MSCF-16 PMT

(Data sheet V5.1_01)

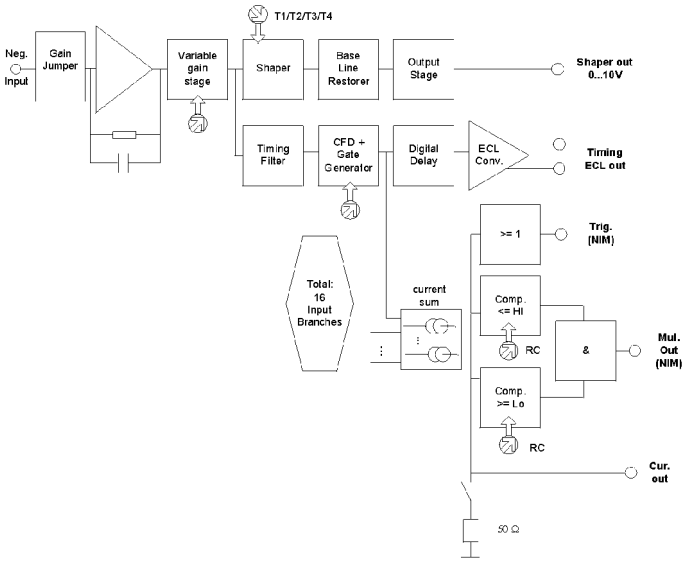
16 fold Spectroscopy Amplifier with CFDs and Multiplicity Trigger

mesytec **MSCF-16-PMT** is an integrating shaping / timing filter amplifier with constant fraction discriminator and multiplicity trigger. It provides 50 Ω terminated Lemo 00 inputs, and directly processes fast **negative signals** from PMTs or other charge sources.

Features:

- 16 channel NIM module, low power design
- directly interfaces to anode signals from photo multipliers
- Shaping amplifiers with active baseline restorer
- Timing filter amplifiers
- CF discriminators (opt.: leading edge)
- ECL timing output with digital delay of 400 ns
- Trigger output
- Multiplicity trigger
- Remote control of discriminator thresholds, shaping time, gains and PZ
- 4 shaping times
- Gain adjustable from 100 pC to 20 nC for max range
- 50 Ω terminated Lemo 00 input.
- Low noise (0.2 pC rms / 2 pC rms)
- Mostly 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:



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Technical Data

Input stage

- Gain adjust: gain can be set from 1 to 20 in 16 steps with factor 1.22 per step.
- Input connectors: 16x Lemo 00 series.
- Input termination 50 Ω, coded on the gain-polarity jumper.
- Gain jumpers with sensitivity 100 pC…2 nC and 1 nC…20 nC are standard. (Optional 50 pC…1 nC)
- Max allowed input offset: for 1 nC jumper: ±5 mV, for 20 nC jumper: ±100 mV. (direct PMT signals have no offset)

Shaper

- PZ is preadjusted and usually needs not to be user adjusted.
- 5th order Shaper (4th order for 0.12 us to 1 us type)
- Four shaping times
- selectable for groups of 4 channels
- Output amplitude: 0 to 10 V
- Active baseline restorer with settable threshold. (via RC only).
- DC-Offset with BLR: VDC ±5 mV,
- common offset adjust.
- Output connector: 34 pin male connector
- Integral non linearity <0.1 %
- gain drift <0.01 % /°C
- Offset drift with BLR <50 V /°C

Noise

- For 1 nC jumper the noise is 0.1 pC rms
- For 2 nC jumper the noise is 0.2 pC rms
- For 20 nC it is 2 pC rms

Timing filter amplifier

- Time constants see table at the end of data sheet

Discriminator

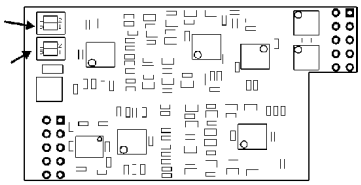
- CFD or Leading edge (jumper selectable)
- CFD delays, and fraction selectable for groups of 4 channels
- CFD-Walk: for 30 ns (10 % to 90 %) input rise time, max ±1 ns (dynamic range 100:1)
- Threshold: adjustable, 0 % to 30 %
- of maximum range, in 256 steps.

Fraction and delay selection of the 4 channel CFD plug on modules

Fraction (sw1)
On: 20 %
Off: 40 %

Delay (sw1, sw2)
off off: 10 ns
on off: 20 ns
off on: 40 ns
on on: 60 ns

Example: CFD-60



For other CFD delays see section „Types and ordering"
See also label inside the movable module side plate.

Gate generator,Timing delay,ECL output

- Pulse width for trigger output: 400 ns
- Timing stop- ECL-Signals: delay 400 or 800 ns from trigger, width 200 ns
- Output connector: 34 pin male connector

Monitor output

- output for timing filter signals
- output for amplitude signals
- selectable by rotary switch (Signal quality of monitor outputs may be slightly degraded compared to direct outputs.)

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 9 W)

- +6 V 300 mA
- –6 V –700 mA
- +12 V 200 mA

MSCF-16 Front panel Operation

Most MSCF-16 parameters can be set and controlled via front panel elements.

Two parameters can be adjusted for each channel individually:
- Threshold
- PZ compensation

Two parameters can be adjusted in groups of four channels (channel 1–4, 5–8, 9–12 and 13–16):
- Gain
- Shaping time

All parameters can as well be set up for all channels in common. Thus there are two different modes of front panel operation:

Common mode:
Threshold, PZ, Gain and Shaping time have a common setting for all channels

Single mode:
Threshold and PZ settings for each individual channel
Gain and Shaping time for each groups of four channels

Common parameters can be copied to individual parameters to easily get a basis for individual settings.

Mode select

Clicking the “single chan” knob switches between single and common operating mode. The orange LED associated with the “single chan” knob signals single channel mode when lighted.

Monitor / Active Channel

One out of 16 available channels is available at the energy and timing monitor outputs. This is also the channel to be modified in Single mode.

Shaping time

Shaping times are changed around by clicking the “Sht” knob, the shaping time value of the currently selected channel (group) is displayed by two LEDs. They indicate an index from 0 (“1” and “2” LEDs both off) up to 3 (both LEDs on). Please refer to individual device labeling for corresponding shaping times.

Gain

Gain values are set by the gain dial, gain values are indicated on the front panel. Gain ranges from 1.0 to 20.0. It can be set commonly for all channels or individual for groups of four channels.

Threshold

Threshold is adjusted with a front panel trimmer, the corresponding voltage can be drawn from the test output. It can be set commonly for all channels or individually for each channel.

PZ

PZ compensation is also adjusted with a front panel trimmer, the corresponding voltage level is output on the test connector. It can be set commonly for all channels or individually for each channel.

General setup

Common mode

In common mode, the trimmer settings for threshold and PZ are followed immediately. Shaping time can be selected for all channels clicking the Sht knob. Gain is set for all channels by selecting the desired gain switch position.

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 four 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 remotely controlled in two ways: USB control and event bus control.

MSCF-16 has two complete parameter sets, one for front panel operation, one for remote control. Switching RC on and off switches between these two parameter sets.

In RC mode there are several more parameters, which will also be used (but can not be controlled) in front panel mode:

- BLR on/off
- Coincidence time window
- Shaper offset
- Threshold offset
- BLR threshold
- Multiplicity trigger thresholds

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.

Interface settings

By default, communication is set to:
9.6 kBd, Data format 8N1
Higher baud rates can be set using the “SB” cmd. On power-up 9.6 kBd will be restored.

Device Parameters

Like in front panel mode thresholds and pz values can be adjusted in common or individually for each channel, while shaping times and gains can be set up for groups of four channels or in common.

For common settings, there’s one virtual channel/group added to parameter indices:

Thresholds, pz compensation:
Channels 1 … 16, 17 = common

Gain, shaping time:
Groups 1 … 4, 5 = common.

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

DS	Display Setup (lists all gains, thresholds, pz values, shaping times, …)
SB *n*	Set Baud rate 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
SBL *val*	Switch BLR on/off (1/0)
SC *val*	Set coinc time window (0..255)
SSO *val*	Set shaper offset (0..200) def. 100
STO *val*	Set threshold offset (0..200) def. 100
SBT *val*	Set BLR threshold (0..255)
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
ON	Switch RC mode on
OFF	Switch RC mode off
AP	Switch automatic pz setting on/off
AP *chan*	automatic pz setting for chan 1..16
CPY F	Copy fontanel settings to RC memory
CPY R	Copy RC settings to front panel memory
V	Display firmware version

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

RC bus control

MSCF-16 can also be controlled using the MRC-1 / MRCC master controller modules.

Bus setup

Up to 32 devices (not only MSCF-16) – 16 on each of the two control buses – can be remotely controlled at a time. Devices have to be connected with lemo cables and t-pieces, the last module on a bus has to be terminated with 50 Ω. The RC master is self terminated. Be sure to assign individual device addresses using the address coders!

RC commands

Remote control via RC bus is basically performed by reading and writing the control register page of the MSCF-16. Basic commands are:

Read: *RE b a m*
Write (Set): *SE b a m v*

With:

b = bus number (0/1)

a = device address (0...15)

m = memory address

v = value

Memory List MSCF-16

The following table shows the MSCF-16 memory layout:

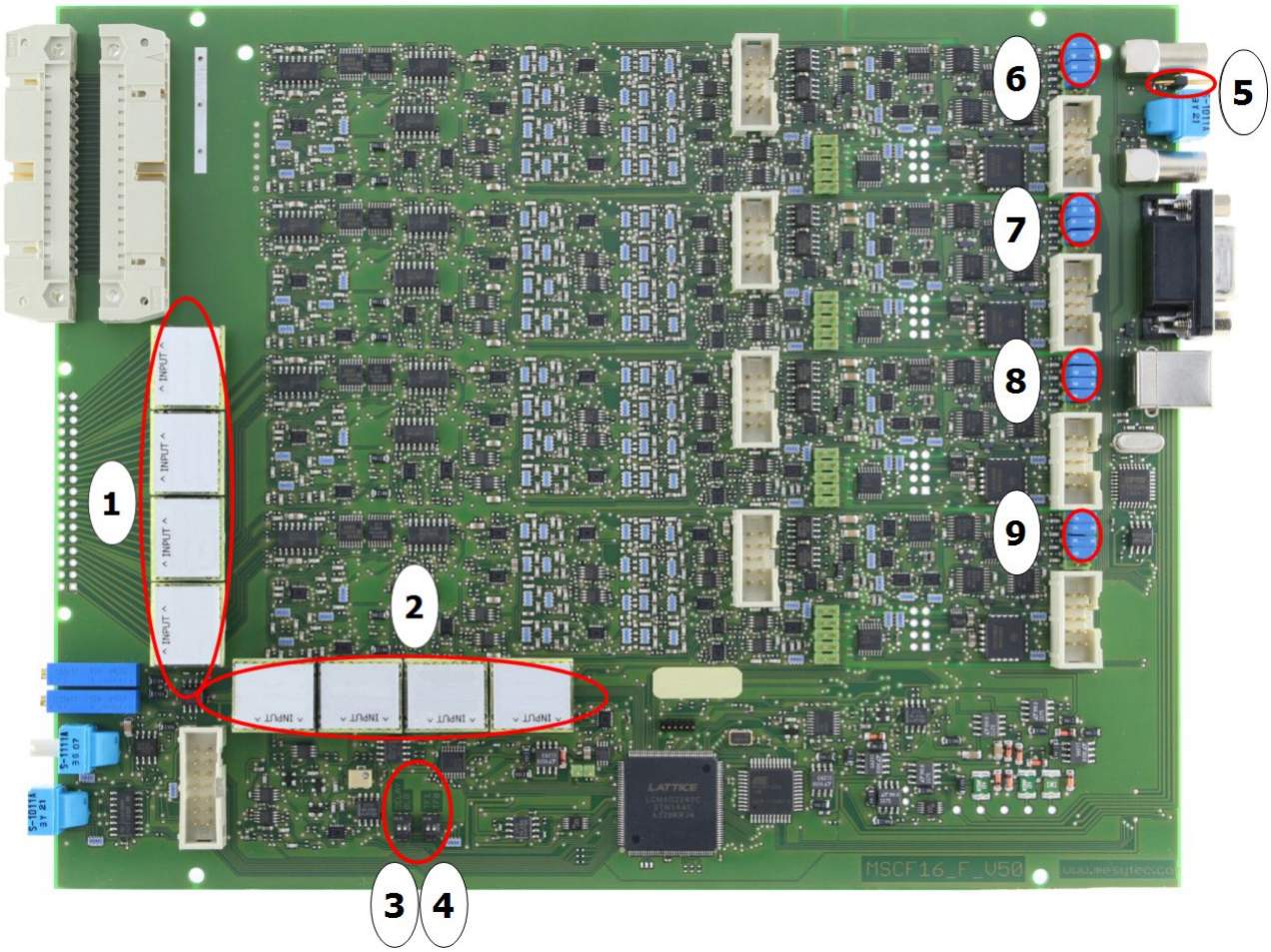
ADR	parameter	comment
0	Gain group 1	Gain setting for channel 1 … 3 and common mode Values from 0 … 15
1	Gain group 2	
2	Gain group 3	
3	Gain group 4	
4	Gain common	
5	Threshold channel 1	Threshold values for channel 1 … 16, 17 = common Values from 0 … 255
6	Threshold channel 2	
7	Threshold channel 3	
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 common	
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 common	
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 / MRCC)
49	Version information	16* maj + min.
50	BLR threshold	0 … 255
51	BLR on/off	1 = on, 0 = off
52	Coinc. Time	0 … 255
53	Threshold offset	100 (=on offs) +/- 100
54	Shaper offset	100 (=on offs) +/- 100

Parameters can be read / written while RC on or off, but will take effect only when RC is on. While RC ON, the front panel control will be blocked until “Enter” is pressed.

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.

MSCF-16 PCB overview



1: Position for the active gain-polarity jumpers.
2: Position to store up to 4 spare jumpers
3: BLR on/off, ECL Trigger delay on/off
4: Timing filter integration time
5: 50 Ω jumper. Is needed if modules are not connected for common multiplicity.
6 to 9: Connector usually occupied by CFD modules. To use only leading edge discriminators, remove CFD module and insert 16 jumpers at the upper side, 4 for each connector. The lower pair on each connector is ground and can be left free.

Types and ordering

Example MSCF-16_F for PMT readout

Appl.	Module name	Shaping times (sigma)	Timing filter integration	Input type	Input connector	Discriminator	CFD-Delay
Fast	**MSCF-16_F**	**_SH1** 0.1 us, 0.2 us, 0.5 us, 1.0 us TF-dif: 33 ns, 70 ns, 150 ns 360 ns	**-5** 5 ns	**_C** Current for direct PMT signals **_V** Voltage, for current preamp signals	**_L** Lemo **_D** Differential header 17x2	**_CFD** Constant fraction discriminator **_LE** Or leading edge only	**60** (avail. 30, 60, 120, 200 ns)

Connected parameters: The timing filter differentiation time corresponds to the selected shaping time. So shortest shaping time results in shortest TF differentiation time.

CFD plug in modules (4 modules per MSCF-16 needed)

CFD-Name	Fraction (via dip switch)	Delays (via dip switch)
CFD-30	20 % / 40 %	5, 10, 20, 30 ns
CFD-60	20 % / 40 %	10, 20, 40, 60 ns
CFD-120	20 % / 40 %	20, 40, 80, 120 ns
CFD-200	20 % / 40 %	30, 60, 130, 200 ns

Integrating standard types

Appl.	Module name	comment
fast decay time scintillators: **Plastic, LYSO…**	MSCF-16_F_SH1-5_C_L_CFD60	Shaping times: 0.12 us, 0.25 us, 0.5 us, 1 us (sigma) Gain jumpers: 2 nC-50 R, 20 nC-50 R ECL output delay 0.4 us TF differentiation time of 33, 70, 150, 360 us TF integration time 5 us BLR threshold step: 5 mV (max 1.25 V)
medium decay time scintillators: **BGO, NaI**	MSCF-16_F_SH2-20_C_L_CFD200	Shaping times: 0.25 us, 0.5 us, 1 us, 2 us (sigma) Gain jumpers: 2 nC-50 R, 20 nC-50 R ECL output delay 0.4 us TF differentiation time of 70, 150, 300, 600 ns TF integration time 20 ns BLR threshold step: 5 mV (max 1.25 V)
slow decay time scintillators: **CsI**	MSCF-16_F_SH8-70_C_L_LE	Shaping times: 1 us, 2 us, 4 us, 8 us (sigma) Gain jumpers: 2 nC-50 R, 20 nC-50 R ECL output delay 0.8 us TF differentiation time of 330 ns, 650 ns, 1.5 us, 3.3 us TF integration time 70 ns BLR threshold step: 5 mV (max 1.25 V)

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