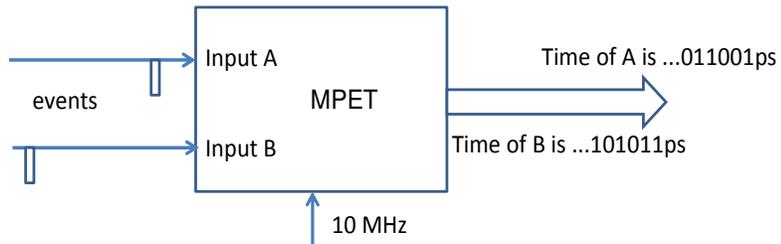
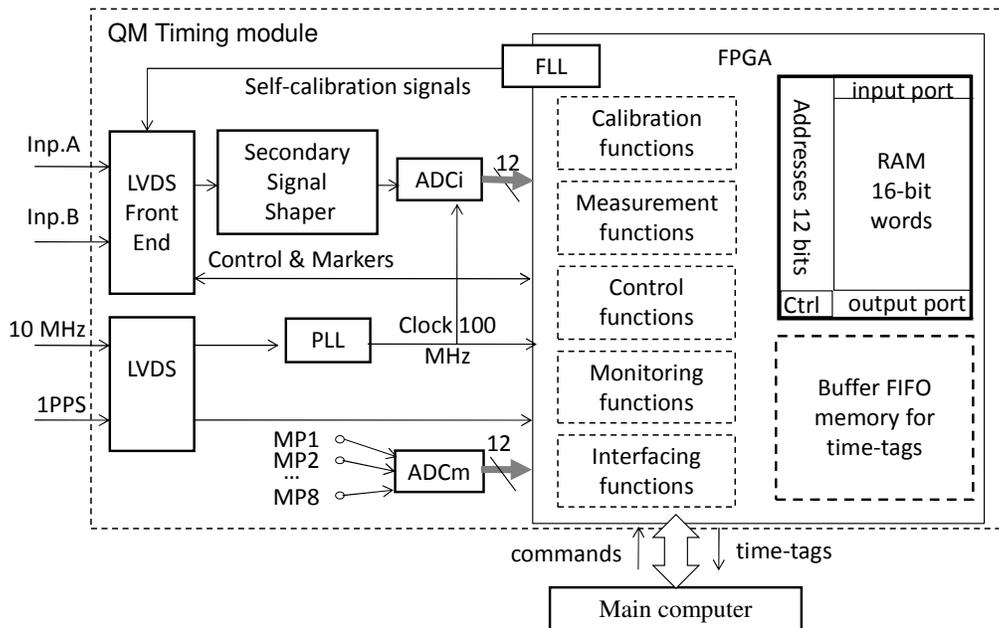


# On-board implementation of the multi-purpose Event Timer (MPET)

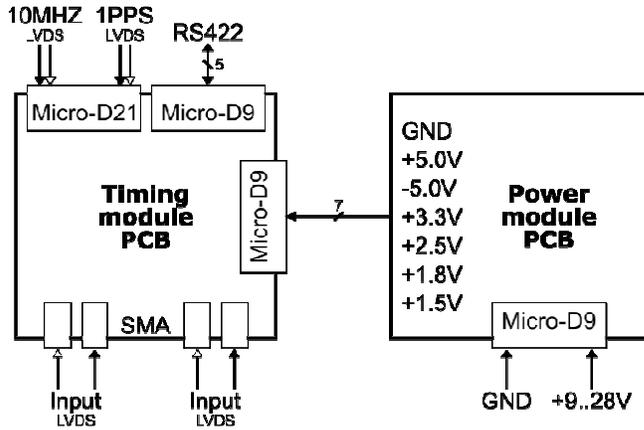
MPET records the arrival time of the event in the timing scale synchronized with the external scale by mean of the external 10 MHz.



MPET is the implementation of the A033-ET timing technology based on Digital Signal Processing of the secondary signal evoked by the input event. In MPET all processing is performed in the FPGA and MPET presents timing data directly in ps. Additionally it allows to monitor voltages from 8 control points at power supplies and thermoresistors. RS422 interface provides for command transfer to MPET and timing and monitoring data reading from.



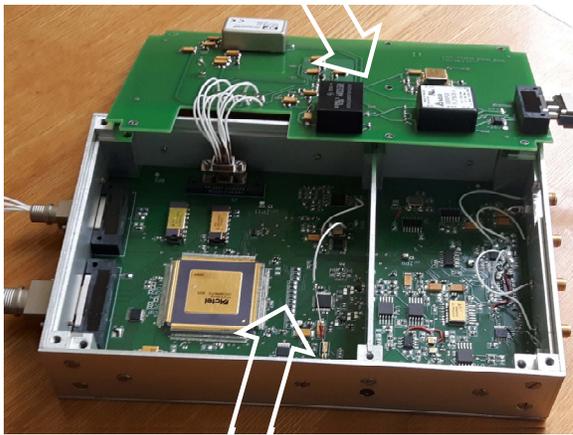
MPET Qualification Model is implemented basically on the space qualified components. The size of Timing module PCB is 190x120x20 mm but can be reduced at about 30 percent for embedding in real application systems.



All external signals are fed to the MPET as LVDS.

The Timing PCB requires 6 voltages. For testing purposes this voltages are supplied from the Power module PCB. And both PCB are placed into a aluminium box for testing in Temperature Chamber.

Power PCB

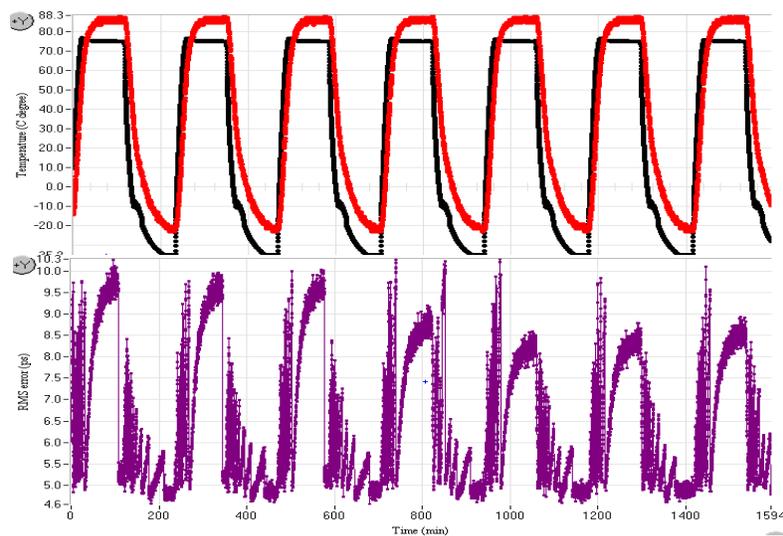


Timing PCB

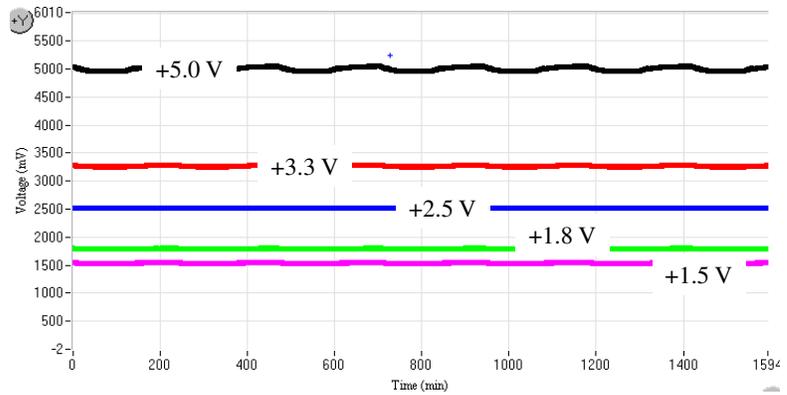


Thermal cycling test procedure in the range from  $-35^{\circ}\text{C}$  up to  $+75^{\circ}\text{C}$  at full MPET functionality revealed no any failures.

RMS error estimation shows that if the self-calibration is repeated at the internal temperature change at  $\pm 10^{\circ}\text{C}$  then RMS is not worse than 10 ps. After calibration it is in the range 5 – 6 ps.



All monitored voltages for the same temperature changing are within the range of the permitted values.



Comparison of the specification parameters of the A033-ET and QM

Circuit defined parameters:	A033-ET	QM
time measurement range:		
from	50 ns	60 ns
up to	1.5.hours	>3 hours
least significant bit	1.2 ps	2.5ps
dead-time	50 ns	60 ns
buffer memory (time-tags)	16K	2K
Precision specifying parameters:		
Measurement uncertainty for intervals:	3-4 ps	5 – 6 ps
including:		
Integral nonlinearity	<2 ps	4.2 ps
Interval nonlinearity (for intervals)	< 1 ps (>100 ns)	<1 ps (>170 ns)
Result dependence on temperature:		
Input-to-input offset drift	0.5 ps/°C	1.5 ps/°C
Single input offset drift	2 ps/°C	30 ps/°C
Operating temperatures range	+5 °C - +45 °C	-35°C - +75°C

MPET implementation on space qualified components is aimed for on-board applications related with laser ranging, altimeters, precise time synchronization by laser link, 3-D Scan and LIDAR systems, data acquisition and data transfer by laser link.

The work is executed in the framework of ESA Contract No. 4000115326/15/NL/Nde with Eventech Ltd.

„On-board implementation of the multi-purpose Event Timer”