The RoentDek CFD1x and CFD7x time and pulse-height converters

RoentDek Handels GmbH

Supersonic Gas Jets
Detection Techniques
Data Acquisition Systems
Multifragment Imaging Systems

The **RoentDek CFD1x** module is an advanced version of the **RoentDek CFD1c** constant fraction discriminator unit that determines not only the exact *timing* of a signal (i.e. from a micro-channel plate detector) but additionally measures the signal's *pulse height* via an additional ***CFDx*** circuit on board. It codes the pulse height information of the incoming signal into a pulse-height proportional time delay: Determining the delay between the NIM-logic level transitions from the timing circuit and from the *CFDx* circuit corresponds to a pulse height measurement. Both transitions can be recorded with a TDC (e.g. the **RoentDek TDC8HP**) or TAC unit. A *CFDx* circuit is also present in one channel of the **RoentDek CFD7x** module*.

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

The pulse-height is coded into the length of the "*CFDx Out*" signal and also into the delay between the "*CFD Out*" (timing) signal and the "*Stop*" signal. The leading edges of these *CFD* and *CFDx* signals determine the timing of the analog input signal (independent from its pulse height), like in the standard **RoentDek CFD** modules (please refer in the respective manual or description sheet about properties of the internal CFD timing circuit).

In combination with a **RoentDek DLD** or **Hex** detector the *CFDx* circuit can track local MCP degradation and local gain saturation effects at high rate operation. It also allows refining imaging response by off-line filtering of signals with too high/low pulse heights ("variable threshold"). It also helps optimizing CFD settings (CFD walk control, tracking pre-trigger signals) and can be used compensating CFD/MCP walk and such improve spatial and temporal resolution

Figure 1: CFD1x

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).

* 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, one of those with pulse height converting function. The operation of this channel is identical to the **CFD1x** operation as described here. Please refer also to the **CFD8c** description/manual.

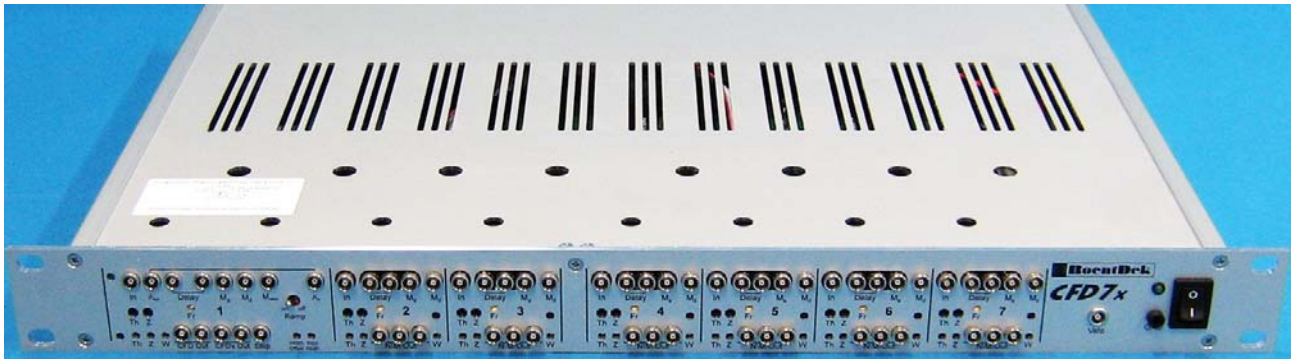

Figure 2: CFD7x version of the CFD8c module hosting six standard CFD circuits and one CFD1x-equivalent. Size, weight and power consumption are identical to the CFD8c.

The following pictures of signal traces on an oscilloscope shall explain the function of the **CFDx** module.

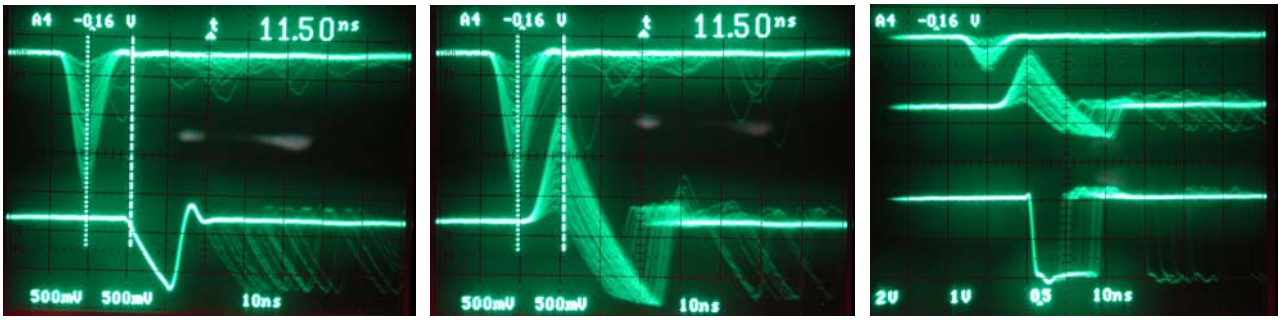

Figure 3: left: ramp on but no input in A_{in}, middle: ramp on and A_{in} connected (for normal operation). Right: Lower trace shows the CFDx output signal, its width coding input signal pulse height. All signals are triggered by the "CFD out" signal (not shown).

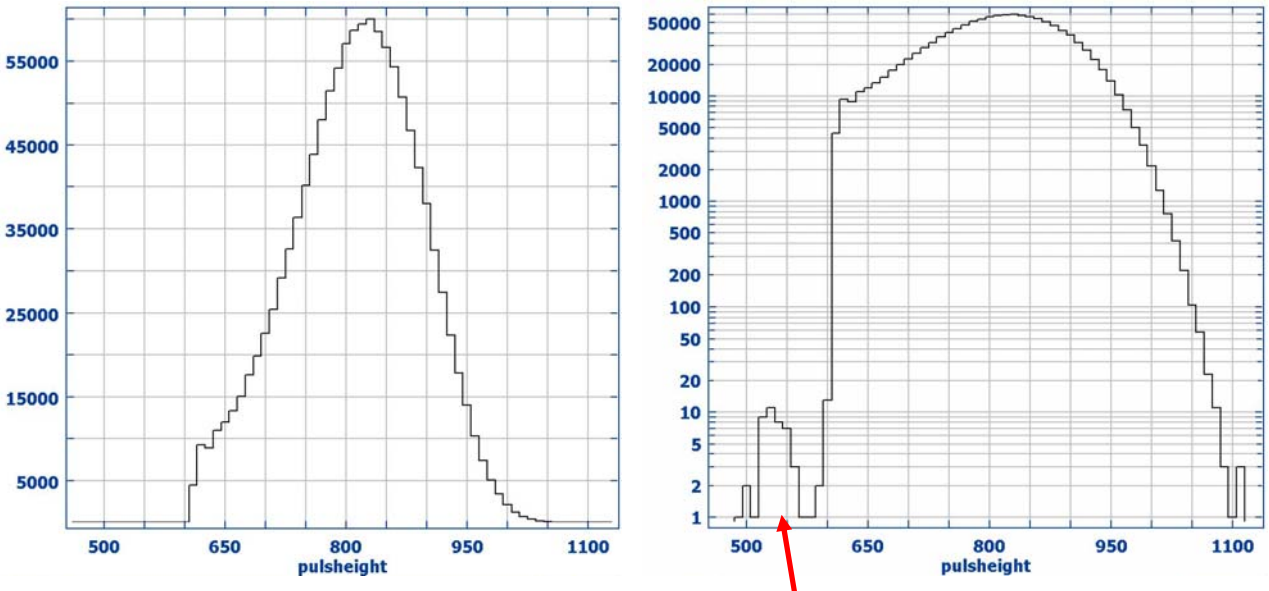

Figure 3: Lin and log plots of the pulse height distribution from a micro channel plate as obtained with a CFD1x. The peak for pulse height zero in the log plot (see arrow) was obtained by temporarily removing the input to A_{in} during data acquisition (as in Figure 3 left). The position of this zero 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 (here: one channel corresponds to 25 ps) is due to the CFD threshold setting.