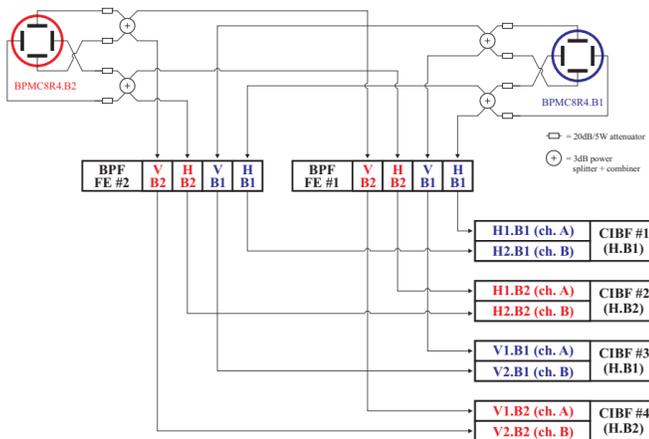
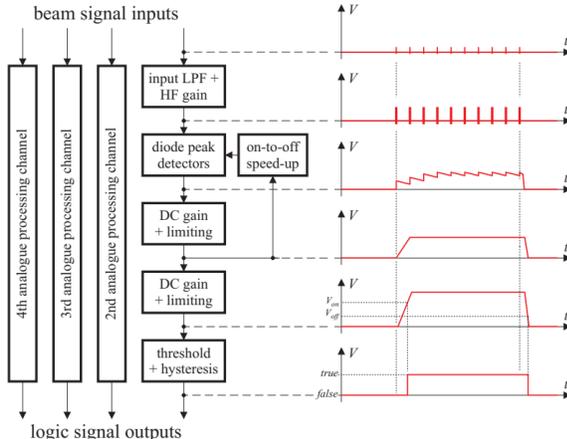


**Abstract.** Before injecting any high intensity bunches into the LHC a circulating low intensity pilot bunch must be present to confirm the correct settings of the main machine parameters. For the 2010 LHC run the detection of this pilot beam was done with the beam current transformer system. To increase redundancy of this important safety function a dedicated beam presence flag system was designed, built and tested with beam to be used operationally in the 2011 run. In this system signals from four electrodes of a beam position monitor (BPM) are processed with separate channels, resulting in a quadruple system redundancy for either beam. Each system channel consists of an analogue front-end converting the BPM signals into two logic states, which are then transmitted optically to the machine protection and interlock systems. For safety reasons the system does not have any remote control or adjustable elements and its only inputs are the beam signals. This paper describes the new LHC beam presence flag system, in particular the analogue front-end based on diode peak detectors.

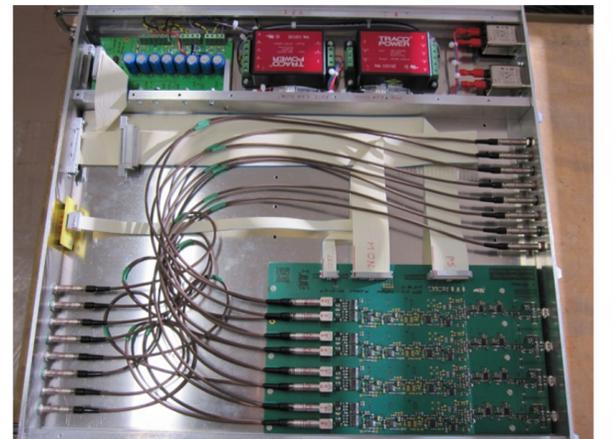
## Hardware



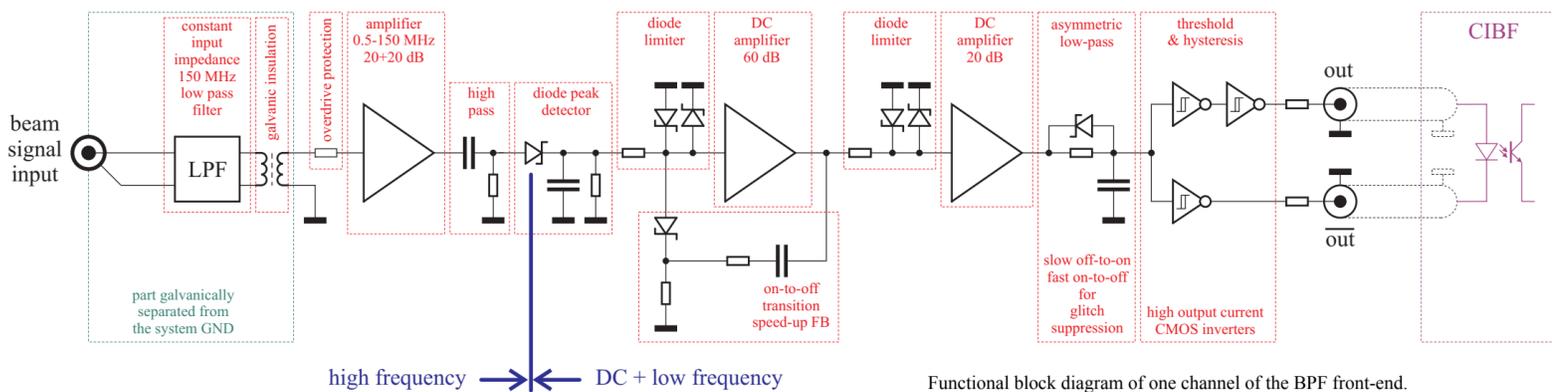
Architecture of the beam presence flag system with full quadruple redundancy.



Block diagram of the beam presence flag analogue front-end.



The beam presence flag front-end is built as a 19" 1U unit, with redundant two power supplies (MTBF > 75 year each).

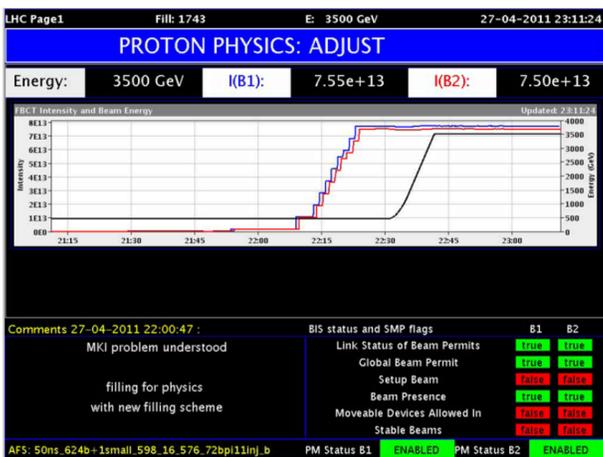


high frequency → ← DC + low frequency

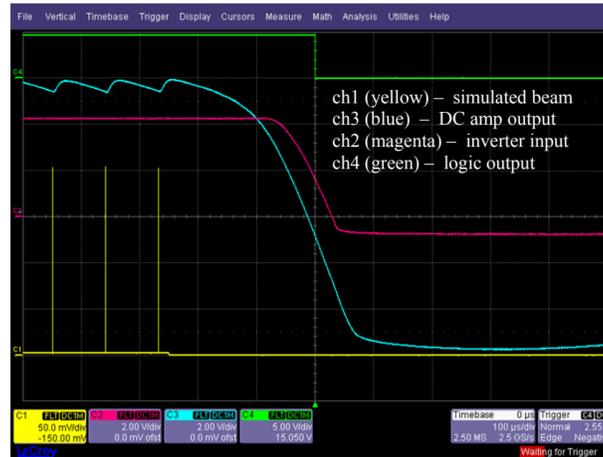
Functional block diagram of one channel of the BPF front-end.



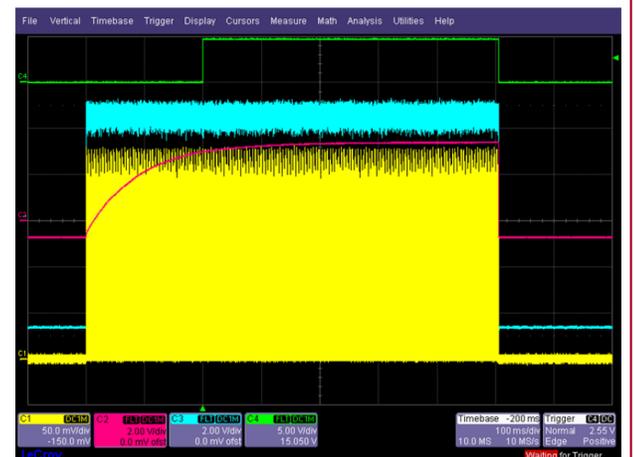
## Measurements



LHC page 1 with beam presence flags. Any high intensity injection is possible only with these flags on.



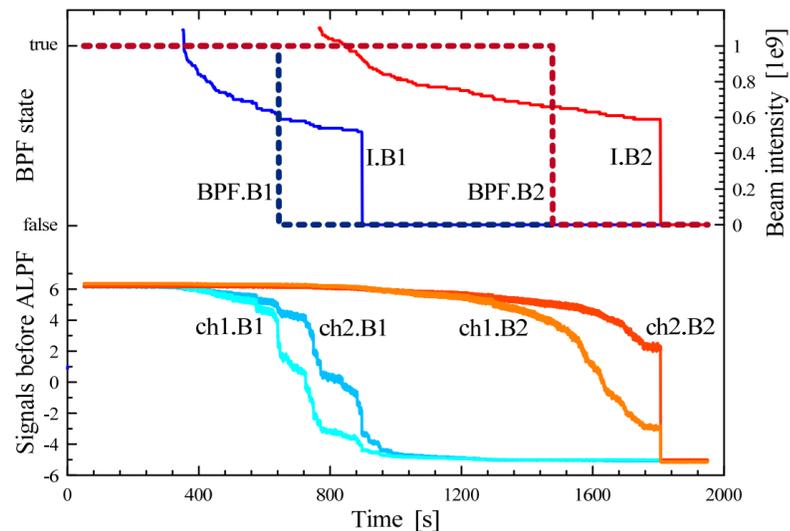
Measurement of the on-to-off transition time, horizontal scale is 100 μs/div.



Measurement of the off-to-on transition time, horizontal scale is 100 ms/div. Scope channel assignment as before.



Threshold measurement with the effect of the asymmetric low pass filter.



Left: measurement of the beam presence flag threshold with beam. Legend:

- BPF1.B1, BPF.B2 are beam presence flag signals;
- I.B1 and I.B2 are beam currents;
- ch1.B1, ch2.B1, ch3.B2 and ch4.B2 are signals before the asymmetric low pass filter;

The measured thresholds are around  $6e8$  protons. This is already with 20 dB attenuators on the front-end inputs, put there also for reliability reasons. As beam signal power can reach some 5 W, in this way on the system inputs the power dissipation is limited to some 50 mW per input.