Crosstalk measurements of the TRT FE electronics using test pulses.

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Abstract

The amplitude crosstalk is measured by injecting test pulses into a single channel and measuring the increase in pulse height of all other channels. The amplitude crosstalk is limited to channels that share the same connector to the straws. These show a crosstalk of up to 0.4 %.

1 Introduction

Crosstalk is a concern since it increases the occupancy in the TRT. For these measurements the FE flex board 8 with ASDBLR boards 16, 17 and 18 was used. The test pulse is injected via the single connector injector board where only one channel was connected to the pulser (the resistor connecting all other channels was removed).
An adequate measurement of the crosstalk is achieved by measuring the amplitude crosstalk. Since the threshold scans indicate a Gaussian pulse shape (fitting of error function to threshold scan always shows adequate description of data) the increase in occupancy can be calculated from the amplitude crosstalk. Measuring the increase in occupancy would have to be done for various thresholds and yields no more information than can be gained from the amplitude crosstalk.
Additionally any hardware connected to inject a test pulse will add noise which will increase the occupancy but will not affect the 50 % values measured for the amplitude crosstalk.

2 Measurements

In order to measure the amplitude crosstalk the input test pulse must be well out of range of the low threshold, i.e. the pulse height cannot be directly measured. Therefore the calibration is used to calculate the pulse height in DAC from the known pulse height in mV (measured with a digital oscilloscope).
The amplitude crosstalk is then measured by calculating the difference of the 50 % values of threshold scans with and without the test pulse. The background measurement (no test pulse) was performed before and after the threshold scans of the test pulses the difference (expected to be zero) is shown in fig. 1.

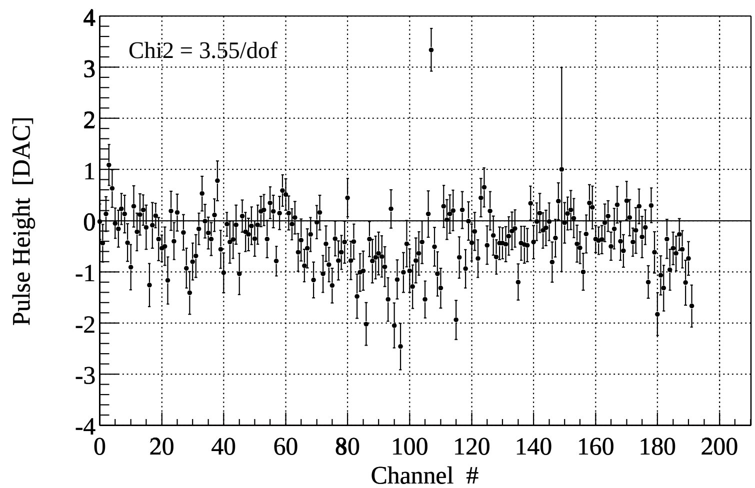

Figure 1: Cross-check of the background measurement. The graph shows the difference between the 50 % values measured before and after the threshold scans with injected pulses.

From the results of the two background measurements it is concluded that the system was stable throughout the data acquisition. The expected value of zero yields a $\chi^2 = 3.55$ per degree of freedom. Two test pulse heights were measured, with amplitudes of 283 mV and 506 mV which corresponds to 2200 DAC and 4000 DAC, respectively. Figure 2 shows the difference in the 50 % values of the background measurement and the test pulse scan of the 283 mV pulse. The channel receiving the input signal is indicated in the figure and is set to 0.

The DAC values are calculated from the calibration of the channel receiving the test pulse (Amplitude(DAC)= 7.83 DAC/mV · Ampli-

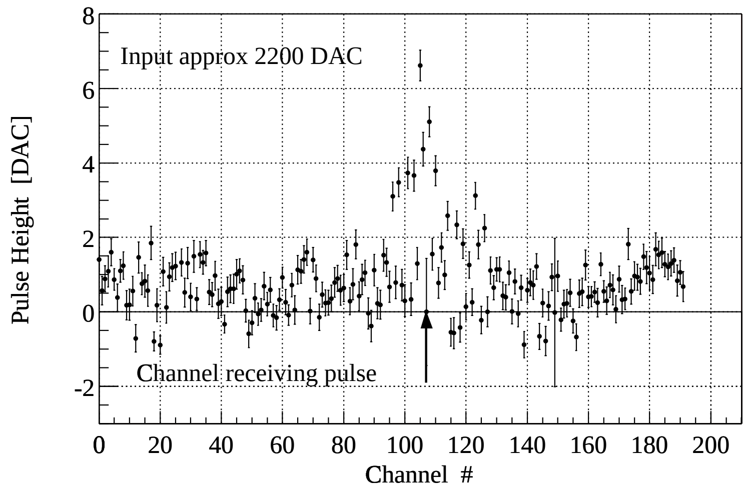

Figure 2: Crosstalk measurement with an input pulse height of 283 mV. The ordinate gives the difference in pulse height in units of DACs.

tude(mV) + 35.9 DAC). The accuracy of the calibration is approximately 10 %. This is estimated from the setup (variations in the outputs of the NIM modules) and from repeated calibration runs.
The energy corresponding to the two test pulses is about 12 keV and 24 keV.

3 Results

The input pulse heights in DAC are used to calculate the amplitude crosstalk in %. The data are shown in fig. 3 and fig. 4 for the input pulse of 283 mV and 506 mV, respectively.

The amplitude crosstalk is around 0.2 to 0.4 % for channels sharing the same connector to the straws (or injector board). For all other channels the amplitude crosstalk is below about 0.05 %. Both measurements give similar results although the lower input pulse yields slightly less crosstalk.
An expanded view of the 32 channels sharing the same connector is shown in fig. 5.

The channels showing significant crosstalk are all connected to the same side of the connector. The crosstalk is on the board level (not ASDBLR chip), however the amount of crosstalk from the injector board cannot be separated from that arising on the ASDBLR board. The measured values are therefore a conservative limit of the ampli-

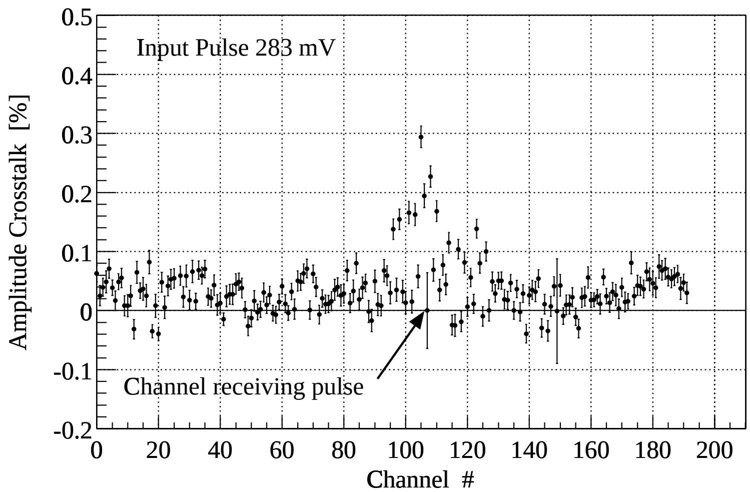

Figure 3: Amplitude crosstalk measured with an input pulse height of 283 mV (2200 DAC).

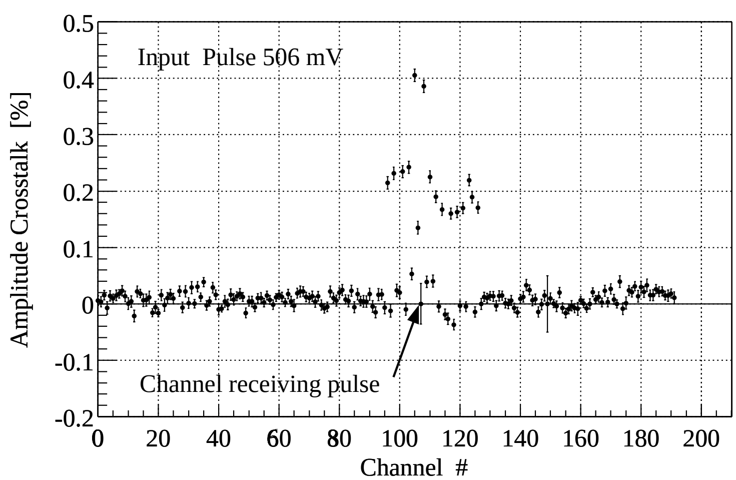

Figure 4: Amplitude crosstalk measured with an input pulse height of 506 mV (4000 DAC).

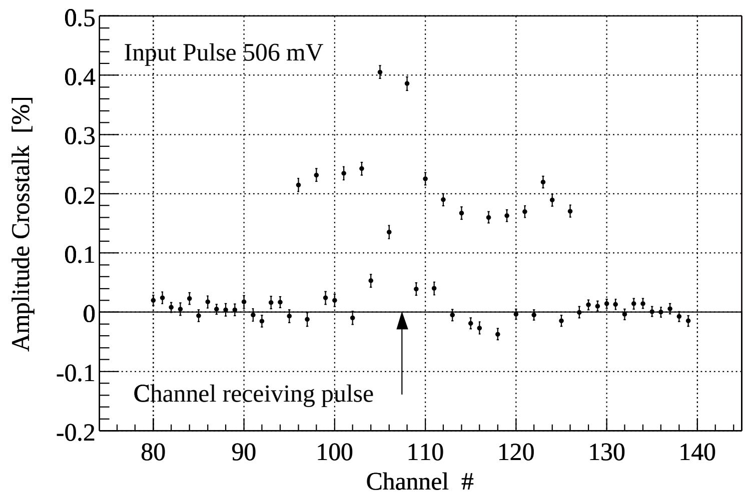

Figure 5: Expanded view of the amplitude crosstalk measured with an input pulse height of 506 mV (4000 DAC).

tude crosstalk.

The channel which was used for injecting the pulse is situated at the edge of the connector (not ideal), it is however not possible to use an other single channel without cutting tracks on the injector board (destroying it). It cannot be excluded that other channels might show higher crosstalk.