Monitoring systems for Forward Spectrometer Calorimeter

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Two types of monitoring

Front-side monitoring system

378 LEDs (1 for 4-channel module) for quick check of photodetector, high-voltage chain, readout electronics.

+ simplicity

+ possibility to check every four cells independently

- low precision (different LEDs, loop fibers)

Back-side monitoring system

Uniform light distribution via optical fibres to each channel from 2 identical *light pulsers* for precise tracking of PMT gain variations.

 + high precision (non-uniformity of light pulses in each channel less than 10%)

Microcontroller unit for monitoring systems

MSCU – monitoring system control unit

Functions:
- To handle LED matrix (front-side monitoring system)
- To monitor LED pulser stability and temperature (back-side monitoring system)

Features:
- PCB 100x100 mm
- based on stm32f407, 120MHz
- 3 ADC channels, 12-bit, 6MSPS
- 1 DAC channel, 12-bit
- 1-wire interface
- isolated Modbus-interface
- 3 LED drivers, 8-bit
- LVDS data receiver and generator (for light pulser testing)

Front-side monitoring system: LED matrix

Matrix: **3** transistors and **3** 8-bit LED driver.
Total: 72 LEDs => 6 microcontroller units for whole detector monitoring system.
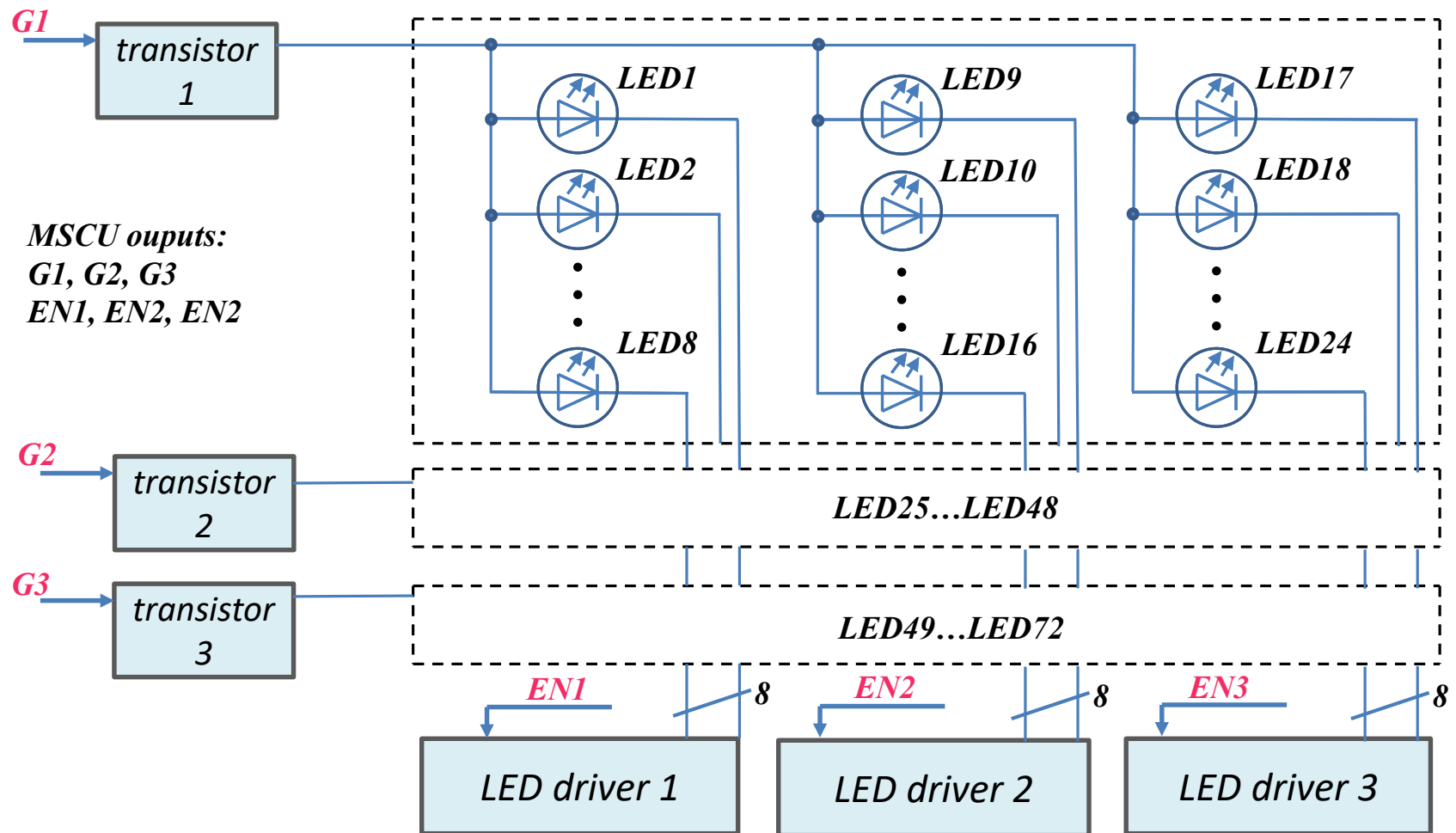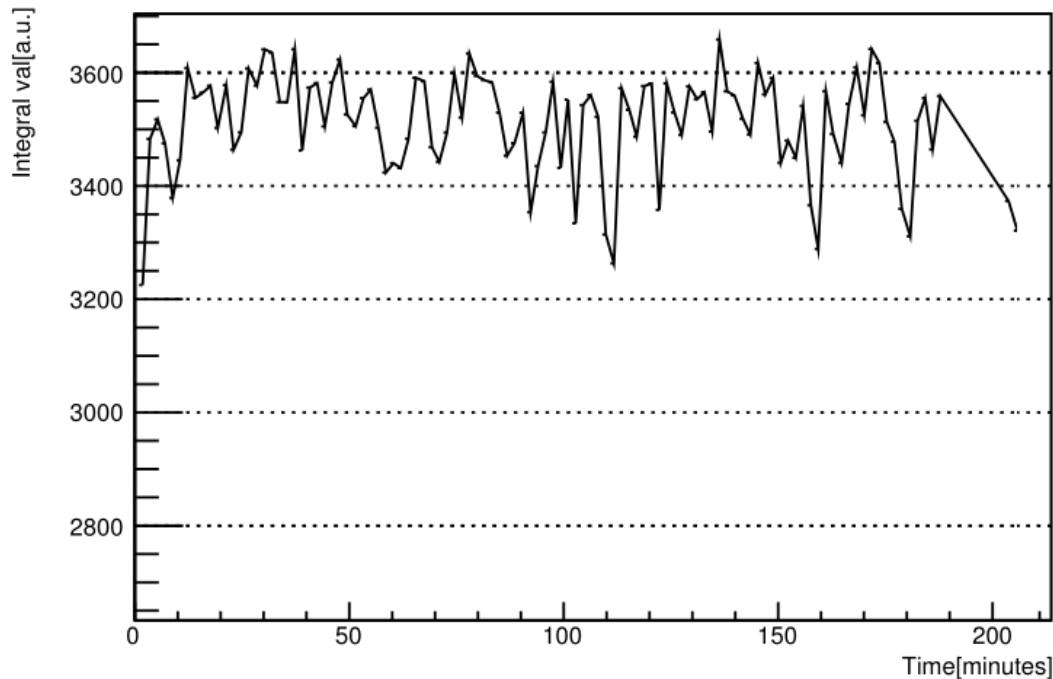
Front-side monitoring system: LED pulses

LED impulse should be less than 400 ns.
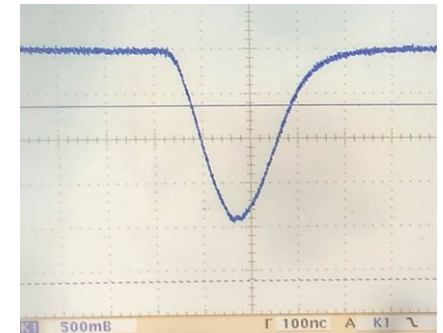Microcontroller frequency 120 MHz, enable signal for LED drivers is 60 ns.
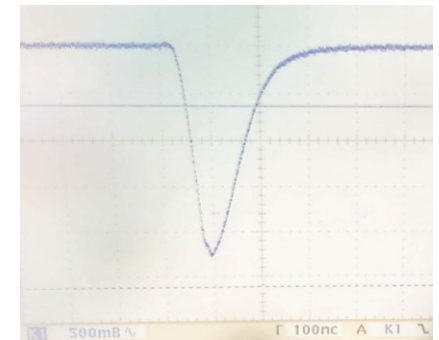LED driver - TLC6C598 (Texas Instruments)

LED signals

LED integral long term stability

<350 ns (with transistor)

<250 ns (without transistor)

Back-side monitoring system

Light pulser consists of:
• a powerful blue LED with a driver;
• a mixing light-guide interface to the fibre bundle;
• reference silicon photodiode to track the LED stability;
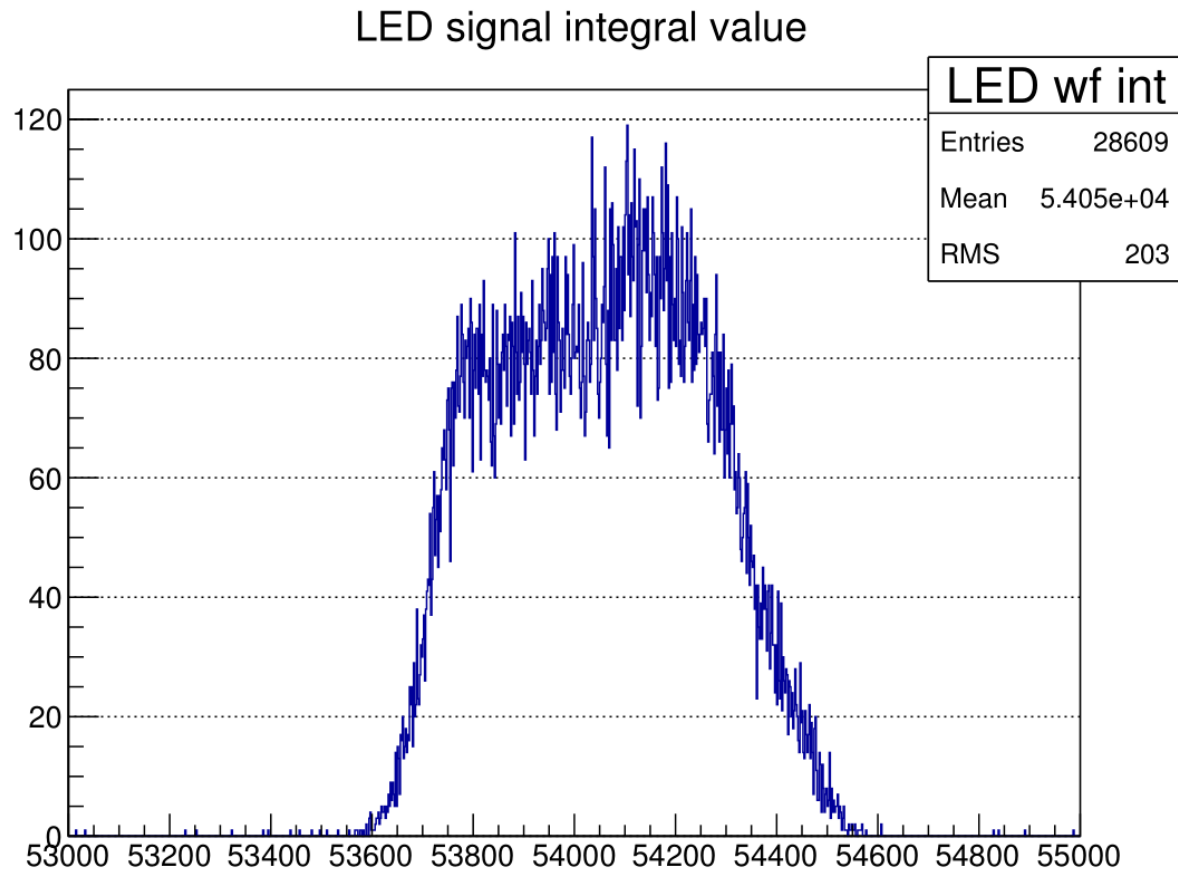• temperature heater with sensors.

Photodiode signal (width 400ns, period 2us) is delayed, amplified and shaped up to a 8 us. And it is not necessary to catch every signal by MSCU.
ADC is triggered by the same signal that triggers light pulser.
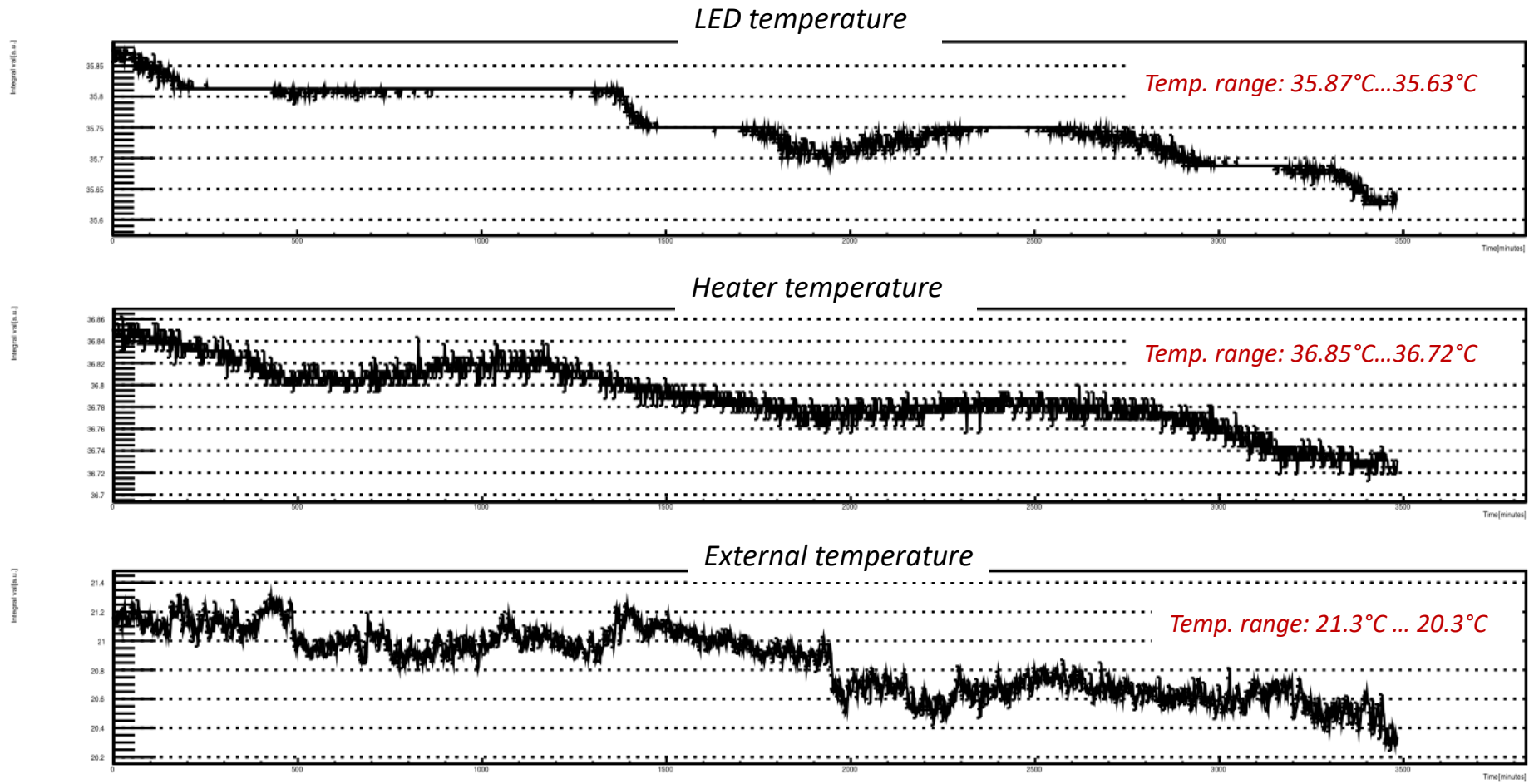Temperature sensors - DS18B20.

79 hours of photodiode signal measurement:

Back-side monitoring system: temperature stability

58 hours of temperature measurement:

LED temperature

Temp. range: 35.87°C…35.63°C

Heater temperature

Temp. range: 36.85°C…36.72°C

External temperature

Temp. range: 21.3°C … 20.3°C

Summary

To measure the front-side monitoring system LED signals stability. Stability of light pulser LED is sufficient.

Interface to monitoring systems is working and is a part of shashlyk DCS (using Raspberry Pi to run input/output controller applications and ArchiveEngine/Control System Studio for data saving and GUI)