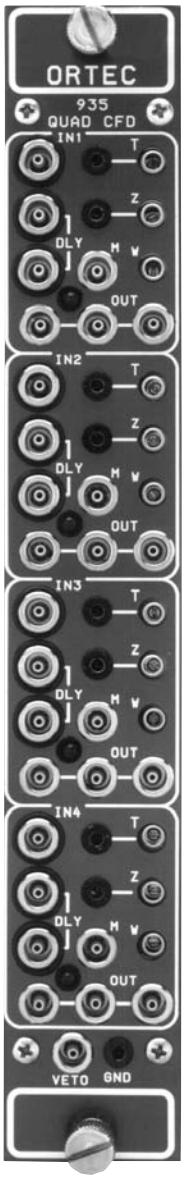
ORTEC®

935

Quad 200-MHz Constant-Fraction Discriminator

- **Constant-fraction timing on signals as narrow as 1 ns FWHM — ideal for microchannel plates, fast photomultiplier tubes, fast scintillators, and fast silicon detectors**
- **Ultra-low walk, guaranteed <±50 ps (typically <±25 ps) over a 100:1 dynamic range**
- **Pulse-pair resolving time <5 ns**
- **Quick and accurate walk adjustment with a zero-crossing signal monitor that displays the full amplitude range**
- **Blocking or updating outputs with adjustable widths**
- **Selectable functions for each of the four channels include a fast veto input, individual gates with coincidence/anticoincidence options, and a bin gate**



The Model 935 Quad 200-MHz Constant-Fraction Discriminator incorporates four separate and independently adjustable timing discriminators in a single-width NIM module. Except where indicated otherwise, the descriptions and specifications apply to each of the four channels in the module.

The ability of the Model 935 to provide constant-fraction timing on fast, negative-polarity signals as narrow as 1 ns (FWHM) makes it ideal for use with microchannel plates, fast photomultiplier tubes, fast scintillators, and fast silicon detectors. The exceptionally low walk delivered by the Model 935 is vital in achieving the excellent time resolution inherent in these fast detectors over a wide dynamic range of pulse amplitudes. The Model 935 can also be used with scintillators such as NaI(Tl) which have long decay times. To prevent multiple triggering on the long decay times, the width of the blocking output can be adjusted up to 1 µs in duration.

The Model 935 uses the constant-fraction timing technique to select a timing point on each input pulse that is independent of pulse amplitude. When properly adjusted, the generation of the output logic pulse corresponds to the point on the leading edge of the input pulse where the input pulse has risen to 20% of its maximum amplitude. To achieve this constant-fraction triggering, the input pulse is inverted and delayed. The delay time is selected by an external delay cable (DLY) to be equal to the time taken for the input pulse to rise from 20% of maximum amplitude to maximum amplitude. Simultaneously, the prompt input signal is attenuated to 20% of its original amplitude. This attenuated signal is added to the delayed and inverted signal to form a bipolar signal with a zero crossing. The zero crossing occurs at the time when the inverted and delayed input signal has risen to 20% of its maximum amplitude. The zero-crossing discriminator in the Model 935 detects this point and generates the corresponding timing output pulse.

"Walk" is the systematic error in detecting the time for the 20% fraction as a function of input pulse amplitude. Minimizing walk is important when a wide range of pulse amplitudes must be used, because walk contributes to the time resolution. The Model 935 uses a transformer technique for constant-fraction shaping to achieve the exceptionally wide bandwidth essential for processing input signals with subnanosecond rise times. As shown in Fig. 1, this results in a walk guaranteed <±50 ps and typically <±25 ps over a 100:1 dynamic range of input pulse amplitudes. The patented shaping technique also provides a zero-crossing monitor output that facilitates quick and accurate walk adjustment, because it displays the full input signal amplitude range.

The extremely short pulses from microchannel plate multipliers and ultra-fast photomultiplier tubes require very short constant-fraction shaping delays. To accommodate

these detectors, the Model 935 incorporates a selectable compensation for the inherent internal delay.

The Model 935 includes a number of controls that considerably broaden its utility. The threshold discriminator is useful for rejecting low-level noise. A front-panel test point permits precise measurement of its setting in the range from –20 to –1000 mV. Each channel provides three bridged timing outputs. These are standard, fast negative NIM outputs. The outputs can be selected to have either updating or blocking characteristics. The updating mode is useful for reducing dead time in overlap coincidence experiments. The blocking mode simultaneously minimizes multiple triggering and dead time on scintillators with long decay times. The output pulse width is adjustable from <4 ns to >200 ns in the updating mode, and from <5 ns to >1 µs in the blocking mode. The pulse-pair resolution is <5 ns at minimum pulse width in the updating mode.

Switches on the printed circuit board allow selection of which channels will respond to the front-panel fast-veto input. Additional fast gating capability is provided by individual gate inputs for each channel on the rear panel. The mode of these separate gate inputs can be individually selected to be either coincidence or anticoincidence via DIP switches on the printed circuit board. Each channel can also be programmed to ignore or respond to the slow bin gate signal on pin 36 of the power connector for NIM bins incorporating that signal.

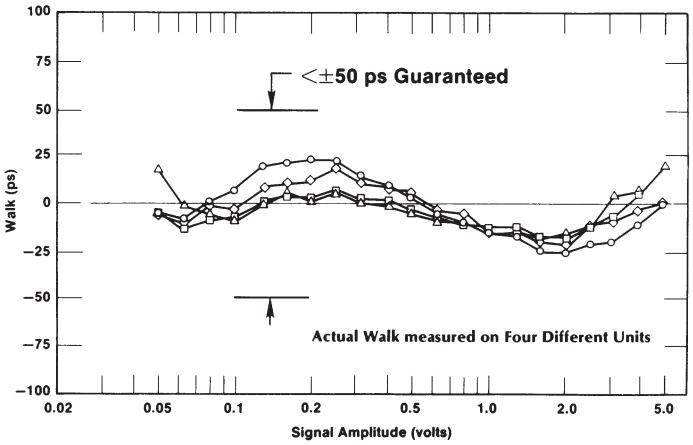


Fig. 1. Actual Walk Measured on Four Different Units.
See Walk Specification for Measurement Conditions.

Specifications

The Model 935 contains four independent and identical constant-fraction discriminators. Except where stated otherwise, the descriptions and specifications are given for an individual channel, and apply to each of the four channels.

PERFORMANCE

WALK Guaranteed <±50 ps (typically <±25ps) over a 100:1 dynamic range. Measured under the following conditions: input pulse amplitude range from 50 mV to 5 V, rise time <1 ns, pulse width 10 ns, external shaping delay approximately 1.6 ns (33 cm or 13 in.), internal offset delay enabled, threshold approximately 20 mV.

CONSTANT FRACTION 20%.

PULSE-PAIR RESOLUTION <5 ns in the updating mode, <7 ns in the blocking mode.

INPUT/OUTPUT RATE Operates at burst rates >200 MHz in the updating mode, and >150 MHz in the blocking mode.

TRANSMISSION DELAY Typically <13 ns with 1.6-ns external delay.

OPERATING TEMPERATURE RANGE 0 to 50°C.

THRESHOLD TEMPERATURE SENSITIVITY <0.01%/°C, from 0 to 50°C. Threshold referenced to the –12 V supply level supplied by the NIM bin.

TRANSMISSION DELAY TEMPERATURE SENSITIVITY <±10 ps/°C from 0 to 50°C.

CONTROLS

THRESHOLD (T) A front-panel, 20-turn screwdriver adjustment for each discriminator channel sets the minimum pulse amplitude that will produce a timing output. Variable from –20 to –1000 mV. A front-panel test point located to the left of the threshold adjustment monitors the discriminator threshold setting. The test point voltage is 10X the actual threshold setting. Output impedance: ≤2 kΩ.

WALK ADJUSTMENT (Z) A front-panel, 20-turn screwdriver adjustment for fine-tuning the zero-crossing discriminator threshold to achieve minimum walk. Adjustable over a ±15 mV range. A front-panel test point located to the left of the walk adjustment monitors the actual setting of the zero-crossing discriminator. Output impedance, 1 kΩ.

OUTPUT WIDTH (W) A front-panel, 20-turn screwdriver adjustment for each discriminator channel sets the width of the three output logic pulses. The range of width adjustment depends on the positions of jumpers W2 and W3.

B GATE ON/OFF Rear-panel switch turns the Bin Gate on or off for all channels programmed to accept the Bin Gate.

GATE COIN/ANTI A printed wiring board DIP switch selects either the coincidence or anticoincidence mode for the individual channel's response to the rear-panel gate input.

VETO YES/NO A printed wiring board DIP switch selects whether or not an individual channel will respond to the front-panel VETO input.

BIN GATE YES/NO A printed wiring board DIP switch selects whether or not an individual channel will respond to the bin gate signal.

INTERNAL OFFSET DELAY (W1) Printed wiring board jumper W1 is normally omitted to enable the 1.7-ns internal offset delay. This delay compensates for internal delays and makes it possible to implement the very short shaping delays required with 1-ns input pulse widths. With jumper W1 installed, the minimum shaping delay is limited by a +0.7-ns internal contribution. With W1 omitted, the internal delay contribution is effectively –1.0 ns. The Model 935 is shipped from the factory with the W1 jumper omitted. Spare jumpers for this position are located in the storage area towards the rear of the module.

UPDATING/BLOCKING MODE (W2) The printed wiring board jumper W2 selects either the updating mode (U), or the blocking mode (B) for the output pulse widths. In the blocking mode, a second input pulse will generate no output pulse if it arrives within the output pulse width W caused by a previous input pulse. In the updating mode, a second input pulse arriving within the output pulse width W from a previous pulse will extend the output pulse, from the time of arrival, by a length W. The Model 935 is shipped from the factory in the updating mode.

OUTPUT PULSE WIDTH RANGE (W3) The printed wiring board jumper W3 selects the range of output width adjustment as listed in Table 1. The Model 935 is shipped from the factory with the W3 jumper omitted. Spare jumpers for this position are located in the storage area towards the rear of the module.

INPUTS

IN1, IN2, IN3, or IN4 A front-panel LEMO connector input on each channel accepts the fast linear signal from a detector for constant-fraction timing. Linear range from 0 to –10 V. Signal input impedance, 50 Ω, dc-coupled; input protected with diode clamps at ±10 V. Input reflections <10% for input rise times >2 ns.

GATE INPUTS 1, 2, 3, or 4 A rear-panel BNC connector for each channel accepts a negative, fast NIM logic signal to gate the respective constant-fraction timing output. Coincidence or anticoincidence gating is selected by a printed wiring

board DIP switch (See GATE COIN/ANTI). Input impedance, 50 Ω. For proper gating operation, the leading edge of the GATE INPUT should precede the IN1 (IN2, IN3, or IN4) signal by 1 ns and have a width equal to the CF Shaping Delay plus 5 ns.

VETO A single, front-panel LEMO connector accepts NIM negative fast logic pulses to inhibit the timing outputs on all the channels chosen with the VETO YES/NO switch. Input impedance, 50 Ω. For proper FAST VETO operation, the leading edge of the VETO signal must precede the IN1 (IN2, IN3, or IN4) signal by 3 ns and have a width equal to the CF Shaping Delay plus 5 ns.

BIN GATE A slow master gate signal enabled by the rear-panel B GATE ON/OFF switch permits gating of the timing outputs when the Model 935 is installed in a bin that provides a bin gate signal on pin 36 of the NIM power connector. Clamping pin 36 to ground from +5 V inhibits operation of all channels selected by the BIN GATE YES/NO switch.

OUTPUTS

CF SHAPING DELAY (DLY) A front-panel pair of LEMO connectors for selecting the required constant-fraction shaping delay. A 50-Ω cable is required. For triggering at a 20% fraction, the length of the shaping delay is approximately equal to the time taken for the input pulse to rise from 20% of its full amplitude to full amplitude.

CF MONITOR (M) Permits observation of the constant-fraction shaped signal through a LEMO connector on the front panel. Output impedance, 50 Ω, ac-coupled. The monitor output is attenuated by a factor of approximately 5 with respect to the input when driving a terminated 50-Ω cable.

OUT Three bridged, updating or blocking, fast negative NIM output signals, furnished through front-panel LEMO connectors, mark the CF zero-crossing time. Amplitude –800 mV on 50-Ω load. Each output connector has its own 51-Ω resistor in series with the common output driver.

GND Front-panel test point provides a convenient ground connection for test probes.

EVENT-OCCURRED LED Front-panel LED for each channel indicates that an output signal has occurred.

ELECTRICAL AND MECHANICAL

POWER REQUIREMENTS The Model 935 derives its power from a NIM bin/power supply. Required dc voltages and currents are: +24 V at 0 mA; +12 V at 33 mA; +6 V at 225 mA; –6 V at 1400 mA; –12 V at 169 mA; –24 V at 55 mA.

WEIGHT

Net 1.1 kg (2.6 lb).
Shipping 2.0 kg (4.4 lb).

DIMENSIONS NIM-standard single-width module, 3.43 X 22.13 cm (1.35 X 8.714 in.) per DOE/ER-0457T.

Ordering Information

To order, specify:

Model	Description
935	Quad 200-MHz Constant-Fraction Discriminator

ORTEC®
www.ortec-online.com
Tel. (865) 482-4411 • Fax (865) 483-0396 • ortec.info@ametek.com
801 South Illinois Ave., Oak Ridge, TN 37831-0895 U.S.A.
For International Office Locations, Visit Our Website
AMETEK® ADVANCED MEASUREMENT TECHNOLOGY