BPM electronics based on compensated diode detectors – results from development systems

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Abstract. High resolution beam position monitor (BPM) electronics based on diode peak detectors is being developed for processing signals from BPMs embedded into the future LHC collimators. Its prototypes were measured in a laboratory as well as with beam signals from the collimator BPM installed on the SPS and LHC BPMs. Results from these measurements are presented and discussed.

Hardware

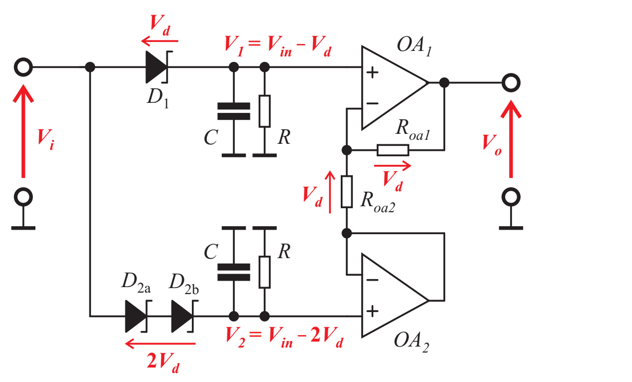
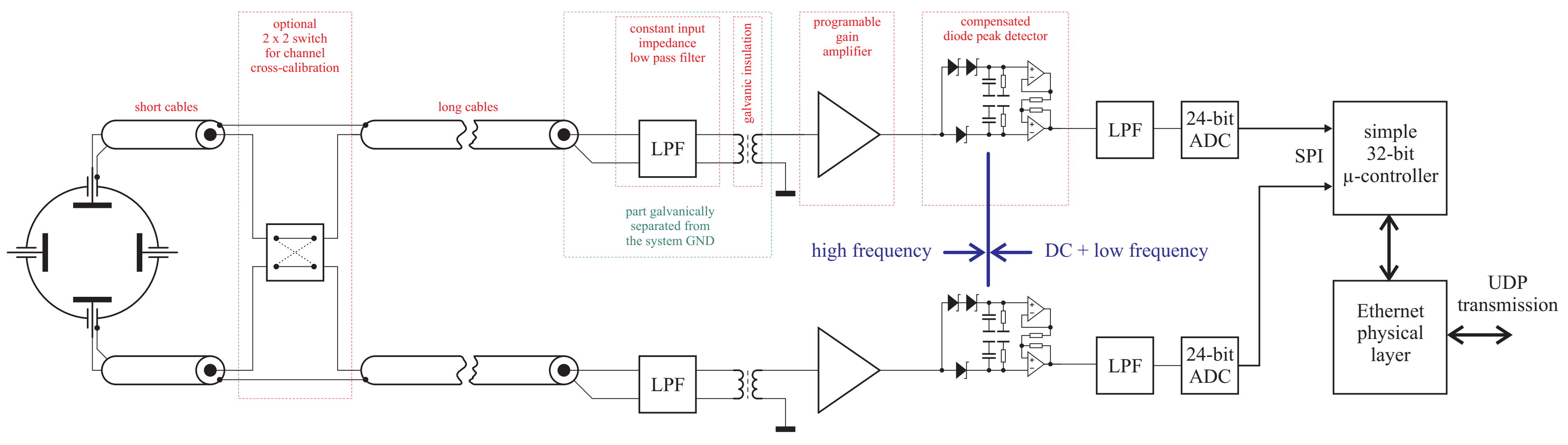


Diagram of the compensated diode detector

The compensated diode detector consists of two peak detectors, one with single, and second with double fast Schottky diode, integrated into one package for good symmetry of the forward voltages and thermal coupling. The difference of the output voltages from both peak detectors is equal to one diode forward voltage V_d. This voltage is converted into current V_d / R_{oa2}, which in turn is converted back into V_d with $R_{oa1} = R_{oa2}$. In this way $2V_d$ is added to the output of OA_2, compensating $2V_d$ drop on the two diodes D_{2a}, D_{2b} and the output voltage V_o is equal to the input voltage V_i.

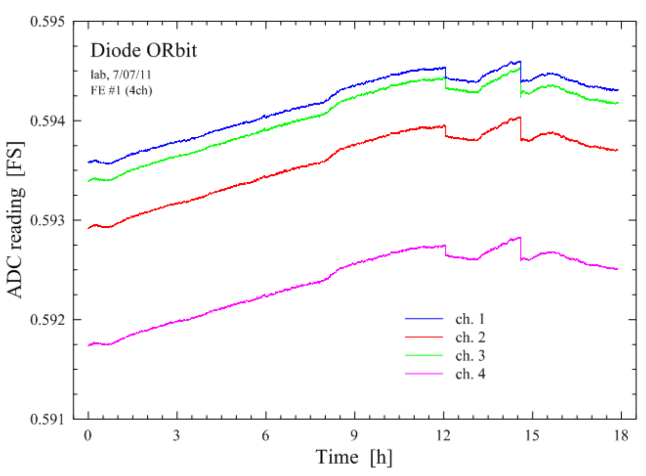


Diode ORbit (DOR) Measurement

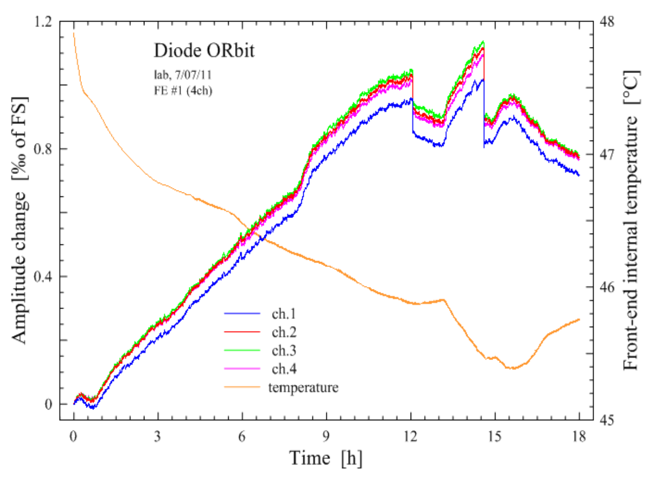
2 channels shown for one pick-up plane,
one 19" 1U unit accommodates 8 channels

One plane of the DOR measurement system consists of two symmetrical channels converting fast beam signals from the opposing electrodes of a position pick-up into slowly varying DC signals. The multiplexer is foreseen for cross-calibration of each channel pair.

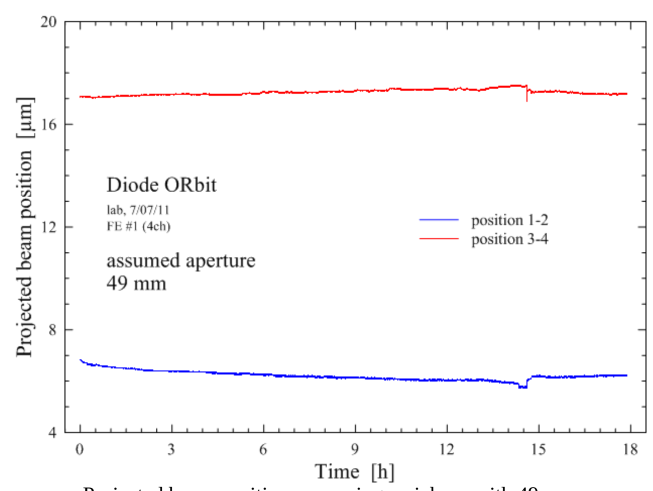
Measurements



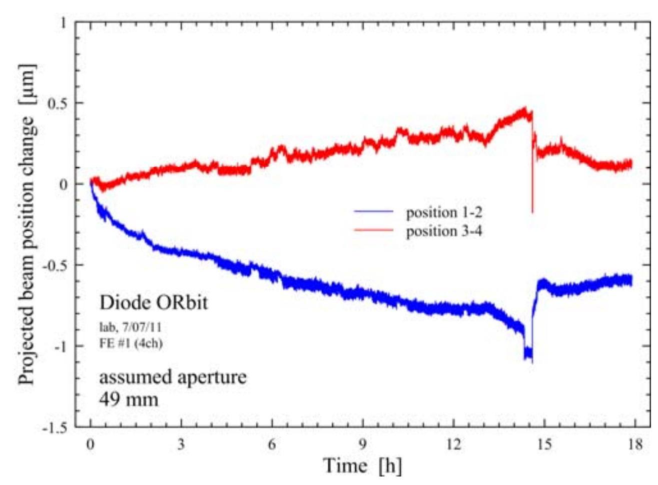
Lab measurements of the long term stability, raw ADC signals. 10 MHz sinewave is connected to all 4 system channels.



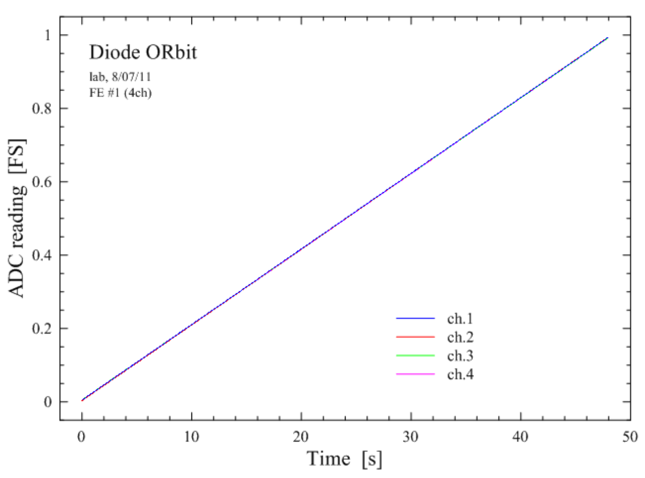
Drift of the raw signals shown in the left adjacent plot together with the variation of the front-end box internal temperature.



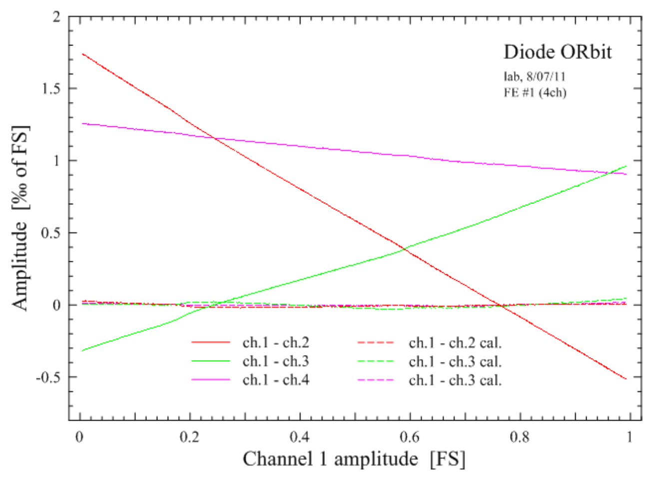
Projected beam positions assuming a pick-up with 49 mm electrode distance, like in the LHC arc pick-ups.



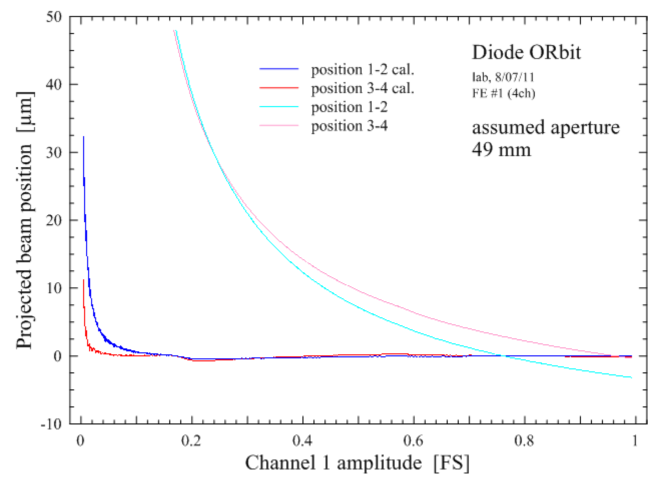
Drift of the projected positions shown in the adjacent left plot; no temperature compensation, no calibration used.



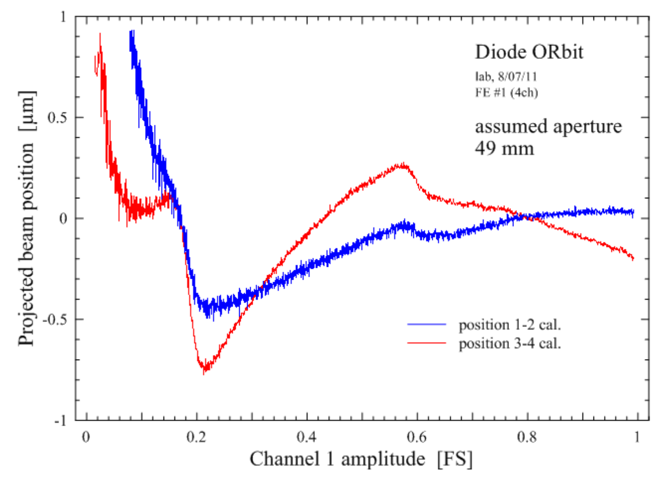
Lab linearity measurements with simulated centred beam, raw ADC signals. Input: 10 MHz sinewave with ramped amplitude.



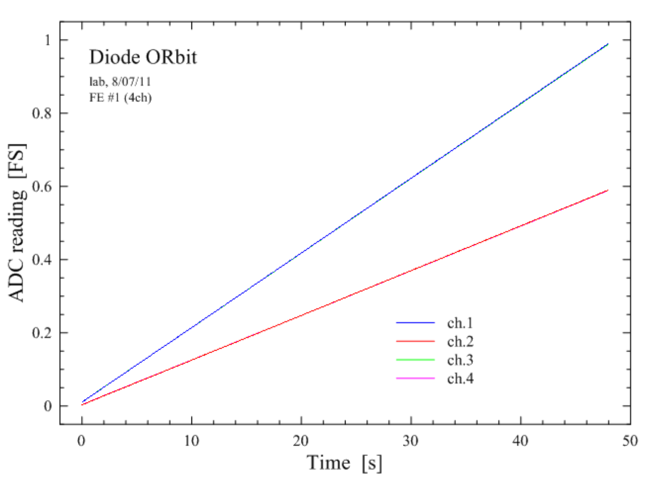
Differences of the signals shown in the left adjacent plot for raw signals and signals calibrated using correlation coefficients.



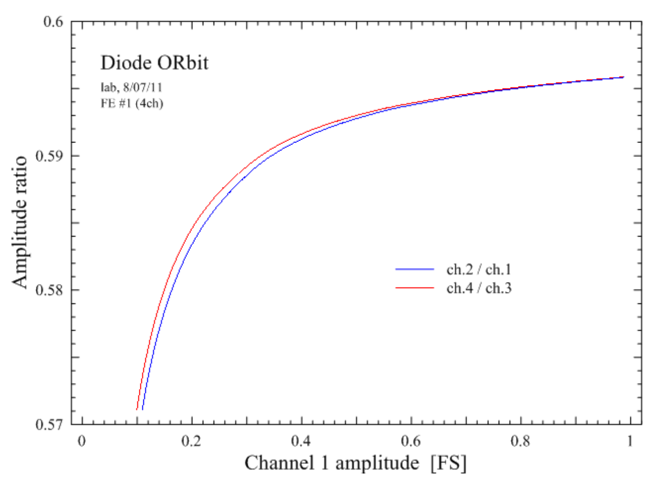
Projected beam positions assuming a 49 mm aperture pick-up, shown for both, raw and calibrated signals.



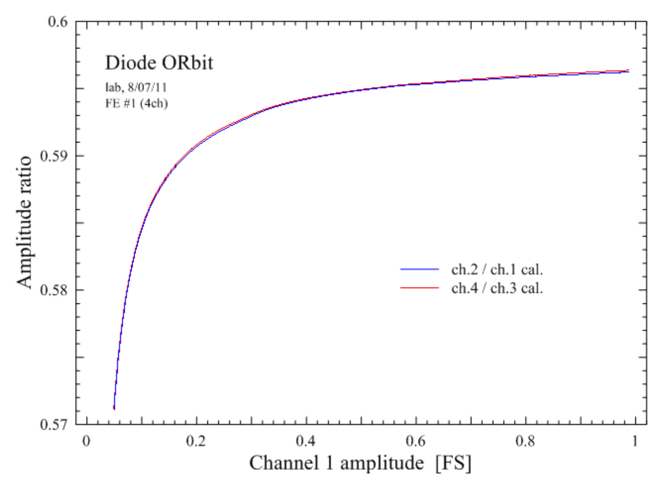
Projected beam positions assuming a 49 mm aperture pick-up, shown for calibrated signals only.



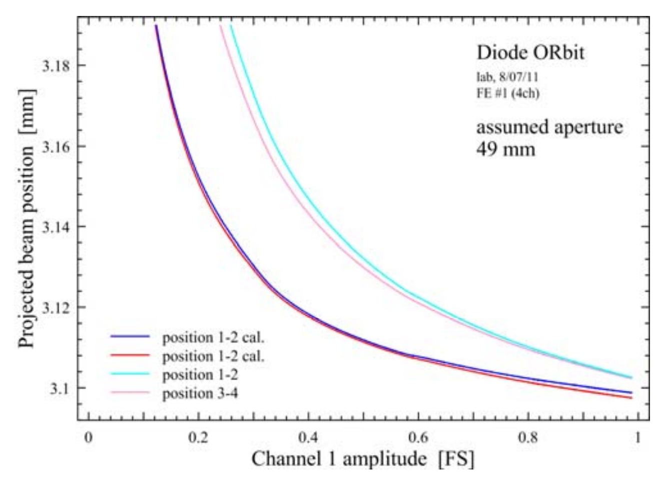
Lab linearity measurements with simulated off-centred beam, raw ADC signals. Input: 10 MHz sinewave with ramped amplitude.



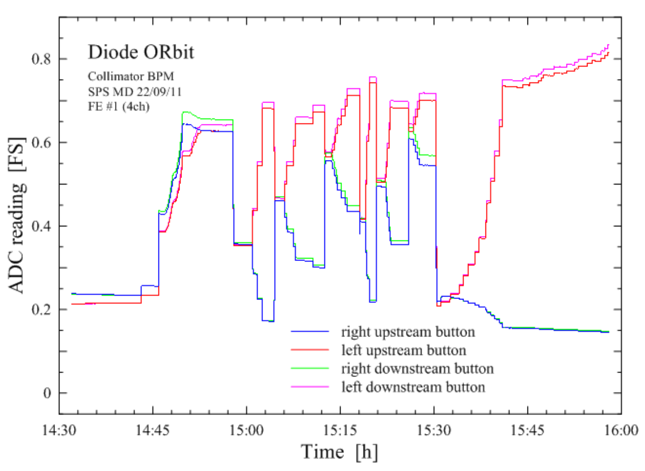
Ratios of the raw signals as a function of the input amplitude.



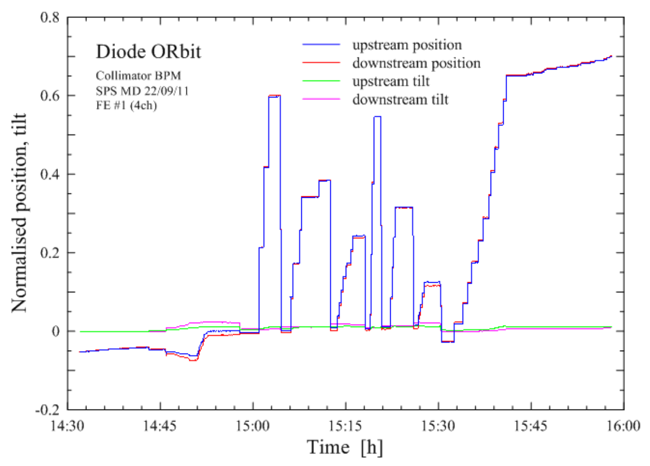
Ratios of the calibrated signals as a function of the input amplitude.



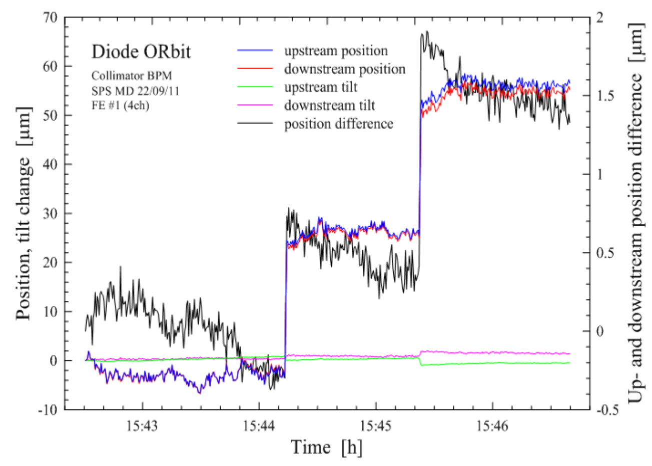
Projected beam positions assuming a 49 mm aperture pick-up, shown for both, raw and calibrated signals.



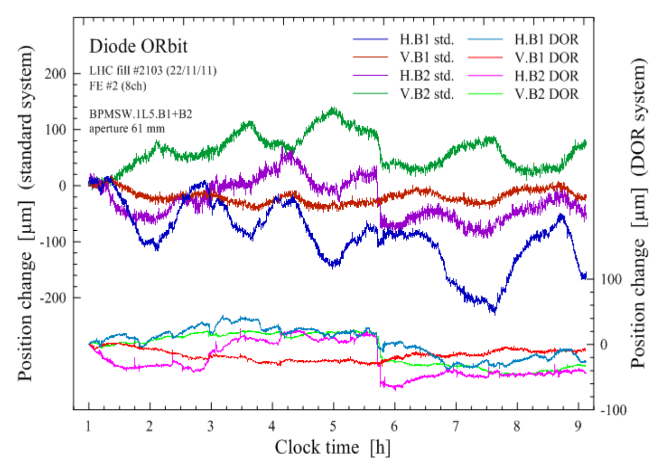
Measurement of the LHC collimator prototype with embedded button electrodes, raw signals from the 4 BPM ports, SPS beam.



Normalised positions and tilts derived from the raw signals shown in the adjacent left plot.



Position and tilt changes during motion of one collimator jaw. The difference of the upstream and downstream positions is shown (black).



LHC measurement: comparison of the DOR electronics to the standard LHC one. Both systems were connected to the same two LHC BPMs.