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MSCF-16 F
(Data sheet V51_02)

16 fold Spectroscopy
Amplifier with CFDs
and Multiplicity Trigger

mesytec **MSCF-16 F** is a shaping / timing filter amplifier with constant fraction discrimina-tor and multiplicity trigger and provides active baseline restorers. It is well suited for multi strip silicon detectors and for high quality spectroscopy applications. The differential input version is ideal with the pre amplifier family MPR-16 / -32 / -64.

For Ge-detectors see data sheet for MSCF-16 LN. For direct PMT interfacing see data sheet MSCF-16-F-C.

Features:

- 16 channel NIM module, low power design
- Shaping amplifier with active baseline restorer
- Timing filter amplifier, 4 integration times
- 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, threshold
- 4 shaping times
- Gain adjustable from 1 to 600 (optional 2000)
- Differential or unipolar (Lemo) input versions.
- Low noise: <7 uV
  (gain = 100 and shaping time = 2 us)
- Low integral non-linearity
- Fully controllable via front panel
- Remote control via USB and mesytec control bus
- 4 selectable timing filter integration times
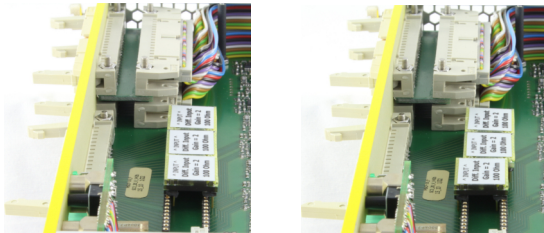- ECL timing delay can be switched off

Schematics:
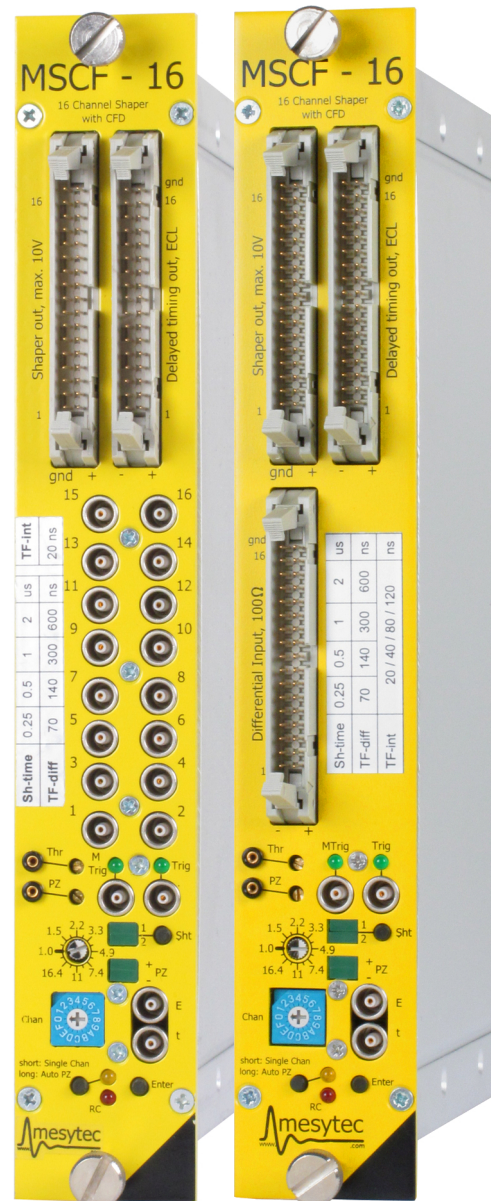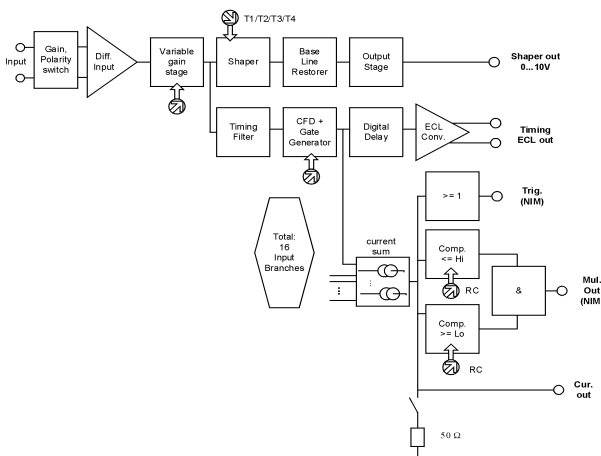
Technical Data

### Input stage

- Polarity setting

Polarity of input signal can be set by jumper position. In the picture below, the lower jumper is set to the two positions.

negative input signals   *positive input signals*

For header connector, positive signal means: positive at + input and negative on – input.

- 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. So with a gain jumper G2, and G30 a total gain of 2 to 600 is standard.
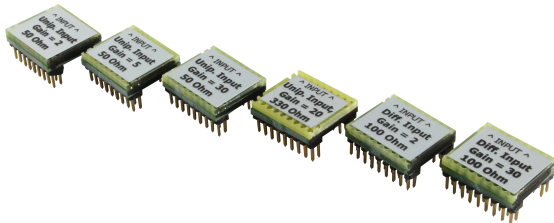
unipolar version

- Input connectors: 16 x Lemo 00 series
- Input termination: 50 Ω, coded on the gain-polarity jumper are possible.
  Gain jumpers from gain = 1 to 95 are possible. See table for details

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

When using unipolar jumpers for MSCF-16 with 34 pin input header connectors, the "-" lines are grounded. MHL-32 or MAD-34 adaptors can be used to interface to Lemo.

Noise

- Input noise at gain = 100 and 2 us shaping time = 7 uVrms.

Shaper

- PZ adjustable with front panel trimmer
- 5th order filter CR-RC^5
- Four shaping times selectable for groups of 4 channels
- Output amplitude: 0 to 10 V at 1 kΩ
- Active baseline restorer
- DC-Offset: VDC ← 5 mV, common offset adjust
- Output connector: 34 pin male connector
- Integral non linearity <0.05 %
- gain drift <0.0075 % /°C
- Offset drift <50 uV /°C

Timing filter amplifier

- Four selectable integration times.
- Differentiation times are selected with shaping time (See Table).

Discriminator:

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

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

Fraction (sw 1)   Example: CFD-120
   On: 20 %
   Off: 40 %
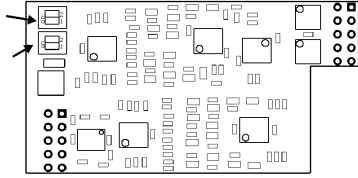
Delay (sw 1, 2)
   off off: 20 ns
   on off: 40 ns
   off on: 80 ns
   on on: 120 ns

For other CFD delays see section "Tables"
See also label inside the movable module
side plate.

Timing delay, ECL output

- Pulse width for NIM trigger output: 450 ns
- Timing stop ECL-Signals:
  delay see table, can be switched off.
  Pulse width 200 ns
- Output connector: 34 pin male connector

Multiplicity trigger

- Each channel above threshold contributes to
  multiplicity level, a multiplicity trigger is ge-
  nerated for:
  lower multiplicity threshold <= multiplicity
  level <= upper multiplicity threshold
- Coincidence interval adjustable via RC from
  20 ns up to 200 ns
  (default 120 ns = Value 128).
- The multiplicity trigger is delayed by
  the coincidence time to the trigger signal.
- Multiplicities selectable via remote control
- Lower multiplicity threshold: 1 … 8 and inf
- 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	360 mA
– 6 V	–780 mA
+12 V	270 mA

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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

Three parameters can be set only for all channels by switches on the motherboard:
• Baseline restorer (BLK) on / off
• Timing (ECL) delay on / off
• TF integration: four times (see table)

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. this is done by clicking the "Single chan" knob while "enter" is pressed

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 labelling 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 point. It can be set commonly for all channels or individually for each channel.

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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 individual 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 breaks the process.

Remote Controlled Operation

MSCF-16 can be remotely controlled in two ways: USB control and mesytec control bus.

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:

- Coincidence time window
- BLR threshold
- Multiplicity trigger thresholds

Only for factory setting or experts:

- Shaper offset
- discriminator threshold offset

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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 Set up (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 coincidence 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 hi can also be set to 9 = infinite
MC *chan*	Set monitor output to chan chan = 1…16
SI *0/1*	Single channel mode 0 = off, 1 = on
SE *0/1*	ECL delay 0 = off, 1 = on
SF *val*	Timing filter integration time val = 0 / 1 / 2 / 3
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 front panel 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 bus addr memaddr*
Write (Set): *SE bus addr memaddr val*

With:
bus = bus number (0/1)
addr = device address (0 … 15)
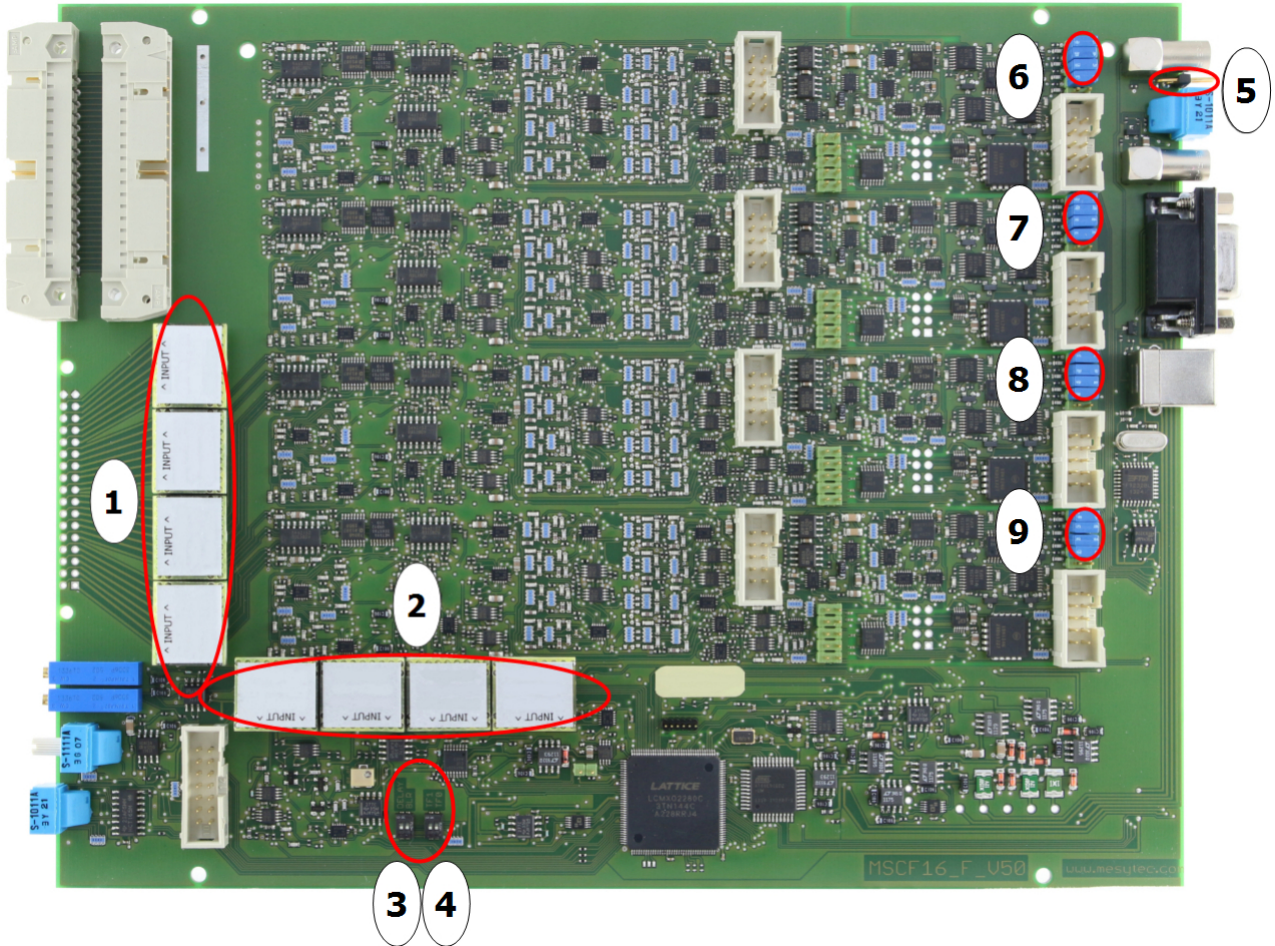memaddr = memory address
val = value

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	

ADR	parameter	comment
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 (=no offs) +/-100
54	Shaper offset	100 (=no offs) +/-100
55	n.a.	
56	n.a.	
57	ECL trigger delay	0 = off, 1 = on
58	TF int time	0...3 (one of four)

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 = 20.

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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 Ohm 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 positions, 4 for each connector. The lower pair on each connector is ground and can be left free.

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Tables: data, types and ordering

Example MSCF-16 F for particle detector readout

Applic.	Module name	Shaping times (σ)	Input type	Input connector	Discriminator	CFD-Delay
All particle detect-ors	**MSCF-16_F**	**_SH2** switchable: 0.25 us, 0.5 us, 1 us, 2 us	**_V** Voltage input for charge Preamp. tail pulses	**_L** Lemo **_D** Differential	**_CFD** Constant Fracti-on discriminator **_LE** Leading Edge Discriminator	**120** available: 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 MSCF16 needed)

CFD-Name	Fraction (via dipswitch)	Delays (via dipswitch)
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

Preferred type

Applic.	Module name	comment
Silicon Detectors IO Chambers MWPC…	MSCF16_F_SH2_V_X_CFD120 with X="D": FRC Header input X="L": Lemo inputs	Shaping times: 0.25 us, 0.5 us, 1 us, 2 us (sigma) Gain jumpers: G2, G30 ECL output delay 0.4 us TF differentiation time of 70, 150, 300, 600 ns TF integration time 20, 40,80,120 ns BLR threshold step: 4 mV (max 1.0 V)

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Special types

Applic.	Module name	comment
Silicon Detectors IO Chambers MWPC…	MSCF16_F_SH4_V_X_LE with X="D": FRC Header input X="L": Lemo inputs	Shaping times: 0.5 us, 1 us, 2 us, 4 us (sigma) Gain jumpers: G2, G30 ECL output delay 0.8 us TF differentiation time of 140 ns, 300 ns, 600 ns, 1.2 us TF integration time 40, 80, 150, 220 ns BLR threshold step: 4 mV (max 1.0 V)
Scintillators Silicon Detectors MWPC…	MSCF16_F_SH1_V_X_LE with X="D": FRC Header input X="L": Lemo inputs	Shaping times: 0.12 s, 0.25 us, 0.5 us, 1 us (sigma) Gain jumpers: G2, G30 ECL output delay 0.4 us TF differentiation time of 35 ns, 75 ns, 150 ns, 300 ns TF integration time 10, 20, 35, 50 ns BLR threshold step: 4 mV (max 1.0 V)

For Ge- Detectors see MSCF16_LN series.

For direct PMT interfacing see datasheet MSCF-16-F-C.

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