MCPD-8 is a module which collects the data of up to eight MPSD-8+ or MSTD-16 modules, creates a full time stamp with 48bits width, buffers the position amplitude and timing data and sends it via ethernet to a data acquisition PC.

It also transmits the configuration data between control PC and the peripheral modules. There is a communication path via synchronisation line to the other MCPD-8 or MDLL modules in a setup, allowing to synchronise the time stamps between those data collectors, and transmit basic commands like start, stop and run number.

Features:

- **High rate capability** up to 2 mega events/s permanently. No additional dead time up to the rate limit. Bursts with rates up to 6.4 mega events/s can be stored in the main buffer.

- **48 bit time stamp** for all events with 100ns resolution (running 325 days).

- **4 external digital inputs** for connection of monitor counters or chopper signals. Can create fully time stamped events of multiple types which are fed to the event data stream.

- **2 voltage inputs** digitized by 12bit ADCs, sample rate max. 100kHz. Data can be time stamped and sent to the data stream

- **2 voltage outputs**, voltage created by 12bit DACs. Can be controlled via control PC.

- **Synchronisation bus,** is a Lemo coax connection between several MCPD-8 or MDLL modules. One MCPD-8 module is configured as master module and synchronises all connected modules. Also basic signals like start, stop and a run number is transmitted.
  The master MCPD-8 itself can be synchronised to an externally applied 10 MHz clock (i.e. chopper time base, TTL signal at input mon/chop 3).

- **PC Software:** MCPD-8 and MDLL communicate with the control and (if existing separately) data acquisition PCs using a UDP based protocol. The open source data acquisition and control software **mesydaq/ qmesydaq,** running on Linux OS, is provided for data acquisition, online visualisation and system control.

Functional Overview
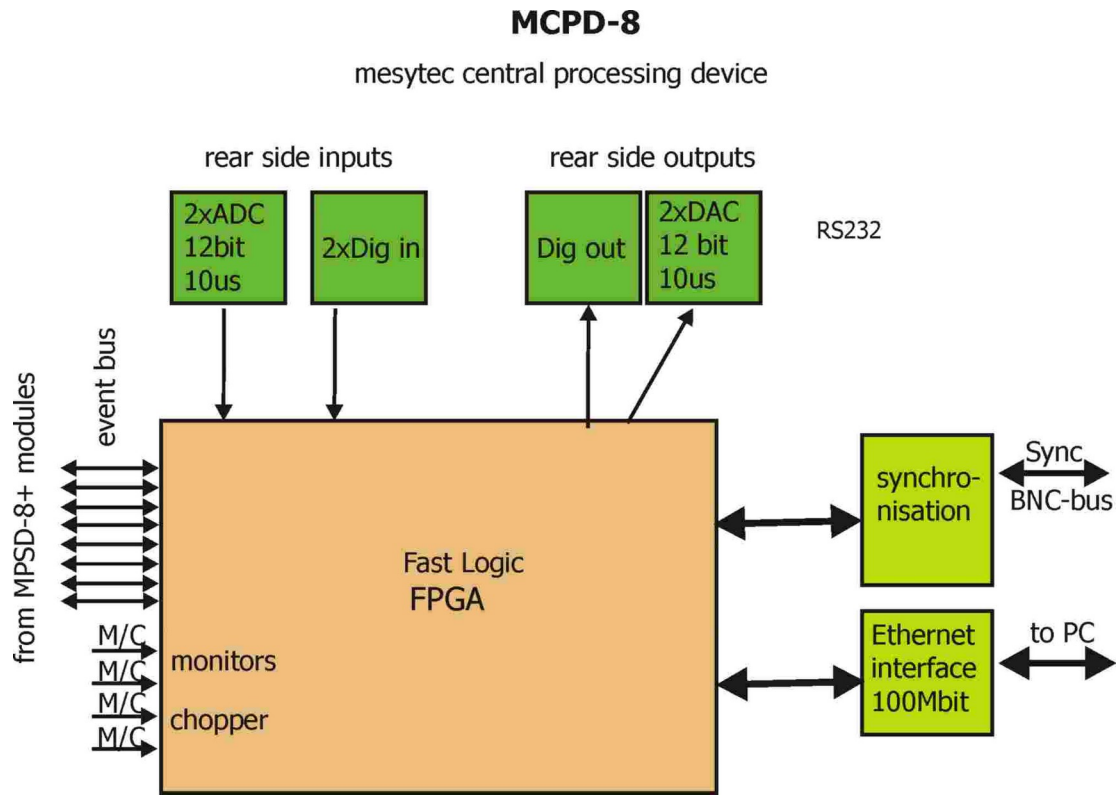
MCPD-8

mesytec central processing device

fig. 5 : internal design of the MCPD-8_V2 module

The internal design consists a programmable logic, which services the eight fast event buses, creates the time stamps, accumulates all incoming data in a FIFO , and counts the external monitor signals. As additional features the MCPD-8 has two ADC inputs (12 bit) and can create periodic time stamped ADC events which are accumulated with the other events in the FIFO. This is for example useful to add additional experiment parameters (temp, pressure, fields, …) to the data stream.
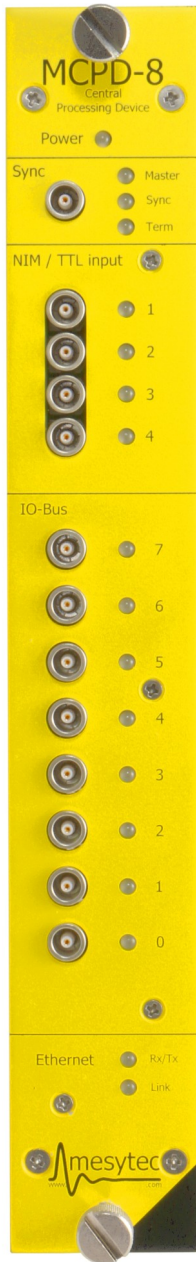
The programmable logic does not add any additional dead time to the event bus. It can manage event bus rates of up to 6.4MHz.

The FPGA also services the ethernet connection. It can deliver the theoretical maximum transmission data rate of the 100Mbit on ethernet. The maximum event transmission rate to the
ethernet will be around 2Mevents/s.
(6bytes per event: 10bit amplitude, 10bit position and time stamp + 5% protocol overhead)
A system with 128 detector tubes (16 x MPSD-8, 2 x MCPD-8) will process a peak rate of 12.8MHz (detector limit100 kHz per detector) and an average rate of 4MHz.

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2/6

Front panel elements

Synchronisation IO

100 Mbit Ethernet

4 digital inputs (mon ctrs, Choppers)

2x ADC input, +-3V or +6V (internal jumper selectable)

2x DAC output +-3V or +6V (internal jumper selectable)

8 x bus IOs (max 30m length)

USB2 Programming connector

NIM connector

Ethernet indicators

On the front panel a Synchronisation IO is provided. When configured as Master MCPD-8 provides periodic synchronisation time stamps and a clock signal output for any number of slaves, also MDLL can be synchronised. The master also transmits "start" "stop" and run number.

Four monitor inputs can count pulses of monitor counters and determine rate and more.

Eight bus IOs can control MNPSD-8 and MSTD-16 modules over a distance of up to 30m.

When bus data transfer is correct, LEDs blink green. When there are data errors, the LEDs turn red.

On the rear side the Ethernet connector is availble. Further 2 DAC outputs and 2 ADC inputs to monitor or control external peripherics.

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3/6

MCPD-8 data sheet

Power consumption:
- P   = 2W
- U   = +6V, 0.30A
  = -6V, 0.15A

Event buses:
- Maximum event bus data rate: up to 0.8MHz / bus
- Event bus dead time per event: down to 1.2us
- Signal level: 0 to +0.7V; Terminated inputs.

Ethernet:
- 100Base-TX
- Maximum Ethernet event rate to PC: 2MHz

4 Monitor, chopper inputs:
- TTL input:
- minimum High level 2.8V
- maximum low level: 0.8V
- Minimum pulse length: 200ns

2 DAC outputs:
- 0 to 6V or ± 3V, (selected by jumpers)
  max 30mA, protected

2 ADC inputs:
- 0 to 9V or ± 4.5V   (selected by jumpers)
  input resistance 6kΩ

Sync in / out:
- Provides and receives time reference and control signals
- Oscillator: 1.25MHz (is multiplied by 8 in the receiver modules)

Time stamp generation:
- Standard oscillator: stability 10^{-5}

Ethernet DHCP setup, new for revision V2, from 2023
====================

When using the new MCPD-8_v2 via Ethernet some network setup has to be done.

The easiest way to get a working setup is if you are running a DHCP server on your network. The MCPD-8_v2 will request an IPv4-Address and a hostname via DHCP after powerup.
The hostname is mcpd-NNNN where NNNN is the serial number shown on the back side of the module, near the ethernet port. After the DHCP phase the MCPD should be reachable via its hostname:

    ping mcpd-0010

for MCPD-8_v2 with serial number 0010.

Ethernet ARP setup
===================

In case DHCP with hostname assignment should not or cannot be used an alternative approach is to manually associate the MAC-address of the MCPD-8_v2 with an IP-address.

The MAC address is printed on the back side of the module. The MAC-address has the form 04:85:46:d4:NN:NN where NN:NN is the serial number of the MCPD-8_v2 in decimal. For MCPD-0012 the full MAC address is 04:85:46:d4:00:12.

With the MAC-address at hand we can now create an IPv4-address to MAC-address mapping in the operating systems ARP table.

This step is specific to the operating system and will require root/admin permissions. The below examples associate the IP-address 192.168.100.42 with the MCPDs MAC-address. You have to change the IP-address to match your local network setup, otherwise the operating system does not know how to reach the controller.

    Creating the ARP entry under GNU/Linux:

    With root permissions an ARP entry can be addded this way:

        arp -s 192.168.100.42 04:85:46:d4:00:12

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5/6

To make the entry permanent (at least on debian and ubuntu systems) the file /etc/ethers can be used. Add a line like this to the file:

    04:85:46:d4:00:12 192.168.100.42

This will take effect on the next reboot (or when restarting the networking services).

Creating the ARP entry under windows:

Open a cmd.exe prompt with administrator permissions and use the following command to create the ARP entry:

    arp -s 192.168.100.42 04-85-46-d4-00-12

To verify connectivity the `mcpd-cli` tool can be used: `mcpd-cli --address 192.168.100.42 version` prints the firmware revision of the MCPD-8.

The module accepts the destination IP of the first valid command packet it receives. This will also terminate the DHCP sequence and the module will now respond to ping requests.

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6/6