

Beam Current Monitor Update

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ESS BI section

3rd Beam Diagnostics Forum, Trieste - Italy
26-27 April 2017

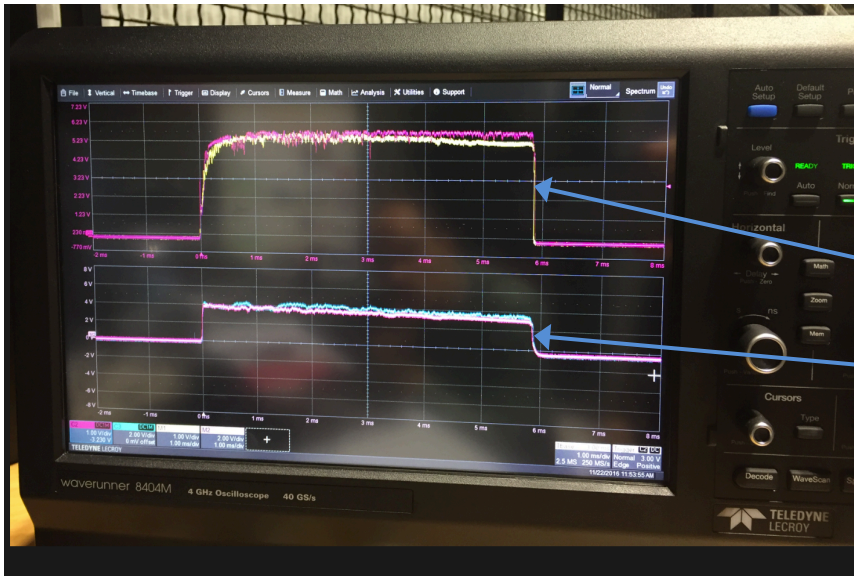
Summary of main updates

- BCM toroid installed on loan at INFN-Catania to measure pulsed output current of the Ion Source HVPS - Nov. 2016
- LEBT ACCT toroid tested and shipped to Catania – 25 April 2017
- ACCT uTCA electronics including demo SW/FW (with reduced functionality): tested, verified and shipped to Catania – 25 April 2017
- Design, manufacturing and successful tests of a prototype ACCT Interface Unit including ACCT-E Interface Module, ACCT Calibrator Module and Ethernet Module
- ‘LEBT version’ of the BCM FW including custom and integration FWs received and tested.
- Development of the ‘LEBT version’ BCM SW including operator interface: work in progress
- BCM-BIS interface definition: work in progress

BCM sensor summary

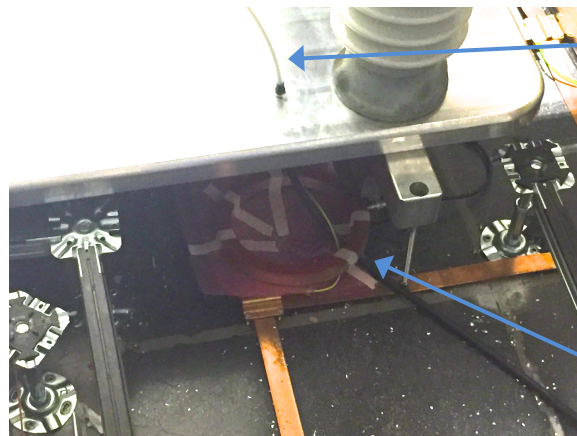
Section	No. of sensors	type	Source	Status
LEBT	1 ACCT	Bare toroid	ESS	Procured, shipped to Catania
RFQ	1 ACCT	Bare toroid	ESS	Awaiting specifications from CEA to start with procurement
MEBT	1 ACCT 1 combined ACCT/FCT 1 current monitoring BPM	Bare toroid Flanged Welded	ESS-B IK	ESS-B Held PDR in July 2016
DTL	5 ACCTs	Toroid in epoxy-resin-filled enclosure	INFN-Legnaro IK	Requirements communicated with IK partner
MB	1 ACCT	Flanged	STFC IK	Requirements communicated with IK partner
HB	1 ACCT	Flanged	STFC IK	Requirements communicated with IK partner
HEBT	2 ACCTs	Flanged	STFC IK	Requirements communicated with IK partner
A2T	2 ACCTs	Flanged	STFC IK	Requirements communicated with IK partner
DmpL	3 ACCTs	Flanged	STFC IK	Requirements communicated with IK partner

ACCT installation in Catania – Nov. 2016



FC (ion source exit)

ACCT (HVPS output)

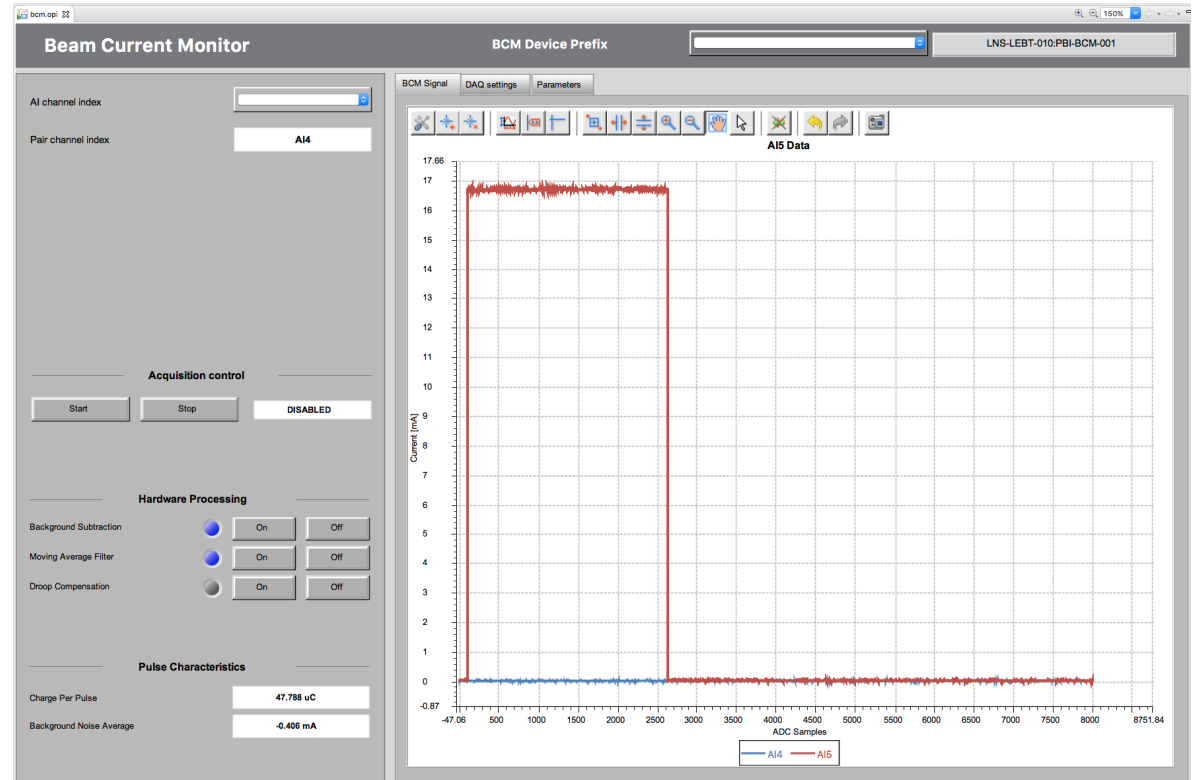
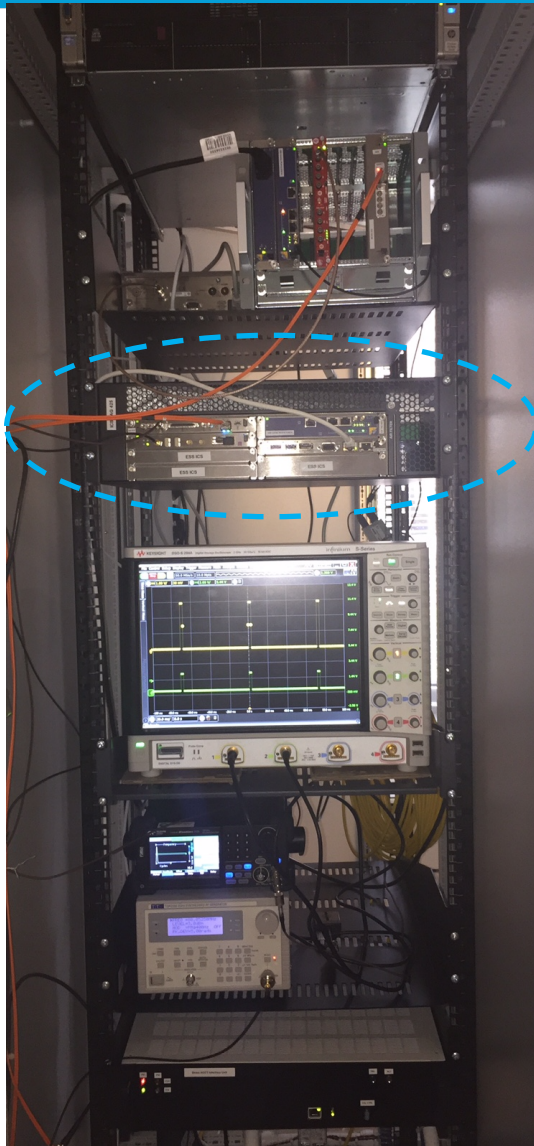


HVPS cable to the platform

ACCT toroid

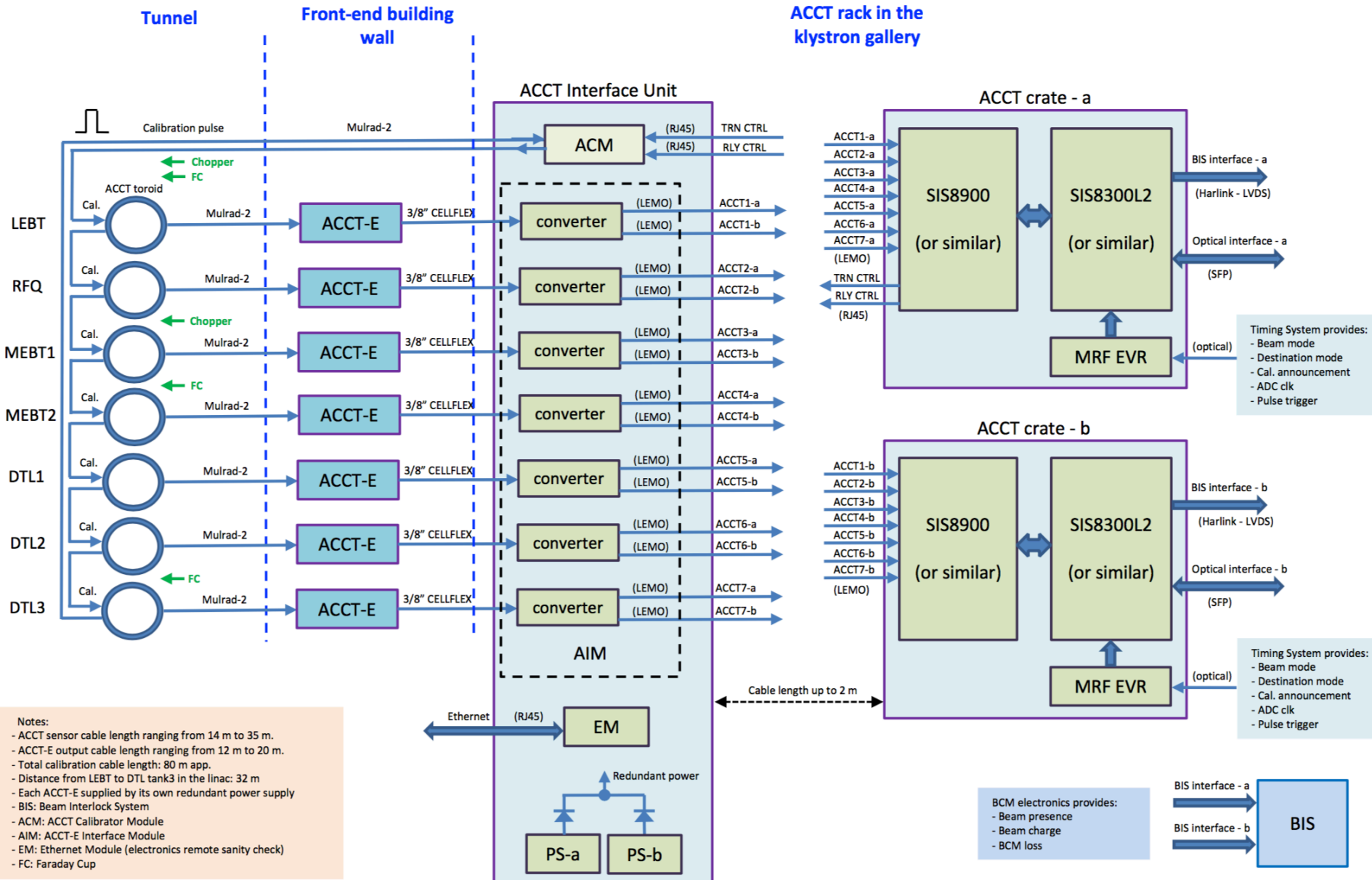


LEBT ACCT installation in Catania – foreseen in May 2017



The new shipment includes a new toroid, Bergoz FE, cables, uTCA electronics, EVR module as well as BCM FW and SW.

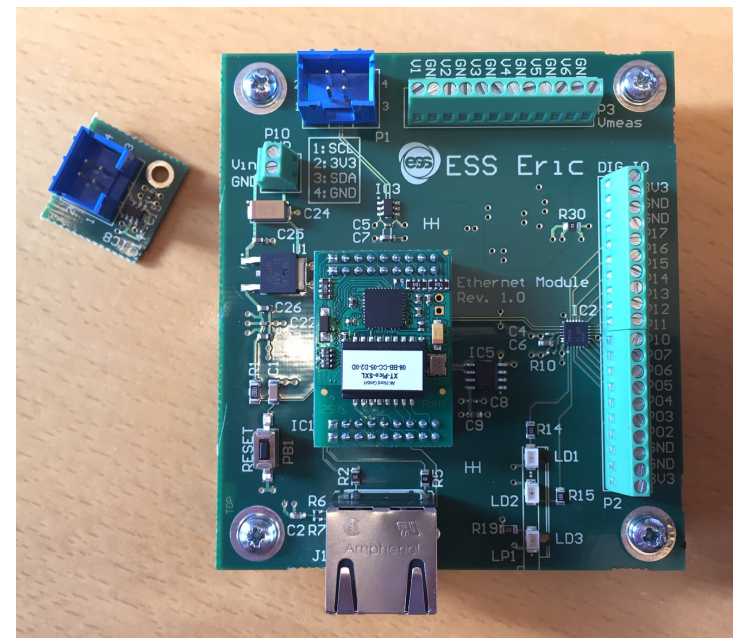
Draft BCM layout: from LEBT to DTL tank 3



Electronics sanity check

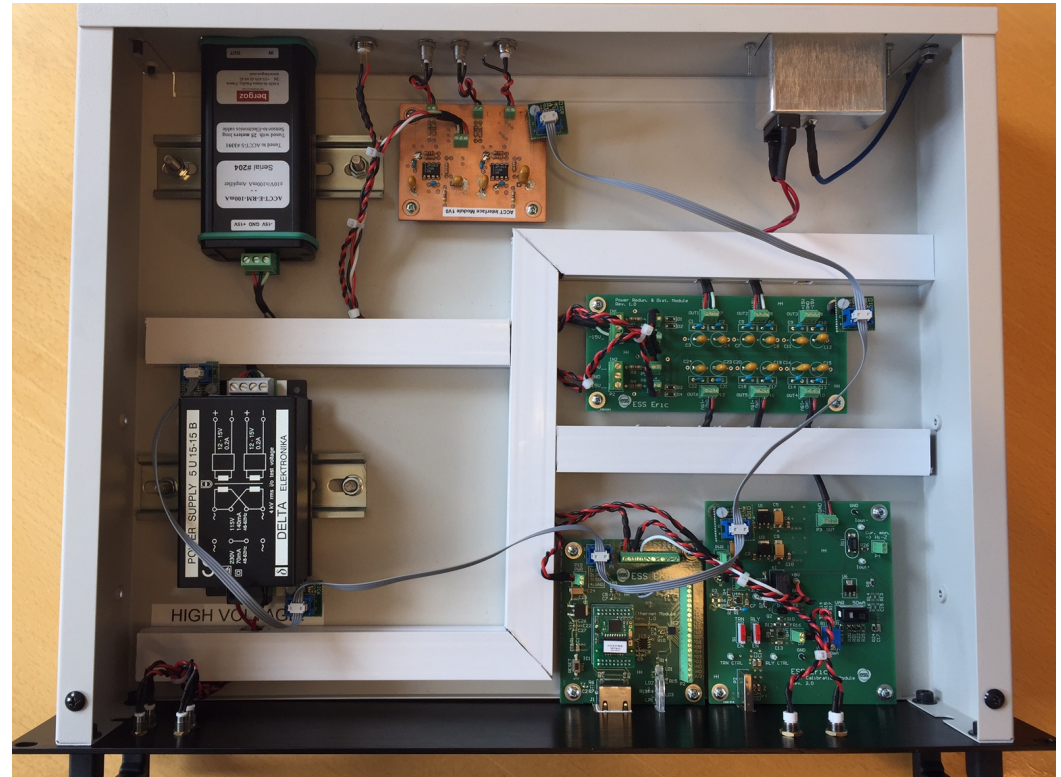
- Two ways are foreseen to do electronics sanity check:
 - Sending a current pulse to the calibration winding and measuring/verifying the ACCT output signal before running the system with beam
 - Remote monitoring of electronics voltage and temperature with an Ethernet Module

- The Ethernet Module provides:
 - Network connection (RJ45)
 - 1 on-board and 6 external temperature sensors
 - Port expander including 14 general-purpose digital I/O
 - 2 on-board and 6 external analog voltage monitors
 - 2 MBIT EEPROM
 - Connection to external devices through I2C bus
 - Programmable LEDs



ACCT Interface Unit (AIU)

- The AIU includes:
 - ACCT-E Interface Module
 - ACCT Calibrator Module
 - Ethernet Module
 - Redundant Power Supply

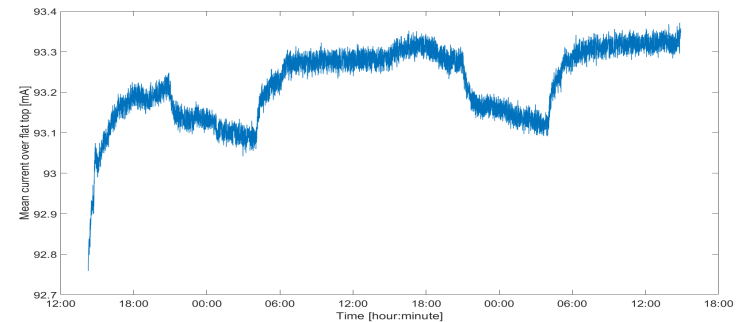
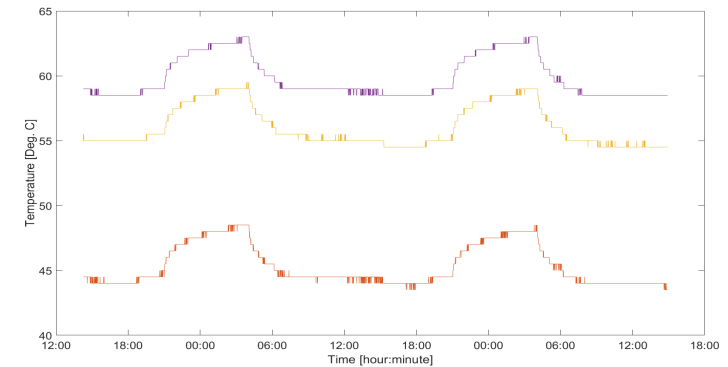
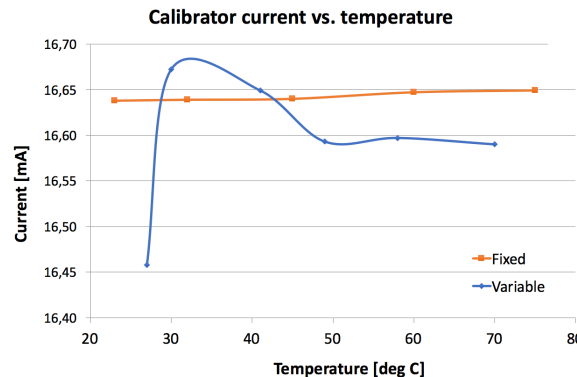


- A prototype AIU has been designed, built and successfully tested in the lab.
- Discussions with external partners have started for possible design modifications and series production of final units.

Tests with prototype calibrator module

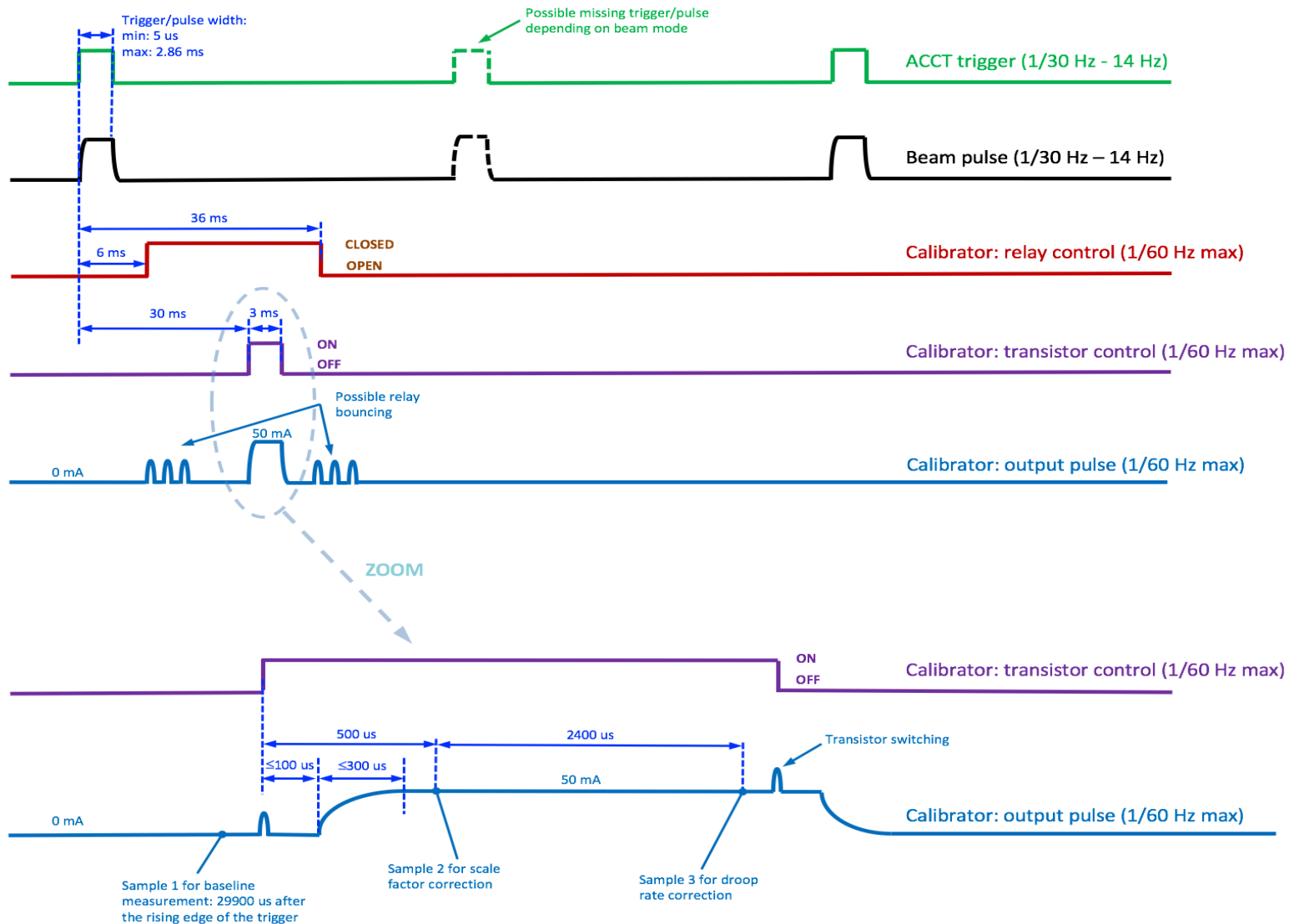
Calibrator design considerations:

- Short rise time
- Constant current over pulse flat top
- Insensitive to temperature variations
- Insensitive to cable length variations
- Relay for disconnecting the calibrator from the toroid(s) when not operating in calibration mode
- Calibrator control from the Struck digital port
- Tolerant to more than 100 V of voltage difference on the cable shield
- Fail-safe



Long-term tests with a low-quality coaxial cable of 60 m (on the ACCT-E output) shows a clear correlation between temperature variations and ACCT signal drifts.

Calibrator synchronization with the beam pulse (draft proposal)



ACCT firmware and software

- FW is divided into two parts:
 - Custom FW including ACCT-specific DSP (collaboration with DESY)
 - ACCT integration FW based on the Struck SIS8300L2 FW performing clock multiplexing, register and memory maps, data decimation etc. (collaboration with Cosylab)
- ‘LEBT version’ of the ACCT FW with functionality covering warm linac (excluding optical interface) already received and tested.
- SW includes:
 - EPICS modules
 - CSS application-specific panels
 - ACCT post processing in software

BCM cable and connector types (draft)

- ACCT:
 - Toroid: MULRAD 2 (Siltem) from Lapp-Muller
 - Calibrator: MULRAD 2 (Siltem)
 - ACCT-E: 3/8" CELLFLEX
- FCT:
 - 3/8" CELLFLEX
- Fast BPM:
 - 3/8" CELLFLEX
- Connectors:
 - BNO on the toroid cable
 - 'N-type' on the ACCT-E cable
 - Short patch cables (possibly with different connector types) are planned at the sensor and the electronics ends.



Current issues

- ACCT-E calibration (by Bergoz) based on final cables lengths -> discussion with Bergoz and IK partners
- Sensor/cable/electronics connection to protection ground -> the aim is to use a grounding scheme that is believed to give best performance, but also make it possible to switch to other grounding schemes if needed
- BCM-BIS interface: too many signals through a limited number of digital output pins -> type and number of signals being discussed with the MPS and the ZHAW, may need to serially transfer the data
- Calibration timing: dedicated calibration mode (no beam) or in between two consecutive beam pulses? -> ongoing discussion with the MPS/ZHAW and DESY
- ADC data gets stuck after a few times of switching OFF/ON the external clock source to the AMC -> foresee to resolve this in a future FW revision