

mesytec
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**detector electronics
&
readout systems**

short form catalog
nuclear physics
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REPRESENTED BY:

mesytec offers a broad range of readout electronics - from single channel preamplifiers to highly integrated, multichannel, multiplexing systems. A set of accessories (Bias supply, remote control, cabling) enables to set up complete systems. The following table shows the available standard devices and lists some main properties. Each product is presented in detail following this overview.

Device	Applications*	Description	Page
*: P : preamp, S : shaper, TF : timing filter, LE : leading edge discr., CF : constant fraction discr., RC : remote control M : multiplexing readout, n/γ : neutron / gamma pulse shape discr., A/D : ADC, B : Bias supply			
Single Channel Preamplifier			
MPR-1	P	Single channel charge integrating preamplifier	6
Multi Channel Preamplifier, Shaper Devices			
MSI-8	P S TF	8 channel charge integrating preamplifier, shaper, timing filter	8
MPRS-16	P S TF LE	16 channel charge integrating preamplifier, shaper, timing filter, LE discriminator	10
Multichannel Preamplifier			
MPR-16 MPR-16-L MPR-32 MPR-64	P	Multichannel charge integrating preamplifiers Various standard energy ranges from 25 MeV to 1 GeV 16 / 32 / 64 channel versions with differential or unipolar output	12
MPR-16-log MPR-16-L-log MPR-32-log MPR-64-log	P	Multichannel charge integrating preamplifiers, fast recovers, linear/logarithmic gain curve 16 / 32 / 64 channel versions with differential or unipolar output	14
MPRT-16	P TF LE	16 channel charge integrating preamplifier with timing filter and leading edge discriminators. NIM timing output	16
MPRB-16	P B RC	16 channel charge integrating preamplifiers. Built-in detector bias supply with temperature compensation. Various standard energy ranges from 25 MeV to 1 GeV	18

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Multichannel Shaper, Timing Filter, Discriminator			
STM-16+	S TF LE RC	High quality spectroscopy amplifier 16 channel shaper, timing filter, leading edge discriminator, ECL timing output, remote controllable by mesytec control, 1/12 NIM	20
MSCF-16-F-V (Standard)	S TF CF RC	High quality fast spectroscopy amplifiers 16 channel shaper, timing filter, constant fraction discriminator, ECL timing output. 4 switchable shaping times, all parameters remote controllable by mesytec control / USB, 1/12 NIM	22
MSCF-16-LN	S TF CF RC	Ultra low noise version of MSCF-16 For Ge-detector applications	24
MSCF-16-F-C	S TF CF RC	Fast current input version of MSCF-16 Built-in PMT amplifiers for direct input of PMT signals	25
Multichannel CFD with fast preamps and pattern processing			
MCFD-16	CF P RC	16 channel constant fraction discriminator with built-in fast preamps Sophisticated pattern processing / trigger logic. 1/12 NIM Fully remote controllable by mesytec control / USB	26
Multichannel Shaper, Timing Filter			
MDS-8	S TF	8 channel spectroscopy amplifier shaper, timing filter, 1/12 NIM	28
Multichannel Devices, Multiplexed Readout			
MUX-16 MUX-32	P S LE RC M	16 channel preamplifier with HV bias filter, shaper, leading edge discriminators Multiplexed output, chainable for larger setups (e.g. 128 channels read out with 4 standard peak sensing ADC channels) Remote controllable with MRC-1 / MRCC. PCB version for in vacuum use reduces cabling	30
MTM-16 MDI-2	P S LE RC M A/D	16 channel preamplifier with HV bias filter, shaper, leading edge discriminators. PCB version for in vacuum application. VME based sequencer and digitizer module Several time stamping modes. Remote control master for frontend electronics.	32

Device	Applications*	Description	Page
*: P : preamp, S : shaper, TF : timing filter, LE : leading edge discr., CF : constant fraction discr., RC : remote control M : multiplexing readout, n/γ : neutron / gamma pulse shape discr., A/D : ADC, B : Bias supply			
Peak Sensing ADC / QDC / TDC VME			
MADC-32	A/D	32 channel peak sensing VME ADC 11 to 13 bit (2 k to 8 k) resolution, 800 ns conversion time. Timestamping, zero suppression.	34
MQDC-32	A/D	32 channel VME QDC 11 to 13 bit (2 k to 8 k) resolution, 800 ns conversion time. Timestamping, zero suppression.	36
MTDC-32	T/D	32 channel VME QDC 11 to 13 bit (2 k to 8 k) resolution, 800 ns conversion time. Timestamping, zero suppression.	37
MDPP-16	A/D	16 channel VME digital pulse processor fast high resolution time an amplitude digitizer.	38
Fast Neutron Detection / Pulse Shape Discrimination			
MPD-4	n/γ RC	4 channel pulse shape discriminator module. Fast neutron / gamma discrimination in multichannel liquid scintillation detectors. Variable gain PMT input amplifiers. Comprehensive frontpanel operation. Remote controllable by mesytec control / USB, 1/12 NIM	39
MPD-8	n/γ RC	8 channel pulse shape discriminator module. Fast neutron / gamma discrimination in multichannel liquid scintillation detectors. Variable gain PMT input amplifiers. No frontpanel operation, fully remote controllable by mesytec control / USB, 1/12 NIM	41
Signal Converter			
MDC-8		Differential → unipolar signal converter. Can also be used as analog inverter module 1/12 NIM	42
Detector Bias Supply			
MHV-4 new version!	RC	4 channel detector bias supply. 800 V, 20 μA, 4 large and bright displays for simultaneous voltage or current display of each channel. 1 nA current resolution. Remote controllable by mesytec control / USB. Temp. compensation for APDs, 1/12 NIM	43
Accessories			
MNV-4		4 channel NIM voltage controller / distributor for preamp voltage supply. 1/12 NIM	45
MRC-1 / MRCC	RC	Remote control master module for mesytec control bus. For remote control of: STM-16+, MSCF-16, MHV-4, MUX-16, MPD-4, MPD-8, MCFD-16. 1/12 NIM / handheld	46
Cable sets Adapters		Collection of detector adapters, multipole vacuum suitable signal cables, vacuum feedthroughs, signal cables and several cable converters/adapters	47

mesytec **MPR-1** is a charge integrating preamplifier module. It provides two outputs which can be jumpered to different or same polarity. One can be configured as timing filter output. Both can drive terminated BNC cables. The sensitivity can be changed by a factor of 5 via front panel switch. This helps to get larger signals at low charge deposition.

For photo multiplier readout a special version "MPR-1-PMT" is available.

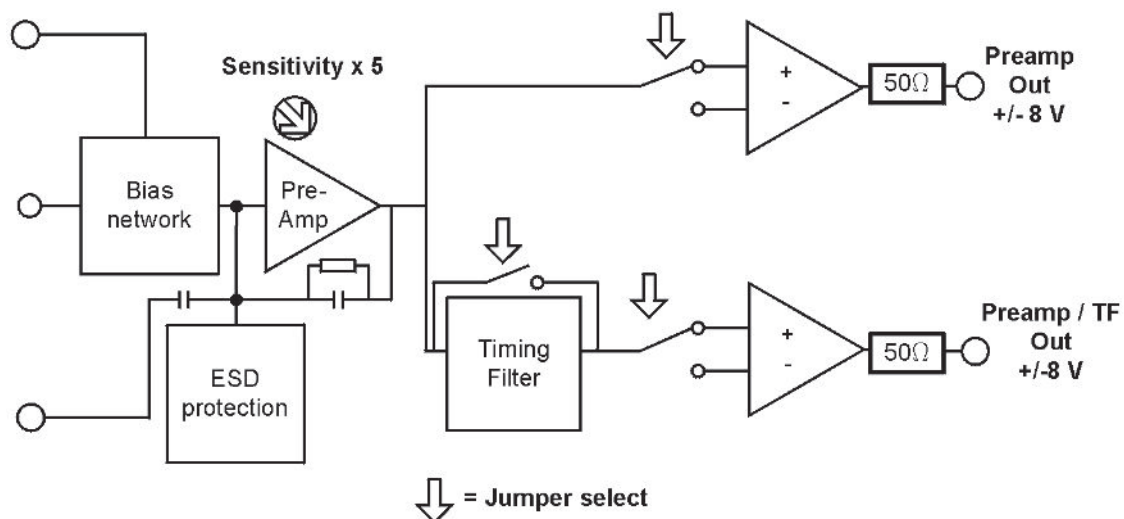
MPR-1 is available with Lemo, BNC, MHV and SHV connectors.

Features:

- Conductive, fully shielded case
- ESD input protection
- Positive and negative input charge
- Pulser input
- Bias voltage up to ± 3000 V
- Two outputs (selectable polarity, one can be configured as timing filter output)
- Strong output driver for 50 W (optional 93 W) termination
- Fast risetime ($t < 12$ ns)
- Two sensitivities (switch selectable)
- Low power



Schematics:



Technical Data

Different standard ranges are available

Range in energy deposition in silicon detectors.
Divide by 3.6 to get number of electrons
(1 GeV = $2.8 \cdot 10^8$ electrons). All values for ± 8 V
output, left number for switch position low
sensitivity, right number for high sensitivity.

- **200 MeV type:** 200 MeV / 40 MeV
→ low noise
(for energies up to 200 MeV [Si] = 9 pC)
- **1 GeV type:** 1 GeV / 200 MeV
→ Si detectors in heavy ion experiments
→ PMTs
(for energies up to 1 GeV = 45 pC)

Other ranges on request.

Preamplifier

- ESD protected
- Positive and negative charge can be amplified equally
- Open loop gain typ 60000 @ 1 pF integration capacity
- Temperature drift $< \pm 50$ ppm / °C
- Nonlinearity < 50 ppm
- Energy rate capacity:
at 200 MeV: $2 \cdot 10^6$ MeV / s
at 40 MeV: $4 \cdot 10^5$ MeV / s
- Risetime of energy and timing output

Detector + cable capacity	signal risetime
0 pF	12 ns
100 pF	25 ns
330 pF	50 ns

Pulser input

- Tail pulse, rise-time TR = 0...100 ns, decay time typ. 500 μ s
- Terminated with 50 Ω
- Amplitude: max 10 V
- For 200 MeV type: 1 V corresponds to a charge injection of 10-12 C or 22 MeV [Si]
- For 1 GeV type: 1 V corresponds to 4.7*10-12 C or 100 MeV

Output stage

- Positive and negative output for single or differential use. Internally switchable: same polarity, or one output with timing filter
- The timing filter is a single differentiation with time constant $\tau = 33$ ns
- Output swing: 0 to ± 8 V (not terminated)
- Decay time TD = 100 μ s

Input capacity

- The preamplifier can handle capacities of more than 1000 pF
- Preamp input capacity typ. 10 nF

Detector bias (Bias Network)

- Maximum: ± 3000 V
- Bias filter: T-filter (RCR) with
- 10 M Ω from bias input, 4.7 nF filter capacitor to ground, 50 M Ω resistor to detector input.

Amplifier noise

200 MeV type

For 1 μ s shaping time (= 2.3 μ s FWHM):

$$N = 2.3 \text{ keV} + 0.021 \text{ keV} / \text{pF}$$

Detector + cable capacity	noise [FWHM] 1 μ s shaping time	0.35 μ s Shaping time
0 pF	2.3 keV	2.7 keV
50 pF	3.5 keV	4.7 keV
100 pF	4.1 keV	5.9 keV
330 pF	9.1 keV	15 keV

1 GeV type

Detector + cable capacity	noise [FWHM] for 1 μ s shaping time:
0 pF	6 keV
50 pF	8.5 keV
100 pF	11 keV
200 pF	16 keV
400 pF	25 keV

Power consumption

- + 12 V 40 mA + output current
- - 12 V 30 mA + output current

Dimensions

- 60 mm * 143mm * 30mm incl. connectors.
- Weight: 240 g

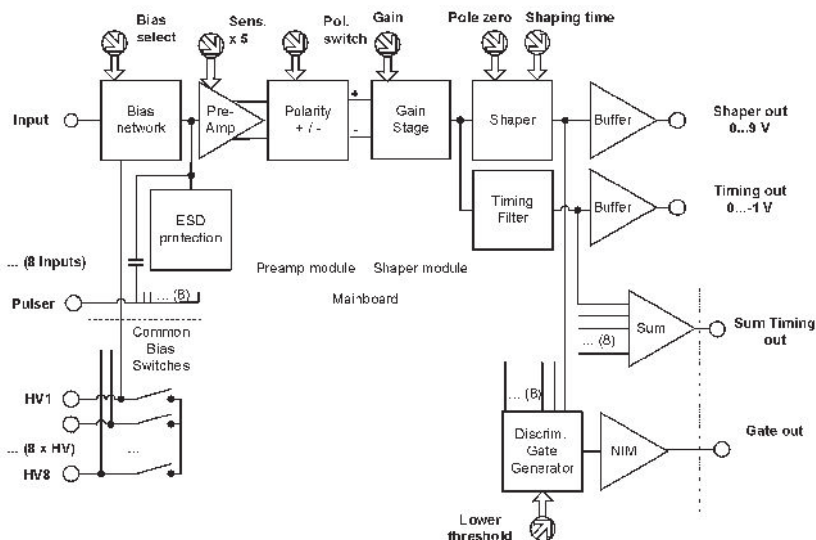
mesytec **MSI-8** is a compact 8 channel preamplifier shaper box with integrated timing filter amplifiers. Due to the modular setup, preamplifier and shaper module types can be selected individually for each channel. **MSI-8** is the ideal solution for setups with a mix of different detectors requiring individual bias supply and energy ranges. It is also well suited for moderately segmented strip detectors or as an easy to use and flexible lab system.

Features:

- 8 channel compact standalone module
- Preamplifier and shaper modules individually selectable
- Shapers with baseline restorers
- Two shaping times, jumper selectable
- Integrated timing filter amplifier
- Individual and common timing output
- Single and common detector bias – a group of bias inputs can be connected to allow easy biasing with same voltage
- All outputs can be terminated with 50 Ω
- Lemo connectors for in- and outputs
- Discriminator gate output for peak sensing ADCs
- Preamp-only version: MSI-8 p

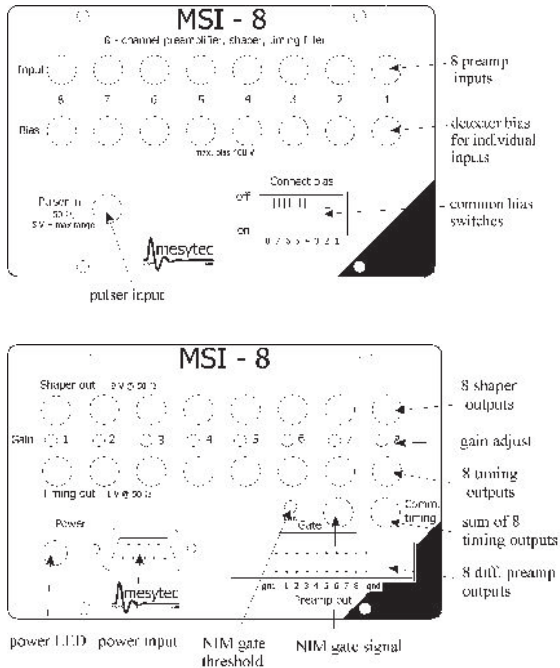


Schematics:



Technical Data

MSI-8 has a very flexible modular design. Preamplifiers and shaper, timing filter amplifiers are pcb modules mounted on a common main board. They can be chosen individually for each channel. This gives maximum flexibility for multi channel setups with different detectors.



Preamplifier inputs

- Lemo connectors directly situated on the preamplifier module
- Preamplifier modules are available with sensitivities from some MeVs to GeVs

Detector bias

- Lemo connectors directly situated on the preamplifier module

Pulser input

- Tail pulse, or square pulse
- Internally terminated with 50 Ω
- 5 V for maximum output voltage at minimum gain

Common bias switches

bias inputs with switch "on" are connected with each other. This allows bias supply with a single lemo connector plugged to one of the connected bias inputs.

Shaper outputs

- Lemo connector
- Positive, gaussian pulse
- Max 10 V (8 V at 50 Ω)
- Two jumper selectable shaping times (standard is 1 μ s FWHM and 2 μ s FWHM)

Timing output

- Lemo connector
- Fast negative signal
- Max - 1 V

Common timing

- Analog sum of all timing signals
- Attenuated by a factor of 2
- Maximum peak voltage: - 4 V

Gain adjust

- Gain can be adjusted by a factor of 5
- Another factor 5 by preamp sensitivity switch (at the preamp module)

Differential preamp outputs

- 20 pin standard connector
- 8 differential preamp signals
- Can be connected to a twisted pair cable and terminated with 100 Ω
- Amplitude: \pm 1 V for maximum range

Gate output and gate threshold adjust

- NIM signal output
- Useful for gating an external peak sensing ADC in lab tests. As long as one of the shaper outputs exceeds the threshold voltage, the NIM-output gets negative

Power supply

- SUB-D9- female connector.
- Supply voltages (typical currents for box with 8 shapers and 8 preamps): Total power: 4.3 W
- + 12 V 250 mA
- + 6 V 50 mA
- - 6 V - 170 mA

Box size

length = 170 mm / width = 105 mm / high = 67 mm

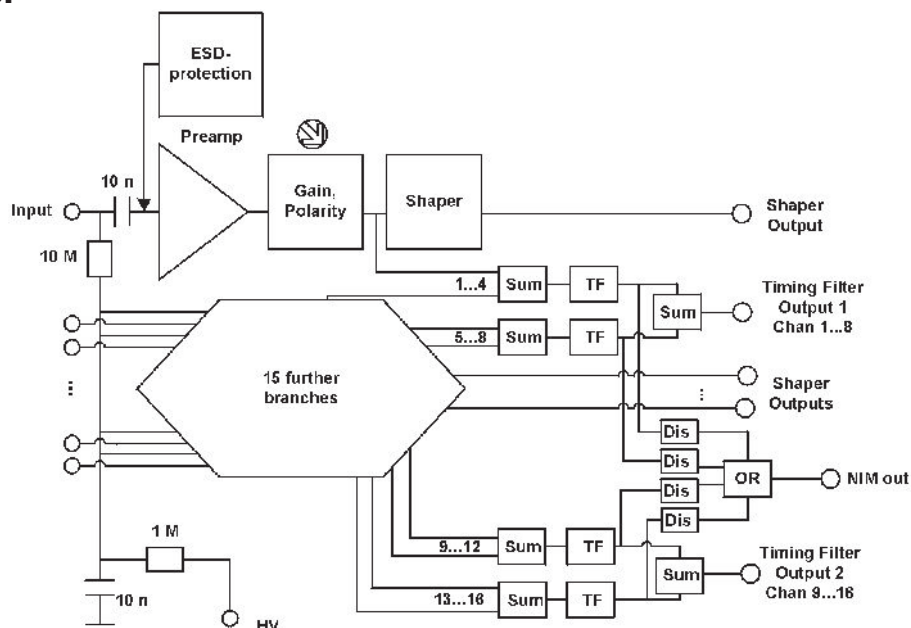
mesytec **MPRS-16** includes 16 channels of charge sensitive preamplifiers, shapers, timing filter amplifiers and leading edge discriminators. It provides two timing filter outputs, where each is the sum of 8 channels. It also provides a NIM trigger output which is the orred signal of the discriminators. It is well suited for high resolution timing and trigger generation. The input polarity and sensitivity can be selected in 8 steps by a rotary switch. The shaper outputs are designed to connect directly to standard 10 V peaksensing ADCs. The modules are especially well suited for single or double sided multistrip silicon detectors.

Features:

- 16 channel compact module
- Includes: preamplifier, shaper, timing filter
- High quality discriminator output (NIM) for good timing resolution or trigger generation, adjustable common threshold.
- Sensitivity and polarity selectable with rotary switch in steps: 3.3, 5, 6.7, 10, 17, 25, 33, 50 MeV full range
- Shaper output 10 V @ 1 k Ω , 1 μ s FWHM
- Pulser input
- Bias voltage up to \pm 400 V
- Preamplifier input protection
- PCB module available for in vacuum use



Schematics:



Technical Data

Input stage

- Input connector(s): SubD 25 female connector
- Pos. and neg. charge can be amplified equally
- The guardring output (24) is connected via R-C- R filter (100 k Ω , 10 nF, 100 k Ω) to the common detector bias input

Noise

- 5.5 keV Si + 0.064 keV/pF (1200e- FWHM + 18e-/pF)
- maximum input capacity: 1000 pF (detector + cable)

Pulser input

- Tail pulse, or square pulse, internally not terminated
- Amplitude: Typ. 11 MeV/V \pm 10% (0.5 pF couple capacity)

Sensitivity

- Sensitivity can be changed by a rotary switch. The following max ranges (8 V output at the shaper module) can be set: 3.3, 5, 6.7, 10, 17, 25, 33, 50 MeV.

Shaper Outputs

- Unipolar positive gaussian pulse (CR(RC)5). Output amplitude: 0 to 10 V, max 50 mA
- Peaking time 790 ns.
- Crosstalk $<3 \cdot 10^{-3}$ (– 50 dB) to neighbor channel, less than – 70 dB to others.
- Pin assignment of 34 pole output connector:
- pin 1 channel 1, pin 3 channel 2...
- pin 2, 4, ..., 32, 33, 34 output ground
- Option: low power output stage (max 4 V output signal). Is useful for in vacuum use.

Timing Filter Outputs

The MPRS provides two timing filter outputs. The signals are generated from the sum of channel 1...8 and 9...16. The signals are negative and are scaled and polarized with the rotary switch setting. Output amplitudes: – 1.5 V for maximum range in a single channel. The amplitude will vary to some extent with detector capacity and signal risetime.

Discriminators

The MPRS provides a NIM trigger output, which is the ored sum of its 4 leading edge discriminators, working each on the analog timing sum of 4 channels. Multiple discriminators are used to provide a high quality low jitter NIM signal. The discriminators have a common threshold, which can be adjusted via 10- turn potentiometer. The threshold value is available at the sense output. 10 V of output voltage corresponds to 100 % of the chosen sensitivity range. (1 V threshold voltage in the 25 MeV range means 10 % which corresponds to 2.5 MeV threshold value)

Detector bias input

- Lemo connector
- Maximum voltage \pm 400 V
- When detector side must be on ground level: terminate bias input with 50 Ω

Ground connections

- Ground screws on rear side

Power Supply

Connector:

- SubD9 connector:
1, 2 = gnd, 3 = + 6 V, 4 = + 12 V, 5 = – 6 V

Power consumption

With 10 V output driver = 2.3 W

- + 12 V 100 mA
- + 6 V 130 mA
- – 6 V – 100 mA

With 4 V output driver = 1 W

- + 6 V 140 mA
- – 6 V – 20 mA

Due to the low power consumption cooling is not necessary.

Dimensions

- Length: 173 mm (without connectors)
- Width: 105 mm
- Height: 46 mm

The mesytec **MPR-Series** provides a set of state of the art multichannel preamplifier modules specially designed for single or double sided multistrip silicon detectors. The MPR series can be used as stand alone modules and can also easily be combined with the mesytec STM-16 or MSCF-16 shaping-/timing filter/ discriminator module.

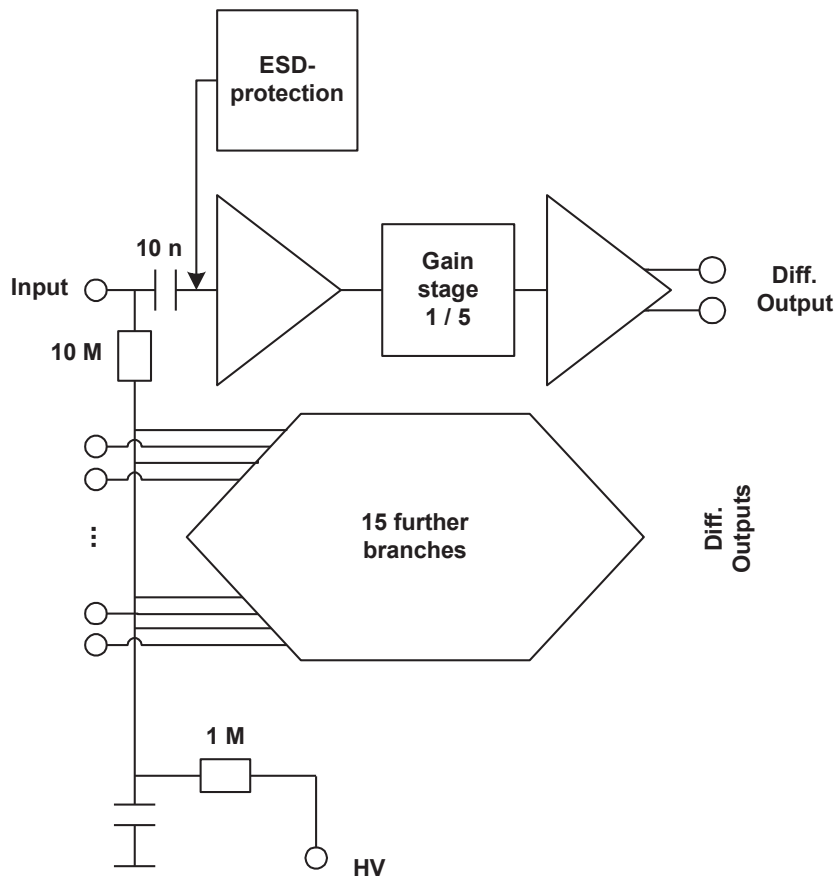
Features:

- 16 / 32 / 64 channel compact module
- Sensitivity switch, factor 5
- ESD input protection
- Differential output 100 Ω or MPR-16_L with unipolar output (Lemo connectors)
- Pulser input
- Bias voltage up to ± 400 V
- PCB module available for vacuum use



Schematics:

(for MPR-16)



Technical Data

Energy ranges

The MPR series provides a switch to amplify the output signal by a factor of 5. This helps to provide large output signals even at low charge depositions and thus provides good noise immunity. Sensitivity can be changed by a switch. Together with STM-16 the following max ranges (8 V output at the shaper module) can be set:

- **Type "5 GeV":**
0.33, 0.5, 0.65, 1.0, 1.7, 2.5, 3.3, 5.0 GeV
- **Type "100 MeV":**
6.6, 10, 13, 20, 33, 50, 65, 100 MeV
- **Type "25 MeV":**
1.5, 3, 4, 6.0, 7.5, 12, 15, 25 MeV.

Other ranges can be realized on request.

Input stage

- Input connector(s): SubD 25 female connector (for a 16 channel unit)
- Positive and negative charge can be amplified equally
- The guardring output (24) is connected via R-C-R filter (100 k Ω , 10 nF, 100 k Ω) to the common detector bias input

Output stage

- Differential output for twisted pair 34 pin male header connector
- Output amplitude: 0 to ± 1 V (headroom ± 4 V)
- Single ended Lemo output: 4 / 10 V

Noise

For the MPR-16 series, power modes can be selected by a jumper on the PCB.

High Power mode reduces noise, while low Power mode may be useful for in vacuum use.

power mode	shaping time	MPR16-25 MPR16-100
	Ⓢ / FWHM [μ s]	noise [keV]
LP	0.4 / 1	(5 + 0.06 /pF)
	1 / 2.5	(4 + 0.04 /pF)
HP	0.4 / 1	(5 + 0.04 /pF)
	1 / 2.5	(4 + 0.027 /pF)

Pulsar input

The pulser is internally distributed to individual charge termination capacities.

Tolerances ± 10 %.

MPR16-25	MPR16-100
0.78 pF (17 MeV/V)	1.13 pF (25 MeV/V)

Detector bias input

- Lemo connector
- Maximum voltage ± 400 V
- When connected detector side must be on ground level: terminate bias input with 50 Ω

Power consumption for 16 channels

Parameter	MPR16-25 MPR16-100	MPR16-500 MPR16-2500
	current [mA]	
LP/HP + 6 V	50	50
LP/HP - 6 V	50	50
LP + 12 V	40	-
HP + 12 V	80	40
total power LP-mode	1.1 W	-
total power HP-mode	1.6 W	1.1 W

LP = low power mode, HP = high power mode

Cooling

Due to the low power consumption cooling is not necessary. For **in vacuum use**, select low power mode if possible. The power of a single PCB can be dissipated without problems. If several PCBs are densely packed, heat conducting metal sheets should be placed in between the PCBs. Avoid to warm up silicon detectors by the dissipated power.

Dimensions

- Length: 173 mm (without connectors)
- Width: 105 mm
- Height: 46 mm (MPR-16)
67 mm (MPR-32)
92 mm (MPR-64)

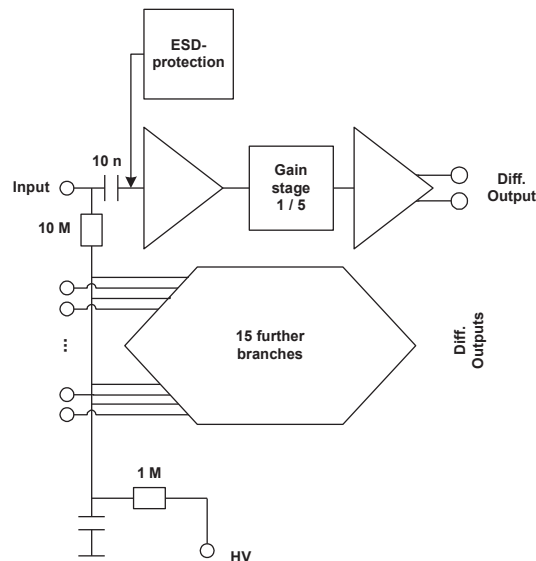
The mesytec **MPR-LOG series** provides a new type of multichannel preamplifier modules which are specially designed for applications where very fast recovery from large signals and precise spectroscopy of very small signals is required. They will usually be used for silicon strip detector readout. A typical application is decay spectroscopy after implantation of a heavy ion into a silicon detector. The MPR series can best be combined with the mesytec STM-16 or MSCF-16 shaping- / timing filter / discriminator module.

Features:

- 16 / 32 / 64 channel compact module
- Sensitivity switch, 2.5 / 10 MeV linear
- Recovers within 15 μ s from 3 GeV signals
- ESD input protection
- Differential output 100 Ω or MPR-16_L with Lemo output connectors
- Pulser input
- Bias voltage up to \pm 400 V
- PCB module available for in vacuum use



Schematics: (for MPR-16)

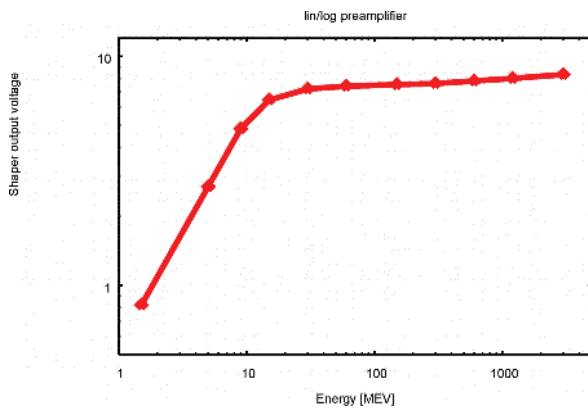


Technical Data

Energy ranges

The MPR-LOG series provides a linear range, which covers 70 % of the total range. The last 30 % cover the range of up to 3 GeV. A switch allows to choose a linear range of 2.5 MeV or 10 MeV.

With STM-16+ the optimum gain setting (with gain jumper G2) is $G = 2.2$.



10 MeV lin range with $2 \mu\text{s}$ (FWHM) spectroscopy amplifier STM-16+

Input stage

- Input connector(s): SubD 25 female connector (for a 16 channel unit)
- Positive and negative charge can be amplified equally.
- The guardring output (24) is connected via R-C- R filter (100 k Ω , 10 nF, 100 k Ω) to the common detector bias input.

Output stage

- Differential output for twisted pair 34 pin male header connectors
- Output amplitude: ± 1.3 V for maximum energy
- Pin assignment of output connector:
pin 1, 2 channel 1, pin 3, 4 channel 2 ...
pin 33, 34 output ground

Rise and decay time

Standard decay times is 10 μs .

Risetime is 12 ns for 0 pF input capacity.

Noise

$N = (6.5 + 0.06 / \text{pF}) \text{ keV [FWHM]}$ for 2 μs FWHM shaping.

Pulsar input

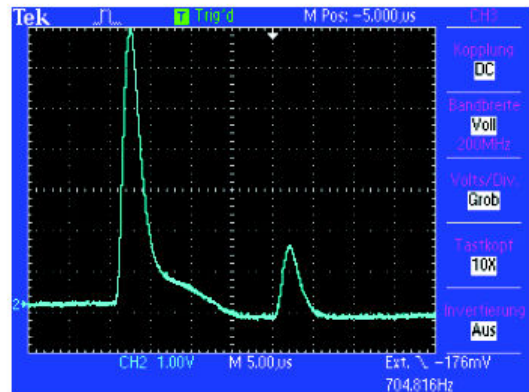
The pulser is internally distributed to individual charge termination capacities. Tolerances ± 10 %.

MPR-16 log
0.78 pF (17 MeV /V)

Detector bias input

- Lemo connector
- Maximum voltage ± 400 V
- When connected detector side must be on ground level: terminate bias input with 50 Ω Lemo terminator

STM16+ Shaper output (10 MeV-lin range)



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Shaper signal for implantation with energy of 3 GeV followed by a decay signal of 2.5 MeV

(The undershoot after implantation is artificial and due to the tail pulser)

Power consumption for 16 channels

Total power HP-mode = 1.3 W

- + 6 V 70 mA
- - 6 V 60 mA
- + 12 V 40 mA

Dimensions

- Length: 173 mm (without connectors)
- Width: 105 mm
- Height: 46 mm (MPR-16),
67 mm (MPR-32),
92 mm (MPR-64)

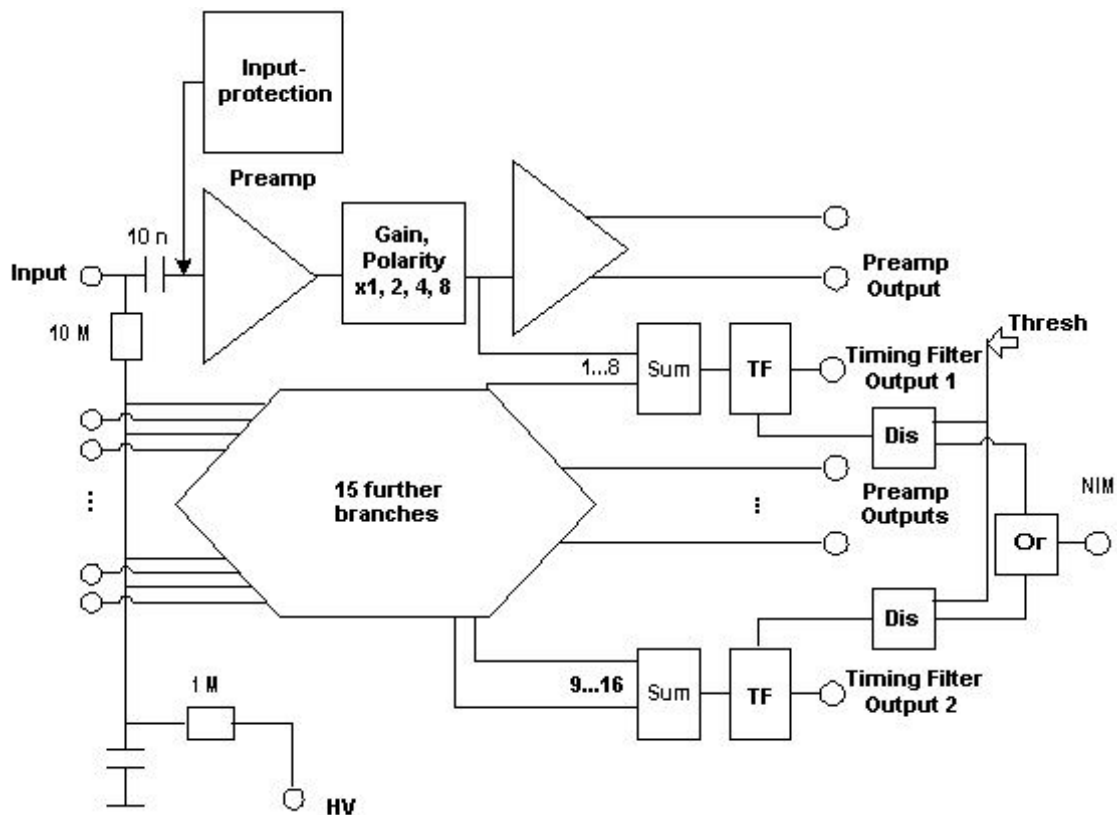
MPRT-16 is a state of the art multichannel charge integrating preamplifier. It includes a timing path with discriminators, providing a trigger to start external electronics.

Features:

- 16 channel compact module
- Sensitivity switch, factor 1, 2, 4, 8
- Input protection
- Pulser input
- Bias voltage up to ± 600 V
- Header or Lemo output
- NIM-trigger output
- 2 Timing Filter outputs for groups of 8 channels



Schematics:



Technical Data

Input stage

- Input connector: SubD 25 female connector
- Positive and negative charge can be amplified equally
- Guardring output is connected via R-C-R filter (100 k Ω , 10 nF, 100 k Ω) to the common detector bias input
- Sensitivity selection:
Rotary switch setting 4 pos., 4 neg. gain values

Timing filter outputs

- Two timing filter outputs (channel 1-8, channel 9-16)
- Negative signals (~ -1.5 V max. range), scaled and polarized according to gain selection
- TF constants: 250 ns integrating, 450 ns differentiating

Discriminators

- NIM trigger output as ored sum of 4 leading discriminators (Multiple discriminators provide a high quality, low jitter NIM signal)
- Common threshold, adjusted by 10 turn potentiometer
- Analog threshold sense output (-4.5 V = 45 % full range)

Detector bias input

- Lemo connector
- Maximum voltage ± 400 V
- When detector side must be on ground level: terminate bis input with 50 Ω

Ground connection

- Ground screw on rear side

Output stage

- Differential output for twisted pair 34 pin male header connector
- Output amplitude: 0 to ± 4 V (terminated ± 2 V)
- Unipolar output: 4 V unterminated 2 V terminated with 50 Ω (positive input charge \rightarrow positive output voltage)

Rise and decay time

- Standard decay time: 35 μ s
- Risetime: 10 ns (for 0 pF input capacity)

Noise

- Two power modes selectable:
 - High power mode reduces noise
 - Low power mode useful for in vacuum use

power mode	Shaping time	MPRT16-25 MPRT16-100
	σ / FWHM [μ s]	Noise [keV]
LP	0.4 / 1	(5 + 0.06 /pF)
	1 / 2.5	(4 + 0.04 /pF)
HP	0.4 / 1	(5 + 0.04 /pF)
	1 / 2.5	(4 + 0.027 /pF)

Pulsar input

- Test pulser internally distributed to individual charge termination capacities.
Tolerances ± 10 %.

Detector bias input

- Lemo connector
- Maximum voltage ± 600 V
- When connected detector side must be on ground level: terminate bias input with 50 Ω Lemo terminator

Power consumption, cooling

- Total power = 1.6 W (low power) ... 2.2W
- ± 6 V 80 mA
- + 12 V 50 mA (low power) ... 100 mA
- Cooling is not necessary. (For in vacuum use, select low power mode if possible).

Dimensions

- Length: 173 mm (without connectors)
- Width: 105 mm
- Height: 46 mm

MPRB-16 is a 16 channel charge sensitive preamplifier with integrated bias voltage generators. The device is remote controllable via mesytec control bus, which allows to adjust the 16 bias voltages individually for each channel in 100 mV steps, up to 600 V. It is designed to operate and read out arrays of avalanche photo diodes or strip detectors. A temperature sensor can be connected and allows the MPRB-16 to compensate the APD gain drift with temperature by adapting the bias voltage with temperature.

Features:

Preamplifier:

- Sensitivity switch, factor 5 or 10 (also remote controllable)
- Input protection
- Differential output 100 W
- Pulser input
- Differential or unipolar output

Bias supply:

- Individual bias supply for 16 channels, max. 600 V
- Voltage remote controllable
- Adjustable in steps of 0.1 V
- Voltage stability: 100 ppm /°C (without temp. compensation)
- temperature compensation with external temperature sensor, programmable slope (pos. / neg.)
- readout via RC bus:
 - temperature value of sensor
 - sum current of 16 channels
 - status of 16 bias channels (error code)
- MPRB-16-p for positive bias
- MPRB-16-n for negative bias



Technical Data

Energy ranges

The MPR series provides a switch to amplify the output signal by a factor of 5 or 10.
 Standard max. energy ranges are:
 25 MeV, 100 MeV, 300 MeV, 1 GeV.

Input stage

- Input connector(s): SubD 25 female connector (for a 16 channel unit)
- Positive and negative charge can be amplified equally.

Output stage

- Differential output for twisted pair 34 pin male header connector.
- Output amplitude: max. ± 1 V (headroom ± 4 V)
- Single ended Lemo output: 4 / 10 V

Noise

For the MPR-16 series, power modes can be selected by a jumper on the PCB.

shaping time	MPR16-25 MPR16-100
$\text{FWHM} / \text{FWHM} [\mu\text{s}]$	noise [keV]
0.4 / 1	(5 + 0.04 / pF)
1 / 2.5	(4 + 0.027 / pF)

Pulsar input

The pulser is internally distributed to individual charge termination capacities.
 Tolerances ± 10 %.

(For more details regarding preamplifier stage, please see also data sheet for MPR series)

Bias Voltage Supply

- Prefilter: 50 M Ω
- Stability: 100 ppm / $^{\circ}\text{C}$
 (slope = 0, temp sensor not connected)
- Maximum voltage difference between channels: 300 V
 (When set value difference is larger, channels with low voltage are increased. Lowest channel voltage = highest channel voltage – 300 V)

Dimensions

- Length: 173 mm (without connectors)
- Width: 105 mm
- Height: 55 mm

Power consumption with MPRB-16-300

- Total power = 2.2 W
- + 6 V 130 mA
- – 6 V – 70 mA
- + 12 V 80 mA

Temperature compensation

An NTC sensor can be connected at the detector input connector (with mesytec cable set also at detector position).

- Sensor type:
 NTC thermistor, Epcos B57861-S502-F40
 (5 k Ω @ 25 $^{\circ}\text{C}$, B = 3988)



Offset slope adjustment (via RC)

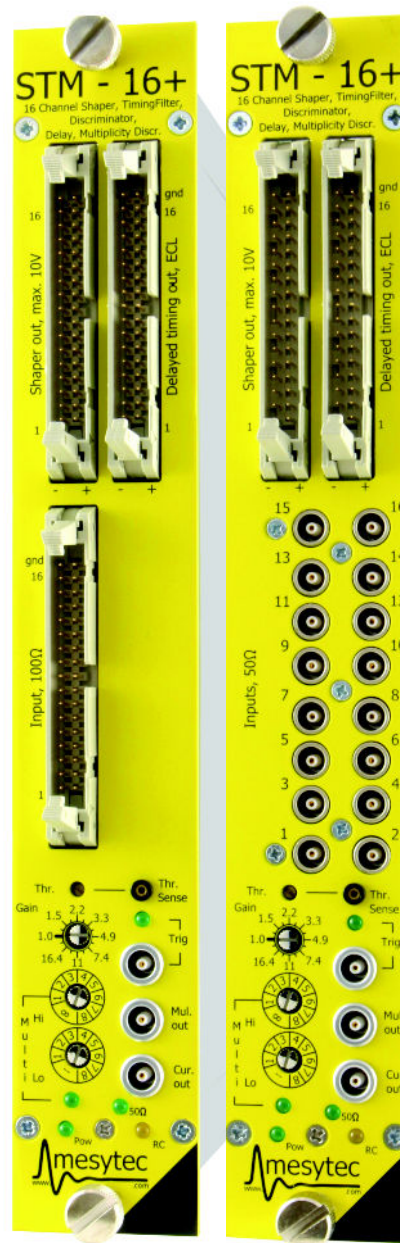
For modules with positive bias:

- Slope parameter = 0: voltage is increased by 1.79 V / $^{\circ}\text{C}$
- Slope parameter = 128: slope about 0
- Slope parameter = 255: voltage is decreased by 1.79 V / $^{\circ}\text{C}$

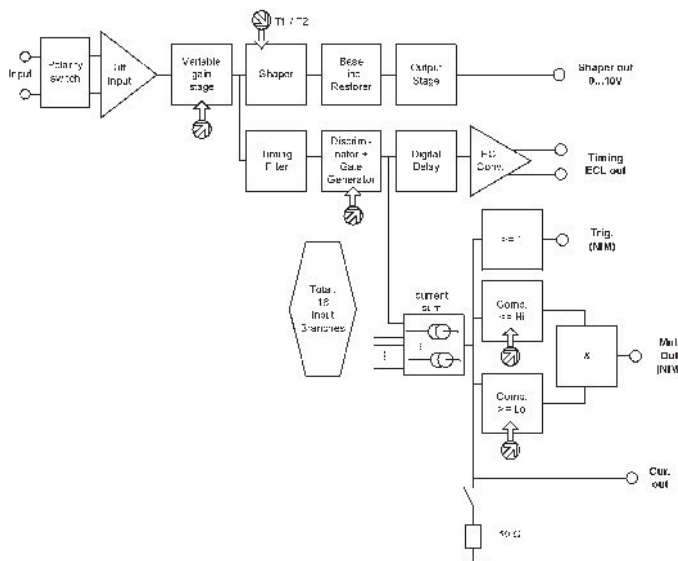
mesytec **STM-16+** is a shaping and timing filter amplifier with discriminator and multiplicity trigger. It is well suited for high quality spectroscopy applications.

Features:

- 16 channel NIM module, low power design
- Shaping amplifiers with baseline restorer
- 2 shaping times: 0.4 μ s / 1 μ s or 2 μ s / 5 μ s
(= 1 μ s / 2 μ s or 5 μ s / 12 μ s FWHM)
- Gain adjustable from 1 to 600
- Low noise: < 7 μ V
(gain=100 and shaping time = 2 μ s)
- Low integral nonlinearity
- Timing filter amplifiers
- Leading edge discriminators
- Digital delay of 450 ns for timing stop
- ECL timing output
- Trigger output
- Multiplicity trigger
- Remote control of discriminator thresholds and gains
- Unipolar Lemo input option



Schematics:



Technical Data

Input stage

- Gain adjust: gain can be set from 1 to 20 in 16 steps with factor 1.22 per step

Differential version

- Input connector: 34 pin male connector
- Input resistance: terminated with 100 Ω , adapted to twisted pair cables.
- Gain-Polarity jumper with multiplication factor of 2 and 30 are standard (Gain range from 2 to 600)
- input noise at gain = 100: 10 μ Vrms for 1 μ s shaping time, 7 μ Vrms for 2 μ s shaping time
- Common mode suppression: 50 dB

Unipolar version

- 16 Lemo 00 input connectors
- Input termination option: 1 k Ω and 50 Ω , coded on the gain-polarity jumper
- Gain-Polarity jumper with multiplication factor 2 and 30 are standard
- Input noise at gain = 100, 2 μ s shaping time and 50 Ω input = 7 μ Vrms

Shaper

- PZ adjustable with trimmers inside the case from 8 μ s to infinity
- Two shaping times of 0.4 μ s / 1 μ s or 2 μ s / 5 μ s jumper selectable, common for all channels
- Output amplitude: 0 to 10 V
- Passive baseline restorer
- DC-Offset: VDC \pm 5 mV, common offset adjust
- Output connector: 34 pin male connector
- Integral nonlinearity < 0.05 %
- gain drift < 0.0075 % / $^{\circ}$ C
- Offset drift < 50 μ V / $^{\circ}$ C

Timing filter amplifier

- RC-CR, 7 ns / 100 ns
- 4 monitor outputs for timing filter signals, each providing the sum signal of 4 channels (Amplitude: – 1.5 V per channel for 10 V shaper output)

Discriminator

- Leading edge
- Threshold: adjustable, 0 to 4 V (= 0 % to 40 % of maximum range)

Gate generator, Timing delay, ECL output

- Pulse width for trigger output: 400 ns
- Timing stop- ECL-Signals:
 - delay 400 ns from trigger
 - width 200 ns
- Output connector: 34 pin male connector
- Typical timing resolution for 5 MeV signals from silicon detector (10*10 mm², 500 μ m, 60 V bias): dT = 400 ps. If necessary, a walk correction can be easily implemented in software using the shaper amplitude.

Multiplicity trigger

- Each channel above threshold contributes to multiplicity level, a multiplicity trigger is generated for: lower multiplicity threshold \leq multiplicity level \leq upper multiplicity threshold
- coincidence interval adjustable from 40 ns up to 150 ns (default 100 ns).
- The multiplicity trigger is 100 ns delayed to the trigger signal.
- Lower multiplicity threshold: 1...8, upper multiplicity threshold: 1...8 and ∞
- Multiplicity chaining: multiplicity outputs from several modules can be connected, resulting in a total multiplicity level of all connected modules. Multiplicity trigger windows of the connected modules act independently on the total multiplicity.

Power consumption (Total power = max. 7 W)

- + 6 V 280 mA
- – 6 V – 680 mA
- + 12 V 80 mA

Remote control

The modules are equipped with the mesytec remote control receiver, which can be addressed by a MRC-1 or a MRCC module.

Adjustable parameters:

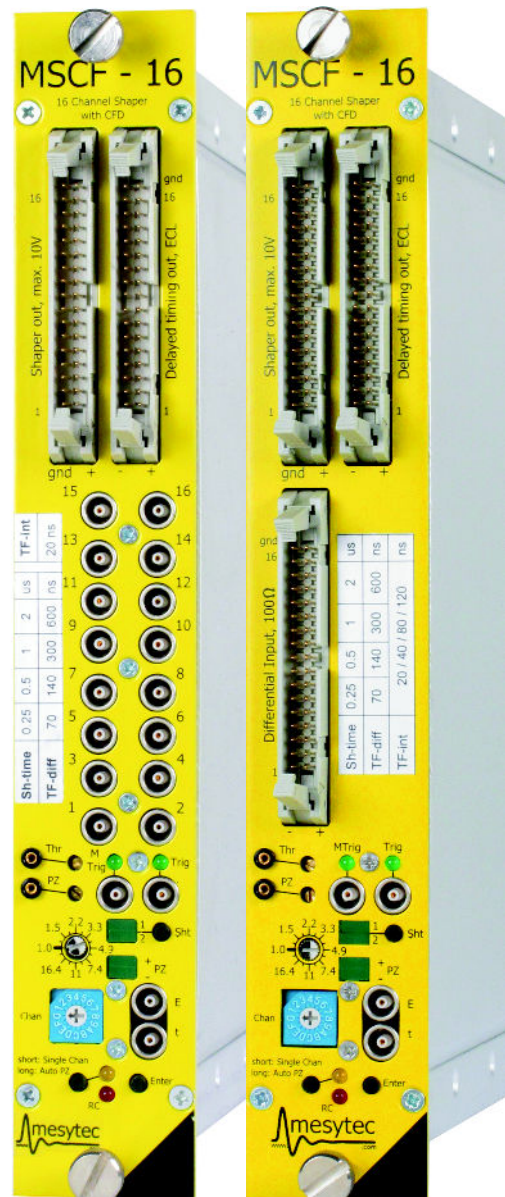
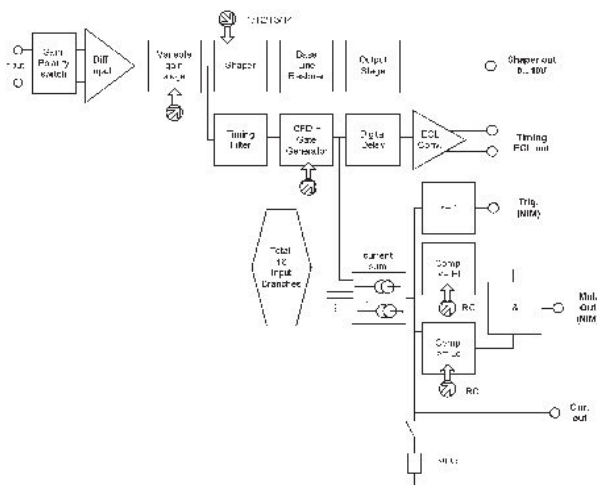
- individual thresholds
- gains for pairs of channels

mesytec **MSCF-16-F** is a shaping / timing filter amplifier with constant fraction discriminator and multiplicity trigger and provides active baseline restorer. It is well suited for multistrip silicon detectors and for high quality spectroscopy applications. The differential input version is ideal with the preamplifier family MPR-16 / -32 / -64. For Ge-detectors see data sheet for MSCF-16-LN. For direct PMT interfacing see datasheet MSCF-16-FC.

Features:

- 16 channel NIM module, low power design
- Shaping amplifiers with active baseline restorer
- Timing filter amplifiers
- CF discriminators (opt.: leading edge)
- ECL timing output with digital delay of 450 ns
- Trigger output (NIM)
- Multiplicity trigger (NIM)
- Remote control of discriminator thresholds, shaping time, gains, PZ, BLR-threshold
- 4 shaping times
- Gain adjustable from 1 to 600 (optional 2000)
- Differential or unipolar (Lemo) input versions
- Low noise: < 7 mV
(gain = 100 and shaping time = 2 ms)
- Low integral nonlinearity
- Fully controllable via front panel
- Remote control via USB and mesytec control bus
- 4 selectable timing filter integration times
- ECL timing delay can be switched off

Schematics:



Technical Data

Input stage

- Gain adjust: gain can be set from 1 to 20 in 16 steps with factor 1.22 per step. The gain is multiplied with the gain jumper factor

unipolar version

- Input connectors: 16 x Lemo 00 series
- Input termination: 330 Ω , 93 Ω or 50 Ω , coded on the gain-polarity jumper are possible. Gain jumpers from G1 to G95 are possible.

differential version

- Input connector: 34 pin male connector
- Input resistance: terminated with 100 Ω , adapted to twisted pair cables.
- Gain-Polarity jumper with multiplication factor of G2 and G30 are standard. (total Gain range from 2 to 600)
- Common mode suppression: > 50 dB

Noise

- Input noise at gain = 100 and 2 μ s shaping time = 7 μ Vrms.

Shaper

- PZ adjustable with front panel trimmer.
- 5th order filter CR-RC⁵ (Sh2-type 4th order)
- Four shaping times (σ -values)
- selectable for groups of 4 channels
- Output amplitude: 0 to 10 V at 1 k Ω
- Active baseline restorer
- DC-Offset: VDC \pm 5 mV, common offset adjust.
- Output connector: 34 pin male connector
- Integral nonlinearity < 0.05 %
- gain drift < 0.0075 % / $^{\circ}$ C
- Offset drift < 50 μ V / $^{\circ}$ C

Discriminator

- CFD or Leading edge (jumper selectable)
- CFD delays and fraction selectable for groups of 4 channels
- CFD -Walk: for 30 ns (10 % to 90 %) input risetime, max \pm 1 ns (dynamic range 100:1)
- Threshold: adjustable, 0 % to 30 % of maximum range, in 256 steps
- CFD: 2 fractions selectable for groups of 4: 20 % / 40 %

- CFD-Walk: for 30 ns (10 % to 90 %) input risetime, max 1ns (dynamic range 100:1)
- Threshold: adjustable, 0 % to 75 % of maximum range, in 256 steps

Gate generator, Timing delay, ECL output

- Pulse width for trigger output: 400 ns
- Timing stop- ECL-Signals:
- delay 400 ns from trigger, width 200 ns
- Output connector: 34 pin mal connector

Multiplicity trigger

- Multiplicities selectable via remote control
- Lower multiplicity threshold: 1...8, upper multiplicity threshold: 1...8 and ∞

Power consumption (Total power max. 9 W)

- + 6V 400 mA
- - 6 V - 800 mA
- + 12 V 100 mA

Frontpanel Operation

Most MSCF-16 parameters can be set and controlled via frontpanel.

Remote Controlled Operation

MSCF-16 can be remote controlled in two modes: USB control and eventbus control. MSCF-16 has two complete parameter sets, one for frontpanel operation, one for remote control. Switching RC on and off switches between these two parameters sets.

USB Control

For USB control a USB 1.1 or 2.0 connection is required. The MSCF-16 can be operated as a generic serial device on a virtual com port. Virtual com port (VCP) drivers for various operation systems for this rc mode are available.

MRC-1 / MRCC control

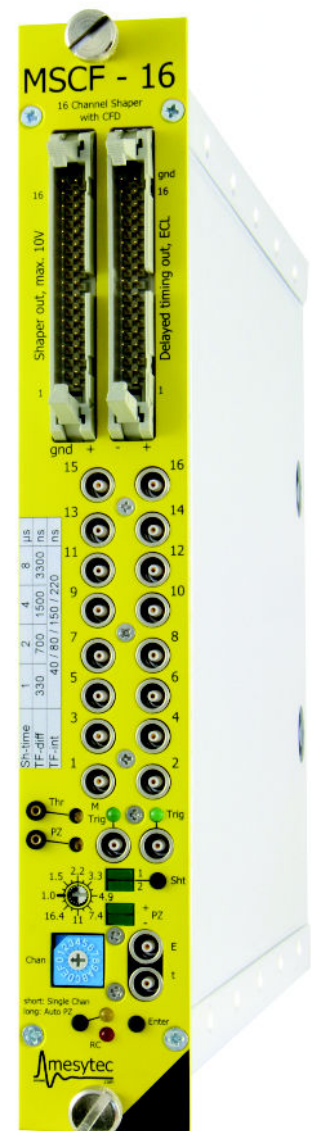
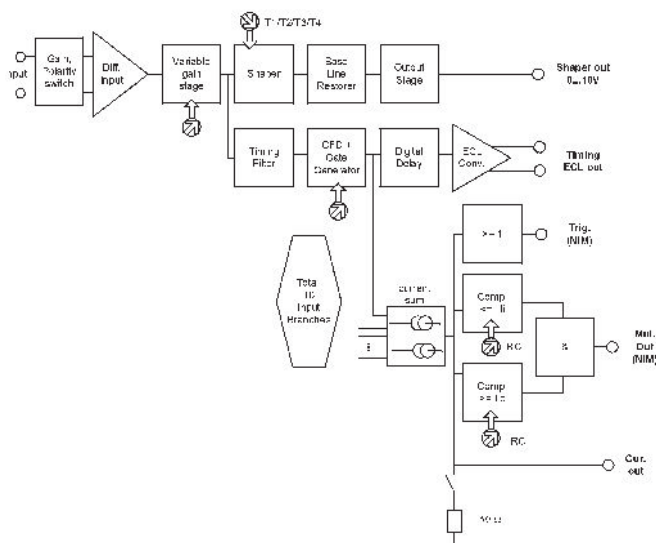
MSCF-16 can also be controlled using the MRC-1 or MRCC controller module. Up to 16 modules (not only MSCF-16) can be connected on one bus, up to 32 on the two buses of the MRC-1 or MRCC.

mesytec **MSCF-16-LN** is an **ultra low noise** spectroscopy amplifier with active baseline restorers. It provides timing filter amplifiers with constant fraction discriminators and a multiplicity trigger. It is completely revised to meet the requirement of high quality germanium detector readout. It competes with the best single channel spectroscopy amplifiers.

Features:

- low noise: $< 4 \mu\text{Vrms}$ (gain = 100 and shaping time = $8 \mu\text{s}$)
- 16 channel NIM module, low power design
- shaping amplifiers with active baseline restorer
- timing filter amplifiers
- CF discriminators (opt.: leading edge)
- ECL timing output with digital delay of 800 ns
- trigger output (NIM)
- multiplicity trigger (NIM)
- remote control of discriminator thresholds, shaping time, gains, PZ
- 4 shaping times
- gain adjustable from 1 to 600 (optional 2000)
- unipolar (Lemo „00“) inputs
- low integral nonlinearity
- fully controllable via front panel
- remote control via USB and mesytec control bus

Schematics:



MCFD-16 is an easy to use, fast 16 channel constant fraction discriminator (CFD) for high timing resolution applications. It provides fast amplifiers at the inputs which can be set for input polarity and gains. The amplifier outputs are split to the CFD unit and are available as unipolar or differential signals (configurable) at an output connector. The discriminator signals are available as ECL differential outputs at a 34 pin header connector. In differential mode, the analog outputs allow to drive long twisted pair delay cables to introduce the necessary delay needed for charge sensitive ADCs (QDCs). A fast pattern processing is implemented, well suited to produce complex triggers from input coincidences.

Features:

Built in fast preamplifier:

- Gain 1, 3, and 10
- Polarity selectable
- 300 MHz band width
- Output configurable via Jumper: unipolar or differential

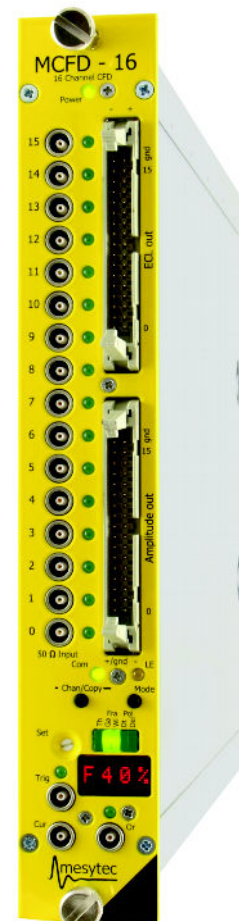
Constant fraction discriminator:

- All parameters adjustable by front panel and remote control
- Standard delay chips (SIP-7), default 20 ns
- Pulse width: 7 ns to 300 ns, dead time: 25 ns to 700 ns
- Fraction 20 % and 40 %
- Delay in 5 steps (default 4 ns to 20 ns)
- Walk ± 100 ps (input range 35 mV to 3.5 V)
- Lowest signal at Gain = 1 is 1.2 mV
- CFD or leading edge discrimination selectable
- 16 ECL outputs
- Common OR (NIM) and current output (1 mA/chan)

Pattern processing:

- Common OR
- Or of two independent definable groups of channels
- Multiplicity
- Full par coincidence matrix
- Coincidence window 5 ns to 600 ns
- Built in gate generator
- 3 NIM / TTL Trigger outputs, one veto input

- Control:
- Front panel
- USB
- mesytec control bus



Technical Data

Fast Preamplifier

- 16 Lemo signal inputs, 50 Ω terminated
- Amplitude range (offset + signal);
positive -2 V to $+3.5\text{ V}$ /
negative $+2\text{ V}$ to -3.5 V
- Polarity: Configurable Input polarity
(front panel / RC)
- Range: linear input range (signal only)
Gain = 1 : 0 V to $\pm 3.5\text{ V}$
Gain = 3 : 0 V to $\pm 1.2\text{ V}$
Gain = 10 : 0 V to $\pm 350\text{ mV}$
- Minimum detectable signal:
(@ 25 ns rise time)

Gain	CFD-mode (100 % triggers)	LE-mode (100 % triggers)
1	5 mV	1.2 mV
3	2 mV	0.8 mV
10	1 mV	0.5 mV

- Bandwidth Limit (register selectable):
150 MHz (2 ns rise time) / 30 MHz (10 ns r.t.)

Discriminator

- Threshold: adjustable 0 %...3 % full range
- Width and dead time adjust: 20 ns to 1.2 μs
- Automatic offset compensation (Auto walk)
Walk @ amplitude 35 mV to 3.5 V: $\pm 100\text{ ps}$
- Delay: Configurable via frontpanel or RC:
5 tps with 4 ns each (with SIP-7 standard delay chips, 20 ns, 100 R)
- Fraction settable via front panel or RC:
20 % and 40 %
- CFD Crosstalk < 60 dB (1000:1) for all types of signals within allowed input range

Delays

CFD zero crossing takes place at the pulse maximum \rightarrow timing is referenced to pulse maximum.

Output	Delay [ns]
individual ECL outputs	2 ns
Fast OR output	10 ns
Trig 0, 1, 2	typ 25 ns

Channel mask

Inputs can be masked individually via RC control.

Timing Outputs

- 16 ECL discriminator outputs
- 1x current OR output, 1 mA per hit
- 1x fast logic OR output NIM

Analog output

- Signal after amplification 1, 3 or 10
- Can be configured as unipolar or differential
- Max $\pm 3.5\text{ V}$ unterminated
- Source resistance 50 Ω

Data interfaces

- USB 2.0 connector
- mesytec control bus
(Lemo „00“ and ID-coder)

Coincidence unit

MCFD-16 offers sophisticated coincidence and trigger logic with pattern processing:

- multiplicity trigger
- „or“ coincidence, coinc. Window 5 ns...2 μs
- pattern processing: full pair coincidence matrix

Gate generator

- Built in gate generator
- adjustable rising and falling edge
- Minimum delay 10 ns, maximum 1 μs
- Any of the three coincidence units can trigger the GG

Veto input

- Input signal, dual level: NIM or TTL

Trigger outputs

- 3x Trigger outputs, TTL or NIM
- Pulse length type. 60 ns
- Configurable sources

Power consumption

- + 12 V 100 mA
- + 6 V 1.2 A
- - 6 V 2.0 A

Total power consumption:

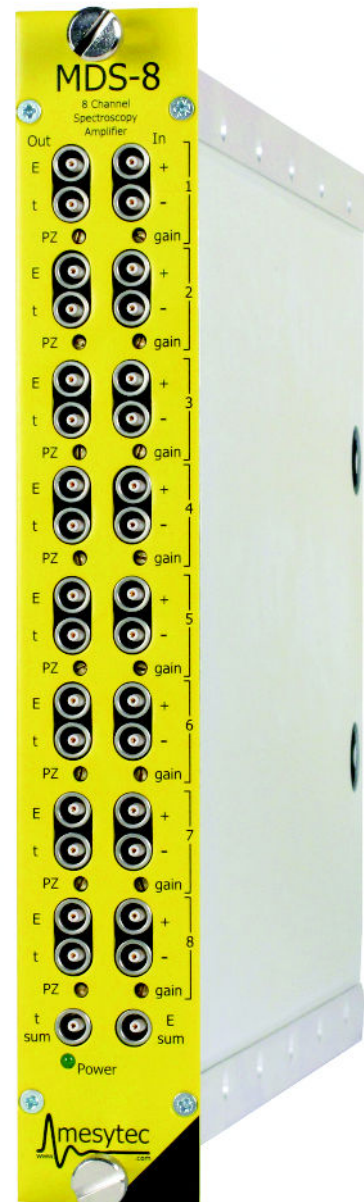
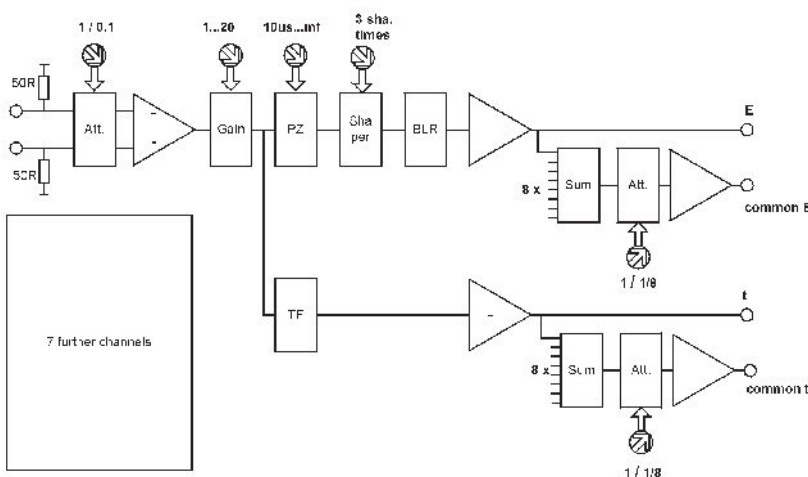
Gain = 1: max 16 W,
Gain = 10: max 20 W

mesytec **MDS-8** is an 8-channel spectroscopy amplifier with integrated timing filter amplifier in a 1/12 wide NIM module. It provides an adjustable gain of 1 to 160 and 3 different shaping times.

Features:

- 8 differential Lemo inputs, can be used single ended
- Input resistance 50 Ω
- 3 shaping times: 0.4 μ s, 1 μ s, 2.5 μ s (FWHM)
- Passive baseline restorer
- Adjustable gain and PZ compensation at front panel
- Individual outputs:
 - + 10 V shaped pulse
 - - 2 V timing filter output
- Common outputs:
 - sum of shaping outputs
 - sum of timing filter outputs

Schematic:



Technical Data

Shaper inputs

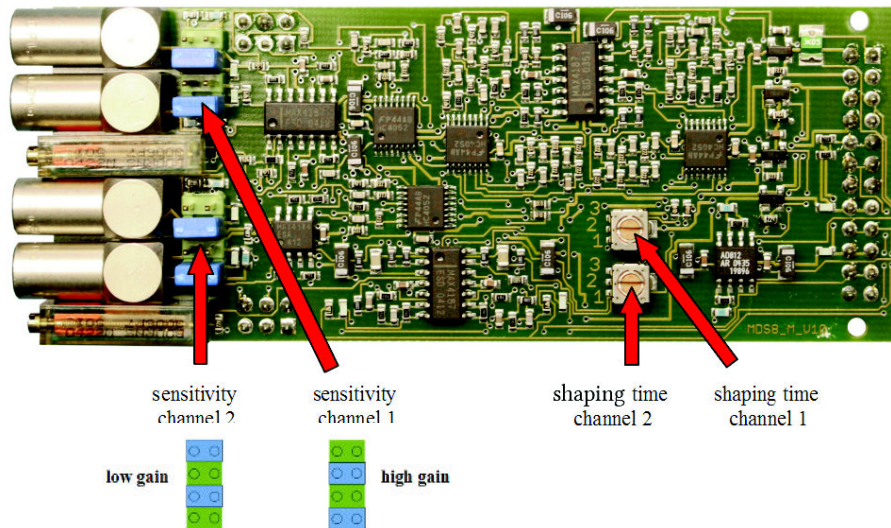
- internally terminated with 50 Ω (differential use 100 Ω)
- positive and negative input
- adjustable gain range: 1...160. (Factor 20 with 10 turn potentiometer plus factor 8 by attenuator jumpers).

Energy outputs

for each channel:

- Shaper output amplitude: max 10 V (into 1 k Ω)
- Shaping time switch selectable for each channel: 0.4 μ s, 1 μ s, 2.5 μ s
- Integral nonlinearity < $2 \cdot 10^{-4}$
- Input noise: 20 μ Vrms @ gain = 100 (all shaping times)
- Offset: max 3 mV

Servicable elements inside the module



Timing outputs

for each channel:

- scaled with gain setting
- output voltage max – 2 V full range
- integration time = 15 ns
- differentiation time = 200 ns
- can be terminated with 50 Ω

Common Energy output

- sum value of all energy outputs (only useful for same shaping time in all channels)
- max 10 V output amplitude

Pole zero adjustment

- Front panel potentiometer. Range 10 μ s to ∞

Common Timing output

- sum value of all 8 timing outputs
- max – 4 V output amplitude
- Attenuator for factor of 8 is jumper selectable
- can be terminated with 50 Ω

Power consumption (Total power 1.7 W)

- + 12 V + 60 mA
- + 6 V + 50 mA
- 6 V – 110 mA

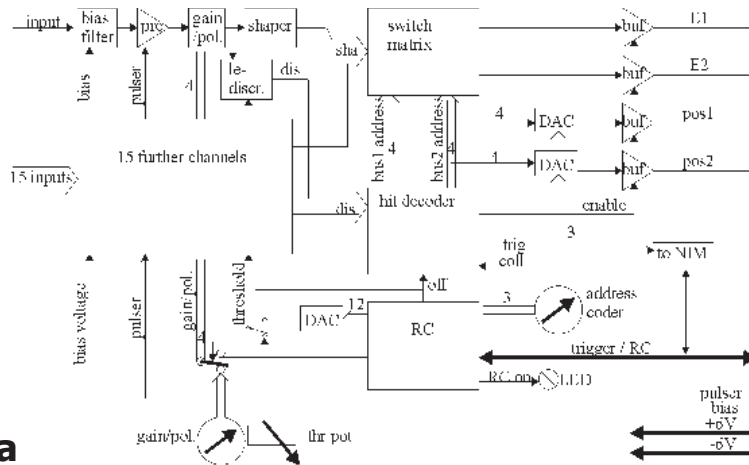
mesytec **MUX-16** is a very fast 16 channel multiplexed preamplifier shaper and discriminator combination with very good energy and timing resolution. Up to two simultaneously responding channels are identified and two amplitudes plus the two corresponding amplitude coded addresses are switched to a bus. Up to eight modules (128 channels) can be connected to one bus, so only 4 channels of peak sensing ADCs are needed to digitize energy and position signals. The modules are especially well suited for single hit applications (maximum two hits on one module) with single or double sided multistrip silicon detectors or multiwire proportional chambers. Due to low power consumption, the MUX-16 PCB can be used in vacuum without cooling.

Features:

- **High rate:**
up to 800 kHz rate capability per bus
- **Very good timing resolution:**
1 fast leading edge discriminator per channel. Ored NIM timing output, reject output
- **Low noise** preamplifiers and 5th order shaping amplifier allow very good energy resolution
- **Very flexible:**
sensitivity (and polarity) selectable with rotary switch (or RC) in 8 steps
- **Low power:** 1.45 W for 16 channels
- **Compact:** 185 x 100 x 16 mm³
- fully remote controllable for use in vacuum
- Includes 16 channel bias filter and AC coupling for bias voltages up to ± 400 V
- Processes single and double hits per 16 channel unit
- Up to 8 modules = 128 channels on one bus, only 2 or 4 peak sensing ADC channels needed
- Pulser input
- Preamplifier input protection
- Option: individual discr. Thresholds for all channels
- Reject: signal output if more than 2 hits or if module collision on the bus



Schematics:



Technical Data

Sensitivity

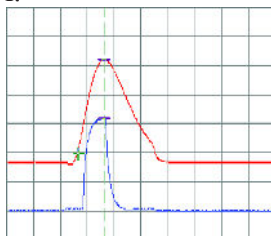
- Sensitivity can be changed by a rotary switch. The following max ranges (3.5 V output) can be set:
50 MeV: 3, 4, 6, 9, 15, 25, 35, 50 MeV
100 MeV: 6, 8, 12, 20, 30, 50, 70, 100 MeV
1 GeV: 60, 80, 120, 200, 300, 500, 700, 1000 MeV

Discriminators

Input for the 16 discriminators are fast timing filter signals, which are amplified with the same factor as the shaper signals. The discriminators have a common threshold, which can be adjusted via 10 turn potentiometer or remote control (Option with individual threshold via RC is now available).

Position / amplitude outputs

- Unipolar positive pulse (RC). Output amplitude: 22.2 mV increment per bin, 460 mV fixed offset, the address coder gives an additional offset of 355 mV x address. Maximum output range is: 0.46 to 3.3 V, max 20 mA.



Output amplitude / position, Y = 1 V, X = 500 ns

Detector bias input

- Lemo connector
- Maximum voltage ± 400 V

Dimensions

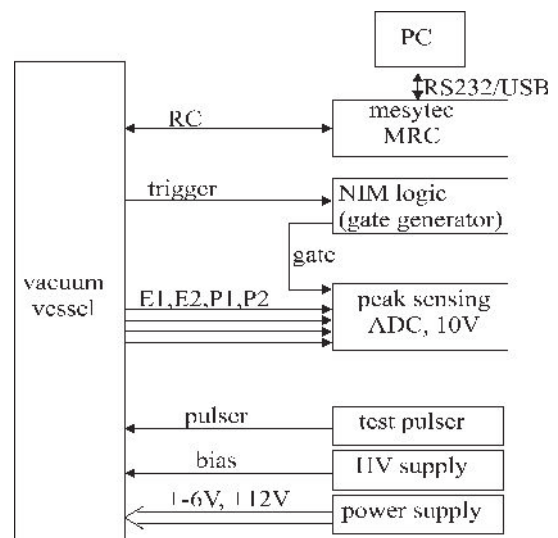
- Length: 185 mm (with connection)
- Width: 100 mm
- Height: 16 mm

Driver PCB (V2.1), 10 V type

A driver PCB is provided which includes strong output drivers to serve ADCs with 10 V input range. It also splits the Trigger-RC bus to a pure trigger line and an RC input.

Operation of MUX-16 devices in vacuum

Remote control with mesytec MRC-1 or MRCC is recommended to setup gains and thresholds in vacuum. This also allows pulser test with several MUX-16 devices connected to the bus.



mesytec **MTM-16** and **MDI-2** are the two components of a sophisticated multiplexing VME based readout system for multichannel detectors.

MTM-16: 16 channel preamplifier, shaper, discriminator and multiplexer

MDI-2: VME sequencer and high precision ADC

Up to 32 MTM-16 can be read out by one MDI-2 (two channels with 16 attached MTM-16 each), allowing for total readout of up to 512 detector channels. Multiplexing architecture and advanced readout options (zero suppression, multi event buffer, timestamping, several data transfer modes) allow setting up a high performance readout system with minimum hardware cost.

MTM-16 Features:

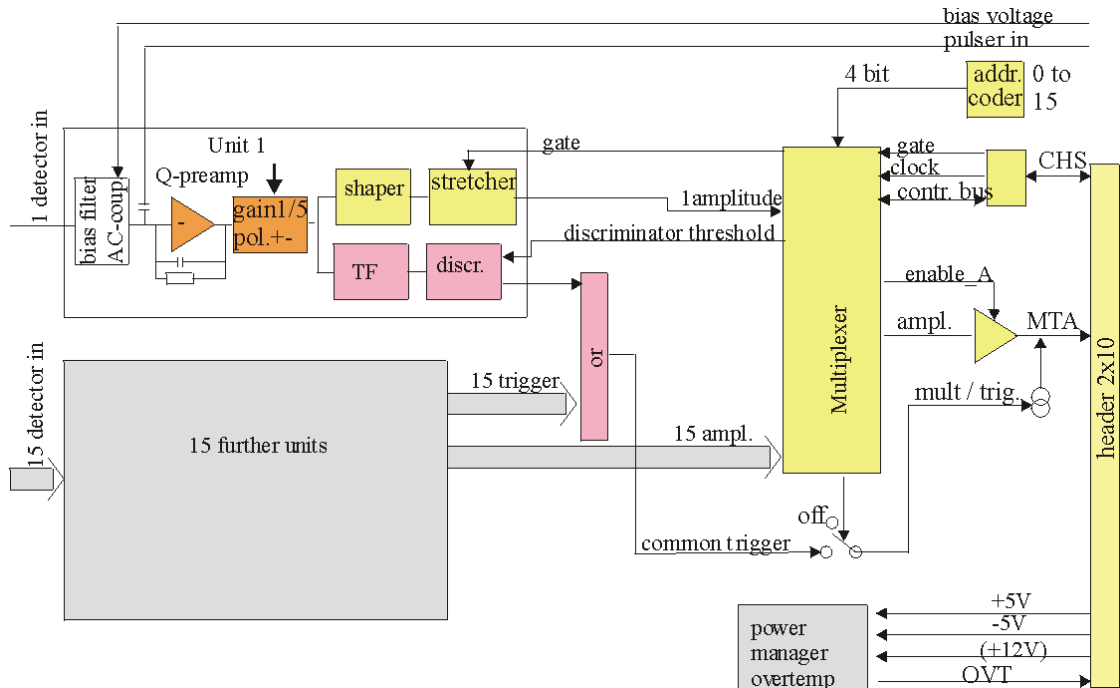
- charge sensitive preamplifier
- switchable gain and polarity
- timing filter amplifier / discriminator
- spectroscopy amplifier + stretcher
- detector bias supply network (400 V)
- remote controllable
- test pulser input
- power supply:
± 5 V, + 12 V (from MDI-2)
50 to 160 mW /chan = 0.8 to 2.6 W
per 16 chan.

MDI-2 Features:

- high quality 12 bit (4 k) conversion with sliding scale ADC (DNL < 1 %)
- 10 Msamples /s per bus
- up to 512 channels
- multi event buffers
- zero suppression with individual thresholds
- different types of timestamping
- remote control of MTM-16 modules
- Address modes: A24 / A32
- Data transfer modes: D16, 32, 64, BLT32, MBLT64, CBLT
- Multicast for event reset and timestamping start

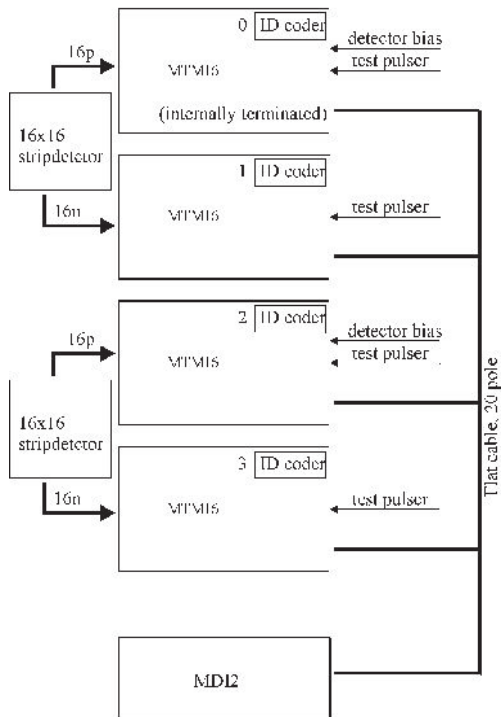


MTM-16 frontend schematics:

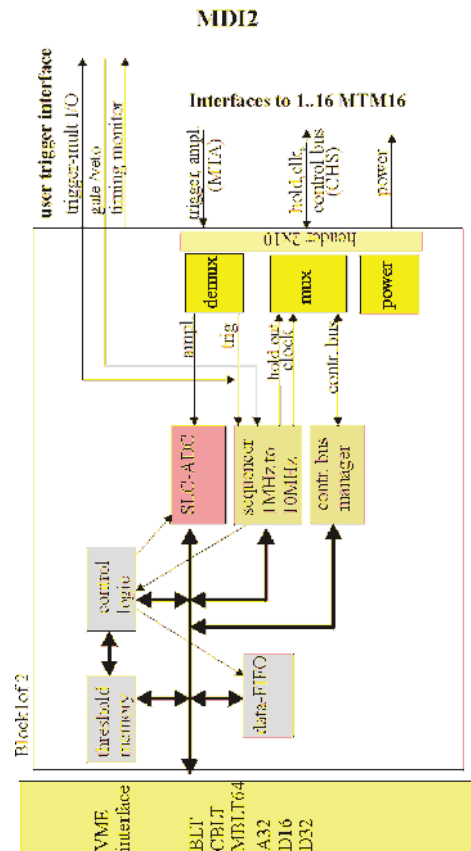


Chaining several MTM-16 units

Chaining the MTM16 modules, connection to MDI2
Example: readout of two 16x16 silicon strip detectors



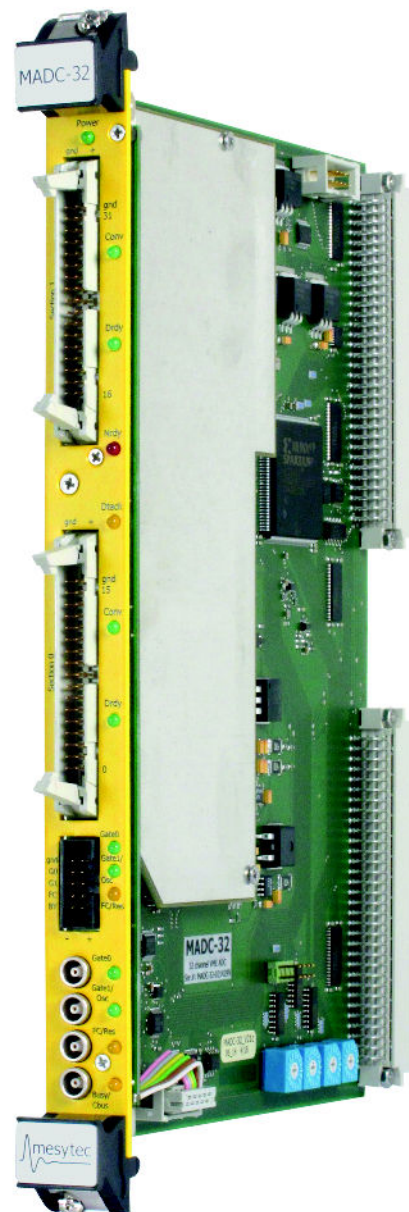
MDI-2 schematics



MADC-32 is a fast and high precision 32 channels peak sensing ADC. It provides 11 bit to 13 bit (2 k to 8 k) resolution with low differential non linearity ($< 1\%$) due to sliding scale method. In 8 k mode it provides the high INL and resolution required for Ge detector readout. The conversion time is 800 ns for 32 channels at 2 k resolution. MADC-32 supports zero suppression with individual thresholds.

Features:

- High quality 11 bit to 13 bit (2, 4, 8 k) conversion with sliding scale ADC (DNL $< 1\%$ @ 4 k)
- 800 ns, 1.6 μ s, 6.4 μ s conversion time for 32 channels with 2, 4, 8 k resolution
- 8 k (32 bit-) words multi event buffer (1 word corresponds to 1 converted channel => 240...2730 events total)
- Zero suppression with individual thresholds
- Supports different types of time stamping
- Independent band operation
- Two register adjustable gate generators are built in
- Input range, register selectable 4, 8, 10 V
- mesytec control bus to control external mesytec modules
- Address modes: A24 / A32
- Data transfer modes: D16 (registers), D32, BLT32, MBLT64, CBLT, CMBLT64
- Multicast for event reset and time stamping start
- Live insertion (can be inserted in a running crate)
- 8 k words memory
- lower INL for very long shaping times and low amplitudes
- Thresholds can be deactivated with a single register
- Extended time stamp also for independent bank operation



Technical Data

Input / Output

Conversion input:

- 1 k Ω , 4 V, 8 V or 10 V (register configurable)
- Risetime min: 50 ns, max: DC

ECL inputs:

- standard ECL input, can be individually terminated via register
- Rise time min: 50 ns, max: DC-conversion possible

NIM inputs:

- standard NIM

NIM output:

- - 0.7 V terminated

mesytec control bus output:

- shares connector with busy output
- + 0.7 V terminated

Digital in-/outputs:

- 4 x ECL: Gate 0/1, fast clear, busy (alternative: Gate 1 = external timestamp osc., Fast clear = reset time stamp counter)
- 4 x NIM (functions identical to ECL)

Gate generators

- 2 gate generators, one for each bank of 32 channels

Output formats, resolution, conversion time

(Sliding scale needs 1/16 of the full binary value)

Resol.	Typ. Noise	Max. Noise	Conv. time
[bits]	[chan RMS]		[μ s]
2 k	0,6	0,8	0,8
4 k	0,9	1,2	1,6
4 k hires	0,7	1	3,2
8 k	0,9	1,2	6,4
8 k hires	0,7	1	12,8

Power consumption (Total power 4.0 W)

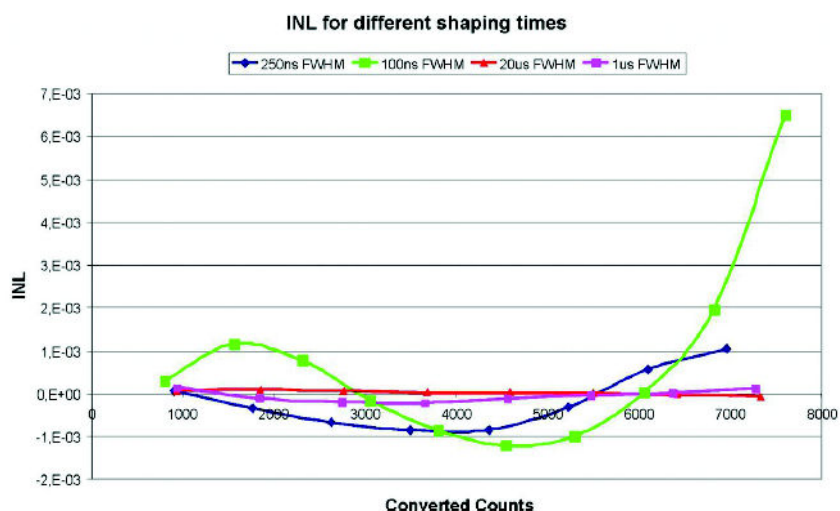
- + 5 V + 190 mA
- + 12 V + 160 mA
- - 12 V - 80 mA

Integral nonlinearity

INL @ 20 μ s FWHM shaping time typ $1 \cdot 10^{-4}$ (max $2 \cdot 10^{-4}$) in the range 0.2 % to 100 %

INL @ 1 μ s FWHM shaping time typ $2 \cdot 10^{-4}$ in the range 0.2 % to 100 %

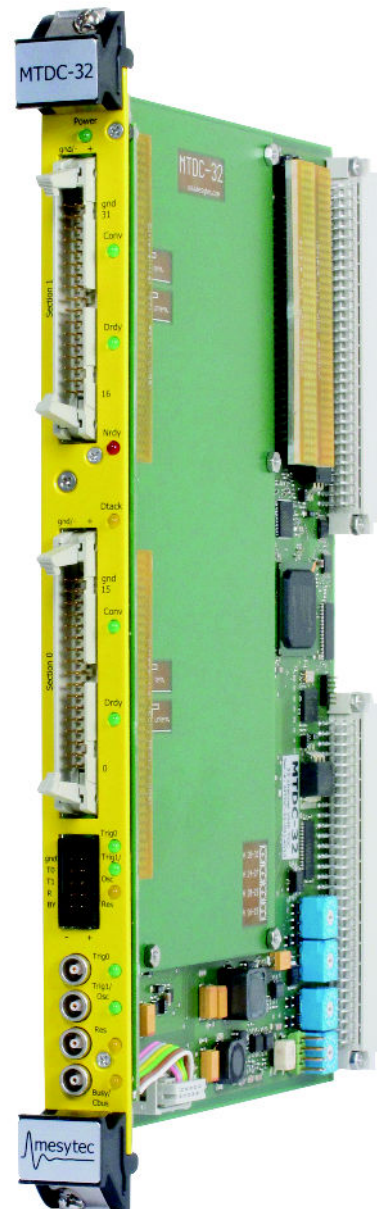
INL @ 0.25 μ s FWHM shaping time typ $1 \cdot 10^{-3}$ in the range 1 % to 100 %



MTDC-32 is a fast 32 channel high resolution time digitizer. It internally realises as a 32 + 2 channel time stamper (32 channels + 2 triggers). Two trigger inputs are available, which allow, optionally for each bank, to establish a window of interest which can be shifted from $-16 \mu\text{s}$ to $+16 \mu\text{s}$ in time (in 1 ns steps). In standard mode the time difference between start of the window and channels is calculated.

Features:

- 32 + 2 channel time stamping TDC
- Channel to channel or trigger to channel TOF resolution
- typical 5 ps maximum 10 ps rms
- Conversion time 160 ns
- Two operation modes:
 - start-stop mode with configurable window of interest and 16 bit conversion output
 - time stamper with 46 bit time stamp
- High quality conversion with very low INL and DNL
- 48 k (32 bit-) words multi event buffer (1 word corresponds to 1 converted channel)
- Channel inputs configured by Jumpers:
 - differential: ECL, LVDS and LVPECL, terminated or unterminated
 - unipolar: register configurable threshold, NIM, TTL or analogue signals possible
- Supports different types of event synchronisation stamping (based on VME-clock or external clock)
- Independent bank operation
- Multiplicity filter, selects events in specified multiplicity range
- mesytec control bus to control external mesytec modules
- Address modes: A24 / A32
- Data transfer modes: D16 (registers)
- D32, BLT32, MBLT64, CBLT, CMBLT64
- Multicast for event reset and time stamping start
- Live insertion (can be inserted in a running crate)
- Power consumption: 22 W, + 5 V and ± 12 V needed



mesytec **MDPP-16** is a fast high resolution time and amplitude digitizer. It is internally realised as a 16 channel adjustable low noise amplifier and a variable differentiation stage, followed by filters and 80 MHz sampling ADCs. The digitized data are analyzed in an FPGA and reconstructed with highest precision. This allows to achieve unique timing and amplitude resolution.

Hardware features:

- **Low noise variable gain input amplifiers.**
 - Input signals for maximum range (highest spectrum channel) from **1.5 mV to 20 V**.
 - Input noise down to **2 μ V @ 2 μ s** shaping.
- **Variable hardware pre-differentiation**
Allows large offsets and signal stacking without effect on the amplitude or timing resolution.
- **Reset stage** (supports reset preamplifiers)
Dynamical range for reset preamps: reset pulse / noise = $1.5 \cdot 10^6$ at 2 μ s shaping time. Recovery within **2 μ s** + shaping time .
- **Gain-polarity jumpers**
determine: termination, polarity, input range and input configuration (differential / unipolar).
- **Two high resolution monitor outputs**
for monitoring internal signals and noise via oscilloscope.
- **Up to 4 software modules**
can be stored on board and can be selected by switch or VME.
- **Installation and update via USB or VME**

Software modules

Large digital resources allow precise wave form reconstruction.

- timing down to **75 ps rms**
- amplitude resolution better than **32k**.
- Trigger threshold down to **1/3000** of maximum range.

Existing and planned software modules:

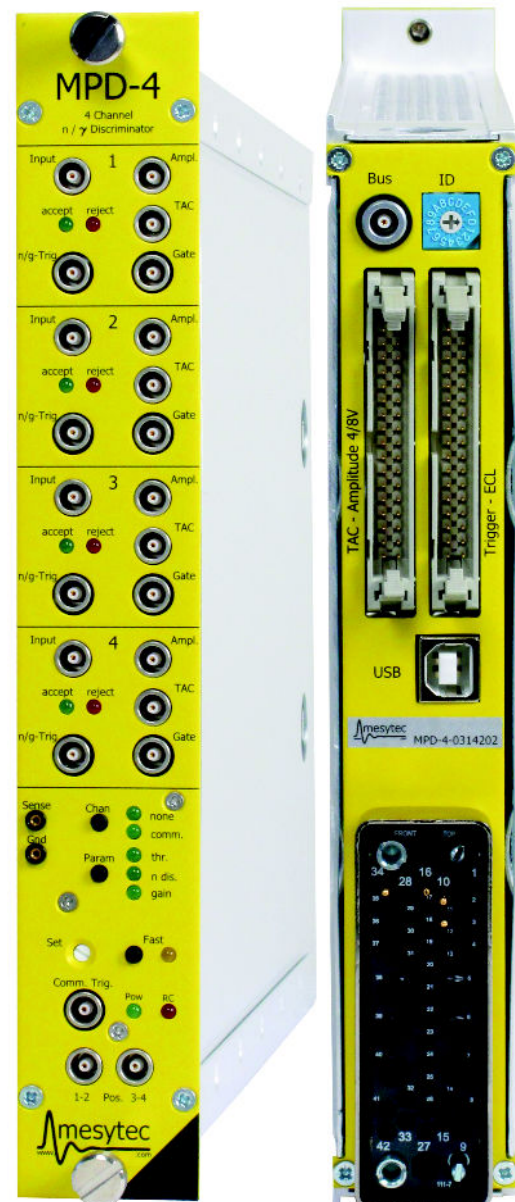
- Amplitude & time for standard preamps (SCP), 32 k/75 ps
- Amplitude & time for reset preamps (RCP) 32 k/75 ps
- QDC: charge & time , self gating, 4 k/75 ps
- Peak sensing ADC, 16 k, self gating or external
- Pulse shape discrimination for CsI

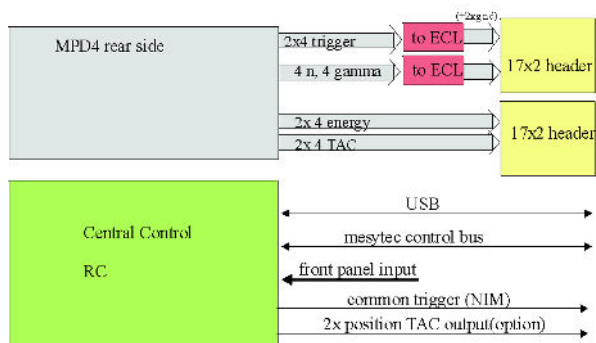
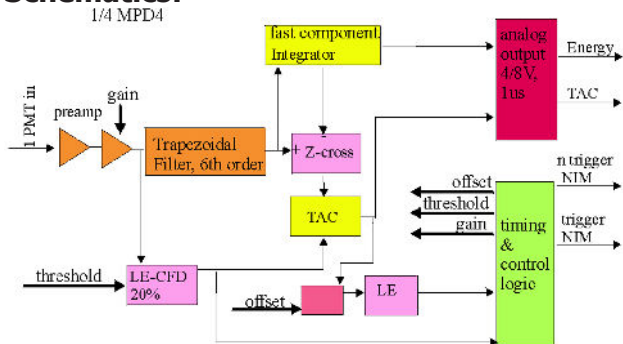


mesytec **MPD-4** is a four channel pulse shape discriminator module. MPD-4 is used for particle discrimination in multi channel liquid scintillation detectors (for example BC501 or NE213). The identification signals are available as NIM and ECL pulses. For discriminator monitoring only 2 channels of peak sensing ADCs per scintillator channel are needed. Fast preamps are integrated. The 4 channel unit fits into a single width (1/12) NIM module.

Features:

- fast variable gain PMT input amplifier
- Signal filter, optimised for liquid scintillators
- Pulse shape detection unit based on a constant fraction discriminator (CFD) for rising edge start and a zero crossing detector for tail length detection. The measured tail length is converted to an amplitude signal via time to analog converter (TAC)
- for monitoring:
 - TAC output pulse (1 μ s) for neutron identification, amplitude independent
 - Amplitude output pulse (1 μ s)
- Identification signals:
 - Gate output (n + γ signals)
 - Trigger output selectable n or γ or both
 - Common trigger output, NIM, chainable (also usable as ADC gate)
 - Multiple ECL trigger and amplitude / TAC signals at the rear side
- in fast mode: deadtime reduced to 250 ns. Trigger output width reduced to 30 ns. Analog outputs suppressed.
- all parameters can be set via front panel, USB or mesytec control bus



Schematics:

Technical Data
Parameter setting
Threshold

The PMTs are directly connected to the inputs. The CFD threshold is preadjusted to a certain offset and so can best be used at minimum value.

Gain

The „gain“ value should be selected as low as possible. Prefer to increase the PMT voltage which will result in better noise immunity of the connection from PMT to MPD-4.

Ndis

The MPD-4 TAC-output has a fixed discrimination threshold of 1.9 V (0.95 V in 4 V mode) to discriminate neutrons from gammas. If the TAC output is below the threshold, gammas are identified, above the threshold neutrons are identified. With „ndis“ parameter the TAC outputs can be shifted up and down to get the correct identification cut. The typical difference in TAC amplitude for neutrons and gammas are 1 V to 1.5 V (8 V range).

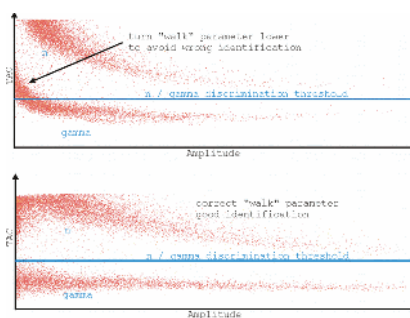
Walk (adjustment range 50...150)

If the maximum discrimination resolution is needed, the additional parameter „walk“ can be adjustable: take a spectrum „Ampl vs. TAC“ with gammas on the scintillation and adjust the curve with the „walk“ parameter to get a flat top for the gamma line. The „walk“ parameter influences the TAC amplitude in the low energetic region.

Operating modes
Slow mode:

Used for system adjustment or very precise measurements or at moderate rates to preserve all information. Amplitude and TAC signals are available. Dead time is determined by the Amplitude and TAC output signals and the

conversion and readout time of the external peak sensing ADC.


Fast mode:

For non position sensitive scintillator panels, usually only the number of neutron hits within the acquisition time is important. By using scalers to count neutron events and, if necessary, total number of events (for dead time determination) the amount of data and the dead time can be reduced by large factors. The MPD-4 allows to switch to fast mode which reduces the total dead time to 250 ns.

Signal	standard mode	fast mode
Ampl_out	1µs long pulse, 4/8 V	-
TAC_out	1µs long pulse, 4/8 V	-
trig-Gate_out	1 µs long pulse	30 ns
Gam/n_out	1 µs long pulse	30 ns
Pos_TAC	1 µs long pulse	-
rear side ECL	1 µs	30 ns
com trigger	1 µs	30 ns
common position TACs	1µs long pulse 4/8V	-
dead time per event	1.25 µs	250 ns

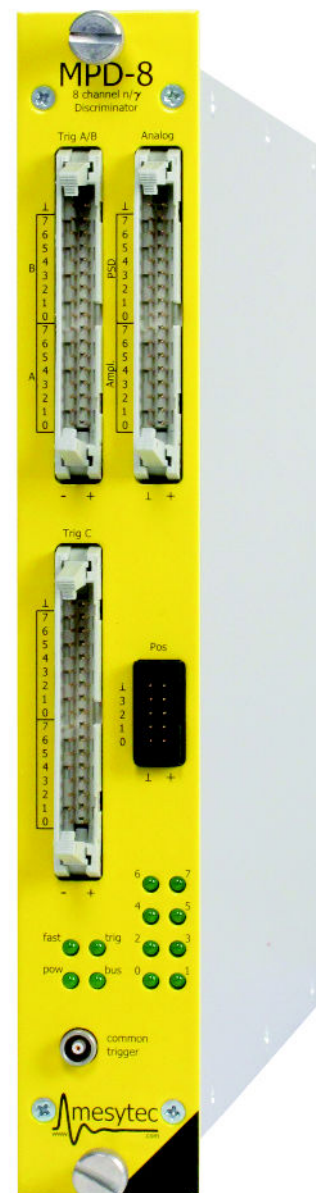
Remote controlled operation

MPD-4 can be remotely controlled via USB or mesytec control bus (MRC-1 or MRCC needed).

mesytec **MPD-8** is an 8 channel pulse shape discriminator module. MPD-8 is used for particle discrimination in multi channel liquid scintillation detectors (for example BC501 or NE213). The identification signals are available as ECL pulses and at common NIM output. For discriminator monitoring only 2 channels of peak sensing ADCs per scintillator channel are needed. Fast preamps are integrated. The 8 channel unit fits into a single width (1/12) NIM module.

Features:

- fast variable gain PMT input amplifier (Gain 1, 2, 4, 8)
- Signal filter, optimised for liquid scintillators
- Pulse shape detection unit based on a constant fraction discriminator (CFD) for rising edge start and a zero crossing detector for tail length detection. The measured tail length is converted to an amplitude signal via time to analog converter (TAC)
- for monitoring:
 - TAC output pulse (1 μ s) for neutron identification, amplitude independent
 - Amplitude output pulse (1 μ s)
- 4 ECL trigger and identification signals per channels
- Common trigger output, NIM, chainable (also suited as ADC gate).
- In fast mode: deadtime reduced to 250 ns
Trigger output width reduced to 70 ns
- All parameters can be set via USB or mesytec control bus



mesytec **MDC-8** is an 8 channel differential to single signal converter in a 1/12 wide NIM module. It is used to convert e.g. differential preamplifier signals from MPR-1 after transmission over long distances. Can also be used as analog inverter.

Features:

- 8 differential Lemo inputs
- 8 dual amplitude Lemo Outputs
Output "x 1" = (in +) - (in -)
Output "x 0.2" = 0.2 x ((in +) - (in -))

Technical Data:

Power consumption

- + 12 V + 100 mA
- - 12 V - 100 mA

Input (in +, in -)

- Common mode rejection:
factor of 200 (46 dB) @ 0...1 MHz
- Common mode input range:
 ± 10 V, pulsed
- Terminated with 50 Ω

Output

- Output "x 1" = (in +) - (in -)
- Output "x 0.2" = 0.2 x ((in +) - (in -))
- Output range ± 9 V @ 1 k Ω , (50 Ω source resistance)
- Short circuit protection, 100 mA

Frequency range

- DC to 120 MHz (- 3 dB)
- risetime: 1500 V / μ s (3 ns @ 4 V (output "x 1"))

Analog inverter operation

- use "-" input, leave "+" input open
- Output "x 1" = - (in -)
- Output "x 0.2" = 0.2 x -(in -)

mesytec **MHV-4** is a modern 4 channel high precision bias supply unit for detector bias voltages up to 800 V. It is designed to supply highly stable bias voltage for all types of silicon and gas detectors. The output current is limited to 20 μ A. The new revision allows easy operation of large area avalanche diodes, by compensating the bias voltage with temperature. Temperature measurement can be performed with miniaturized NTC temperature sensors. The four temperatures are also available via USB or mesytec control bus.

Features:

- precise voltage setting up to 800 V, in steps of 12.5 mV
- lowest noise voltage of < 1 mVrms at 400 V
- current display resolution 1 nA
- 4 large and bright LED displays allow simultaneous survey of all currents or voltages
- Full 4 digit display
- universal 4 channel temperature measurement and HV compensation for avalanche diodes (external sensors: standard NTCs)
- Adjustable HV ramp speed
- Output connectors: SHV or BNC
- Adjustable current warning threshold and voltage limit for each channel. Acoustical and optical current warning
- Individual polarity select for each channel at the front panel
- Remote control: All parameters can be set via USB or mesytec control bus (using an MRC-1 / MRCC master module)



Technical Data

Voltage Output

- Voltage range: 0...± 800 V
- adjustable in steps of 12.5 mV
- High quality rotational encoders with dynamic step width
- Typical noise $N < 1$ mV (400 V, 5 Hz to 100 MHz)
- voltage stability: typ 0.015 % /°C
- calibration precision: 0.5 %
- output current max 20 μ A per channel, limited
- adjustable voltage ramp up and down: 5 V /s up to 500 V /s
- Ramp up after power failure

Display

- full 4 digit display
- current display with 1 nA resolution up to 20.00 μ A
- voltage display:
up to 100 V: 0.01(25) V steps
100 V to 800 V: 0.1 V steps

Current warning

- individual warning thresholds adjustable from 1 nA to 20 μ A
- Acoustical and optical warning when threshold is exceeded

Connectors

- HV outputs: BNC or SHV
- USB remote control: standard USB B
- mesytec control bus: standard NIM Lemo connector 00 series
- Temperature sensors: 2.54 mm pitch header connector

Power consumption

- + 6 V 700 mA
- - 6 V - 70 mA
- - 12 V - 50 mA

Temperature measurement

When using temperature sensitive detectors (Si detectors with temp. Dependent leakage currents, Scintillators with temp. Dependent light output) it is useful to monitor detector temperature for later corrections in data analysis.

MHV-4 allows to monitor up to 4 temperatures with unexpensive standard NTCs, which can be glued to a setup. Measured temperatures can be displayed and read out via USB or mesytec control bus.

The high resistance of the sensors, and low pass filters in the module, allow to use almost any available cabling like coax or twisted pair cables.

Temperature compensation

For Avalanche Photo Diodes with high gain (50...300), temperature drift of gain should be compensated. MHV-4 offers an automatic temperature compensation feature.

The output voltage of each channel depends on the temperature measured by one of the four possible NTC sensors.

Reference temperature and correction slope can be set in wide ranges.

- Each HV channel can be assigned freely to one of the sensor channels
- compensation offset (= temperature resulting in $V_{comp} = 0$ V) can be adjusted between 0 °C and 50 °C (32 °F and 122 °F)
- Compensation slope can be adjusted between - 9.99 V /°C and + 9.99 V /°C

mesytec **MNV-4** is a 4 channel NIM power distribution and control module. The individual voltage outputs ($\pm 6\text{ V}$, $\pm 12\text{ V}$ and $\pm 24\text{ V}$) are protected by electronic fuses which automatically recover after short circuit. All six voltages are surveyed within $\pm 5\%$ of the nominal voltage for each of the four outputs. The status is displayed by LEDs switching from green to red in error case. The module also helps to check the correct voltage levels of a NIM-bin. If a NIM-bin without $\pm 24\text{ V}$ is used, the corresponding LEDs get off, and the voltage survey of those voltages is skipped.

Features:

- Four output connectors with $\pm 6\text{ V}$, $\pm 12\text{ V}$, $\pm 24\text{ V}$ each
- Survey of all 6 voltages on each output
- Protection of all voltages by self recovering electronical fuses
- Standard voltage output compatible to mesytec electronics and to some other manufacturers
- Visual indication for all input voltages and all power outlets
- Size: 1/12 NIM



mesytec MRC-1 and MRCC are the central controlling module for all remote controllable mesytec devices. The 1/12 NIM MRC-1 module provides a serial (RS-232 / USB) data input and two event bus branches for up to 16 remote controlled devices each, resulting in max. 32 devices per controller. MRCC has nearly the same capabilities (no RS-232), but is a handy standalone module.

Features:

- Easy connection to any computer type via RS-232 or USB
- Script memory for standalone operation
- Up to 32 devices on two event bus branches
- Up to 35 m of bus length

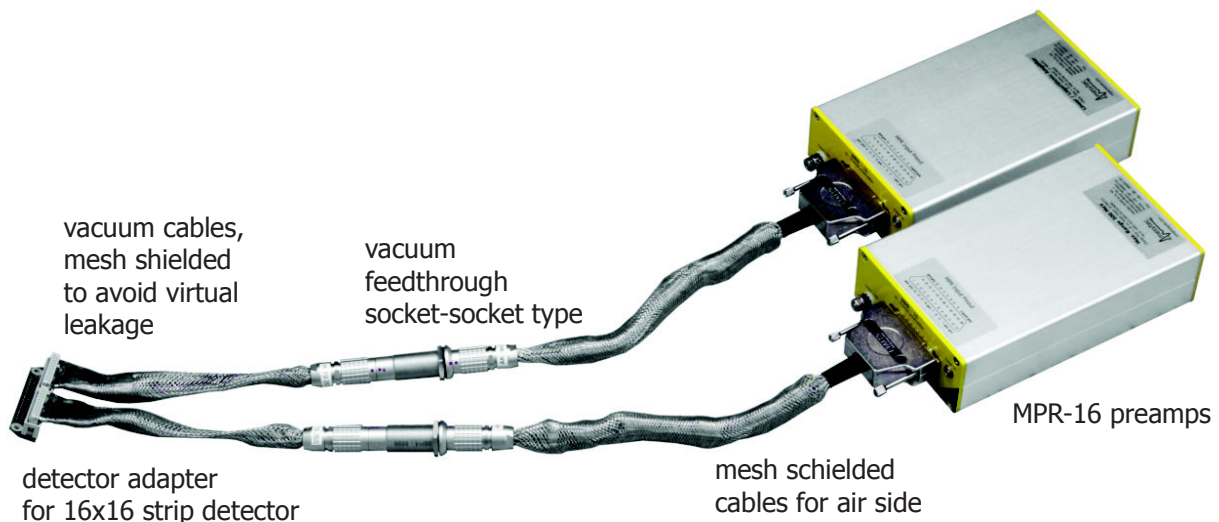


When using silicon (strip) detectors in an accelerator environment, a sophisticated cabling system is necessary to achieve minimum noise and optimum signal quality. mesytec cable sets for multichannel detectors provides an easy to use, "plug and play" cable system. A choice of cable adapters make conversion between multipole flat ribbon connectors and single coaxial connectors (BNC, Lemo, ...) very easy.

mesytec signal cable set:

- Shielded multipole cables for in- and outside the vacuum vessel
- High density multipole vacuum feedthroughs
- Individually designed detector adapters

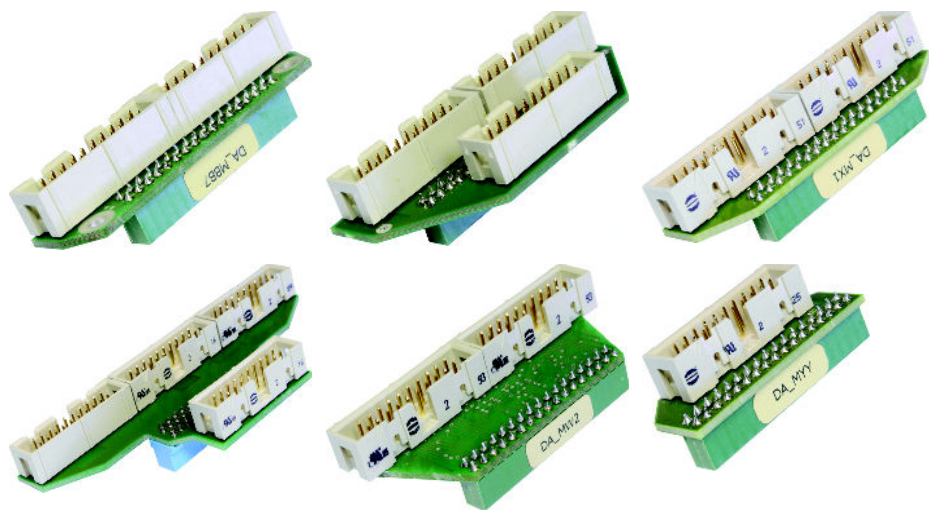
Example cable setup for readout of a micron type "W" detector with two MPR-16:



mesytec detector adapters: (examples)

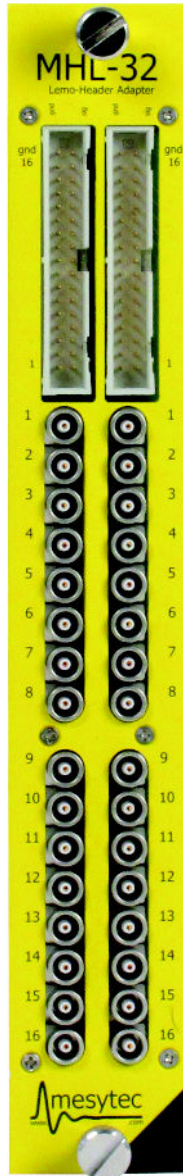
Standard adapters i. e. for micron types:

- W1, W2
- S1, S2
- BB7
- X1
- YY



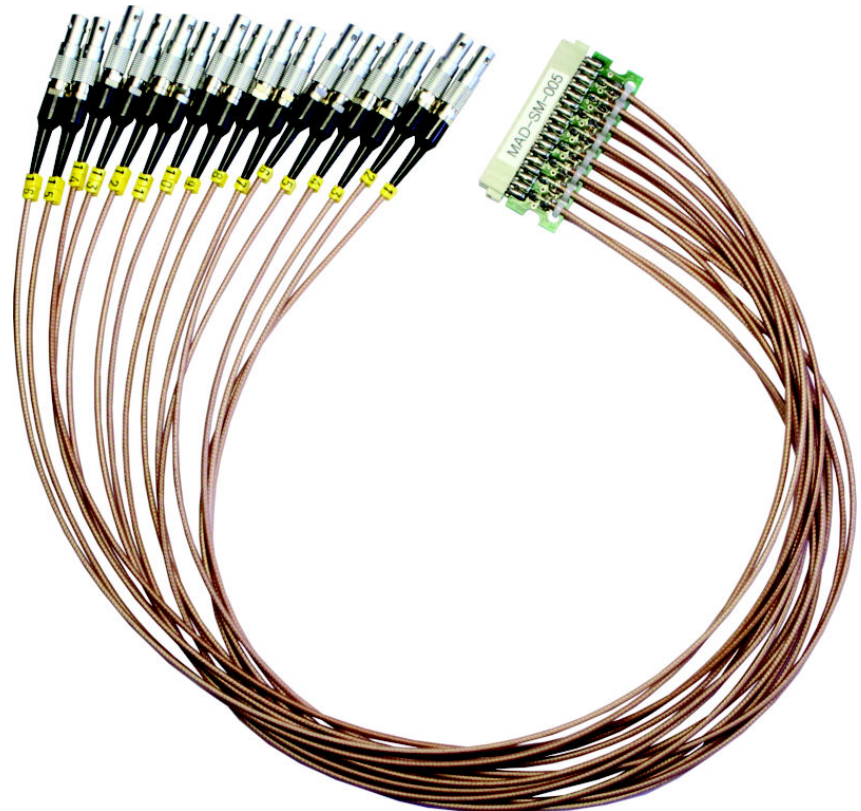
MHL-32

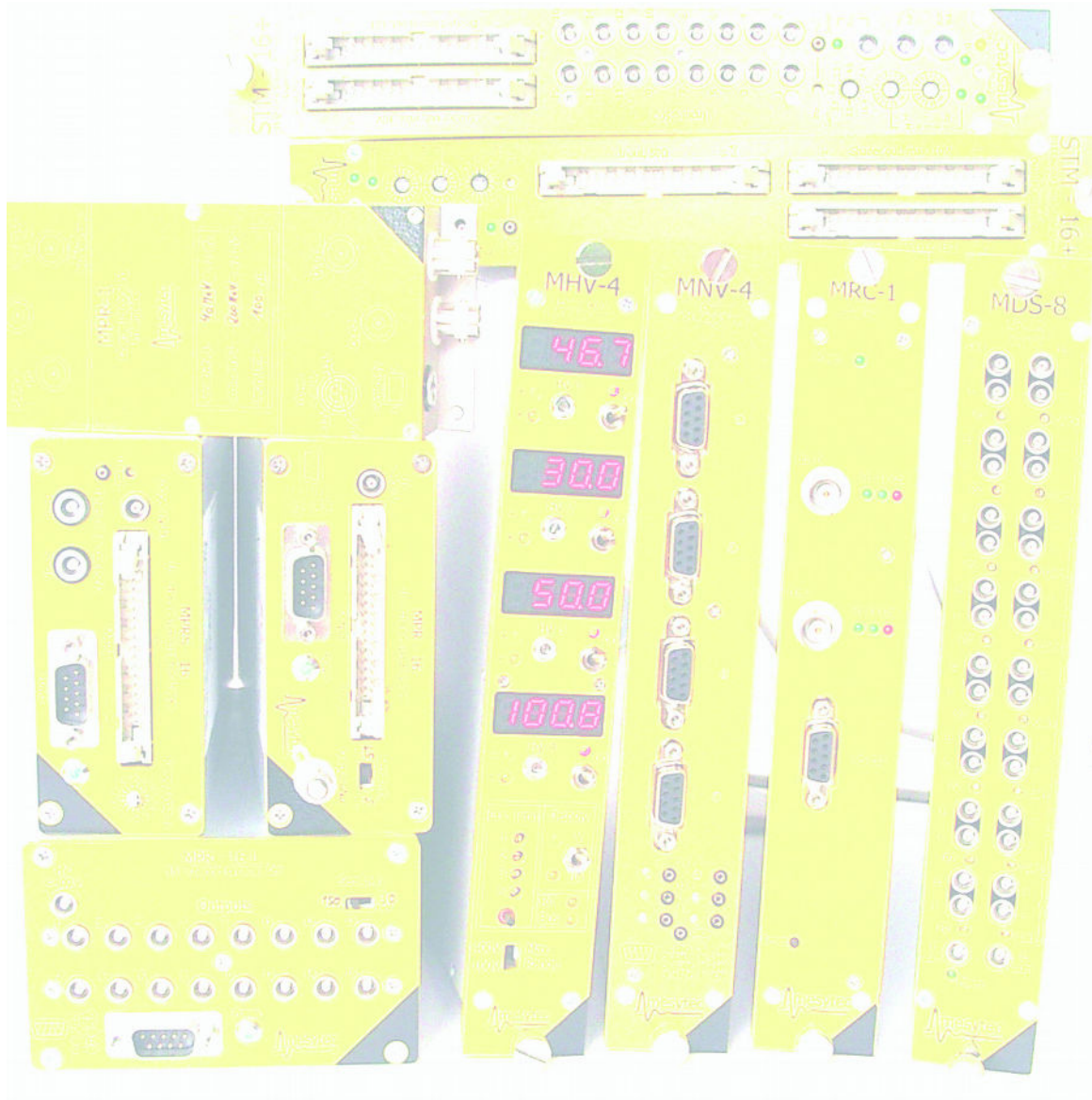
32 (2 x 16) signal channels NIM rack mounted cable converter between 34 pin flat header connector and Lemo "00" series.



MAD-34_16

16 signal channel direct mounted cable converter between 34 pin flat header connector and coaxial connectors. Types (Lemo, BNC, ... with both genders) and lengths are selectable.





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