

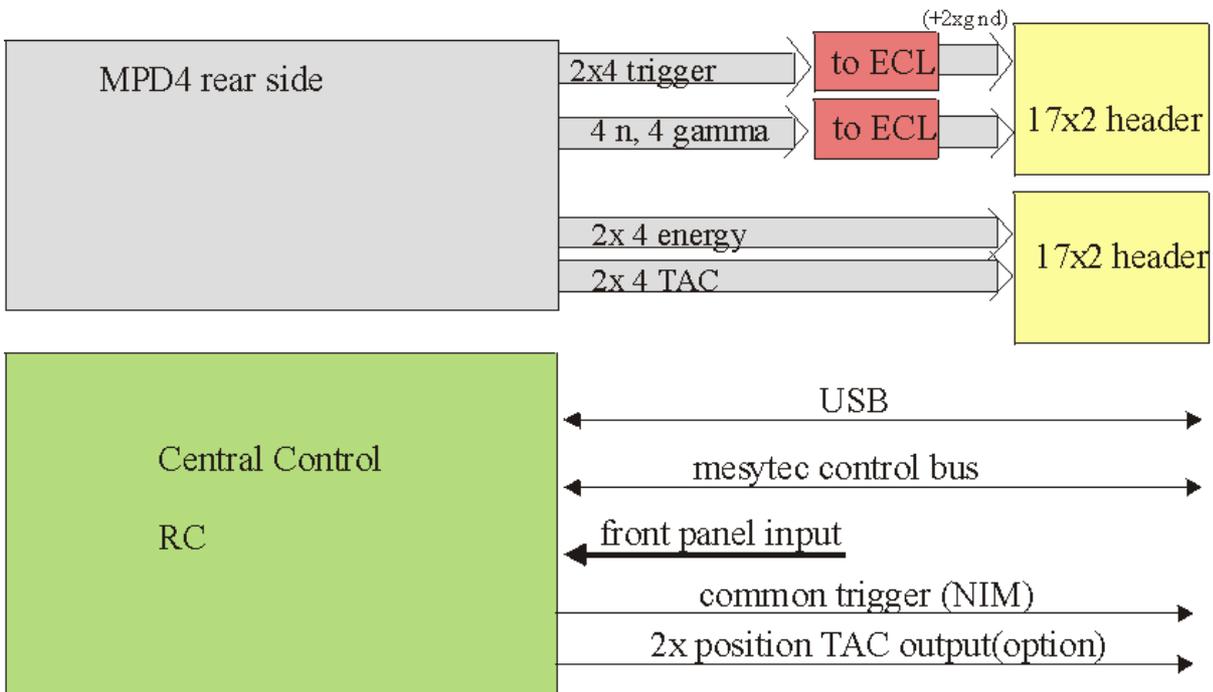
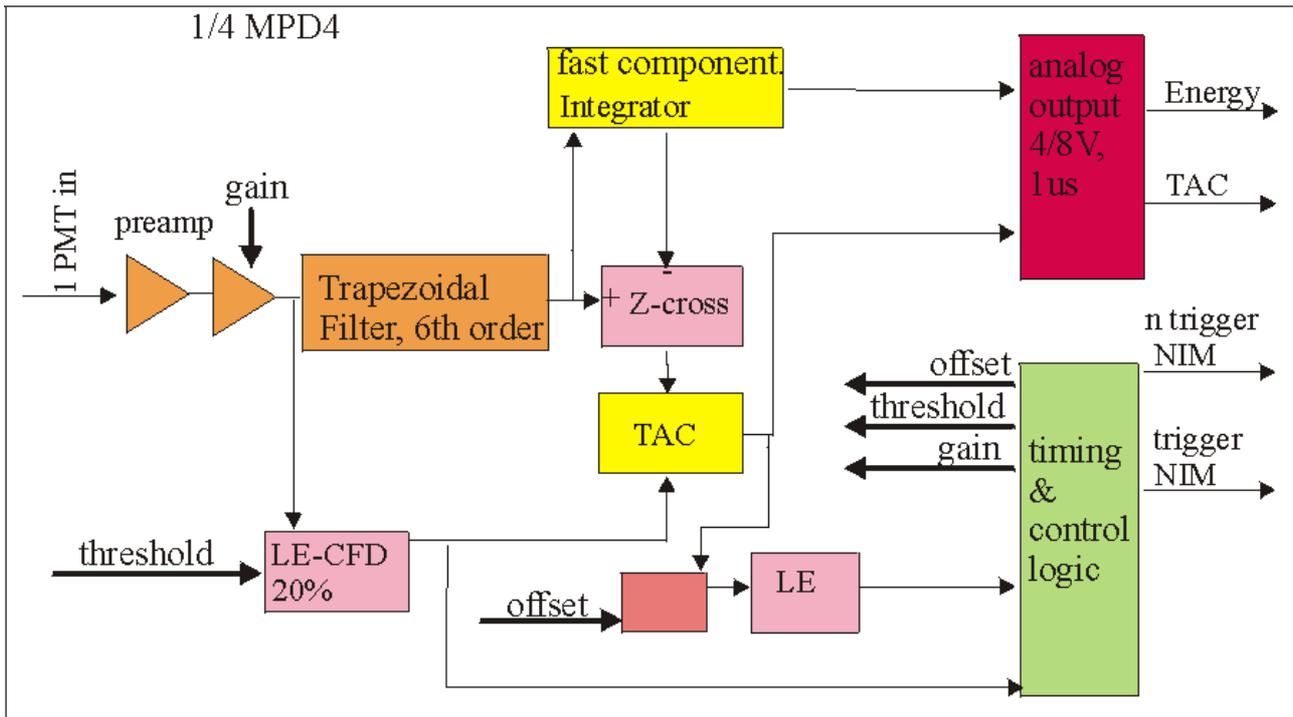
mesytec **MPD-4** is a four channel pulse shape discriminator module. MPD-4 is used for particle discrimination in multi channel liquid scintillation detectors (for example BC501 or NE213). The identification signals are available as NIM and ECL pulses. For discriminator monitoring only 2 channels of 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 us) for neutron identification, amplitude independent
 - Amplitude output pulse (1 us)
- 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.



MPD-4 Schematics:



4-fold channel section



Input:

PMT signal input (anode signal, negative), terminated with 50 Ω .
 Variable gain by a factor of 20 in 16 steps.
 Gain = 0 means a maximum signal of -3 V, gain = 20 means max -150 mV.

Ampl_out:

Integrated PMT charge output. Full range of 4 V and 8 V can be selected via internal jumper.

TAC_out:

Corresponds to ratio of fast to slow component of scintillator light output. Full range of 4 V and 8 V can be selected via internal jumper.

Gate_out:

NIM pulse when signal exceeds CFD-threshold, not particle selective. Length is adapted to deliver ADC gate for Ampl and TAC outputs.

n/g-Trig:

can be configured as neutron, gamma, all or reject output.
 NIM-signal, adapted to deliver ADC gate for Ampl and TAC outputs.

accept LED:

lights up when signal exceeds CFD-threshold, is below maximum value, has a processable amplitude ratio of fast and slow component.

reject LED:

lights up when signal exceeds CFD-threshold and is not accepted.
 Also works as channel indicator during channel adjustment.

Control section:

"Chan" switch:

toggles around the following channel selections:
 C1 → C2 → C3 → C4 → no channel selected (but in single channel mode)
 → common (all channels selected). The selected channel will light its "reject"
 LED as indicator.

"Para"-switch:

toggles around the following parameters to be tuned: thresholds → n.dis → gain.

Input_coder:

central input device for all parameters: the selected parameter in the selected channel(s) is modified.

"fast" switch:

switches between fast and slow/moderate

Sense / gnd output:

The currently tuned parameter is represented as a voltage from 0 to +2 V

Common trigger output:

NIM-trigger when any of the 4 trigger outputs respond. NIM current output -16 mA, can be daisy chained with other modules. In fast mode it outputs "all".

TAC-outputs:

for position sensitive detectors, provides position signal.

Settings will be saved in permanent memory and will be restored after power up.



RC bus section

Bus:

Lemo input for the mesytec rc bus. Has to be terminated with 50 Ω at the last device in chain.

ID:

Bus address (0 ... 9 ... F), each device on a bus has to have a unique address.

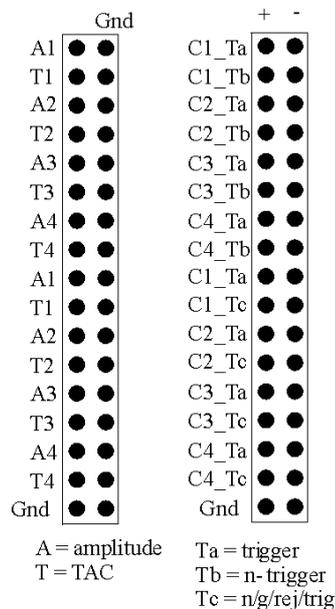
Output section

TAC_ / Amplitude out:

corresponds to ratio of fast to slow component of scintillator light output. Full range of 4 V and 8 V can be selected via RC.

Trigger – ECL:

ECL pulses. Length adapted to deliver ADC gate for Ampl and TAC outputs. Three different triggers are available per channel.



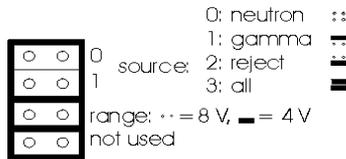
Serial connection

USB:

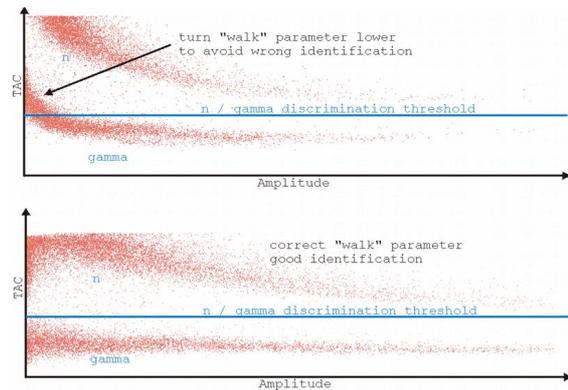
Serial connection for device control. Virtual Com Port drivers for several operating systems can be found at www.ftdichip.com/Drivers/VCP.htm

Jumper settings

Inside the MPD-4 there are four jumper positions to control the output voltage and the source for front trigger, ECL trigger and "common" outputs.



A label inside the device also shows these settings



Parameter setting

Threshold

The PMTs are directly connected to the inputs. The CFD threshold is preadjusted to an offset of 1 % full range, allowing a dynamic range of 100:1. For lowest threshold setting we suggest to power on the detectors, remove any source and adjust the threshold to give a low or no count rate.

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 adjusted: take a spectrum "Ampl vs. TAC" with gammas on the scintillator 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.

Qwin

is only for outmost optimisation purpose and should normally not be changed (default = 100). It will also influence the "walk" parameter.

Stability of TAC signals

The MPD-4 has to handle output signals of many different PMTs combined with different scintillator liquids and scintillator geometries. So the factory calibration only can give start values for "walk" and "ndis" values. Some detector combinations may give no defined output values with the default settings. In this case start with a significantly higher value of "walk" and then adjust it down to the correct value. Also "ndis" may not be a good start value and has to be adjusted.

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 (typ 2 us with MADC-32).

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	1 us long pulse, 4 V / 8 V	-
TAC_out	1 us long pulse, 4 V / 8 V	-
trig-Gate_out	1 us long pulse	60 ns
Gam/n_out	1 us long pulse	60 ns
Pos_TAC	1 us long pulse	-
rear side ECL	1 us	60 ns
com trigger	1 us	60 ns
common position TACs	1 us long pulse 4 V / 8 V	-
dead time per event	1.25 us	250 ns

Power consumption

+12 V	120 mA
+6 V	600 mA
-6 V	-800 mA

Remote Controlled Operation

MPD-4 can be remotely controlled in two modes: USB control and mesytec remote control (MRC).

USB Control

For USB control a USB 1.1 or 2.0 connection is required. The MPD-4 operates 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 MPD-4 can then be controlled e.g. using a terminal program or a proprietary control software.

Command list

(each cmd terminated by <CR>)

VER	show firmware revision
DS	Display Setup (lists gains, thresholds, Ndis values, mode,...)
SG <i>chan val</i>	set Gain chan = 0...4 (4 = all common) val = 0...15
SN <i>chan val</i>	set Ndis value chan = 0...4 (4 = all common) val = 0...255
ST <i>chan val</i>	set Threshold value chan = 0...4 (4 = all common) val = 0...255
SW <i>chan val</i>	set corr. value for Walk chan = 0...3 val = 100 ± 50 (100 = no corr.)
CC	set to common mode only FW-Rev ver 2.7 and higher
CS	set to single mode only FW-Rev ver 2.7 and higher
SQ <i>chan val</i>	Set corr. value for integration window for short signal component chan = 0...3 val = 100 ± 100 (100 = no corr.) Default values need not to be modified normally.

Settings via USB remote control will also be saved in permanent memory and will be restored after next power up. For Fw-Rev 2.7 and higher common or single mode should be set to define which parameter set to load (also at next power up). In the older revisions this selection must be done via front panel switch. Set to "none" to select single, and "common" to set common mode set. The push button must be pressed at least once after USB programming.

MRC control

MPD-4 can also be controlled using the MRC-1 controller module.

Up to 16 modules (not only MPD-4) 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 Ω.

Remote control via MRC-1 is basically reading and writing the control register page of the MPD-4.

Memory List MPD-4

MPD-4 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 channel 1	Gain setting for channel 1 ... 3, Values from 0 ... 15
1	Gain channel 2	
2	Gain channel 3	
3	Gain channel 4	
4	Ndis channel 1	TAC shift for channel 1 ... 3, Values from 0 ... 255
5	Ndis channel 2	
6	Ndis channel 3	
7	Ndis channel 4	
8	Qwin channel 1	Corr. val. f. integration of short sign. Component, Values 100 ± 100 (100 = no corr.)
9	Qwin channel 2	
10	Qwin channel 3	
11	Qwin channel 4	
12	Threshold channel 1	Threshold settings for channel 1 ... 3, Values from 0 ... 255
13	Threshold channel 2	
14	Threshold channel 3	
15	Threshold channel 4	
16	Walk corr. channel 1	Offset to factory walk correction Values 100 ± 50 (100 = no offset)
17	Walk corr. channel 2	
18	Walk corr. channel 3	
19	Walk corr. channel 4	
23	Fast mode	0 = slow mode 1 = fast mode
25	Output range (read only)	0 = 4 V 1 = 8 V
40	Output source (read / write) falls back to jumper setting after power up and "RC off"	Output source for trig outputs: 0 = neutrons, 1 = gammas, 2 = reject, 3 = all (n+g)

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

RC mode has to be ON for writing, reading is possible also with RC OFF. While RC ON, front panel control will be blocked.

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. Output range and source will restart with jumper setting.

Command Summary

Each MRC command has to follow the format described below.

CMD bus [dev] [adr] [val]

data formats:

bus = bus number [0...1]
 dev = device number [0...15]
 adr = parameter number [0...31]
 val = [0...255] (or [0...15] for gain);

Mnemonic Description

SC bus returns id code:
IDC = 21

ON bus dev activate rc for device dev on bus bus

OFF bus dev turn off rc for device dev on bus bus

SE bus dev adr val set memory cell adr for device dev on bus bus to value val

RE bus dev adr read memory cell adr from device dev on bus bus