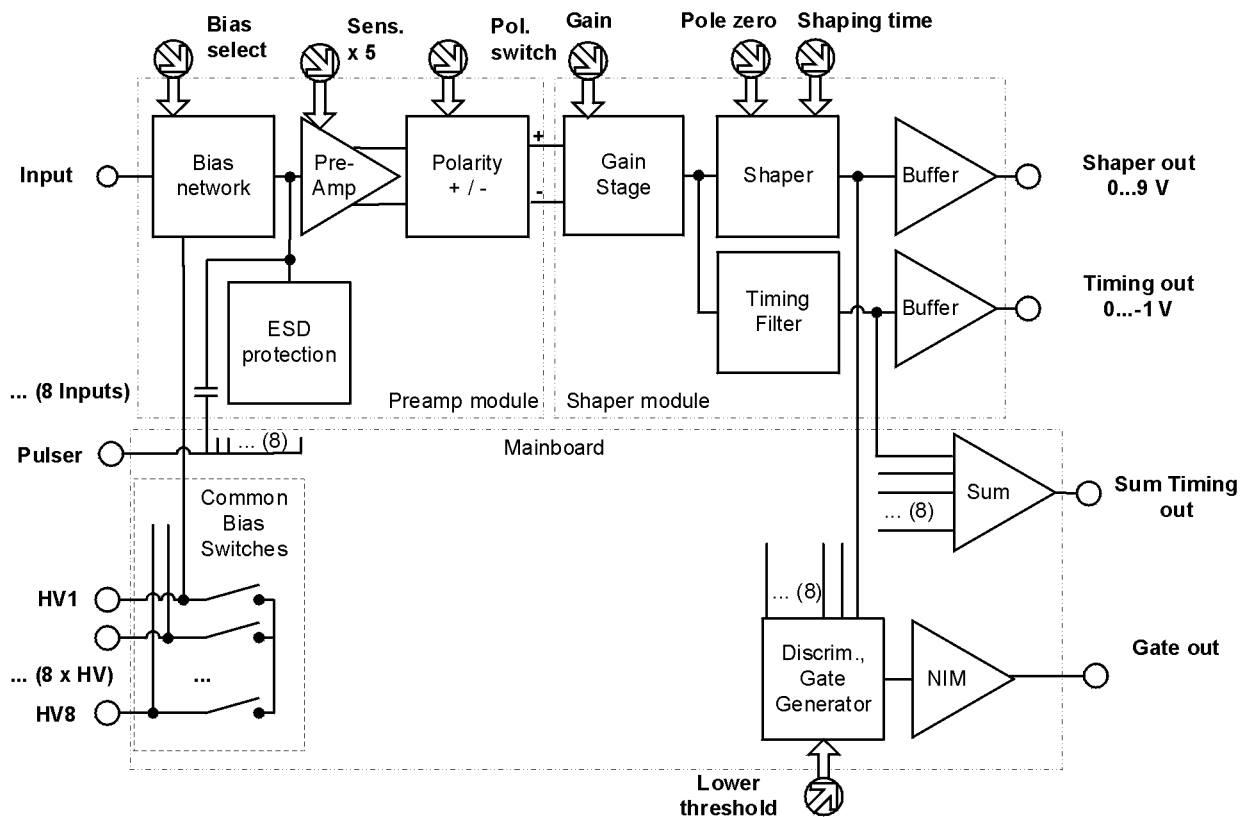


mesytec **MSI-8** is a compact 8 channel preamplifier shaper box with integrated timing filter amplifiers. Due to the modular setup, preamplifier and shaper module types can be selected individually for each channel. **MSI-8** is the ideal solution for setups with a mix of different detectors requiring 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
- Shaper with baseline restorer
- Two shaping times, jumper selectable
- Integrated timing filter amplifier
- Individual and common timing output
- Single and common detector bias
- All outputs can be terminated with 50Ω
- Lemo connectors for in- and outputs
- Discriminator gate output for peak sensing ADCs

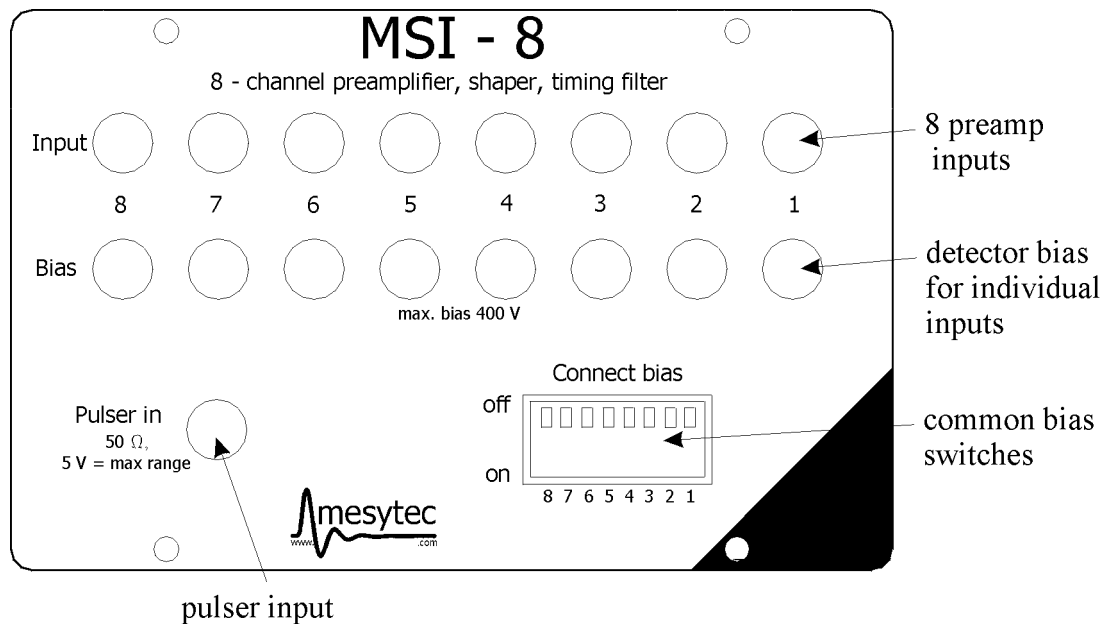
### Schematics:



## System Design

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.

## Rear Panel



### Preamplifier inputs

- Lemo connectors directly situated on the preamplifier module

### Detector bias

- Lemo connectors directly situated on the preamplifier module

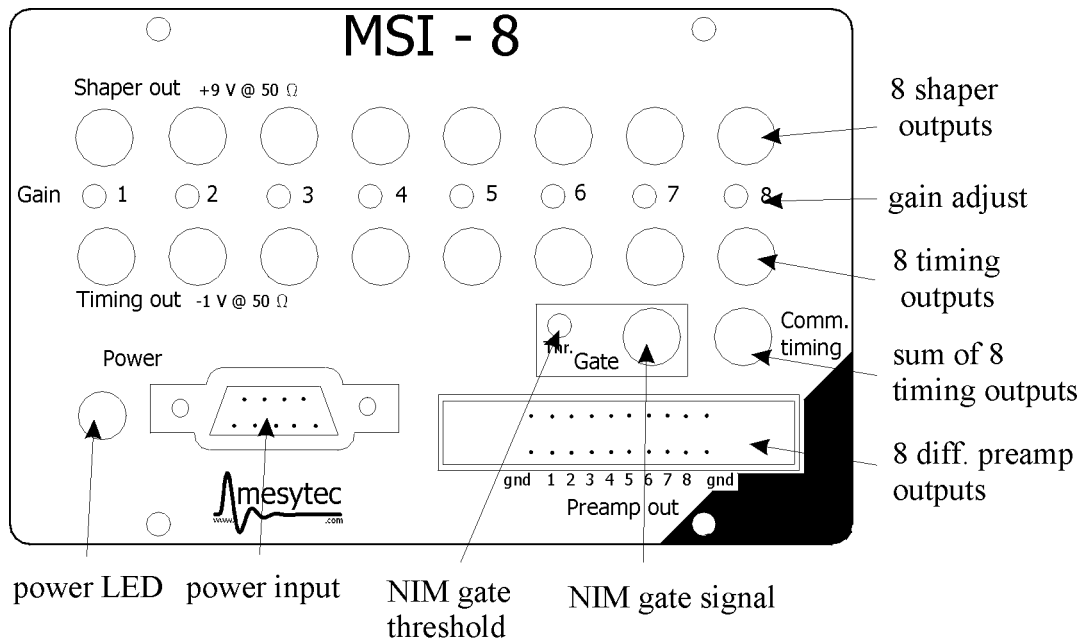
### Pulser input

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

### Common bias switches

bias inputs (not the detector 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.

E.g. for strip detectors, switch all bias inputs to "on" and connect bias voltage to one bias input.

**Front Panel**

**Shaper outputs**

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

**Timing output**

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

**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: +/-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. (NIM convention).
- Supply voltages (currents for box with 8 shapers and 8 preamps):
  - +12 V, 250 mA
  - +6 V, 50 mA
  - -6 V, -170 mA
  - total power: 4.3 W
- Pin connections (numbers are noted on the connector):

Pin	name	pin	name
1	gnd	6	not connected
2	gnd	7	not connected
3	+6V	8	not connected
4	+12V	9	not connected
5	-6V		

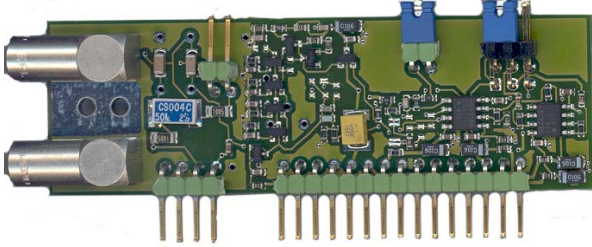
**Geometry:**

**Box size:**

- length = 170 mm
- width = 105 mm
- height = 67 mm



## Preamp Module



### Input:

- The standard preamplifiers can handle capacities of up to 1000 pF.

### Detector bias:

- Maximum bias voltage:  $\pm 400$  V
- Bias filter 10 M $\Omega$  / 50 M $\Omega$  (selectable by internal Jumper).

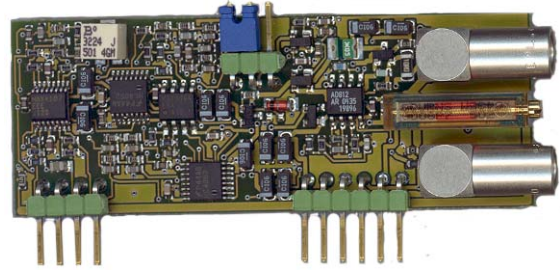
### Power consumption:

- Low power: typ 150 mW
- cooling not necessary.

*For details see data sheet of MMPR1*

## Shaper Module (MMSH1)

The module includes a shaper with passive baseline restorer, an output driver for 10 V (8 V @ 50 Ω) and a timing filter stage with timing output. The jumper allows to select one of the two shaping times.



### Shaper Output

- Filtering: quasi gaussian ( $CR(RC)^5$ )
- Shaping time (FWHM):
  - 2 us: low noise, for low rate applications, very well selected strip detectors. Standard detectors often have a lot of 1/f noise resulting in better noise to signal ratio with shorter shaping time.
  - 1 us: standard, best for large Si-detectors, standard strip detectors
  - 0.5 us: optimized for high countrates
  - 0.25 us: optimized for very high countrates >100 kHz, use fast ADC !
- Baseline shift with frequency:
  - A passive baseline restorer is integrated
  - For 1 us shaping time and a rate of 100kHz, the base line shifts less than 100 mV (1%).
  - DC Offset at shaper output:  $\Delta U < 10$  mV

### Pole zero adjust:

- Modules are adjusted to less than 20 mV of undershoot at the shaper output.
- You can readjust if necessary.

### Timing Output

- Timing filter amplifier (is included on the shaper module)
  - integration: 7 ns
  - differentiation: 200 ns
- Noise:
  - $N = (70 + C_{Det}) * 0.35$
  - $C_{Det}$  = cable + detector capacity, in pF;
  - $N$  = noise FWHM in keV;

### Power consumption:

- +12 V, 10 mA
- -6 V, 10 mA
- total power = 180 mW

### Connector:

(left pin = 1)

pin	name	pin	name
1	gnd	6	+12V
2	in+	7	gnd
3	in-	8	out shaper
4	gnd	9	out timing
5	-6V	10	gnd

**For details see data sheet of MMSH1**

## Timing considerations

### Best timing:

- Use high bias voltage to get maximum charge carrier velocity in the intrinsic zone of the detector.
- Implant particles with low range on the p-side (= strip side or guardring side for 2 sided detectors) !

### Time resolution with leading edge discriminator:

- Use a low threshold to minimize walk.
- If you have a wide range of input amplitudes, use shaped signals for walk-correction.
- If the signal is much larger than the noise, the timing resolution  $\Delta t$  can be estimated:

$$\Delta t = 20ns * \left( \frac{N}{S} \right)$$

N = noise [MeV]

S = signal amplitude [MeV]

- For 100pF detector + cable capacity and 1MeV signal this means a timing resolution of  $\Delta t = 1$  ns.
- Timing resolutions better than 100ps are difficult, even for large signals.

### With constant fraction discriminator:

- fraction = 0.25, delay = 15 ns
- timing is 25% worse, but walk correction is intrinsic.

### Common timing output:

- For low energies (<10 MeV)  
about three times worse than single channel timing (noise increased by  $\sqrt{8}$  ).
- For higher Energies  
Noise is not the limiting factor.  
If a coincidence with responding energy channels is used in software, the 8 channels can be calibrated with individual timing offset parameters.  
If there is no coincidence, the timing information will not get better than 0.5 ns due to delay tolerances for the 8 channels.

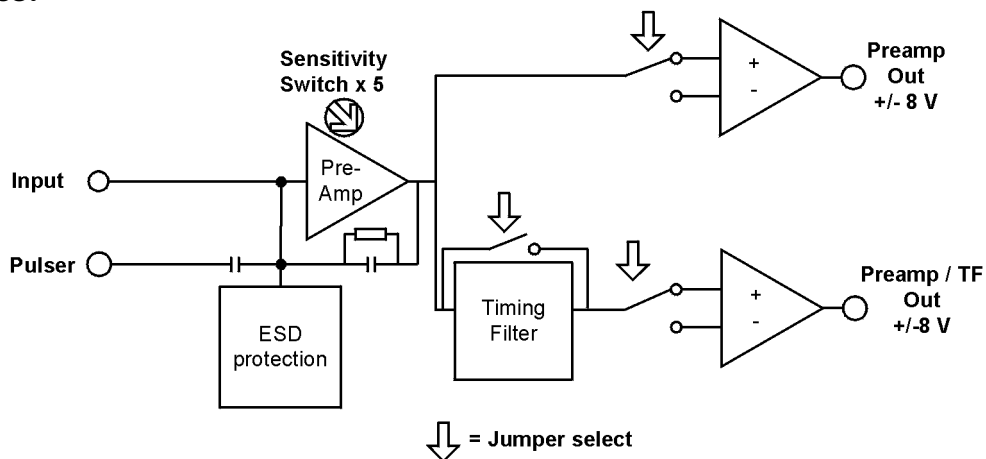
The mesytec **MPR-1-PMT** is a charge integrating preamplifier module. It provides two outputs which can be jumpered to different or same polarity. One can be configured as timing filter output. Both can drive terminated BNC cables. The sensitivity can be changed by a factor of 5 via front panel switch.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

## Features:

- Ni-plated, fully shielded case
- ESD input protection
- Positive and negative input charge
- Pulser input
- Two outputs
- Strong output driver for 50  $\Omega$  (optional 93  $\Omega$ ) termination
- Fast risetime ( $t < 5$  ns)
- Two sensitivities (switch selectable)
- Switchable timing filter
- Low power



## Schematics:





**Technical Data:**

**Standard range:**

Number of electrons max  
 Switch low sensitivity:  $2 \cdot 10^{10}$  electrons = 3.2nC.  
 Switch high sensitivity:  $4 \cdot 10^9$  electrons = 0.6nC.  
 All values for  $\pm 8$  V output.

Other ranges on request.

**Preamplifier:**

- ESD protected
- Positive and negative charge can be amplified equally.
- Temperature drift  $< \pm 50$  ppm/ $^{\circ}$ C
- Nonlinearity  $< 50$  ppm
- Energy rate capacity  $3.2 \cdot 10^{-5}$  C/s
- Risetime of energy and timing output typ 20ns.

**Pulsar input**

- Tail pulse, rise-time TR=0..100ns, decay time typ. 500 $\mu$ s
- Terminated with 50 $\Omega$
- Amplitude: max 10V.
- Charge terminator capacity: 220 pF

**Output stage:**

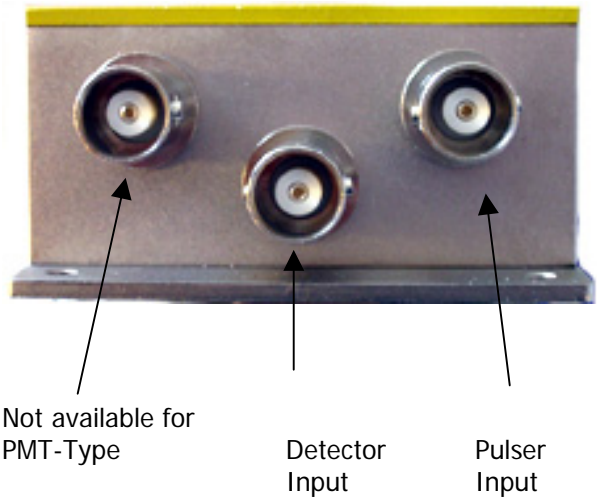
- Positive and negative output for single or differential use. Optional: same polarity, or one output with timing filter. (Customer selectable via internal switches)
- Output amplitude: 0 to  $\pm 8$  V
- Decay time TD = 50  $\mu$ s

**Input capacity:**

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

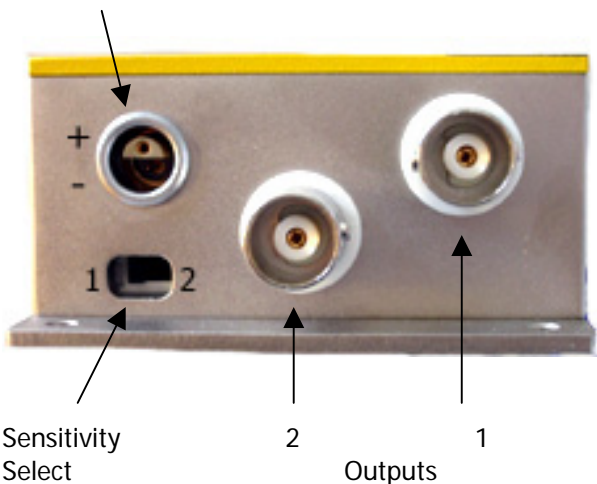
**Input side:**

BNC connectors



**Output side:**

Power



Output 1: polarity + or -  
 Output 2: Polarity + or -, optional Timing filter

**Power consumption:**

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

**Power connector:**

needed plug:  
 Lemo: FFA.0S.303.CLAC44ZN.  
 Lemo to SubD9 cable included at delivery

**Dimensions:**

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