

# Pulser Test of ATLAS Muon Chambers

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At the cosmic ray test facility of the LMU a pulser test was developed in order to identify and fix noisy and dead channels.

In the pulser test trigger signals which initiate 5 V rectangle pulses are sent to the muon chambers. The signals, which are attenuated between 0 dB and 42 dB, are fed into the muon chambers on the HV-side. The remaining signals are counted at the read-out (RO) side of the chambers and are digitized using the standard MDT read-out system. A detailed description of the pulser test can be found in [1]. With attenuation distributions – as shown in figure 1 left – which indicate the characteristic relation between the applied attenuation and the hits counted for each mezzanine card and its channels, the amount of electronic noise as well as cross-talk between neighbouring tubes and its channels can be estimated. The red lines in figure 1 left indicate the threshold value which was determined at 90% of the number of main trigger signals.

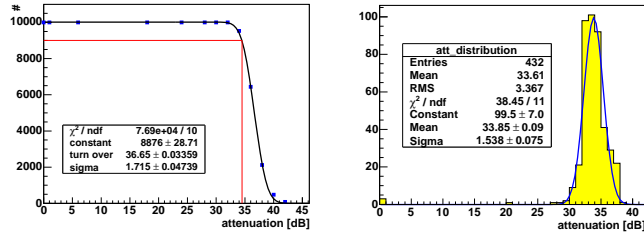


Fig. 1: Left: Attenuation distribution for channel 1 of mezzanine card 1, chamber BOS\_3A\_02. The distribution is fitted with an inverse error function. The red lines mark the attenuation threshold of 90% signal efficiency. Right: Attenuation thresholds for all channels of chamber BOS\_3A\_02.

In this context figure 1 right shows that all threshold values of the regarded chamber BOS\_3A\_02 (apin 013) are located between 27 dB and 38 dB. This behaviour is expected according to the known spread of  $\pm 6$  mV of the ASD chips' internal discriminator thresholds [2], available from the database [3].

The height of the output pulses at the RO side was simulated by Fourier analysis of the periodic pulse, applying the simplified equivalent network as a voltage divider and synthesizing the output signal. The corresponding equivalent network for the calculation is shown in figure 2.

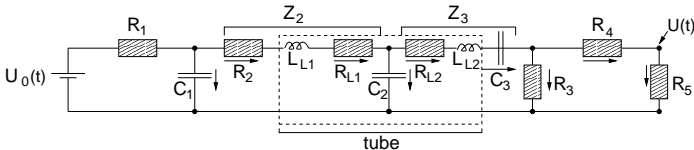


Fig. 2: Equivalent network for pulsertest of ATLAS chamber.  $R_1 = 1$  M $\Omega$ ,  $R_2 = 383$   $\Omega$ ,  $R_3 = 10$  k $\Omega$ ,  $R_4 = 10$   $\Omega$ ,  $R_5 = 240$   $\Omega$ ,  $R_{L1} = R_{L2} = \frac{1}{2} \cdot 44 \frac{\Omega}{m} \cdot 3.75$  m,  $L_{L1} = L_{L2} = \frac{1}{2} \cdot 5.12$   $\mu$ H,  $C_1 = 470$  pF,  $C_2 = 8.7 \frac{pF}{m} \cdot 3.75$  m and  $C_3 = 470$  pF.  $R_5 = 240$   $\Omega$  effects that the mezzanine cards use a differential read-out of  $U(t)$  with 120  $\Omega$  input impedance per line.

An input pulse of 5 V for tubes with a length of 3.75 m,

a diameter of 3.0 cm and wire diameter of 50  $\mu$ m therefore leads to a diminished pulse of about 210 mV at the RO side of the chamber, as shown in figure 3. For the simulation of the mezzanine card the preamplifier and the shaper stages of the ASD chip were represented by frequency-dependent phase-shift and gain [2].

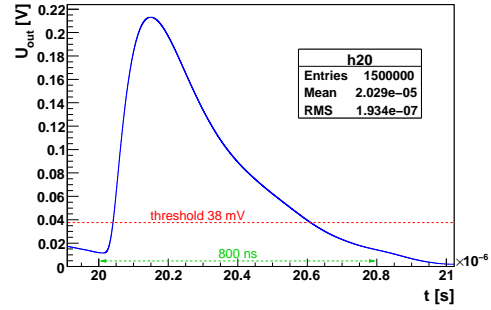


Fig. 3: Voltage at the discriminator input of the ASD chip on the mezzanine card of a muon chamber for  $U_0 = 5$  V.

The resulting pulse is compared with the internal threshold value [2] of 38 mV, which is indicated by the red line in figure 3. If the incoming signal exceeds this internal threshold within a time interval of 800 ns, an output pulse is recorded.

The relation between the output signal  $U_{out}$  and the applied attenuation is shown in figure 4. For an internal threshold of 38 mV (figure 4 left) the signal fails to pass the threshold at an attenuation of 15 dB which is not in very good agreement with the estimated threshold values, shown by figure 1 right.

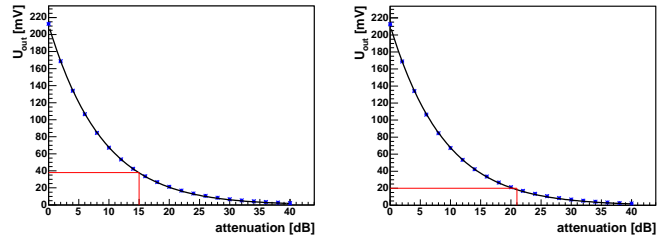


Fig. 4: Simulated output voltage versus applied attenuation for an internal threshold of 38 mV (left) and 20 mV (right).

Considering in addition the channels' internal offset [3] of up to (–)12 mV and the corresponding errors of  $\pm 6$  mV, the signal is recorded up to an attenuation of about 21 dB (figure 4 right). This range from 15 – 21 dB reasonably corresponds to the range of 27 dB to 38 dB found by the measurement. A reason for the slight deviation from the measured values might be that we have used a simplified description for the equivalent network of the pulser test which of course cannot cover all details of the signal line.

## References

- [1] M. Erlebach *et al.*, Annual report 2004, p. 35
- [2] C. Posch, E. Hazen and J. Oliver, “MDT-ASD, CMOS front-end for ATLAS MDT”, ATLAS Muon Note, ATL-MUON-2002-003.
- [3] Harvard BMC Database, <http://hepldb.harvard.edu/elec1/ASDmain.asp>