Software Module MDPP-16-CSI

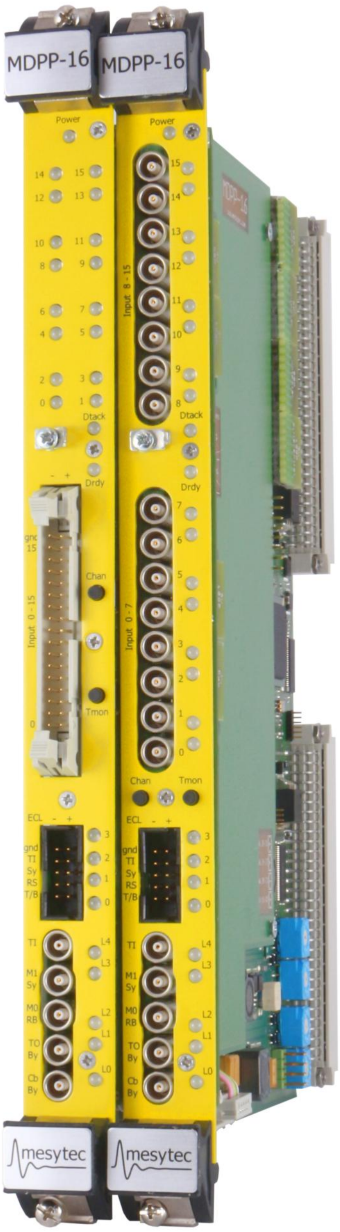
V0004

16 channel VME pulse processor

The software module MDPP-16-CSI works with signals of a charge integrating pre-amplifiers. It calculates a short integral and a long integral while delivering timing information from short integrated signal.

MDPP-16 with CSI software module:

- **Gain-polarity jumpers**
  determine: termination, polarity, input range and input configuration (differential / unipolar).
- **Low noise variable gain input amplifiers.**
- **Timing resolution**
  down to 70ps channel to channel resolution
- **Pulse shape discrimination**
  delivers two amplitudes: one is the short integrated pulse amplitude (integration time 25ns to 1.6us), the second is a long integration up to 25us.
- **AC-coupled and baseline restored**
  Offsets of the input signals have no effect. Even at highest rates, the amplitude keeps stable.
- **Dead time / rate capability**
  Channel dead time is short integration time + long integration time, but at least 350ns.
- **Two high resolution monitor outputs**
  for monitoring input signals and shaped signals.
- **Two high resolution trigger inputs**
  24 ps resolution, start window, add time stamp
- **One high resolution trigger output** (1.5 ns resolution)
- **Installation and update via USB**



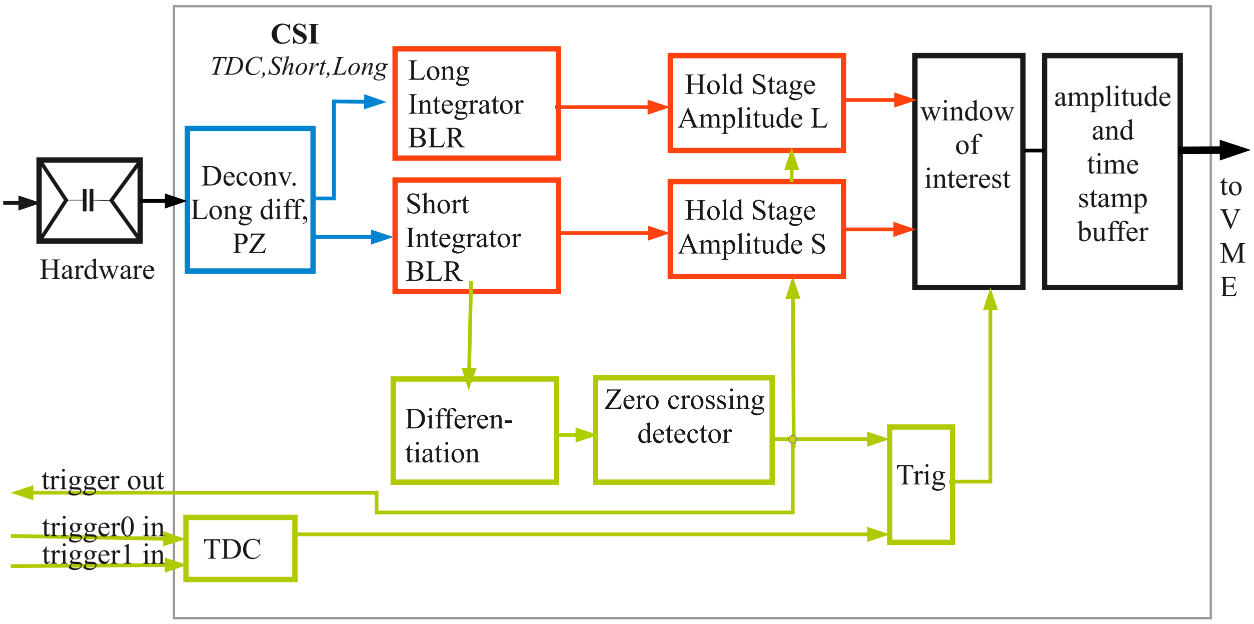
mesytec GmbH & Co. KG
Wernher-von-Braun- Str. 1, D-85640 Putzbrunn, Germany
phone: +49 - 89 / 456007-30 fax: +49 - 89 / 456007-39
info@mesytec.com - www.mesytec.com

Software module: "CSI"

Delivers timing and amplitude and pulse shape analysis for signals from charge integrating preamplifiers. For Example Photo multipliers coupled with CsI(Tl) scintillators, amplified with charge integrating preamplifier.

Replaces dual shaper and TDC.

The following picture shows a schematic representation of the software:



The signal is amplified filtered digitized. Then it is split into two branches: short integration and long integration. The timing branch starts after short integration (which is used as a **timing filter).** The signal is differentiated, followed by a zero crossing detector to create a precise (70ps rms) amplitude independent time stamp.
The short and integrated signals are sampled at the peak maximum.
For the short integration Integration times of 25 ns to 1600 ns are possible. For the long integration up to 25us are possible.

The two amplitude and timing values are filtered by a **window of interest** and stored in a **buffer**.

Short data:

- Amplitude resolution max 1/32000, 16 bits output.
- Trigger to channel time resolution of < **70 ps rms,** uniform at any delay.
- Channel to channel time resolution of < **70 ps rms**, uniform at any delay.
- Trigger input with 24 ps timing resolution

- Outputs internal raw trigger with 1.5 ns time resolution

As easy to operate as all mesytec modules and fully data compatible.

Only 6 parameters have to be set:

In Hardware:

Polarity of the signal,
set Jumper to correct position
Gain jumper range and termination

Register Settings

Signal properties

1. signal decay time (for PZ) 800 ns to ∞.
2. *Gain 1 to 200 in steps of 0.01*

Analysis property

1. long integration (50 ns to 25 µs FWHM)
2. short integration (25ns to 1600ns)
3. Threshold

Output Data
Amplitude:
channel 0..15 Amplitude Long int. (16 bit)
channel 48..63 Amplitude Short int. (16 bit)
Timing: Difference to window start:
channel 16 to 31 channel time difference (16bit)
Chan 32,33 Trigger input 0,1 time diff. (16 bit)

Monitor outputs
(Lemo 2 = mon 0, and Lemo 3 = mon 1)

Switching on the monitor: press pus button "chan", then select a wave form with "Tmon" button. The button "chan" allows to switch through the individual channels.

Wave forms:

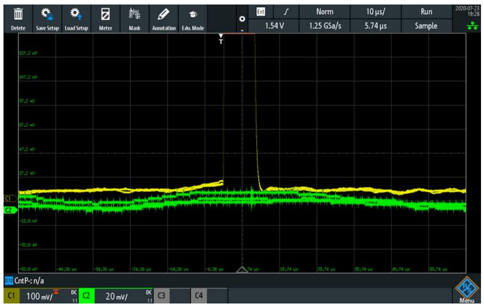
Tmon 0,
Green: Trigger out at NIM 0
Yellow: mon0, hardware differentiated input signal

Tmon 1:
Yellow: mon 0, long integrated signal.
The flicker mark shows the sampling time.
Green: mon 1, short integration signal.

Fig1: Amplitudes as generated by an alpha particle in CsI

Fig2: Amplitudes as generated by a gamma in CsI

Tmon 2 :
Yellow: mon 0, Long integration signal x32.
Green: mon1, baseline from BLR, multiplied x32.



MDPP-16 register set, CSI Firmware.
Only registers which are different to RCP and SCP software modules are listed.

Data FIFO, read data at address 0x0000 (access R/W D32, 64)
only even numbers of 32 bit-words will be transmitted. In case of odd number of data words, the last word will be a fill word (= 0).
FIFO size: 48 k - 512 = 48640 words with 32 bit length

Header (4 byte)

2 header signature	2 subheader	4	8 module id	3 TDC_resolution → 0x6042	3 xxx	10 number of following data words, including EOE
b01	b00	xxxx	module id	bxxx	bxxx	number of 32 bit data words

Data (4 byte) DATA event

2 data-sig	2	4	2	6	4	12
b00	01	xxxx	(x, overflow)	channel number 0..15	0	ADC value long integration

Data (4 byte) DATA event

2 data-sig	2	4	2	6	4	12
b00	01	xxxx	(x, overflow)	channel number 48..63	0	ADC value short integration

Data (4 byte) DATA event

2 data-sig	2	6	6	16
b00	01	xxxxxx	channel number 16..31	TDC time difference

Data (4 byte) DATA event

2 data-sig	2	6	6	16
b00	01	xxxxxx	channel number 32, 33	Trigger time difference T0, T1

Data (4 byte) Extended time stamp

2 data-sig	2	12	16
b00	10	xxxx xxxx xxxx	16 high bits of time stamp

Data (4 byte), fill dummy (to fill MBLT64 word at odd data number)

2 data-sig	30
b00	0

End of Event mark (4 byte)

2	30
b11	event counter / time stamp

mesytec GmbH & Co. KG
Wernher-von-Braun-Str.1, 85640 Putzbrunn, Germany
phone: +49 - 89 / 456007-30, fax: +49 - 89 / 456007-39
info@mesytec.com - www.mesytec.com

Registers

	operation mode				
0x6044	output_format	2	RW	3	0 = time and long integral 1 = long_integral only (QDC-mode) 2 = time only (TDC mode) 3= long_integral, short_integral and time

Channel addressing (select channel which are set)

0x6100	select_chan_pair	4	RW	8	channel to be modified: 0..7 channel pairs; 0 = chan 0,1 1 = chan 2,3 ... 8 = all channels (set to common values)

User Channel setting for a channel pair, software module "CSI"
***** After writing a register in this page, 5us wait time is required ******
Parameters "threshold" and "PZ" are for individual channels, so two parameters per pair.
When channels are all set simultaneously (0x6100 = 8) the "lower channel" parameter codes for even (0,2,4,6..), the "upper channel" parameter for odd (1,3,5,7...)

Address	Parameter.			default	Comment
6110	**Short Integration**	7	RW	**60**	All times are in multiples of 12.5 ns. Common for 2 channels TF-integration/differentiation time, chan 0/1 valid values 2...125 (25 ns to 1.6 us)
611A	**Gain:**	15	RW	**100**	common for 2 channels, gain x 100 gain 1...200, chan 0/1; setting 100 (gain=1) ... 19000 (gain = 200)
611C	**threshold0:**	16	RW	2000	0 to 64k (65535) . 64 k corresponds to full range. sets lower channel (ex. chan4 when pair 2 is selected)
611E	**threshold1**	16	RW	2000	sets upper channel (ex. chan5 when pair 2 is selected)
6124	**Long Integration**	11	RW	**300**	common for 2 channels , FWHM-width values 4...1999 (= 50 ns to 25 us)
6126	**BLR**	2	RW	2	common for 2 channels, Base line restorer setting, 0 = off, 1 = strict (int. time = 4 shaping times), 2 = soft (int. time = 8 shaping times)
6112	**PZ0:**	16	RW	0xffff	signal decay_time0, lower channel (for PZ compensation) valid: 64...64k (65535), 0.8 us to 800 us, and infinite
6114	**PZ1:**	16	RW	0xffff	signal decay_time1, upper channel

How to set channel parameters

Short Integration is the integration and differentiation time for the timing filter.
It must not be set to a higher value than the shaping time!
1) If the timing resolution has to optimised, the integration time should be set to the rise time.
2) If a very low threshold is required, it may be necessary to set it to a larger value than the rise time, maximum value is 127 (=1.6us) or the shaping time.

PZ0 / PZ1: decay time of the pulse. The parameter must be very precise to minimise under- or overshoot of the shaped signal. The value is usually not known very precise, so it is easiest way to minimise the under- or overshoot with the monitor signals (select Tmon 3). An automatic adjust run is under consideration. Example: the decay time is 25us (time the signal needs from 100% to 36.8%) so the set value is 25000/12.5 = 2000.

Gain: The gain can be set in 1% steps. The resulting range (input voltage for highest channel in the spectrum) can be calculated as: Range = Gain_Jumper_Range / Gain.
For example: Gain-jumper with 3V label, Gain setting = 1000 -> Gain = 10, so maximum signal will be 0.3V.

threshold0 / 1: Threshold setting, 64k is full range.
The threshold is required to detect a signal out of the noise. The threshold also signals an approximated noise level to the BLR.
Example: for a low noise application the noise is 1E-3 of the full range. Setting the threshold to 3x noise this results in a set value of 64k*1E-3 * 3 = 197.

Long Integration is the integration time of the shaping filter. The shaping is triangular, the shaping time corresponds to the width of the pulse at half maximum (FWHM).
Compared to the traditional "shaping time" the FWHM is about a factor of 2 longer.
Example: the traditional shaping time should be 1us, the FWHM shaping time has to be set to 2us, this results in a set value of 2000/12.5 = 160;

BLR: can be set to
- 0: off
- 1: soft, may have slight advantages for very low noise signals
- 2: default, compensates also for faster baseline deviations.