The RoentDek CFD1x and CFD7x time and pulse-height converters

RoentDek
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Supersonic Gas Jets
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Data Acquisition Systems
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The RoentDek **CFD1x** module is an advanced version of the RoentDek **CFD1c** constant fraction discriminator unit for determining the exact timing of a signal (i.e. from a micro-channel plate detector) and for additionally measuring the signal's pulse height. The pulse height information is coded as a time delay of a NIM-logic level transition with respect to the (NIM) timing signal from the CFD timing signal and can be recorded with a TDC or TAC unit.

Storing pulse height information with the time and/or position of a particle can be beneficial for reducing background and improving spatial or temporal resolution of a detector. Also an external signal's pulse height ("energy") information can be included into the data stream in coincidence.

For the properties of the CFD timing circuit which is identical in function to the **CFD1c** unit please refer to the separate description sheet resp. manual of the RoentDek **CFD** modules. Here we describe mostly the pulse height encoding function which is identical for the respective channel of the RoentDek **CFD7x** module [*].

The pulse-height is coded into the length of the CFDx signal (linear function) and also into the delay between the CFD signal and the stop signal. The leading edges of the CFD and CFDx signals determine the timing of the analog input signal (independent from its pulse height) like in the standard RoentDek **CFD** modules.

The **CFD1x** comes as a standalone box (W61mm/H129mm/L232mm, weight 0.9 kg) with an external 12 V DC mains adapter for use with 100-250 V AC sockets**.** The power consumption is max. 0.7 A at 12 V DC (< 10 W).

Figure 1: CFD1x module (above)

Figure 2: CFD7x module (below)

[*] The RoentDek **CFD7x** module is a special version of the RoentDek **CFD8c** and contains an identical circuit as the **CFD1x**: two of the standard CFD channels are replaced by a CFD1x-type circuit, yielding seven CFD channels plus one pulse height converting channel. The operation of this channel is identical to the **CFD1x** operation as described here. Please refer also to the **CFD8c** description/manual.

The following pictures of signal traces on an oscilloscope shall explain the function of the **CFDx** module. Except for figure 5 all signal traces are triggered by the “CFD out” signal (not shown).

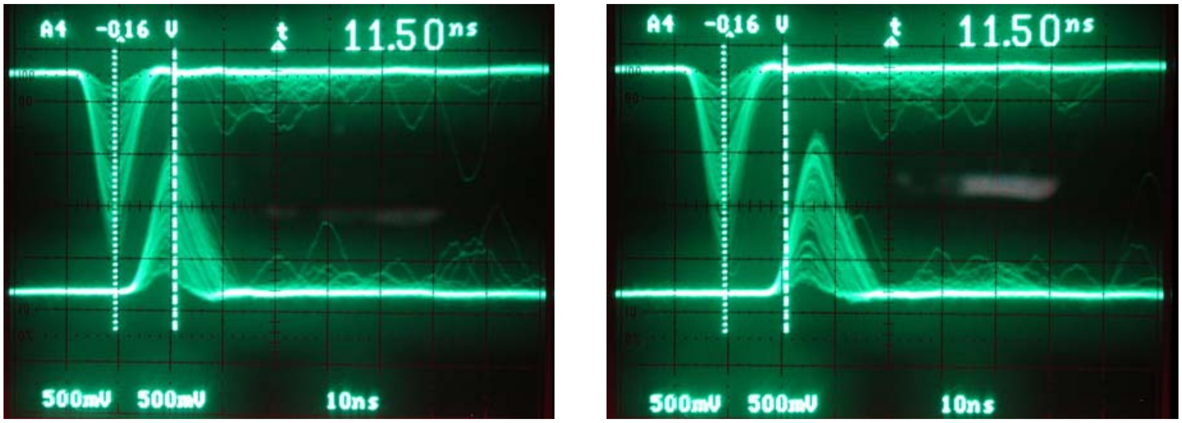

Figure 2: upper traces: input signal “in” (from alternative amplifier output), lower trace: Ramp Monitor Output (when the “ramp” is turned off) for using two different cable lengths between A_{in} and A_{out} sockets.

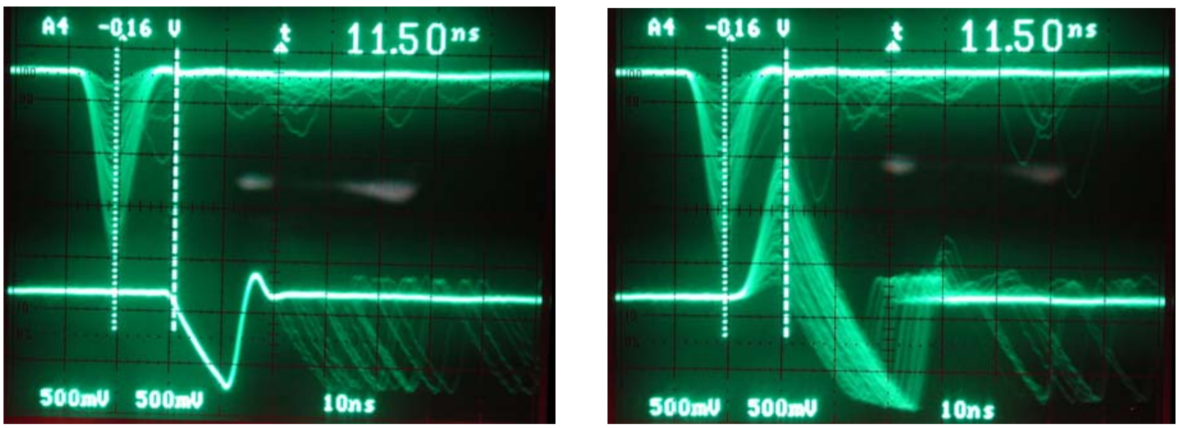

Figure 3: left: ramp on but no input in A_{in}, right: ramp on and A_{in} connected (for normal operation). If the start of the ramp without input in A_{in} appers at the same time as the signal maximum in figure 2 the cable length between A_{in} and A_{out} is optimally chosen (important: use same cable lengths for the oscilloscope inputs). As a thumb rule, the cable length between A_{in} and A_{out} should be of about same length as the “CFD delay” cable.

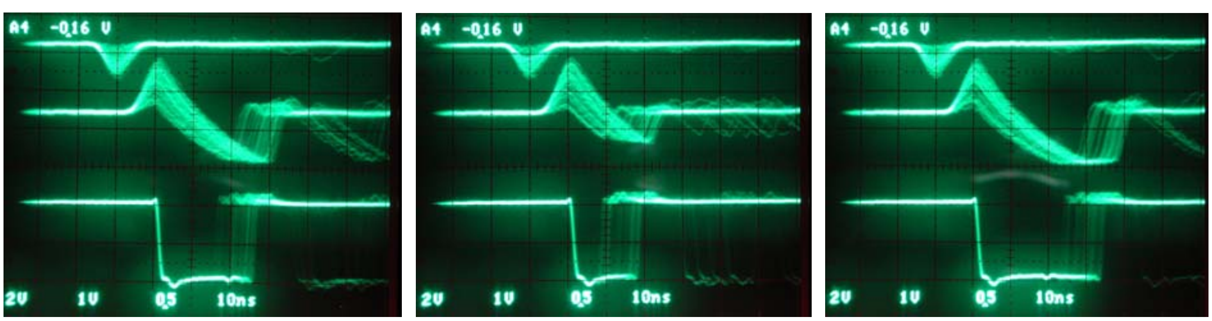

Figure 4: as figure 3 right, but with the “CFDx” output shown (lowest trace) and three different setting of the “width offset” potentiometer. The pulse-height/delay ratio(about 2V/15ns) is not affected by changing this setting, only the delay offset. The left picture shows a typical setting, in the middle picture the setting is optimized for low dead-time (which requires a low TDC dead-time), and in the right picture the offset is too high: The signal trace from the ramp monitor shows a flat base at the end, which it should not do.

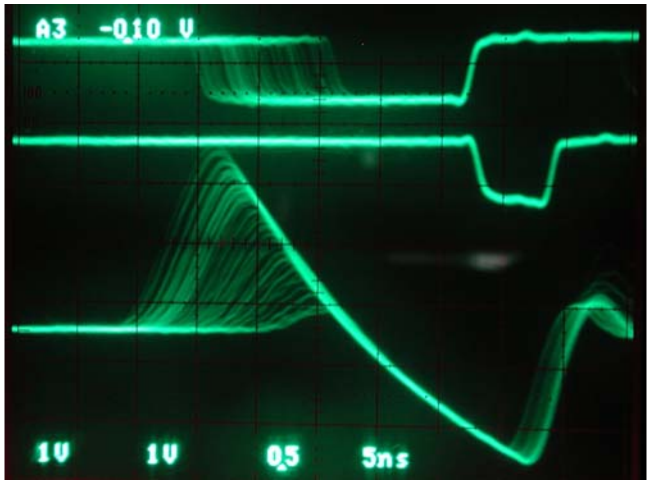

Figure 5: upper trace: "CFDx" output, middle trace: "stop" output (with a pulse width given by the "stop width" potentiometer setting), lower trace: ramp monitor, all traces triggered on the stop signal.
The stop signal should be used if there is a spare TDC channel available. It must *be used if the employed TDC/TAC has no decent multi-stop capability.*

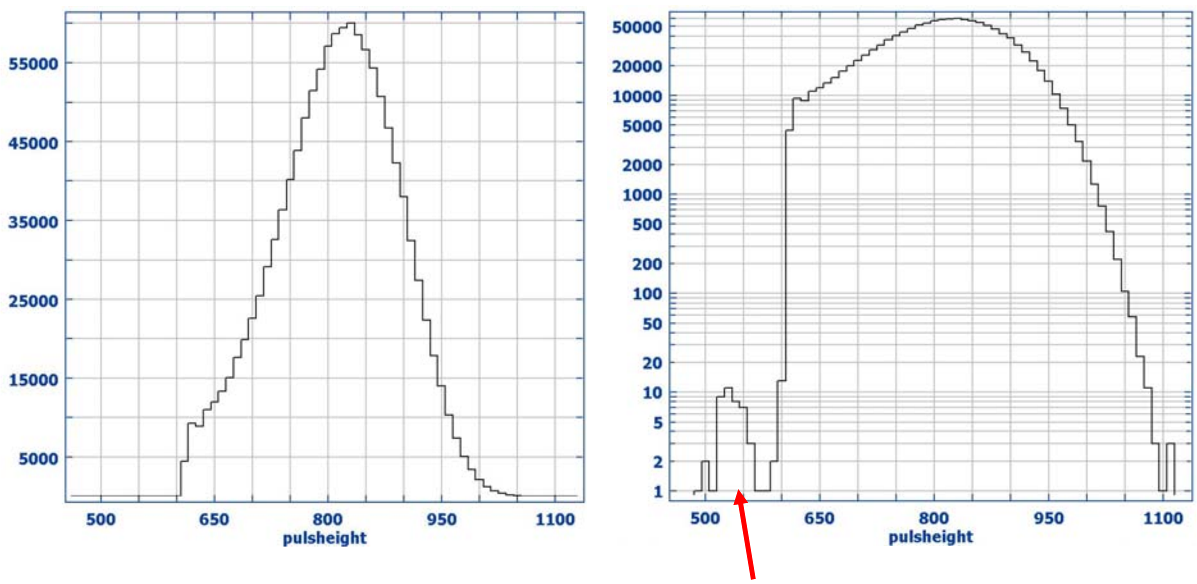

Figure 6: Lin and log plots of the pulse height distribution from a micro channel plate as obtained with a CFD1x. The peak for pulse height zero in the log plot (see arrow) was obtained by temporarily removing the input to A_{in} during data acquisition (as in Fig. 3 left). The position of this zero pulse height position in the histogram depends on the settings of the "min width" potentiometer. If the "stop" output is used the cable lengths to the TDC will also determine this offset position. The cut-off in the pulse height distribution near channel number 600 (one channel corresponds to 25 ps) is due to the CFD threshold setting.