# MSCF-16
V2.4

mesytec MSCF-16 is a shaping / timing filter amplifier with constant fraction discriminator and multiplicity trigger. 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. A single ended input (Lemo) version is also available.

Features MSCF-16:

- 16 channel NIM module, low power design
- Shaping amplifiers with baseline restorer
- Timing filter amplifiers
- CF discriminators (opt.: leading edge)
- ECL timing output with digital delay of 450 ns
- Trigger output
- Multiplicity trigger
- Remote control of discriminator thresholds, shaping time, gains and PZ
- 4 shaping times
- Gain adjustable from 1 to 600
- Differential or unipolar input version.
- Low noise: $< 9.5\mu V$ (gain=100 and shaping time = $2\mu s$)
- Low integral nonlinearity
- Fully controllable via front panel
- Remote control via USB and mesytec control bus

Schematics:
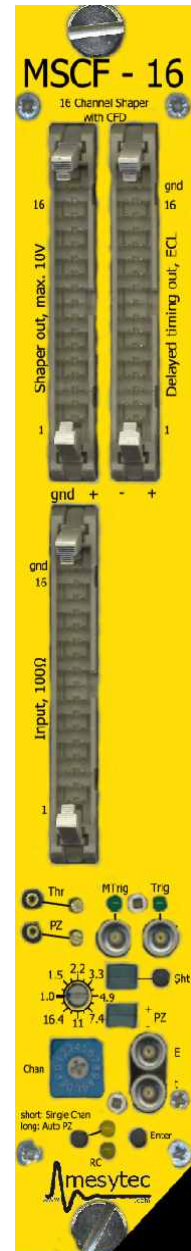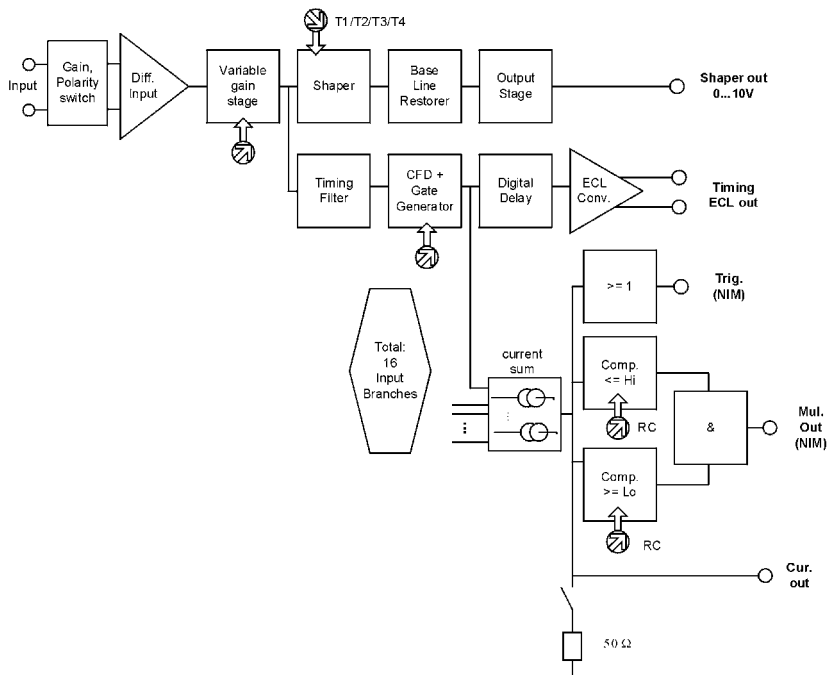
Technical Data:

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: 9.5 µVrms for 2 µs shaping time.
- Common mode suppression: >50 dB

unipolar version
- Input connectors: 16 x Lemo 00 series
- Input termination option: 1k and 50 Ohm, coded on the gain-polarity jumper.
- Gain-Polarity jumper with multiplication factor 2 and 30 are standard. Option: multiplication factor 1.
- Input noise at gain = 100 and 2 µs shaping time = 9.5 µVrms.

Shaper:
- PZ adjustable with front panel trimmer. Range: Pm-type: 4 to ∞ , Si-type 8 to ∞ , Ge-type 15 µs to to ∞.
- 5th order filter CR-RC^5 (PM-type 4th order)
- Four shaping times
  for "Pm-type": 0.1 / 0.2 / 0.4 / 0.8µs
  for "Si-type": 0.25 / 0.5 / 1 / 2µs or
  for "Ge-type": 0.5 / 1 / 2 / 4µs
  selectable for groups of 4 channels
- Output amplitude: 0 to 10 V
- Passive baseline restorer
- DC-Offset: VDC ± 5 mV, common offset adjust.
- Output connector: 34 pin male connector
- Integral nonlinearity < 0.05%
- gain drift < 0.0075% / °C
- Offset drift < 50 µV/ °C

Timing filter amplifier:
- "Pm-type": RC-CR, 5 ns / 100 ns
- "Si-type": RC-CR, 7 ns / 100 ns
  "Ge-type": RC-CR, 15 ns / 200 ns
- 2 monitor outputs for timing filter and amplitude signals, selectable by rotary switch

Discriminator:
- CFD or Leading edge (jumper selectable)
- CFD delays, selectable for groups of 4 channels:
  Pm-type :5,10,20,30 ns
  Si-type :10,20,40,60 ns
  Ge-type: 20,40,80,120 ns
- CFD 2 fractions: selectable for groups of 4: 20% / 40%
- CFD -Walk:
  for 30 ns (10% to 90%) input risetime, max 1 ns (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 male connector
- Typical timing resolution for 5 MeV signals from silicon detector (10 * 10 mm^2, 500 µm thick, 60V bias): dT = 400 ps FWHM.

Multiplicity trigger:
- Each channel above threshold contributes to multiplicity level, a multiplicity trigger is generated for: lower multiplicity threshold ≤ multiplicity level ≤ upper multiplicity threshold
- Coincidence interval adjustable from 20 ns up to 200 ns (default 75 ns).
- The multiplicity trigger is delayed by the coincidence time to the trigger signal.
- Multiplicities selectable via remote control
- 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: (max 9W)
- +6V 400 mA
- -6V –800 mA
- +12V 100 mA

Frontpanel Operation:

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

There are four parameters to be set up for every channel / for groups of 4 channels:

Individual:
- Threshold
- PZ compensation

Groupwise (channel 1-4, 5-8, 9-12 and 13-16):
- Gain
- Shaping time

Settings can be performed for all channels in common or for each channel/group individually. There's one set of parameters for the common setup as well as for the individual setup.
Clicking the "single chan" knob switches between single and common settings.
The "Chan" selector defines which channel is output on the E / t monitor as well as which channel is setup in individual mode.
Shaping times are changed around by clicking the "Sht" knob, the shaping time of the currently selected channel (group) is displayed by two LEDs.

Common mode:
In common mode, the trimmer settings are followed immediately. There's one common value for shaping time, gain, threshold and pz compensation which is used for all channels.

Individual mode:
In single channel mode, trimmer changes are only read and activated when the "enter" knob is pressed during changes. Threshold and PZ settings are remembered individually for each channel. Shaping times and gains are valid for a group of channels.

Copying from Common to Individual:
For an easy basic setup, common settings can be copied to the individual section. Fine tuning can then be done based on this basic setup.
Copy is done by clicking the "Single chan" knob while "enter" is pressed.

Auto PZ setup:
The PZ compensation values can be set up automatically – provided there's a signal at the respective channels.
Holding the "Single chan" knob for about two seconds starts the automatic pz setup. The values found are saved in the individual parameter set.
Clicking "Single chan" again during autopz stops the process.

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 parameter 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 operating systems for this rc mode can be derived from the manufacturer of the USB interface chip: www.ftdichip.com/Drivers/VCP.htm

The MSCF-16 can then be controlled e.g. using a terminal program or a proprietary control software.

By default, communication is set to 9.6 kBd, 8N1, higher baudrates can be set using the "SB" cmd.
On power-up 9.6 kBd will be restored.

Thresholds and pz values can be set for each channel individual, gain and shaping time for groups of 4 channels.
In common mode (= single mode off), one further setting is used for all channels. (#17 for the individuals, #5 for the groups).

Command list: (each cmd terminated by <CR>)

DS	Display Setup (lists all gains, thresholds, pz values, shaping times, …)
SB *n*	Set Baudrate to: n = 1: 9.600 Bd. (Power-Up default) 2: 19.200 Bd. 3: 28.400 Bd. 4: 57.600 Bd. 5: 115.200 Bd.
SG *group val*	Set Gain for groups of 4 channels group = 1…5 (5 = common mode) val = 0…15
ST *chan val*	Set threshold value chan = 1…17 (17 = common mode) val = 0…255
SP *chan val*	Set pz value chan = 1…17 (17 = common mode) val = 0…255
SS *group val*	Set shaping time for a group group = 1…5 (5 = common mode) val = 0…15
SM *hi lo*	Set multiplicity borders hi, lo = 1 … 8
MC *chan*	Set monitor output to chan chan = 1…16
SI *0/1*	Single channel mode 0 = off, 1 = on

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3/4

ON	Switch RC mode on
OFF	Switch RC mode off
AP	Switch automatic pz setting on/off
V	Display firmware version

Settings via USB remote control will be saved in permanent memory and will be restored after next power up.

MRC control:

MSCF-16 can also be controlled using the MRC-1 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, just using T-pieces.
The last module on a bus has to be terminated with 50 Ohms.

Remote control via MRC-1 is basically reading and writing the control register page of the MSCF-16.

Memory List MSCF-16:
MSCF-16 can be controlled by reading / writing the control register page via the mesytec rc bus.
The following table shows the memory layout:

ADR	parameter	comment
0	Gain group 1	Gain setting for channel 1 … 3 and common mode Values from 0 … 15
1	Gain group 2	
2	Gain group 3	
3	Gain group 4	
4	Gain common	
5	Threshold channel 1	Threshold values for channel 1 … 16, 17 = common Values from 0 … 255
6	Threshold channel 2	
7	Threshold channel 3	
8	Threshold channel 4	
9	Threshold channel 5	
10	Threshold channel 6	
11	Threshold channel 7	
12	Threshold channel 8	
13	Threshold channel 9	
14	Threshold channel 10	
15	Threshold channel 11	
16	Threshold channel 12	
17	Threshold channel 13	
18	Threshold channel 14	
19	Threshold channel 15	
20	Threshold channel 16	
21	Threshold all channels	

Memory List MSCF-16 (continued):

ADR	parameter	comment
22	PZ value channel 1	PZ values for channel 1 … 16, 17 = common Values from 0 … 255
23	PZ value channel 2	
24	PZ value channel 3	
25	PZ value channel 4	
26	PZ value channel 5	
27	PZ value channel 6	
28	PZ value channel 7	
29	PZ value channel 8	
30	PZ value channel 9	
31	PZ value channel 10	
32	PZ value channel 11	
33	PZ value channel 12	
34	PZ value channel 13	
35	PZ value channel 14	
36	PZ value channel 15	
37	PZ value channel 16	
38	PZ value all channels	
39	Shaping time group 1	Shaping time settings for group 1 … 3 and common mode Values from 0 … 3
40	Shaping time group 2	
41	Shaping time group 3	
42	Shaping time group 4	
43	Shaping time common	
44	Multiplicity hi	Multiplicity values 1 … 8
45	Multiplicity lo	
46	Monitor channel	1 … 16
47	Single channel mode	1 = on, 0 = off
48	RC	1 = on, 0 = off (set automatically by ON / OFF cmd via MRC-1

The memory positions can be written with SE command and can be read with RE command.

RC mode can be ON or OFF for reading and writing parameters.
While RC ON, the front panel control will be blocked until "Enter" is pressed.

The ON/OFF command makes the remote control active or inactive. The power up default is inactive. While inactive the manual values from the front panel elements are set.

When shut down during RC on, the RC values will be restored after next power up and rc will be active again.

Identification code for MSCF-16 (detected when running the scan bus command "SC") is IDC = 21.

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4/4