. 0)

Note: The maximum possible channel number depends on the number of A/D channels your PC DAQ board offers.

Take care that there is **no** soldering bridge set on slave boards!

2.3.8.1 Block Diagram "Single-MUX" (Master Board)

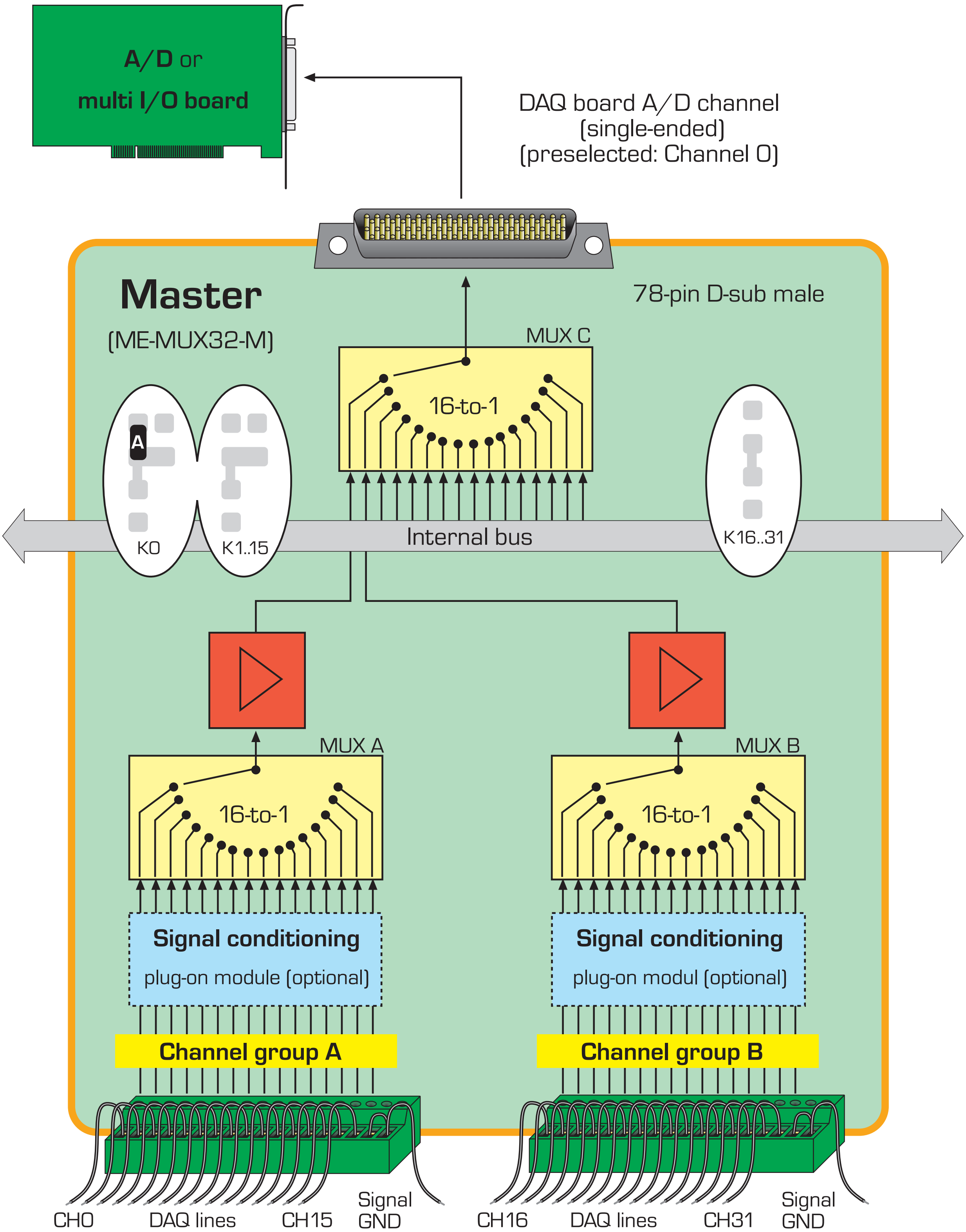


Diagram 11: Block diagram "Single-MUX" (master board)

2.3.8.2 Block Diagram "Single-MUX" (Slave Board)

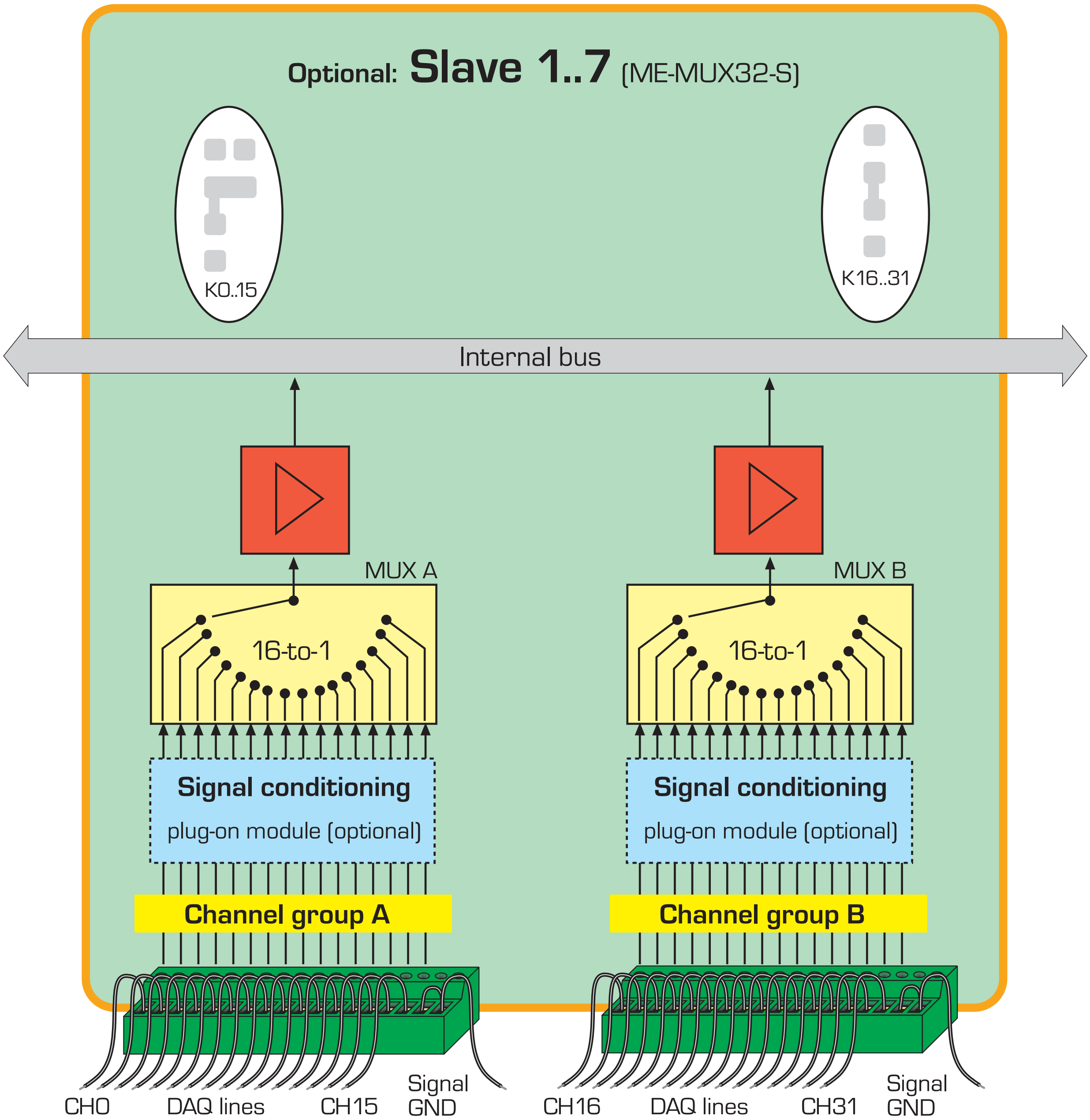


Diagram 12: Block diagram "Single-MUX" (slave board)

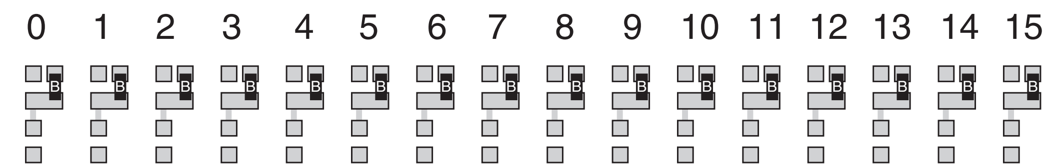
2.3.9 Operating Mode ”Multi-MUX”

The operating mode ”Multi-MUX“ allows you to multiplex 16 channels **groupwise** into the PC DAQ board‘s A/D channels 0..15. For this mode you have to set the soldering bridge ”B” on the master board for the channels 0…15 as shown in diagram 13. This will be set…

- Master board, channel group A to PC board A/D channel 0, Master board, channel group B to PC board A/D channel 1,
- Slave board 1, channel group A to PC board A/D channel 2, Slave board 1, channel group B to PC board A/D channel 3,

… etc. (see also diagram 14 and 15)

Group A, master board (slave boards: no soldering bridges!):



Group B, master board (slave boards: no soldering bridges!):

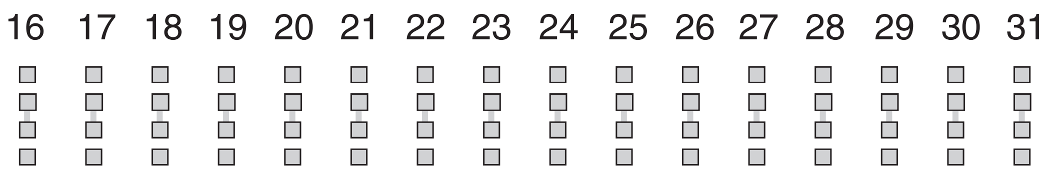


Diagram 13: Soldering bridges ”Multi-MUX”

2.3.9.1 Block Diagram "Multi-MUX" (Master Board)

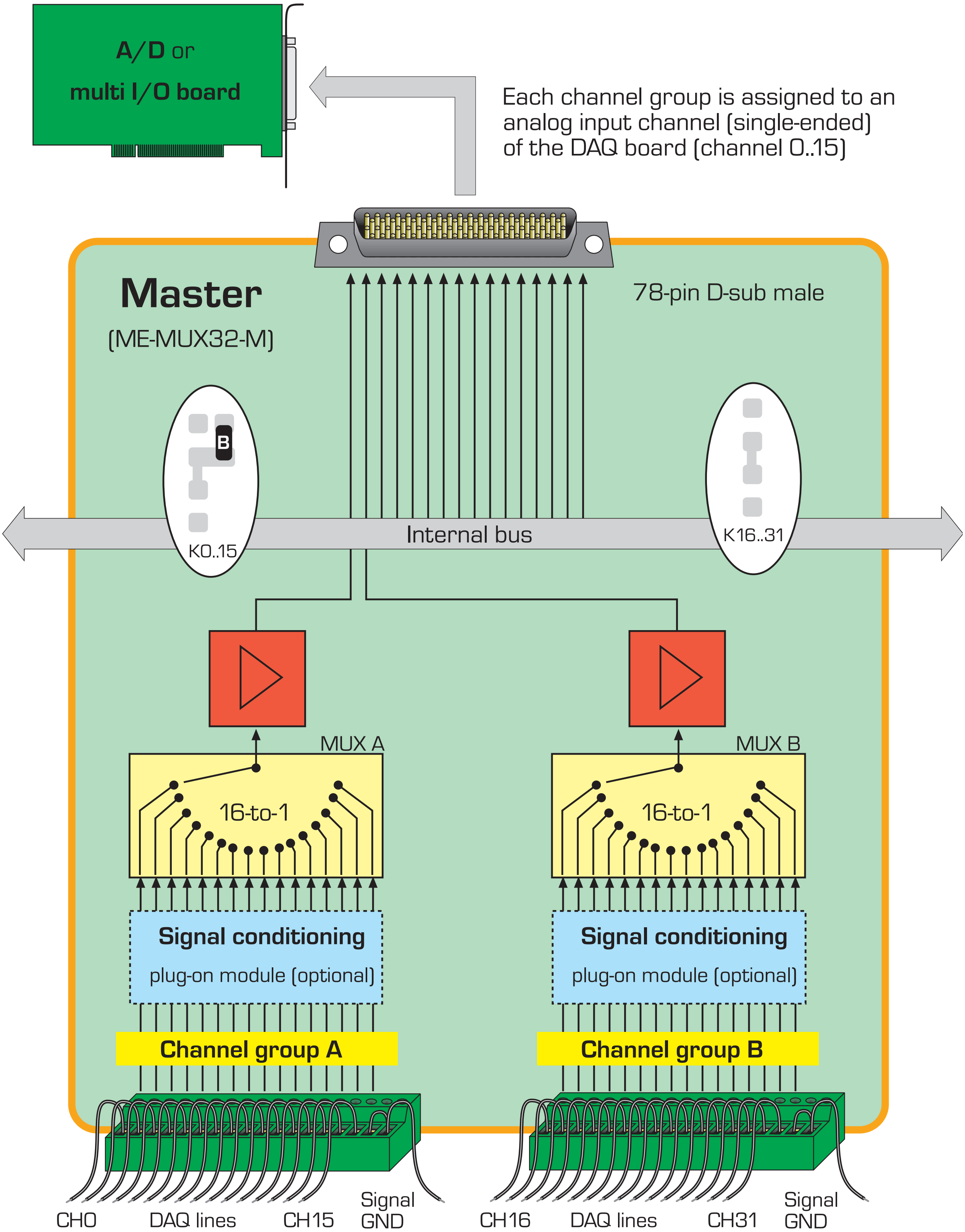


Diagram 14: Block diagram "Multi-MUX" (master board)

2.3.9.2 Block Diagram "Multi-MUX" (Slave Board)

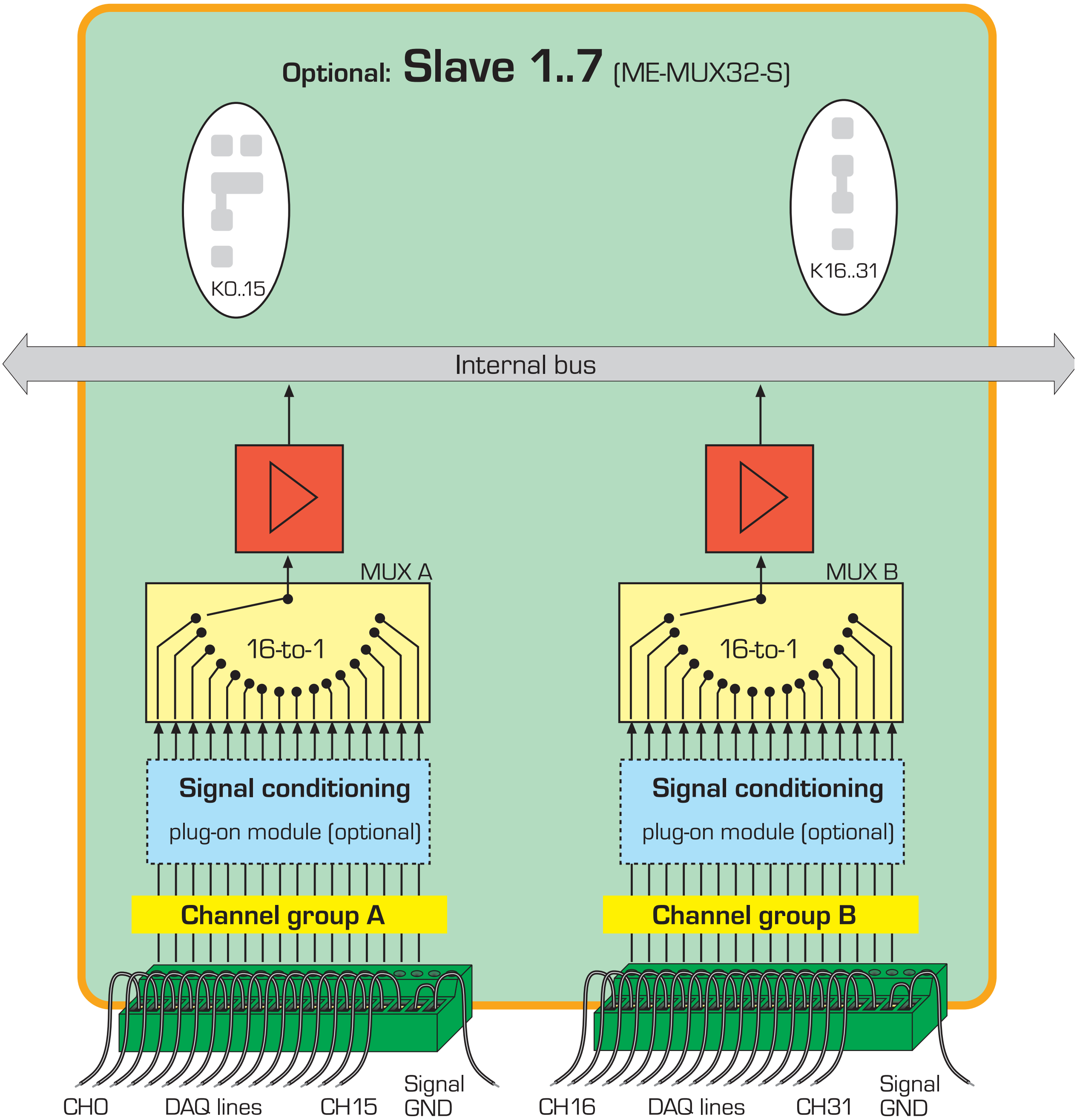


Diagram 15: Block diagram "Multi-MUX" (slave board)

2.4 Model "Demultiplexer"

2.4.1 Demultiplexer Base Board (ME-DEMUX32)

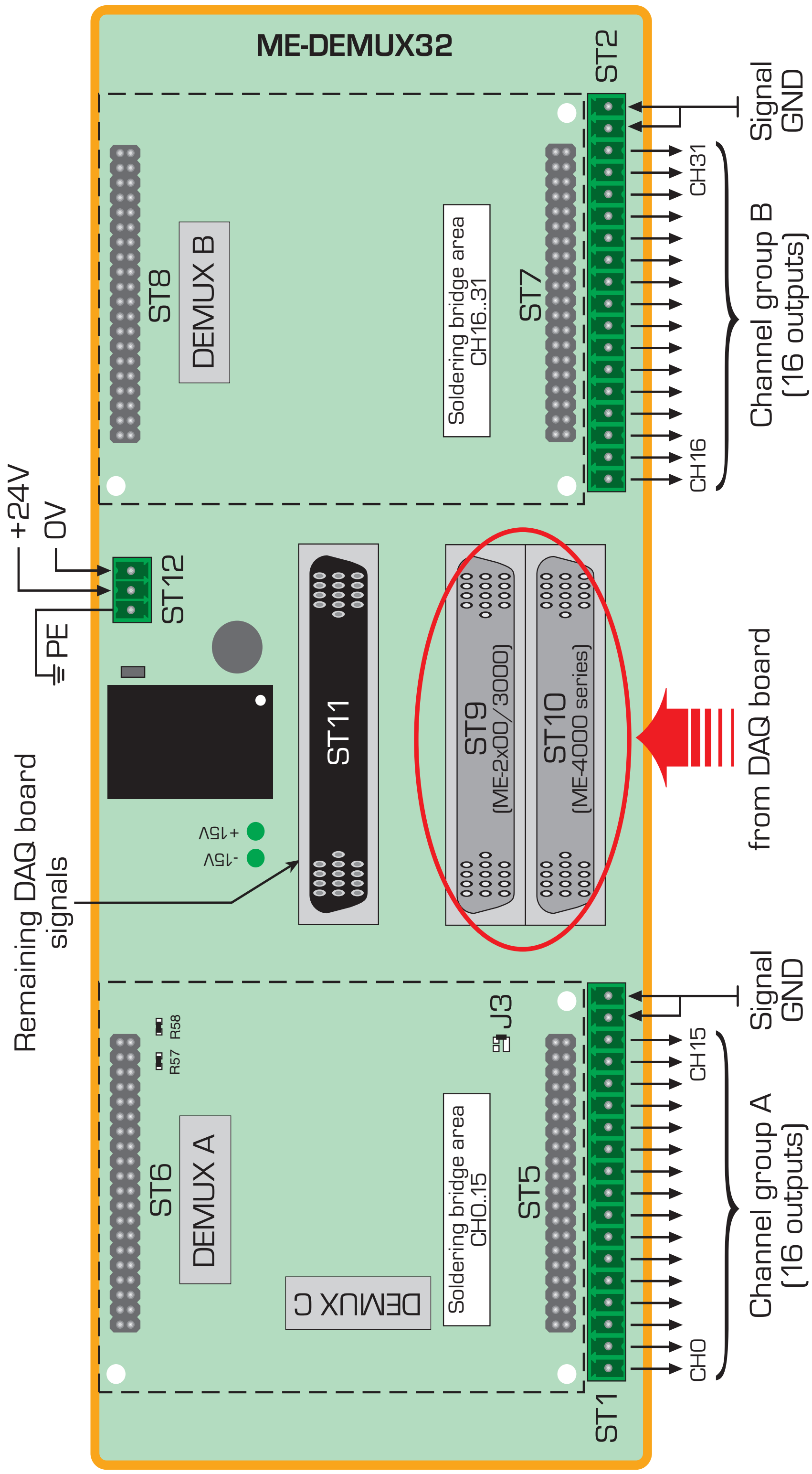


Diagram 16: Demultiplexer base board (ME-DEMUX32)

2.4.2 Operating Mode ”Demux”

This operating mode allows you to ”divide”/demultiplex one PC DAQ board D/A channel into max. 32 output channels. The demultiplexing board (ME-DEMUX32) is directly connected to your D/A or multi I/O board (supported boards see page 8). Connect your Meilhaus board using a 1:1 cable (ME AK-D78) to ST9 (ME-2600/3000) resp. ST10 (ME-4600 series). If you use PC DAQ boards from other manufacturers special cables are required (see also table 2). The PC board‘s analog output channel used for demultiplexing always has to be D/A channel 0 (or A). Depending on the board model, connector ST9 or ST10 is used and the soldering bridge J3 has to be set according to the picture below (ME-2600/3000: connection ”D”; ME-4600 series: connection ”E”):

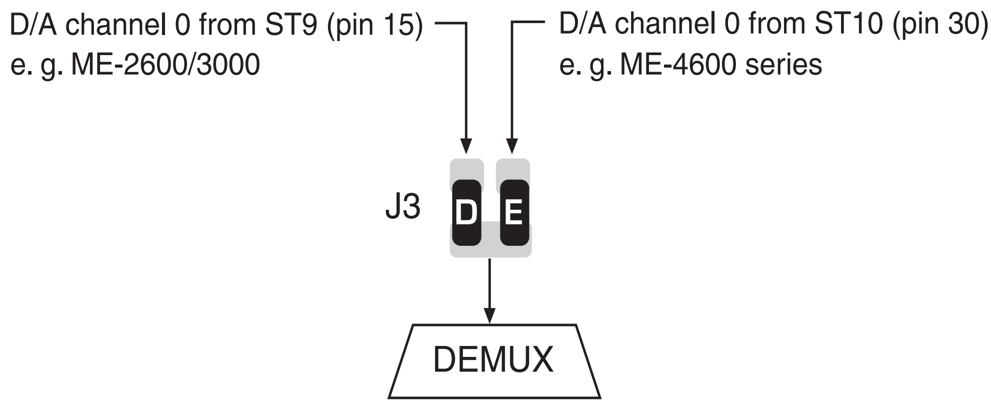


Diagram 17: Soldering bridge J3

Some board types (e.g. ME-2600/3000) may have a sense line (e. g. D/A-Sense A) for each D/A channel. This sense line has to be connected to the output of the first D/A channel (e. g. D/A-Out A) on the demultiplexer board side. To do so, you can use the D-Sub female connector ST11, for example. Please read the chapter refering to the wiring of the D/A channels in your DAQ board user manual.

Custom specific user signal conditioning modules based on the prototyping module can be plugged on instead of the standard bridge module at any time.

Configurations with up to 256 outputs are available on request. Please contact our technical sales team at: sales@meilhaus.com.

2.4.3 Block Diagram "Demux"

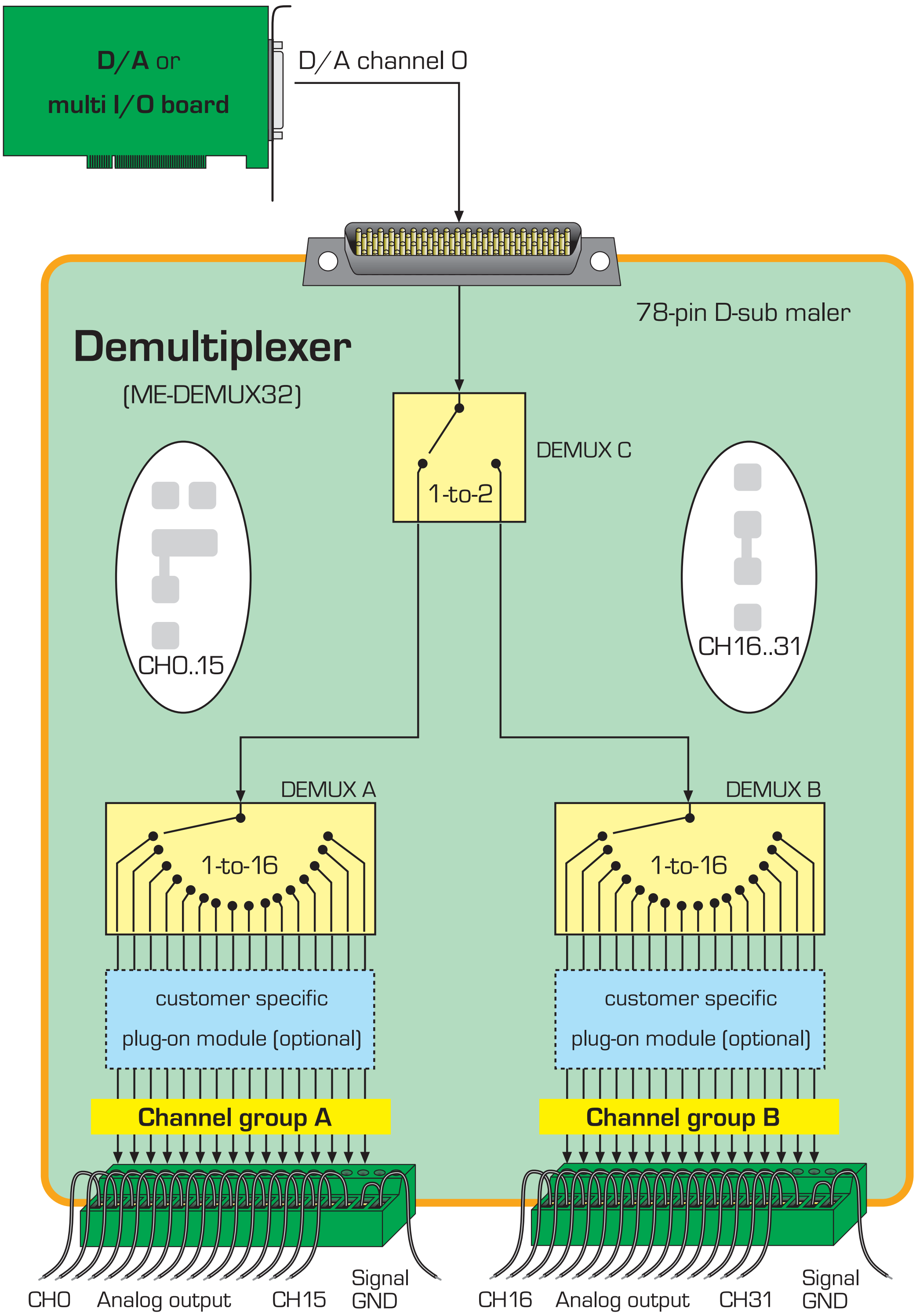


Diagram 18: Block diagram "Demux"

2.5 Model "Signal Conditioning"

2.5.1 Signal Conditioning Base Board (ME-SIG32)

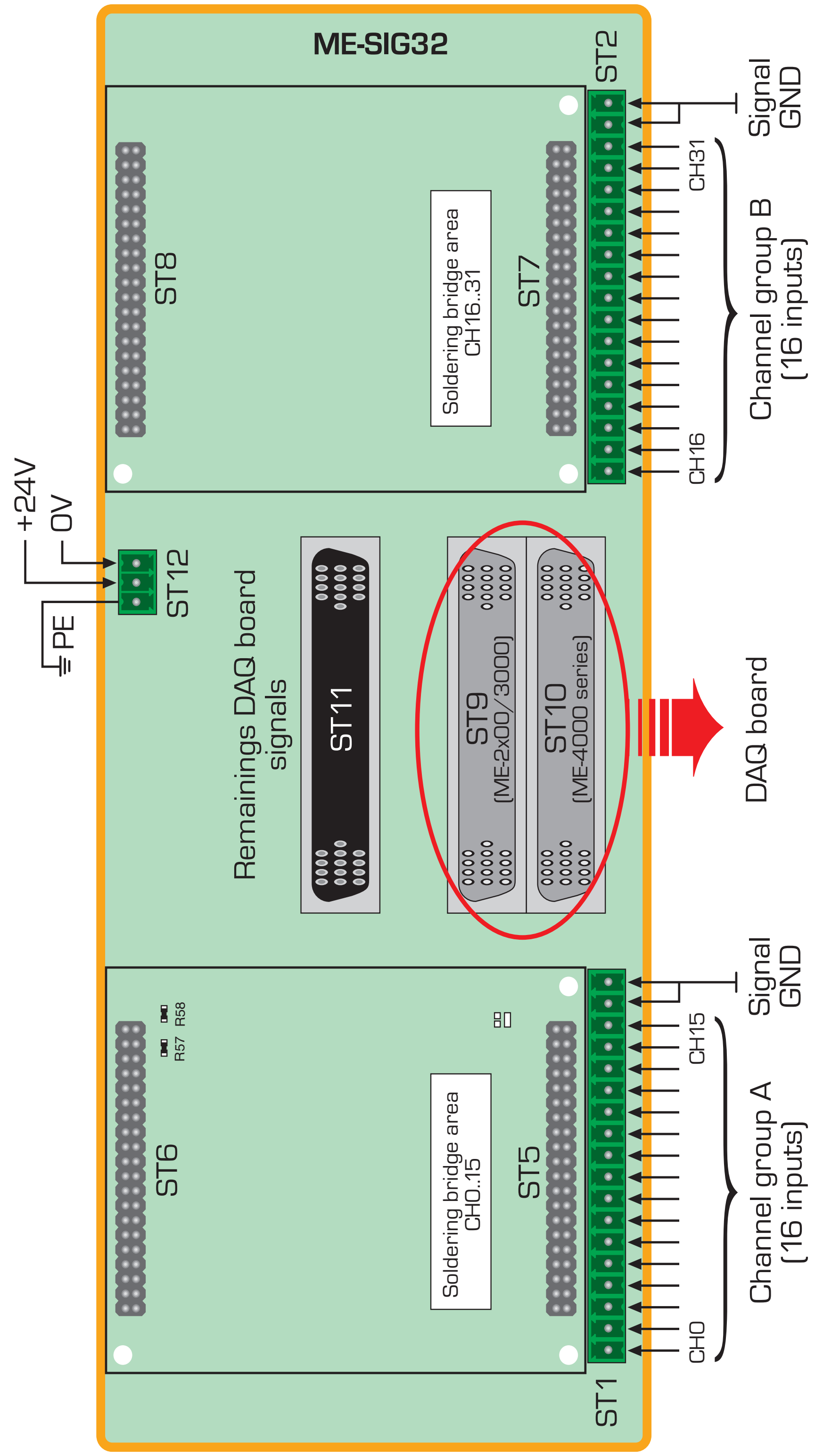


Diagram 19: Signal conditioning base board (ME-SIG32)

2.5.2 Operating Mode "Signal Conditioning"

For **pure signal conditioning** on up to 16 or 32 channels (depending on the multi I/O board channel number) the base board ME-SIG32 is used. This board does not have a multiplexing and gain section, i. e. no digital control lines are required. The base board is directly connected to one of the supported A/D or multi I/O boards (see page 8). Connect your Meilhaus board using a 1:1 cable (ME AK-D78) to ST9 (ME-2600/3000) resp. ST10 (ME-4600 series). If you use PC DAQ boards from other manufacturers special cables are required (see also table 2). Depending on the multi I/O board features, data acquisition under timer control may be possible.

Signal conditioning plug-on modules are available for differential acquisition of voltage or current, for resistance temperature detectors (RTDs) and for prototyping (a detailed description of the modules can be found in chapter "Plug-On Modules" on page 32). The plug-on modules are not included with the base board (for 16 channels at least one module is required).

Custom specific signal conditioning modules based on the prototyping/breadboard module can also be plugged on at any time.

No jumpers or soldering bridges have to be set on the ME-SIG32.

Connect all inputs you will not use in your DAQ system to signal GND (i.e. inputs of the base boards as well as inputs of the signal conditioning modules).

2.5.3 Block Diagram "Signal Conditioning"

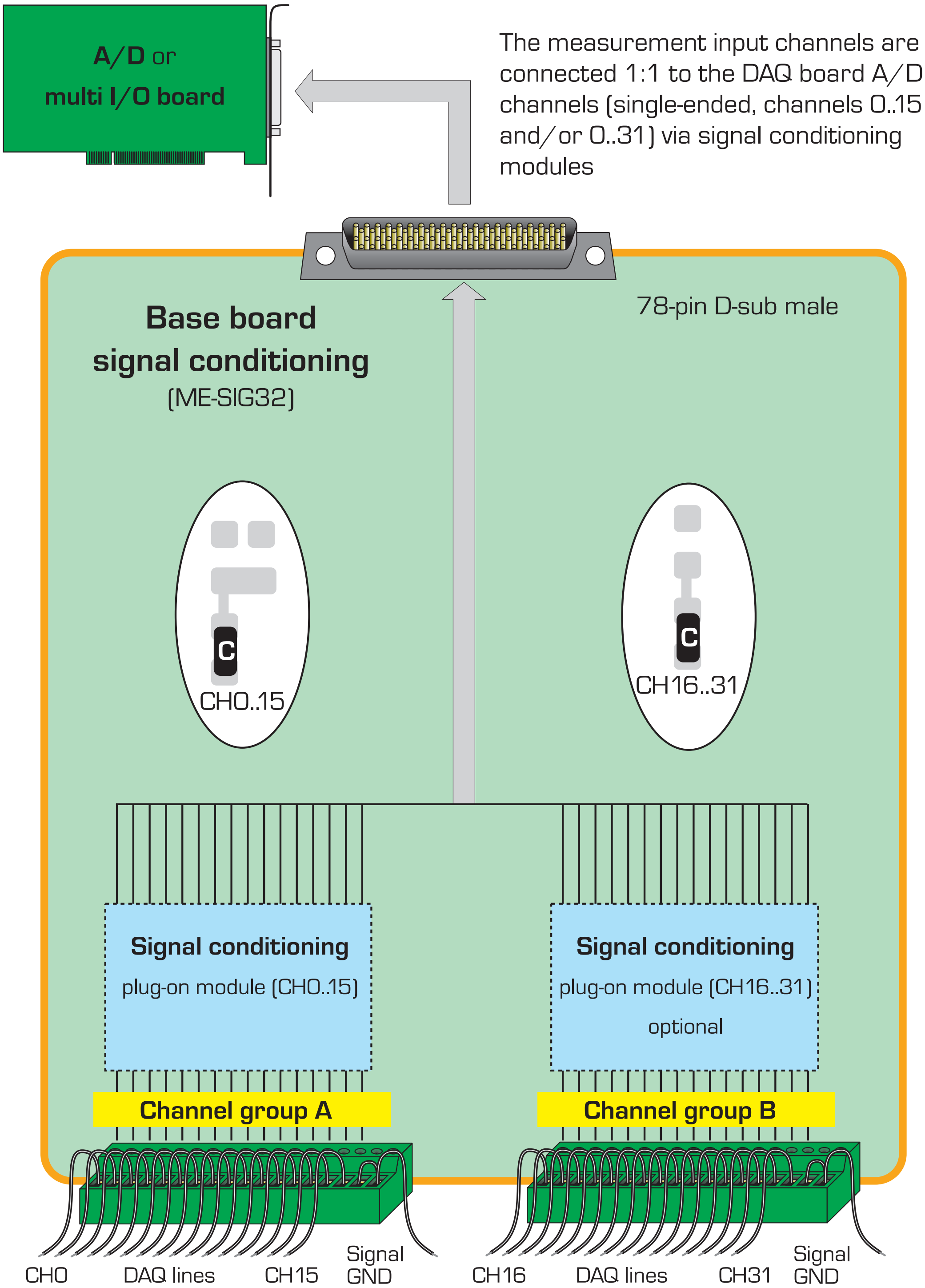


Diagram 20: Block Diagram "Signal Conditioning"

2.6 Plug-On Modules

All base boards, except the ME-SIG32, are supplied with bridge modules (i.e. no signal conditioning function). As an option up to 2 plug-on modules for signal conditioning can be added per base board of type ME-MUX32-M, ME-MUX32-S and ME-SIG32. Using two different plug-on modules on one base board is also possible. The power supply (+24V) is provided by the base board. Supply conditioning is done directly on the module.

Important note: If plug-on modules are used, a gain setting of V=1 should be used on the base board to avoid damage of your DAQ board.

2.6.1 Calculating the measured values

The output voltage range U_N of all modules towards the board is standardized to ±10V. Adapt the input voltage range of your DAQ board (as a rule ±10V).

- **ME-Diff16**: The voltage U_M calculates as follows (see diagram 21 and 23):

  $$U_M = \frac{|U_{FS}|[V]}{10V} \cdot U_N[V]$$

  U_{FS} should be the voltage difference (U+) - (U–) at full-scale depending on the chosen module type (10V, 20V or 50V).

- **ME-Current16**: The current I_M calculates as follows (see diagram 21 and 24):

  $$I_M = \frac{20mA}{10V} \cdot U_N[V]$$

  I_{FS} should be the current difference (I+) - (I–) at full-scale in the range 0…20mA.

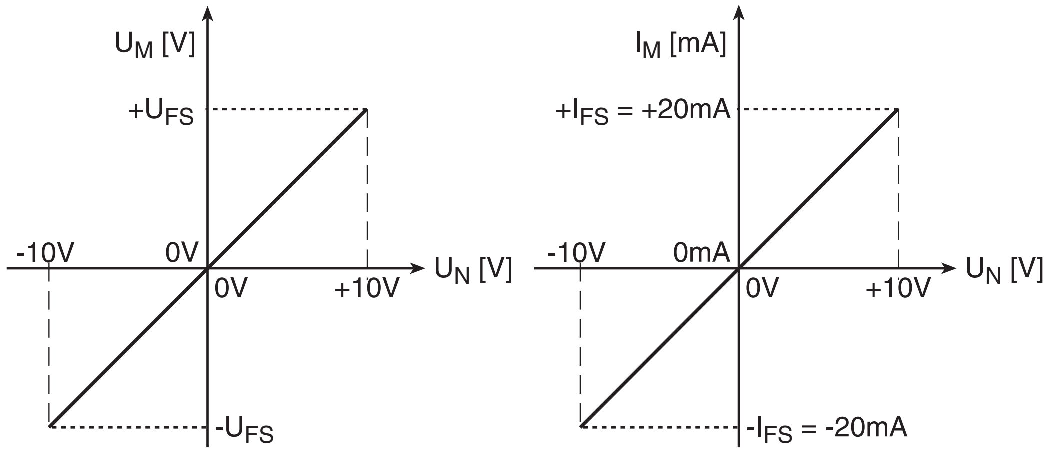


Diagram 21: Characteristic curves ME-Diff16 (left), ME-Current16 (right)

- **ME-RTD8**: For calculating the temperature values please note chapter 2.6.5 from page 37 on.
- **ME-TE8**: For calculating the temperature values please note chapter 2.6.5 from page 37 on.

2.6.2 Module ME-Proto

Prototyping/breadboard module with an area of soldering holes. Use this module to create your own signal conditioning circuitry. Can be used on all base boards. Power supply comes from the base board.

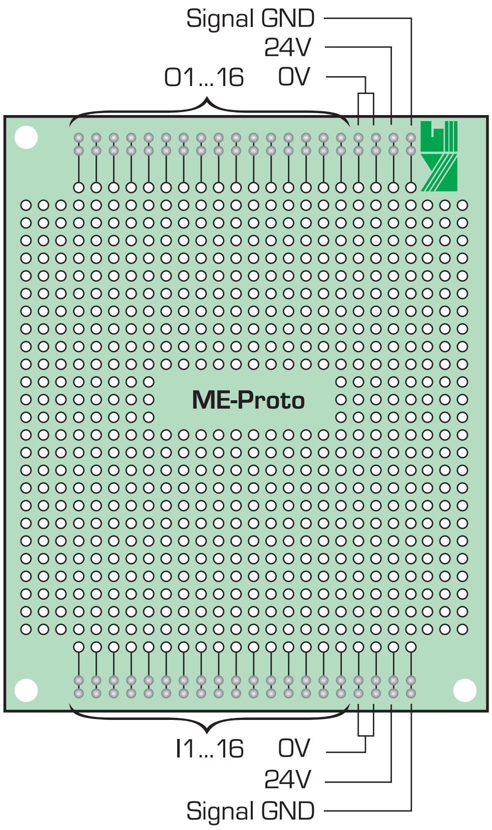


Diagram 22: ME-Proto

2.6.3 Module ME-Diff16

Plug-On module with 16 differential input channels. Depending on the model (see coding on the module backside), the module may have an input range of 10 V, 20 V or 50 V. The absolute value of the voltage difference between the two inputs (U+) and (U–) may not exceed the value of the specified input range. The 50 V input models are available with an input resistance of R_i= 3,75MΩ or R_i=50MΩ .

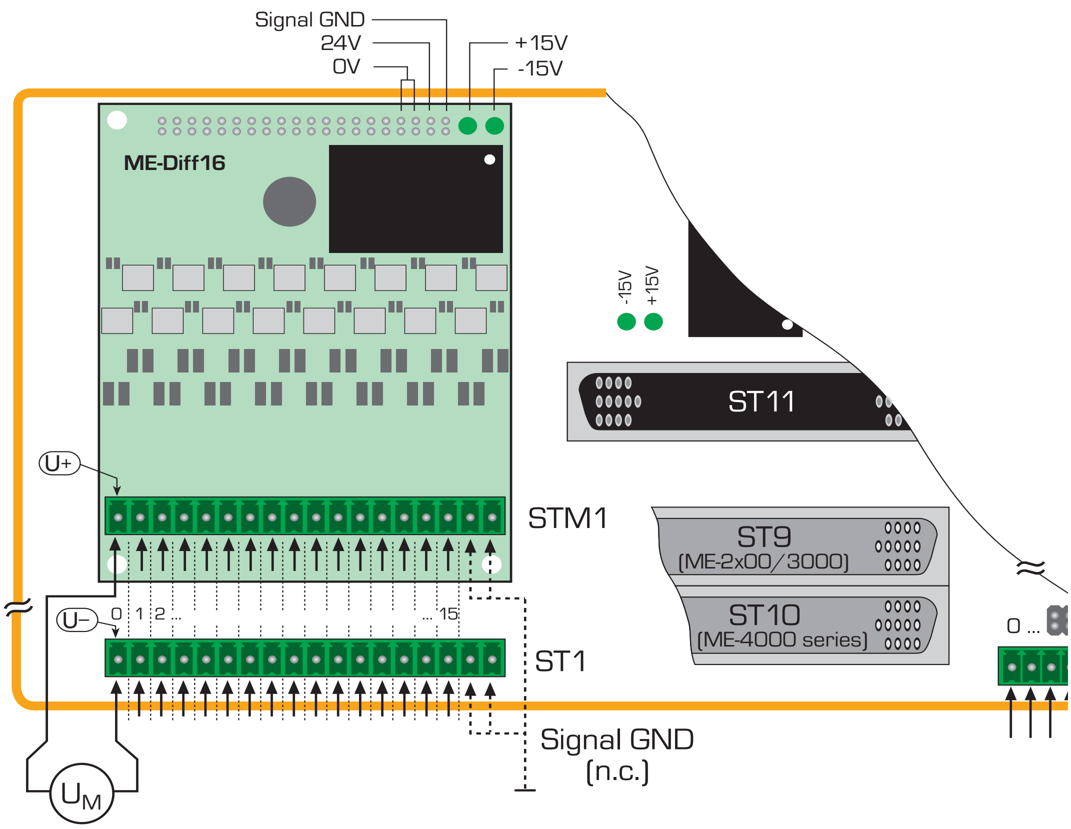


Diagram 23: ME-Diff16

The output of the module is always a bipolar voltage value U_N in the range of ±10V (see curve in diagram 21). Signal GND is not connected. The lines (U+) and (U–) of each measurement channel are connected to the corresponding clamps on the terminals ST1 and STM1 (see diagram 23). Input channels you will not use should be „short-circuited“.

2.6.4 Module ME-Current16

Plug-On module for measurement of current on 16 differential channels. The input range is 0…20 mA. The absolute value of the current difference between the two inputs (I+) and (I–) may not exceed the range of 0…20 mA.

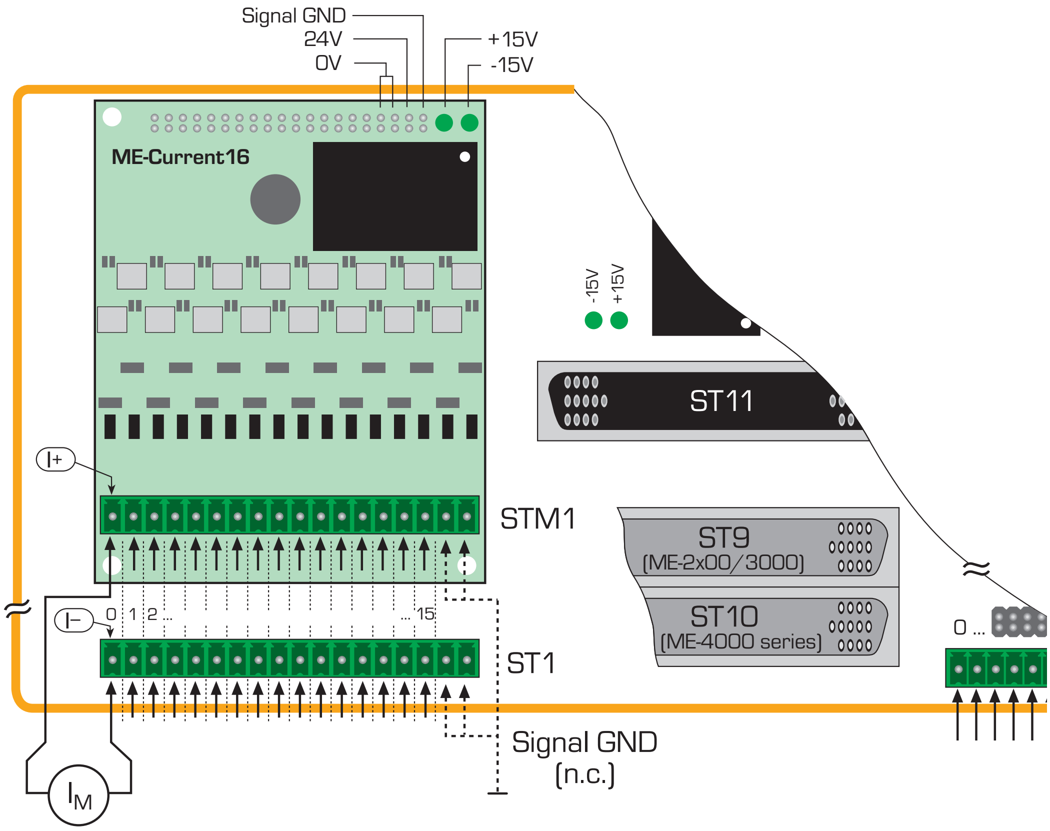


Diagram 24: ME-Current16

The output of the module is always a bipolar voltage value U_N in the range of ±10V (see curve in diagram 21). Signal GND is not connected. Connecting signal GND is not required. The lines of each measurement channel are connected to the corresponding clamps on the terminals ST1 and STM1 (see diagram 24). Input channels you will not use have to be „short-circuited“.

2.6.5 Module ME-RTD8

Plug-On module for temperature measurement with platinum resistors (PTC) according to DIN EN 60751. Depending on the model (see coding on the module backside), up to 8 sensors Pt100 (0,4 Ω/°K), Pt500 (2,0 Ω/°K) or Pt1000 (4,0 Ω/°K) can be connected. The temperature range is -200…+850°C. The measurement method is differential, with 2-, 3- or 4-wire connectivity. This helps to transmit the signal as clean as possible to your PC.

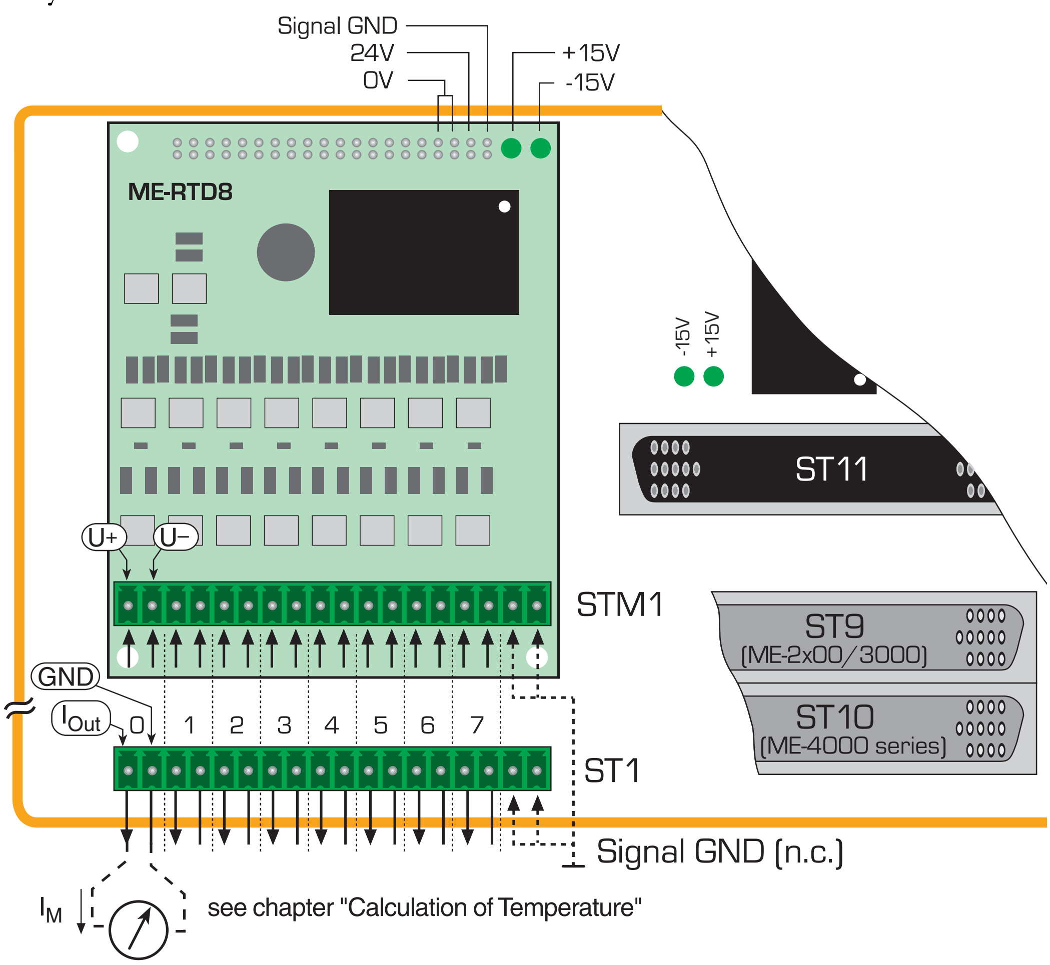


Diagram 25: ME-RTD8

The output of the module is always a bipolar voltage value U_N in the range of ±10V (see curve in diagram 21). Signal GND is not connected. The wires of the temperatur sensors are connected to the corresponding clamps on the terminals ST1 and STM1 (sensor connectivity see page 38 and following). The channels 0…7 of each group will be used.

Unused input channels (U+) and (U–) on STM1 should be „short-circuited“; do not connect I_{Out} and GND!

2.6.5.1 2-Wire Connectivity

The sensor is connected to the module ME-RTD8 using 2 wires (see diagram 26). Like every electric conductor these wires have a resistance, which is in series with the temperature sensor. This means, that the resistance values are added, which will be misinterpreted as a higher temperature. A compensation of this error requires a lot of sophisticated adjustment. To describe the adjustment methods would go beyond the scope of this manual. [2]

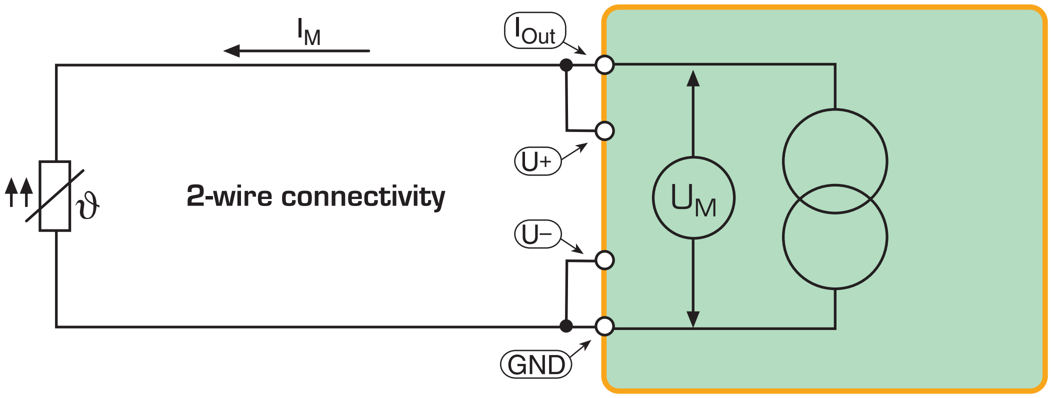


Diagram 26: 2-wire connectivity

2.6.5.2 3-Wire Connectivity

3-wire connectivity (see diagram 27) is used to minimize the influences of the wires‘ resistance and its relation to temperature. An additional third wire leads to a sensor contact. This creates two measurement circuits. One of them is used as a reference (U_R). Using 3-wire connectivity compensates the wires‘ resistance as well as its relation to temperature. A further line compensation is not required. [2]

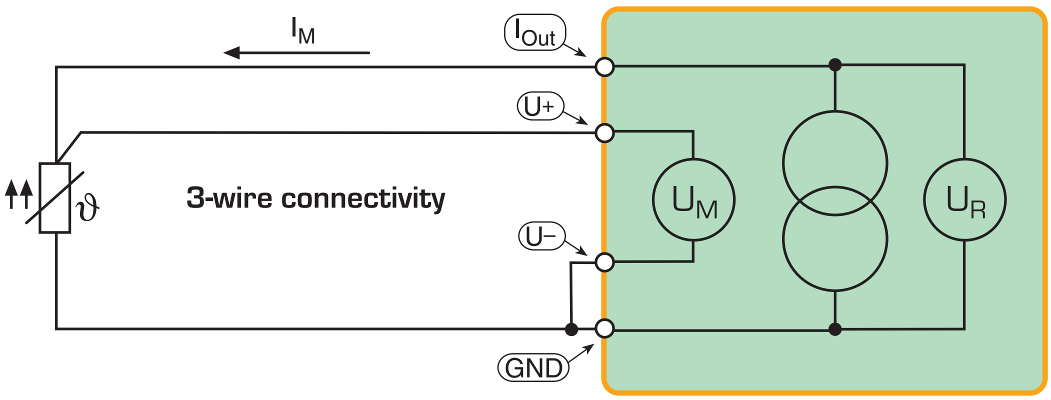


Diagram 27: 3-wire connectivity

2.6.5.3 4-Wire Connectivity

4-wire connectivity is the best way to connect RTDs to the ME-RTD8 module. Measurement data is neither affected by the line resistance nor by its changes through temperature. Further line compensation is not required. The wires supply the temperature sensor with the measurement current I_M. The voltage at the sensor is measured at +U and -U. [2]

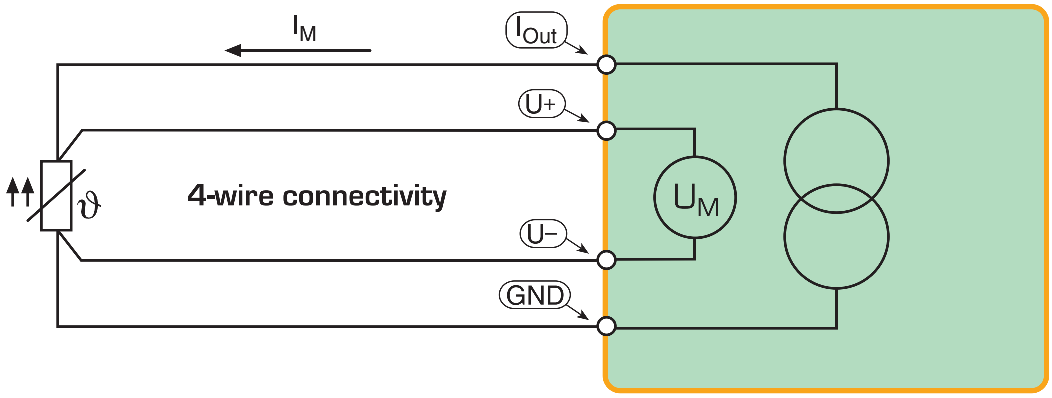


Diagram 28: 4-wire connectivity

2.6.5.4 Calculating the Temperature

Note: If you are using base boards of type ME-MUX32-M/S (operation mode „Single-Mux“) in combination with a board of the ME-4600 series we recommend the function *me4000MultiSig-AIDigitToSize* for simple calculation of the temperature.

Resistance temperature detectors (RTDs) change their resistance depending on the temperature. For the acquisition of temperatures the voltage drop created by a constant measurement current is measured. A small measurement current should be used to prevent the sensor from getting hot. The ME-RTD8 module‘s typical constant measurement current I_M = 500 µA. We recommend to measure the actual constant current of each channel with a high accuracy ampere meter (accuracy better than 1 µA) at the beginning (see diagram 25: example for channel 0) because of unavoidable component tolerances. Note down the measurement value of each channel and use it to calculate the resistance of the temperature sensor:

$$R_M = \frac{U_M}{I_M \cdot V} \qquad \text{[formula 1]}$$

R_M: Calculated resistance of the temperature sensor.

U_M: Voltage measured between U+ and U–.

I_M: real constant measuring current (must be measured by the user between I_{Out} and GND - see above).

V: Gain factor depending on module type:
Pt100: V=40 Pt500: V=8 Pt1000: V=4.

R_0 is the nominal value of the resistance at 0°C. The mean temperature coefficient (α) between 0°C and 100°C represents the average change of resistance referred to the nominal value at 0°C.

Sensor type	Temperature coefficient α	Nominal value R_0
Pt100	0.4Ω/K	100,000Ω
Pt500	2,0Ω/K	500,000Ω
Pt1000	4,0Ω/K	1000,000Ω

Table 5: Sensor characteristics

For a Pt100 the nominal value is R_0 = 100,000 **Ω**. It generates a voltage drop of 50 mV, which is measured by the ME-RTD8 module with very high accuracy. [1]

For the calculation a difference has to be made between the -200…0°C and the 0…+850°C range.

For the range -200…0°C a third degree polynomial is used:

$R(t) = R_0(1 + A \times t + B \times t^2 + C \times (t - 100°C) \times t^3)$ [formula 2]

For the range 0…850°C a second degree polynomial is used:

$R(t) = R_0(1 + A \times t + B \times t^2)$ [formula 3]

…with the coefficients:

A = $3{,}9083 \times 10^{-3}$ °C^{-1}

B = $-5{,}775 \times 10^{-7}$ °C^{-2}

C = $-4{,}183 \times 10^{-12}$ °C^{-4}

The following formula describes the relation of the electric resistance and the temperature for temperatures greater than 0°C:

$$t = \frac{-R_0 \times A + \sqrt{(R_0 \times A)^2 - 4 \times R_0 \times B \times (R_0 - R_M)}}{2 \times R_0 \times B}$$ [formula 4]

R_M: Calculated resistance in **Ω** (from formula 1)

t: Temperature in °C

R_0, A, B: Parameters according to DIN EN 60751 ITS 90 (see above)

2.6.6 Modul ME-TE8

Plug-On module for temperature measurement with thermocouples of type J, T, K, E, N, S, R, B according to DIN EN 60584. The sensor type used can be set by the jumpers JPx1…3 for each channel separately (see diagram 29). For reference junction compensation a sensor is placed near connector STM1. The measurement is always in differential mode with 2-wire connectivity.

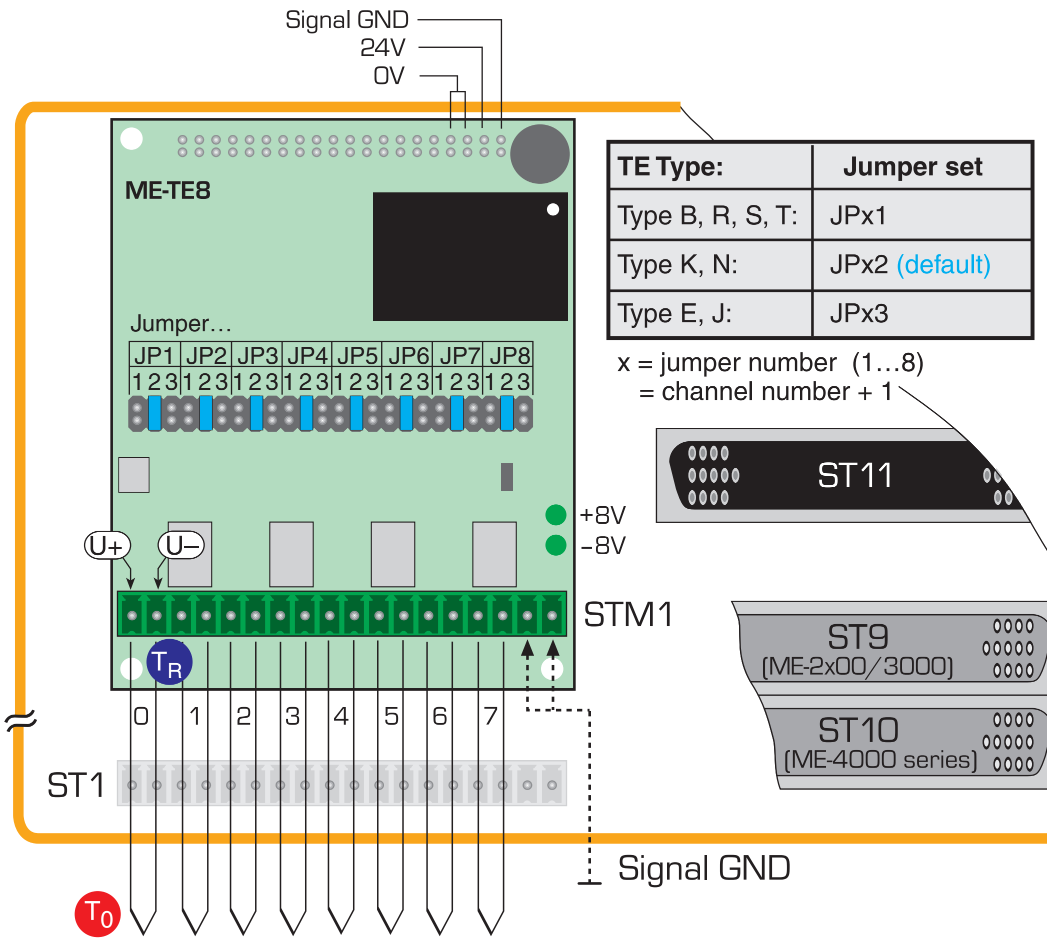


Diagram 29: ME-TE8

The wires of the thermocouples are applied to the clamps on terminal STM1. The positive lines of each thermocouple will be connected to the clamps „U+“ and the negative lines to the clamps „U–“ (ST1 remains not connected). Unused input channels (U+) and (U–) on STM1 should be „short-circuited“. On demand the shield can be connected to Signal GND.

The module uses the „Mux“ channels 0…7 for the thermocouples and „Mux“ channel 8 for measuring the reference temperature T_R (at the terminal). For calculation of the temperature see chapter 2.6.6.4 on page 46.

2.6.6.1 Basics of Thermocouples

With thermocouples the electron flow in an electric conductor is used when it is within a temperature gradient. Now the voltage difference is measured, which depends of the temperature gap and the properties of the conductor material in size and direction. Between the both conductor edges a voltage potential will be extended which results from the temperature gradient along the complete length of the conductor [3].

A disturbing effect occurs when connecting the wire edges to the signal conditioning circuitry (e. g.: ME-TE8). First the thermocouple can only measure the temperature gap ($\Delta T = T_0 - T_R$) between measuring junction and reference junction (terminal). Second the standardization (DIN EN 60584) refers to a reference temperature of 0°C. Because of the real reference temperature is different of it (as a rule) it must be compensated (so called reference junction compensation).

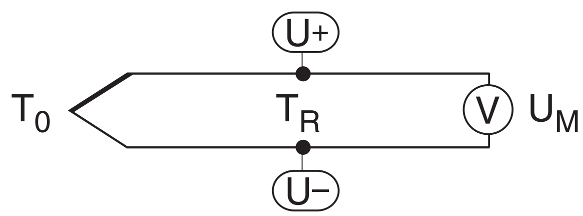


Diagram 30: Reference junction compensation

If the reference temperature T_R (at the terminal) is known, you can calculate the temperature T_0 at the measuring junction directly by the thermo-electric voltage measured. The thermo-electric voltage generated by the reference temperature must be added to the measured voltage and equals the thermo-electric voltage refering to 0°C.

Example: The temperature of the measuring junction should be 200°C, the temperature at the terminal 20°C (reference temperature) and the measured thermo-electric voltage 9mV. This corresponds with a temperature difference of 180°C. Because of the temperature is referenced to 0°C as a rule the value must be corrected by 20°C up [3]. It is valid:

U_0 =	$U_M(180°C)$ +	$U_R(20°C)$
(Thermo-electric voltage refering to 0°C)	(measured voltage)	(Thermo-electric voltage of reference junction temperature)

Note: The voltage caused by the thermo-electric effect is very low and is only a few microvolts per Kelvin. Generally thermocouples will not be used to measure temperatures in the range ot -30…+50°C because of the difference to the reference temperature is to small in order to get an reliable measurement signal [3].

2.6.6.2 Linearity

The voltage generated by a thermocouple is not linear refering to the temperature. Because of that the user must linearize the values by software. In practice electromotive series (linearization tables) are used, which were calculated based on second to fourth order polynomials and are standardized in DIN EN 60584-1. They are all refering to a reference temperature of 0°C. As a rule the real reference temperature is different from it. Therefore the measured thermo-electric voltage must be corrected [3].

Example: Thermocouple type „J“ (Fe-CuNi), measured thermo-electric voltage U_M=15,308mV, reference temperature T_R=20°C.

- Version A (correct):

  Reference temperature of 20°C equals: U_R = 1,019 mV

  $U_0 = U_M + U_R$ = 15,308mV + 1,019 mV = 16,327mV equals a temperature at the measuring junction of **300°C**.

- Version B (wrong):

  Reference temperature of 15,308mV equals: ΔT = 282°C

  $T_0 = \Delta T + T_R$ = 282°C + 20°C = **302°C**

⇒ **300°C** ≠ **302°C**

Because of the non-linearity of the voltage it would be wrong first to determine the temperature which corresponds to the measured thermo-electric voltage and then to subtract the reference temperature. From the thermo-electric voltage the voltage corresponding with the reference junction must be subtracted first [3].

2.6.6.3 Limiting Deviation

For thermocouples according to DIN EN 60584 three tolerance classes have been specified. They are valid for thermocouple wires with a diameter of 0,25 to 3 mm and concern delivery state. The classes cannot consider aging effects, because it greatly depends on the environmental conditions. According to the tolerance class the following tolerance deviations are valid (for each the greater value is valid) [3]:

TC Type	Class	Limiting Deviation	
J (Fe-CuNi)	CLass 1 CLass 2 CLass 3	-40…+750°C ±0,004 · t -40…+750°C ±0,0075 · t —	or ±1,5°C or ±2,5°C —
T (Cu-CuNi)	CLass 1 CLass 2 CLass 3	0…+350°C ±0,004 · t -40…+350°C ±0,0075 · t -200…+40°C ±0,015 · t	or ±0,5°C or ±1,0°C or ±1,0°C
K (NiCr-Ni) und N (NiCrSi-NiSi)	CLass 1 CLass 2 CLass 3	-40…+1000°C ±0,004 · t -40…+1200°C ±0,0075 · t -200…+40°C ±0,015 · t	or ±1,5°C or ±2,5°C or ±2,5°C
E (NiCr-CuNi)	CLass 1 CLass 2 CLass 3	-40…+900°C ±0,004 · t -40…+900°C ±0,0075 · t -200…+40°C ±0,015 · t	or ±1,5°C or ±2,5°C or ±2,5°C
S (Pt10Rh-Pt) und R (Pt13Rh-Pt)	CLass 1 CLass 2 CLass 3	0…+1600°C ±(1+0,003 · (t-1100°C)) 0…+1600°C ±0,0025 · t —	or ±1,0°C or ±1,5°C —
B (Pt30Rh-Pt6Rh)	CLass 1 CLass 2 CLass 3	600…+1700°C ±(0,0025 · t) 600…+1700°C ±0,005 · t —	or ±1,5°C or ±4,0°C —

Table 6: Limiting deviation according to SDIN EN 60584

2.6.6.4 Calculating the Temperature

Notes: Electromotive series (linearization tables) can be found in the specialist literature and from manufacturers like JUMO. Under http://literatur.jumo.info you can download the German PDF document „Elektrische Temperaturmessung“ (FAS146) [3] for free. Additional you can download a useful conversion program named „JUMOsens“ under http://download.jumo.info. It also exports electromotive series in CSV or Microsoft Excel format.

If you are using base boards of type ME-MUX32-M/S (operation mode „Single-Mux“) in combination with a board of the ME-4600 series we recommend the function *me4000MultiSigAIDigitToSize* for simple calculation of the temperature.

Basically the following order of operation is valid for calculation of the temperature in combination with module ME-TE8:

A. Acquisition of the Reference Temperature T_R

For measuring the reference temperature at the terminal a semiconductor temperature sensor with a linearization factor of 10 mV/°C is used. The accuracy within the operating temperature range of the module (0…70°C) is ±3,5°C.

- In combination with ME-MUX32-M/S:
  Read the voltage value U_N from „Mux“ channel 8 of the respective channel group. See page 54.
- In combination with ME-SIG32:
  Read the voltage value U_N from A/D channel 9 resp. 24 of your data acquisition board. See page 59.
- Calculate the reference temperature T_R as follows:

$$T_R = \frac{U_N}{0,04} - 50 \qquad \text{[formula 5]}$$

  T_R is valid for all channels of a module. U_N bewegt sich im Bereich 2V…4,8V (entspricht 0…70°C).

- For later calculation the thermo-electric voltage $\mathbf{U_R}$ corresponding to the reference temperature must be determined in dependency of the thermocouple type used:

Therefore search in the respective electromotive series the temperature value T_R and read the corresponding voltage value (depending on table in mV or µV).

B. Acquisition of the Thermo-electric Voltage at the Measuring Junction

- In combination with ME-MUX32-M/S:
  Read the voltage value U_N from the wanted „Mux“ channel 0…7 of the respective channel group. See page 54.
- In combination with ME-SIG32:
  Read the voltage value U_N from A/D channel 0…7 resp. 16…23 of your data acquisition board. See page 59.
- Divide U_N by the relevant gain factor V (see table):
  $\mathbf{U_M} = U_N/V$

B, R, S, T	K, N	E, J
V = 270,270270270	V = 140,845070423	V = 107,526881720

C. Standardization to Reference Temperature 0°C

- Because of the standardized electromotive series refer to a reference temperature of 0°C the voltage U_R (see „A.“) must be added to U_M: $U_0 = U_M + U_R$
- Search in the electromotive series of the thermocouple used the voltage value next to U_0 (depending on table in mV or µV) and read the associated temperature value in °C.

⇒ Now you have determined the temperature T_0 at the thermocouple wanted. Repeat the steps „B“ and „C“ for the rest of the channels.

Depending on the tolerance class of your thermocouple the limiting deviations according to DIN EN 60584 named in table 6 are valid.

3 Programming

The PC DAQ board's digital ports are used to control the (de)multiplexing and the gain settings. Depending on the base board up to 12 digital output lines are necessary (for ME-SIG32 no specific programming is required). In combination with Meilhaus boards of type ME-2000/2600/3000, their digital I/O lines DIO_0…11 of port A control the base boards. Please use the digital-I/O functions from the function library of your DAQ board for writing the control words. When using opto-isolated versions of the ME-4600 series please read the note on page 8.

After power-up the digital ports of most of the boards are configured as input ports i. e. in high impedance state. To force the digital lines 0…11 into a defined state they are equipped with plugable pulldown (default) resp. pullup resistors (see also chap. 2.2 on page 10). This will set all base boards into their basic state (see chap. 3.4).

Note: If you are using base boards of type ME-MUX32-M/S (operation mode „Single-Mux") or of type ME-DEMUX32 in combination with a board of the ME-4600 series you can use the *„me4000MultiSig"* functions for fast programming and easy calculation of the values. The functions are included with the function library of the ME-4000 driver.

3.1 Control Signals Overview

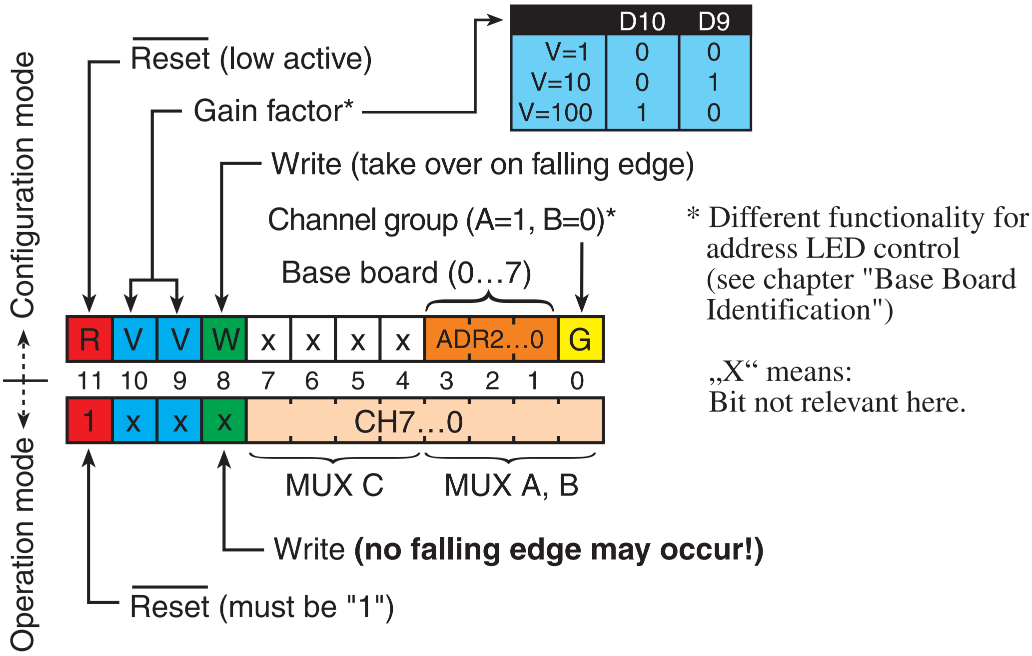


Diagram 31: Control signals

Signal	Description
CH*x*	***ME-MUX32-M, ME-MUX32-S and ME-DEMUX32:*** Addressing the channels for (de-)multiplexer operation. (depending on model and operation mode: 0…255)
ADR*x*	***ME-MUX32-M and ME-MUX32-S:*** Addressing the master (0) resp. the slave boards (1…7) for setting the gain factor and switching the address LED.
G	***ME-MUX32-M and ME-MUX32-S:*** Selection of channel group (A, B) for gain setting.
W	***ME-MUX32-M and ME-MUX32-S:*** Data take-over on the falling edge of the write signal. **Attention**: During a running multiplexer operation no falling edge may occur!
V	***ME-MUX32-M and ME-MUX32-S:*** Select gain factor and for switching the address LED.
R	***ME-MUX32-M and ME-MUX32-S:*** Reset signal sets all master and slave boards to gain V=1 and switches off the address LED.

Table 7: Control signals

If you want to work with a gain factor of V=1 you can continue with chapter 3.5 Multiplexing.

3.2 Gain Setting

The gain factor can be set individually for each channel group of the base bords ME-MUX32-M and ME-MUX32-S. You can use the control bits D10 and D9 to select the gain factors V=1 (default), V=10 or V=100.

Take the following 2 steps per channel group:

1. *Preparation*: release the reset bit, set the gain factor, set the write signal to „1“, address the base board (D3…1 binary coded) and select the channel group.
2. „*Take-over*“: on the negative edge of the write signal the setting will be taken over.

The following example shows, how to control channel group A on the base board with the address 0 (master). The gain factor V=10 will be set:

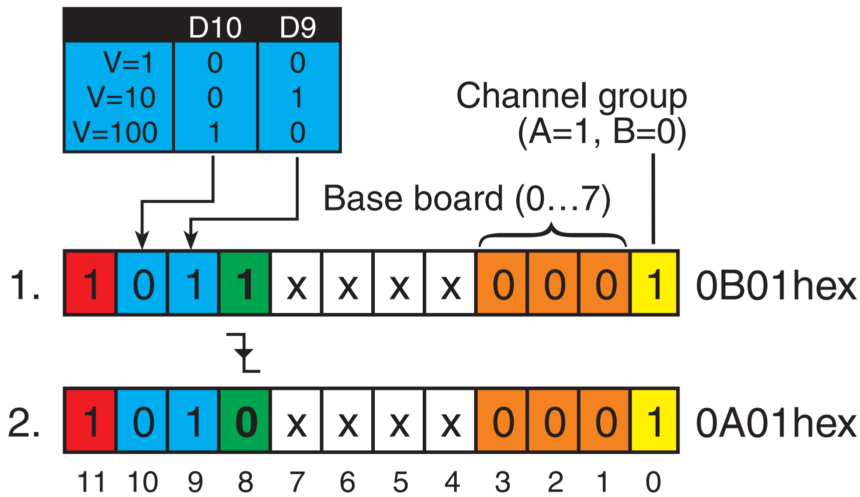


Diagram 32: Gain factor

Continue with measuring with the desired operation mode „Single-Mux“ (see page 54) or „Multi-Mux“ (see page 56).

3.3 Base Board Identification

For maintenance or identification purposes the address LED of the base boards ME-MUX32-M and ME-MUX32-S can be activated. The control bits D10 and D9 must be set to ”1” for this. Note, that this will leave the gain factor unchanged.

Switching on the LED:

1. *Preparation*: release the reset bit, set the bits D10 and D9 to „1“, set the write signal to „1“, address the base board with address 7 (for example) and set bit D0 to „1“.
2. „*Take-over*“: on the negative edge of the write signal the LED will be switched on.

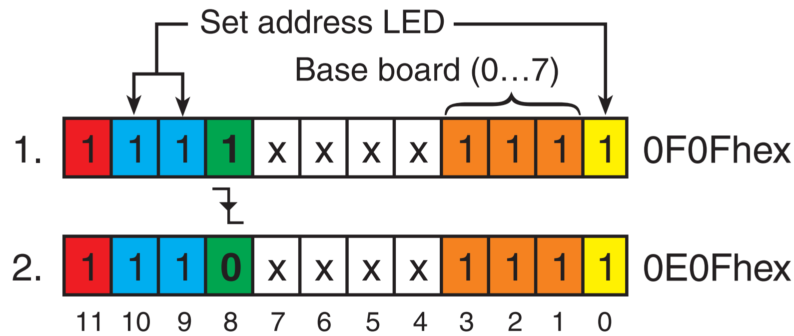


Diagram 33: Switching on the address LED

Switching off the LED:

1. *Preparation*: release the reset bit, set the bits D10 and D9 to „1“, set the write signal to „1“, address the base board with address 7 (for example) and set bit D0 to „0“.
2. „*Take-over*“: on the negative edge of the write signal the LED will be switched off.

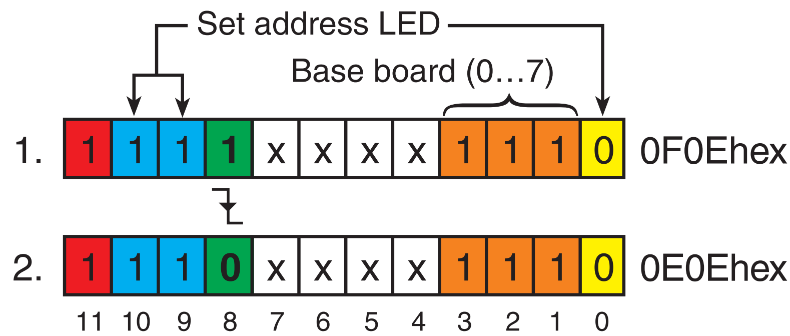


Diagram 34: Switching off the address LED

3.4 General Reset

Using the reset-bit you can reset all master and slave boards with a single control word (0000hex).

Basic state:

- Gain of each group is set to V=1.
- All address LEDs are switched off.

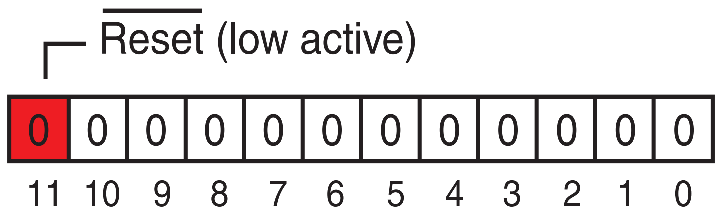


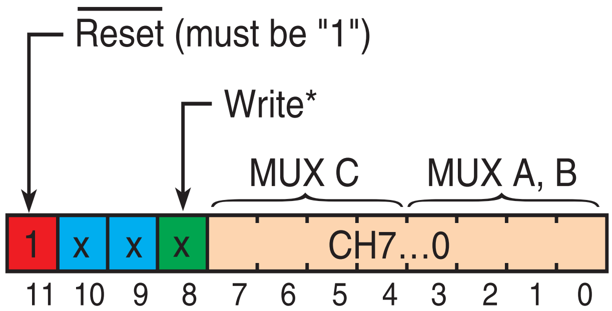
Diagram 35: General reset

3.5 Multiplexing

For multiplexing a master board of type ME-MUX32-M and optional slave boards (ME-MUX32-S) are required. The digital lines D7…0 are used to control the multiplexers (binary coded). MUX A and B are connected in parallel and are controlled with D3…0, MUX C is controlled by D7…4 (only in operating mode ”Single-Mux”).

3.5.1 Operating Mode ”Single-Mux”

Basically the input channel (0…255) selected by the digital lines will be routed to **one specific** A/D channel of the DAQ board. The A/D channel can be defined by the user (see also chap. 2.3.8 on page 20). Useful control words: 0F00…0FFFhex.



***During a running multiplexer operation no falling edge may occur!**

Diagram 36: Multiplexer control for ”Single-MUX”

As a rule the multiplexing is done in a program loop. Beginning with the master board‘s channel 0 of group A, all input channels of a multiplexer chain (max. 256 channels) are multiplexed into one A/D channel of the DAQ board.

Basically order of operation:

Loop: For i=0 to max. „channel number“ - 1 (FFhex)	
	Control word = i + F00hex (Reset and Write must be „1“)
	Write control word to digital port
	Aquire one value on A/D channel 0 of the DAQ board (if master is configured for channel 0)
	increase i in steps of 1
End of loop	

Block Diagram „Single-Mux“

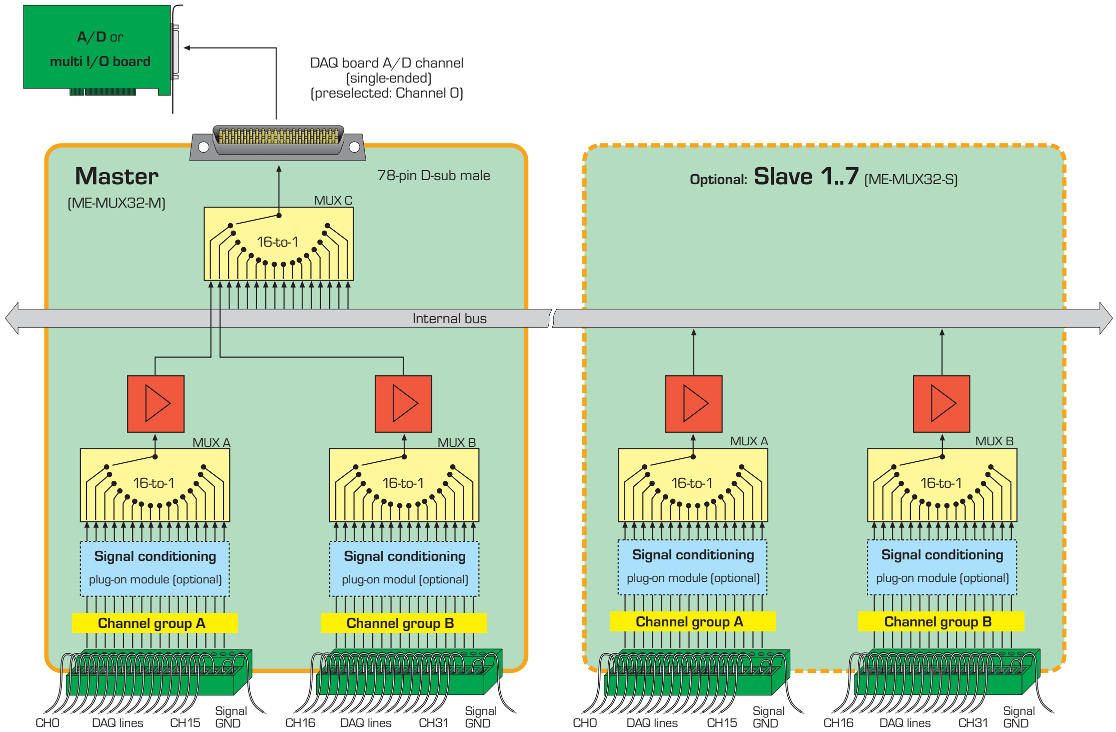


Diagram 37: Block diagram „Single-Mux“

Block Diagram „Multi-Mux“

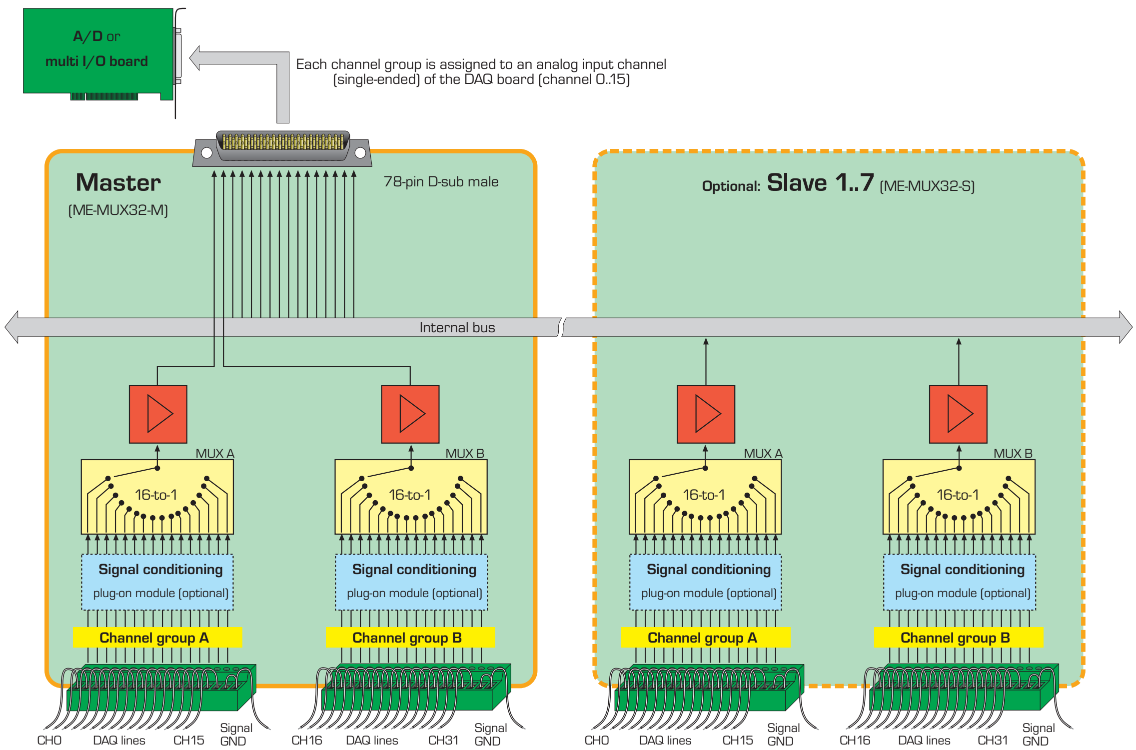
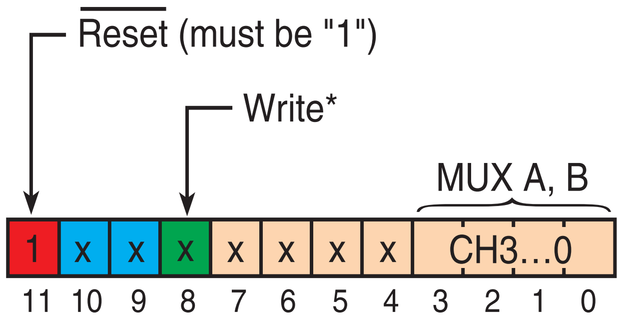


Diagram 38: Block digram „Multi-Mux“

3.5.2 Operating Mode "Multi-Mux"

The assignment of the 16 input channels of a group (max. 16 groups in one multiplexer chain) to the A/D channels of the DAQ board is fixed (see also chap. 2.3.9 on page 23). I. e the inputs of group A on the master board will be acquired by channel 0 of the DAQ board. Depending on the level of expansion this is continued up to group B of slave board 7, whose inputs will be acquired by A/D channel 15. Note that all groups within a multiplexer chain are switching synchron to the channel number K*x* selected by the digital I/O lines. Useful control words: 0F00…0F0Fhex.



***During a running multiplexer operation no falling edge may occur!**

Diagram 39: Multiplexer setting for "Multi-MUX" operation

As a rule the multiplexing is done in a program loop. Beginning with channel 0 (K*x*=0) the 16 input channels are routed in groups to the assigned A/D channel of the DAQ board (see above). The number of necessary A/D channels corresponds with the number of groups in your multiplexer chain (depending on level of expansion up to 16). When using a suitable DAQ board it is also possible to acquire (scan) the channels K*x* of each group by timer control. Then the input channels of the multiplexer boards will be switched to the next channel (max. Kx=15) and a new scan operation can be started.

(see also block diagram on next page)

Basically order of operation:

Loop: For i=0 to max. „channel number per group“ - 1 (0Fhex)	
	Control word = i + F00hex (Reset and Write must be „1“)
	Write control word to digital port
	Aquire A/D channel 0 to max. 15. Can also be done controlled by timer (scan).
	increase i in steps of 1
End of loop	

3.6 Demultiplexing

This operation mode requires a base board of type ME-DEMUX32. First choose the demultiplexer´s output channel (K0…31) by the digital lines. Useful control words are in the range of: 00…1Fhex. Next output the voltage value wanted by D/A-channel 0 of your D/A resp. multi-I/O board.

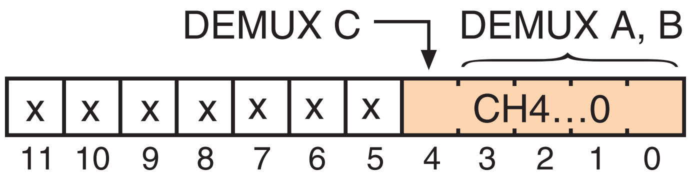


Diagram 40: Controlling the demultiplexer

The bits D11…5 are not relevant in this operation mode.

As a rule demultiplexing is done in a program loop. Beginning with channel 0 of the demultiplexer board, the voltage value to be output will be „demultiplexed" from the D/A- resp. multi-I/O board to the outputs of the ME-DEMUX32.

Basically order of operation:

Loop: For i=0 to max. „channel number" - 1 (1Fhex)	
	Control word = i
	Write control word to digital port
	Output voltage value to D/A channel 0
	increase i in steps of 1
End of loop	

(see also block diagram on next page)

Block Diagram „Demux“

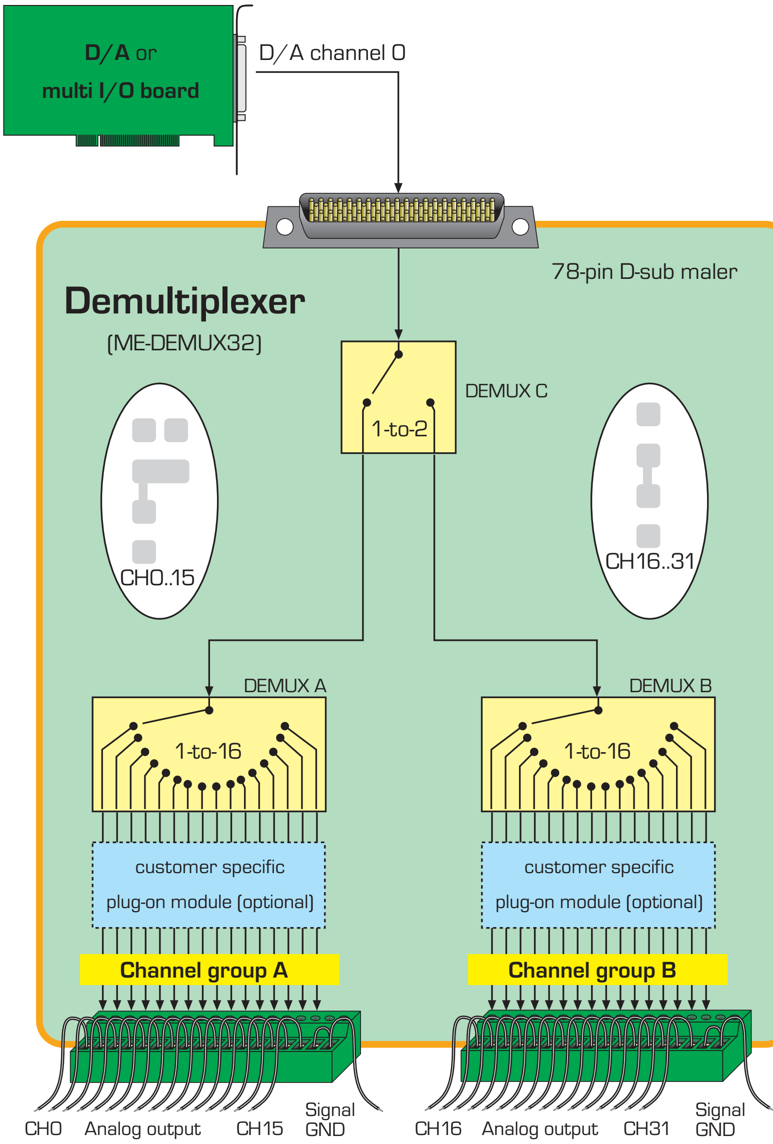


Diagram 41: Block diagram „Demux“

3.7 Signal Conditioning

When using the base board ME-SIG32 no digital control lines are required. Programming will be limited to the analog aquisition with your PC DAQ board. The max. sampling rate depends on the plug-on modules used (see specifications on page 61ff).

Appendix

A Specifications

Base Board ME-MUX32-M (Master)

Analog input channels	32 total in 2 groups (A, B) of 16 channels each
Gain factors	V = 1, 10, 100
Accuracy at V=1	typ. ±0,15% at FS (±10 V)
Accuracy at V=10	typ. ±0,2% at FS (±1 V)
Accuracy at V=100	typ. ±0,5% at FS (±100 mV)
Dynamic signals	V=1: max. 400 kHz at ±10 V V=10: max. 100 kHz at ±1 V V=100: max. 40 kHz at ±100 mV
Multiplexer switching time	≤ 300 ns
Operating modes	”Single-MUX”: max. 256 inputs multiplexed into one A/D channel ”Multi-MUX”: the 16 channels of a group multiplexed into separate A/D channels
Connector - DAQ board	78-pin D-sub male connector (ST9 or ST10)
Connector - power supply	3 screw terminals (plugable) for power supply
Connector - signals	2 x 18pin terminal (plugable)
Master-slave connection	Internal bus via 40-pin flat ribbon cable

Base Board ME-MUX32-S (Slave)

Analog input channels	32 total in 2 groups (A, B) of 16 channels each
Gain factors	V = 1, 10, 100
Accuracy at V=1	typ. ±0,15% at FS (±10 V)
Accuracy at V=10	typ. ±0,2% at FS (±1 V)
Accuracy at V=100	typ. ±0,5% at FS (±100 mV)
Dynamic signals	V=1: max. 400 kHz at ±10 V V=10: max. 100 kHz at ±1 V V=100: max. 40 kHz at ±100 mV
Multiplexer switching time	≤ 300 ns
Connector - power supply	3 screw terminals (plugable) for power supply
Connector - signals	2 x 18pin terminal (plugable)
Master-slave connection	Internal bus via 40-pin flat ribbon cable

Base Board ME-DEMUX32

Analog output channels	32 total in 2 groups (A, B) of 16 channels each
Dynamic signals	max. 2 MHz at ±10 V
Current per channel	max. 25 mA
Forward resistance	<100 Ω
Operating modes	D/A channel demultiplexed into 32 analog outputs
Connector - DAQ board	78-pin D-sub male connector (ST9 or ST10)
Connector - power supply	3 screw terminals (plugable) for power supply
Connector - signals	2 x 18pin terminal (plugable)
Multiplexer switching time	≤300 ns

Base Board ME-SIG32

Analog input channels	16 or 32 depending on PC DAQ board‘s number of A/D channels
Connector - DAQ board	78-pin D-sub male connector (ST9 or ST10)
Connector - power supply	3 screw terminals (plugable) for power supply
Connector - signals	2 x 18pin terminal (plugable)

Plug-On Module ME-Diff16

Measurement channels	16 differential channels
ME-Diff16-10V	input range: ±10 V
	input resistance: >200 GΩ
	accuracy: typ. 0,3%
	dynamic signals: max. 15 kHz at ±10 V
ME-Diff16-20V	input range: ±20 V
	input resistance: >20 MΩ
	accuracy: typ. 0,8%
	dynamic signals: max. 2,5 kHz at ±10 V
ME-Diff16-50V-3,75MΩ	input range: ±50 V
	input resistance: 3,75 MΩ
	accuracy: typ. 0,8%
	dynamic signals: max. 2,5 kHz at ±10 V
ME-Diff16-50V-50MΩ	input range: ±50 V
	input resistance: 50 MΩ
	accuracy: typ. 3,4%
	dynamic signals: max. 1 kHz at ±50 V
Connectors	18pin terminal (STMx) on the module plus
	18pin terminal (STx) on the base board

Plug-On Module ME-Current16

Measurement channels	16 differential channels
Input range	0..20 mA
Input resistance	499 Ω/0,1%
Accuracy	typ. 0,15%
Connectors	18pin terminal (STMx) on the module plus
	18pin terminal (STx) on the base board

Plug-On Module ME-RTD8

Measurement channels	8 channels for PTC/RTD sensors
Connectivity	2-wire, 3-wire or 4-wire
Gain factor	fixed depending on module type: Pt100: V=40 Pt500: V=8 Pt1000: V=4
Sensor type	fixed depending on module type: Pt100: R_0(0°C) = 100,000Ω (α=0,4Ω/K) Pt500: R_0(0°C) = 500,000Ω (α=2,0Ω/K) Pt1000: R_0(0°C) = 1000,000Ω (α=4,0Ω/K)
Temperature range	-200..+850°C
Constant measurement current	typ. 500 µA
Accuracy after determination of actual measurement current:	±1°C
Input resistance	>200 GΩ
Connectors	18pin terminal (STMx) on the module plus 18pin terminal (STx) on the base board

Plug-On Module ME-TE8

Measurement channels	8 channels for thermocouples according to DIN EN 60584
Connectivity	2-wire
Connectors	18pin terminal (STMx) on the module
Sensor types	J, T, K, E, N, S, R, B (tpye selectable by jumper for each channel)
Gain factors	B, R, S, T: V=270,270270270 K, N: V=140,845070423 E, J: V=107,526881720
Gain error	typ. ±0,01%
Linearization error	typ. 3ppm
Input offset voltage	typ. ±1µV
Input bias current	typ. 2,5pA
Sensor for reference junction compensation:	
Type	Semiconductor sensor (V=4)
Linearity factor	+10,0mV/°C
Offset	+500mV
Accuracy	max. ±3,5°C

General

Input range	18…36 V (typ. 24 V)
Power consumption	base board: typ. 60 mA
	modules: typ. 60 mA
Size - base board	250 x 100 mm (L x W) (without card carrier)
Size - modules	72 x 87 mm (L x W)
Mounting	incl. card carrier for DIN rails
Height incl. card carrier, without modules and connectors:	
	67 mm
Height incl. card carrier, modules and connectors:	
	ca. 150 mm
Operating temperature	0…70°C
Storage temperature	0…50°C
Humidity	20…55% (non condensing)

CE Certification

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

B Pinouts

Connecting multi-I/O DAQ boards, depending on the model:

B1 78-pin D-Sub Male Connector ST9

Connector for boards of type ME-2000/2600/3000 and some boards of other manufacturers (see table 2 on page 8).

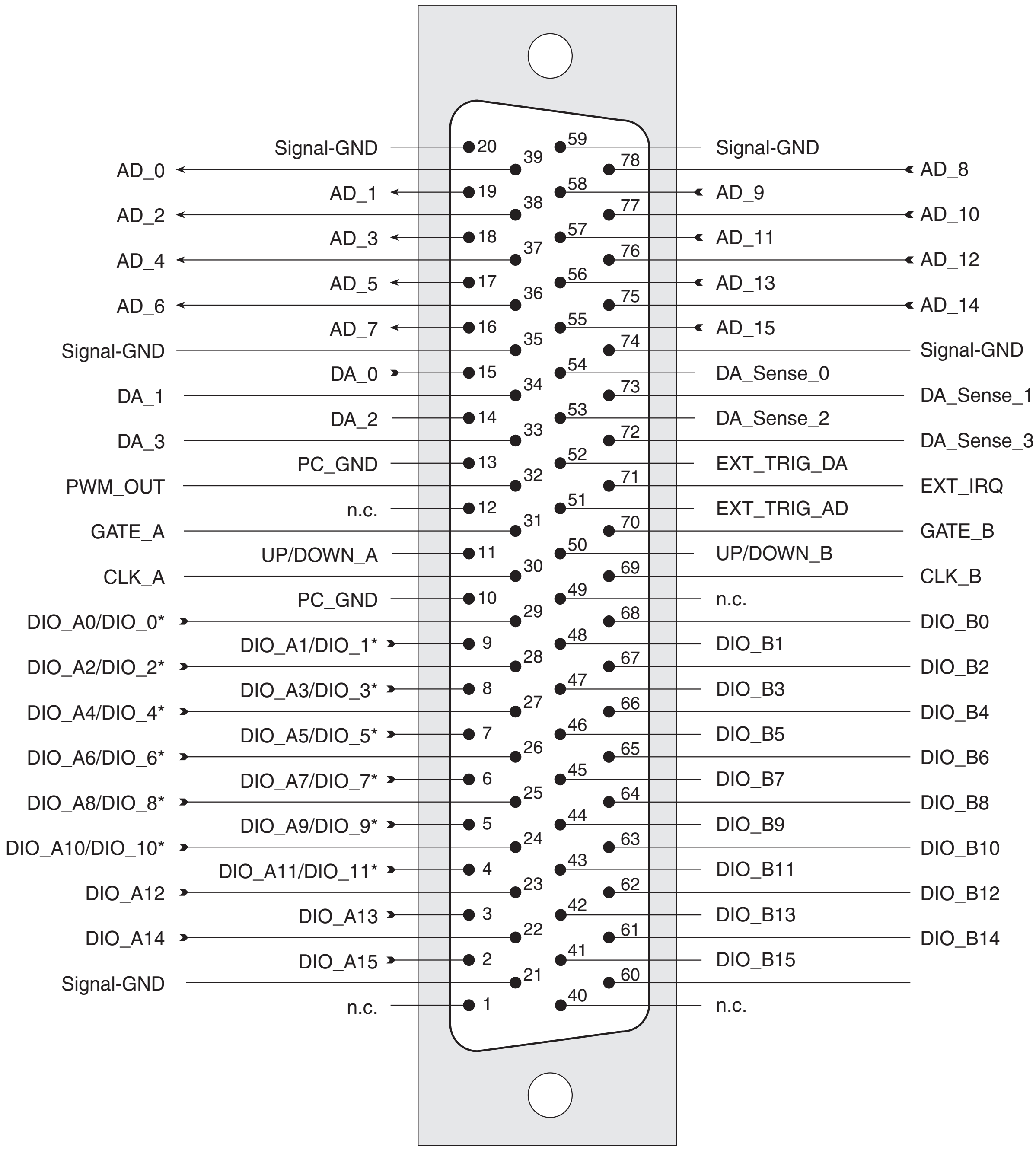


Diagram 42: Pinout 78-pin D-sub male connector ST9

*Index corresponds with the bit number of the MultiSig control lines.

B2 78-pin D-Sub Male Connector ST10

Connector for boards of the ME-4600 series.

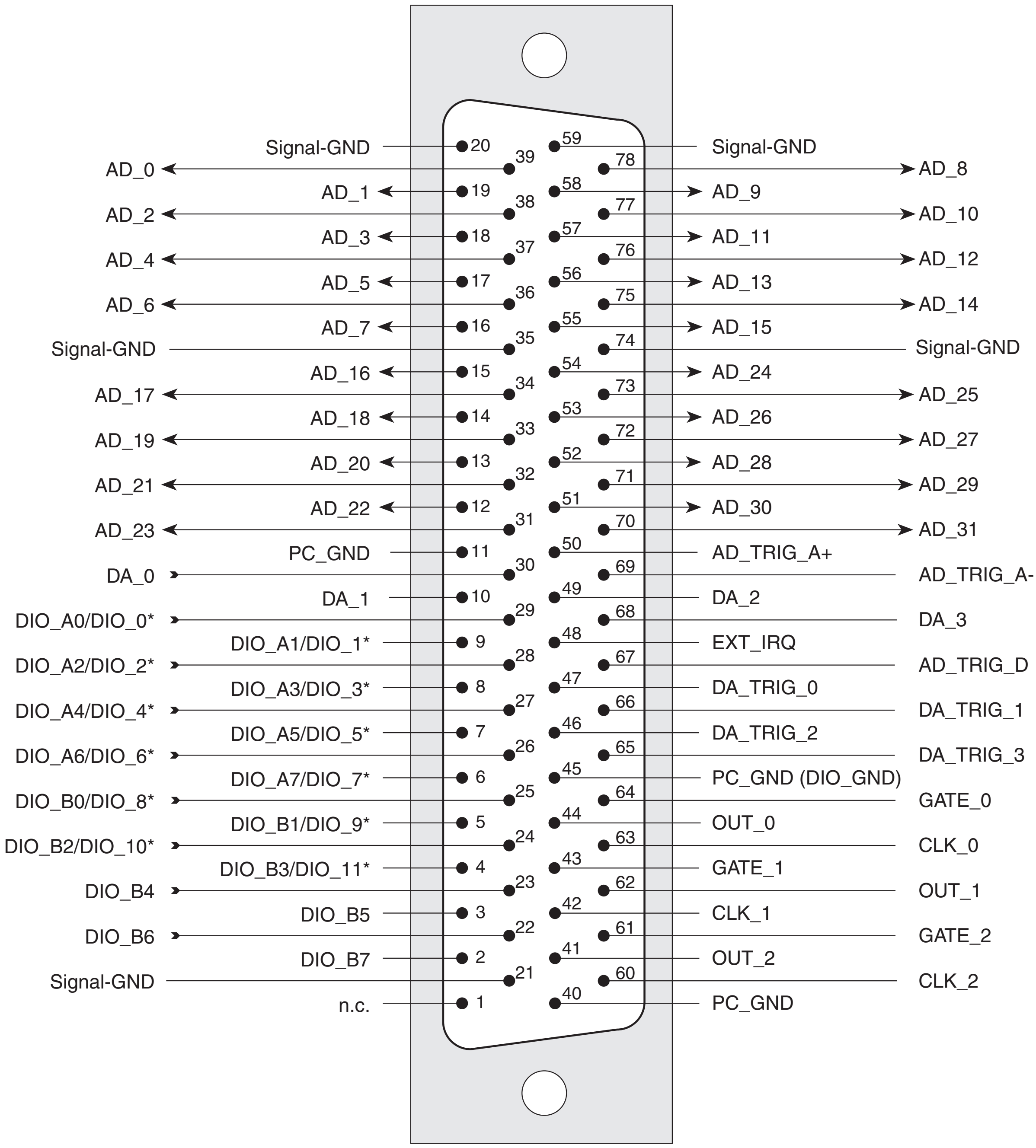


Diagram 43: Pinout 78-pin D-sub male connector ST10

*Index corresponds with the bit number of the MultiSig control lines.
Description in brackets is valid in connection with optoisolated boards of the ME-4600 series.

B3 78-pin D-Sub Female Connector ST11

All lines (except of pin 1) are wired from ST9 resp. ST10 1:1 to the D-Sub female connector ST11.

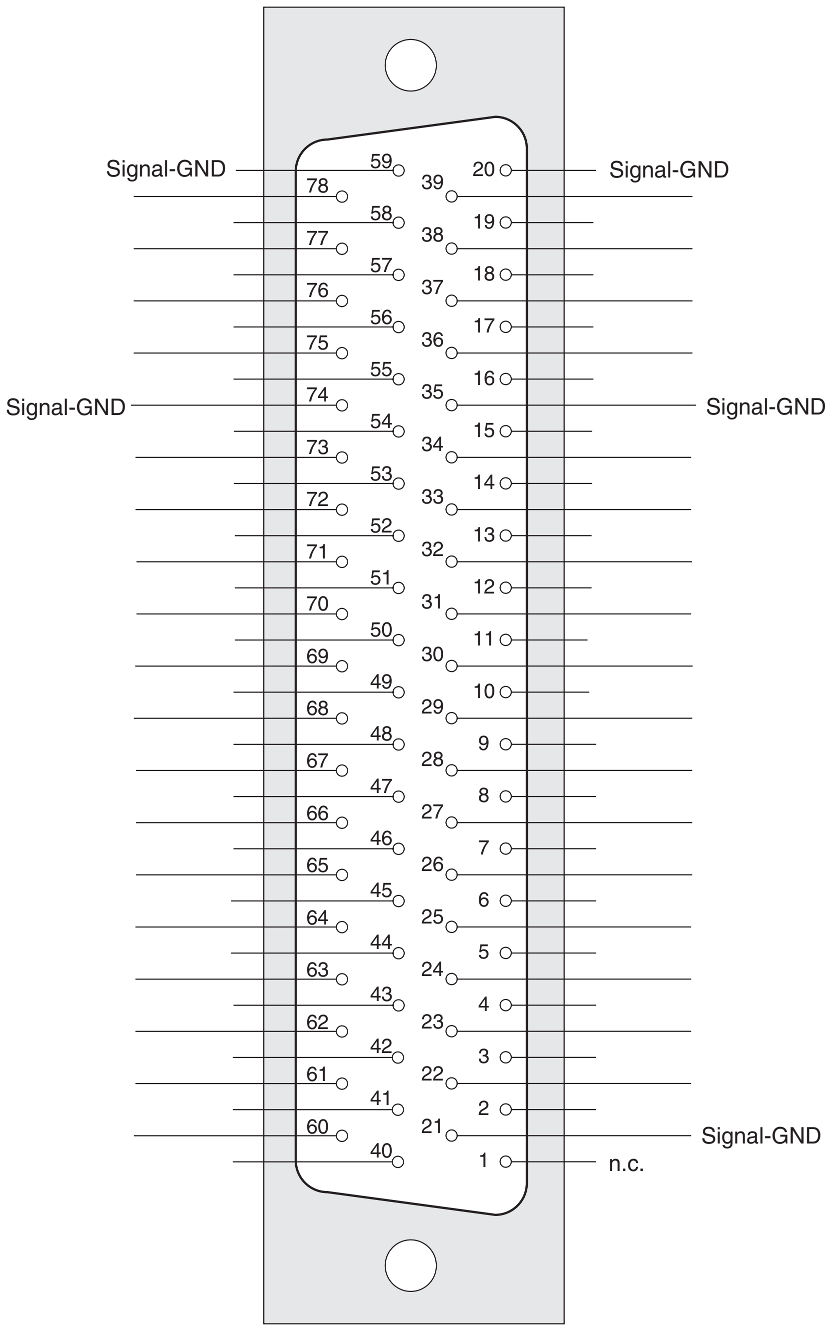


Diagram 44: Pinout 78-pin D-Sub female connector ST11

C Technical Questions

C1 Hotline

If you should have any technical questions or problems with the board , 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.

C2 Service address

We hope that your board will never need to be repaired. If this should become necessary please contact us at the following address:

Meilhaus Electronic GmbH

Service Department
Fischerstraße 2
D-82178 Puchheim/Germany

If you would like to send us a board for repair, please do not forget to add a full description of the problem.

D Bibliography

(in German language)

[1] Texts and formulas in chapter 2.6.5 faithfully translated according to:
„JUMO Typenblatt 90.6000“, page 1.

[2] D.Weber, „Elektrische Temperaturmessung - Mit Thermoelementen und Widerstandsthermometern“, 9th edition, February 2001

[3] Texts and tables in chapter 2.6.5 faithfully translated according to:
Matthias Nau, „Elektrische Temperaturmessung - Mit Thermoelementen und Widerstandsthermometern“, JUMO book number: FAS 146, February 2003, ISBN 3-935742-06-1

[4] TC Meß- und Regeltechnik GmbH, „Handbuch zur Temperaturmessung mit Thermoelementen und Widerstandsthermometern“, 2004

[5] Gerd Scheller, „Messunsicherheit einer Temperaturmesskette mit Beispielrechnungen“, JUMO book number: FAS 625, April 2003, ISBN: 3-935742-12-6

See also:

Literature from JUMO: http://literatur.jumo.info

Software from JUMO: http://download.jumo.info

E Index