- **Constant-fraction timing with fast SCA pulse height selection**
- **Excellent time resolution over a wide range of pulse amplitudes with scintillation and semiconductor detectors**
- **Differential, integral, constant-fraction, and slow-rise-time reject modes**
- **Upper- and lower-level thresholds adjustable from –30 mV to –5 V**
- **Time walk ≤±75 ps over 100:1 dynamic range**
- **Adjustable output pulse width**

The ORTEC Model 583B Constant-Fraction Differential Discriminator is a versatile, and high-performance unit suitable for the most exacting applications in timing spectroscopy. When operated in the Differential Mode, the Model 583B is ideal for use with fast scintillators and photomultiplier tubes. The dual discriminator levels allow this unit to function as a fast single-channel analyzer (SCA) in a fast-timing coincidence system, thus eliminating the need for separate slow-energy side channels. When used in the Integral Mode, the Model 583B is ideal for use with large-volume HPGe detectors and silicon charged-particle detectors operated in the traditional fast/slow coincidence system.

The input constant-fraction circuit uses a transformer and passive circuit pulse shaping technique to achieve better walk performance. It also provides a Monitor Output signal that is a linear representation of the constant-fraction shaped signal. This greatly simplifies the walk adjustment for optimum timing.

The use of surface-mount circuits in the Model 583B has greatly improved the time resolution obtainable at wide dynamic range when using fast scintillators. The excellent time resolution vs. dynamic range obtainable with this unit is shown in Fig. 1. The block diagram of the fast-timing coincidence system in which the Model 583B was used to obtain these results is shown in Fig. 2.

An additional benefit of the Model 583B is that it can greatly improve the data rate capability of a timing experiment. As shown in Fig. 2, the energy selection and coincidence decisions can be made before the time-to-amplitude conversion. This means the time-to-amplitude converter (TAC) must provide conversions only at the true coincidence rate rather than at the much higher single-event rate. Thus, high-count-rate problems in the TAC circuit are significantly reduced.

At the same time, the Model 583B provides simple and convenient operation. Only a few adjustments are needed for normal operation. The upper- and lower-level discriminators set the energy window for energy selection. The Integral/Differential switch determines whether the unit is to be used as a fast SCA or as an integral discriminator. The Constant-Fraction/ Slow-Rise-Time Reject control gives the user the flexibility to achieve good timing even where some relatively slow-rise-time signals are present. An adjustable output pulse width is

provided to prevent multiple triggering on scintillation detectors with long decay times, such as NaI(Tl). The external Constant-Fraction Shaping Delay and Walk Adjustment should be optimized for each application.

Specifications

PERFORMANCE

INPUT PULSE Accepts negative input pulses from 0 V to –10 V without saturation; input protected against overload; reflections ≤10% for input rise time ≥2 ns.

DISCRIMINATOR RANGES
Upper Level –30 mV to –5 V.
Lower Level –30 mV to –5 V.

THRESHOLD INTEGRAL NONLINEARITY ≤±0.5% of full scale.

THRESHOLD INSTABILITY ≤±0.1 mV/°C, 0 to 50°C.

TIME WALK ≤±75 ps for 100:1 dynamic range; Integral Mode, with external shaping delay ~2 ns, input rise time ≤1 ns, input pulse width ~10 ns, threshold = 30 mV.

PROPAGATION DELAY Nominally 18 ns, with external shaping delay ~2 ns.

BLOCKING WIDTH Variable from ≤15 to ≥1000 ns.

MINIMUM PULSE-PAIR RESOLUTION ~50 ns for input pulse width ≤10 ns, or pulse width at the arming threshold +40 ns for input pulse width ≥10 ns.
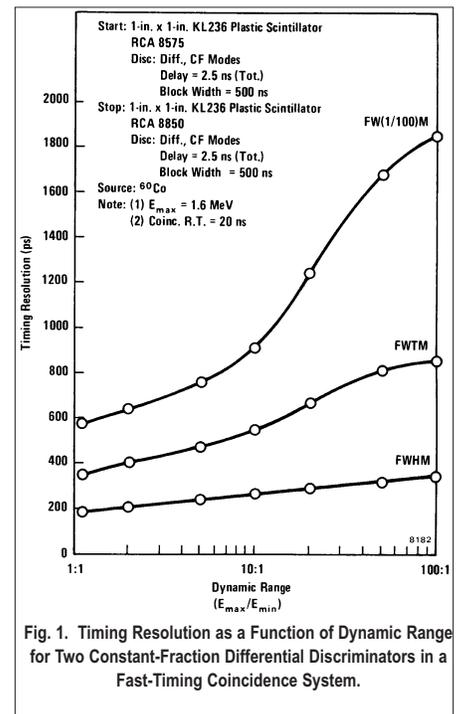

Fig. 1. Timing Resolution as a Function of Dynamic Range for Two Constant-Fraction Differential Discriminators in a Fast-Timing Coincidence System.

CONTROLS

UPPER LEVEL Front-panel 5-turn precision locking potentiometer used to determine the threshold setting for the Upper-Level discriminator.

LOWER LEVEL Front-panel 5-turn precision locking potentiometer used to determine the threshold setting for the Lower-Level discriminator. Also automatically adjusts the threshold level for the constant-fraction pickoff arming discriminator. Adjustable internally from 0.5 to 1.0 times the Lower-Level threshold (factory set to 0.5).

DISCRIMINATOR MODE Front-panel 2-position locking toggle switch selects one of two modes:
Diff (Differential) Functions as a single-channel analyzer (SCA). The Lower-Level (LL) and Upper-Level (UL) thresholds are each independently adjustable from –30 mV to –5 V. To produce an output pulse, the input signal must cross the LL threshold and must not cross the UL threshold within approximately 10 ns after the constant-fraction zero-crossing time.
Int (Integral) Functions as an integral discriminator. The LL threshold sets the minimum input signal amplitude required to produce an output pulse. The UL discriminator is not used to determine the timing response from the instrument.

TIMING MODE Front-panel two-position locking toggle switch selects one of two modes:
CF (Constant Fraction) The instrument operates in the constant-fraction timing mode. The constant-fraction attenuation factor is internally set at 0.2. An external 50-Ω cable must be provided for the constant-fraction shaping delay.
SRT (Slow Rise Time) Reject Inhibits output signals that would be produced by leading-edge timing from the LL and UL discriminators. An input signal that does not cross the LL threshold before the constant-fraction zero-crossing time does not produce an output pulse. In the Diff Mode, an input signal that does not cross the UL threshold before the constant-fraction zero-crossing time will not be inhibited by the UL discriminator from producing an output pulse.

DELAY A pair of front-panel BNC connectors that accept 50-Ω coaxial cable to set the required constant-fraction shaping delay; total delay is ~0.7 ns plus the delay of the external cable.

WALK ADJUST Front-panel 20-turn screwdriver adjustment to set the walk compensation for each application.

WALK MONITOR Front-panel test point, adjacent to the Walk Adjust potentiometer, permits monitoring the actual dc voltage that is set for the zero-crossing reference; normally set in the range from –0.5 mV to +2.0 mV.

CF MONITOR Front-panel BNC connector to permit observation of the constant-fraction bipolar timing signal; 50-Ω cable and 50-Ω termination required.
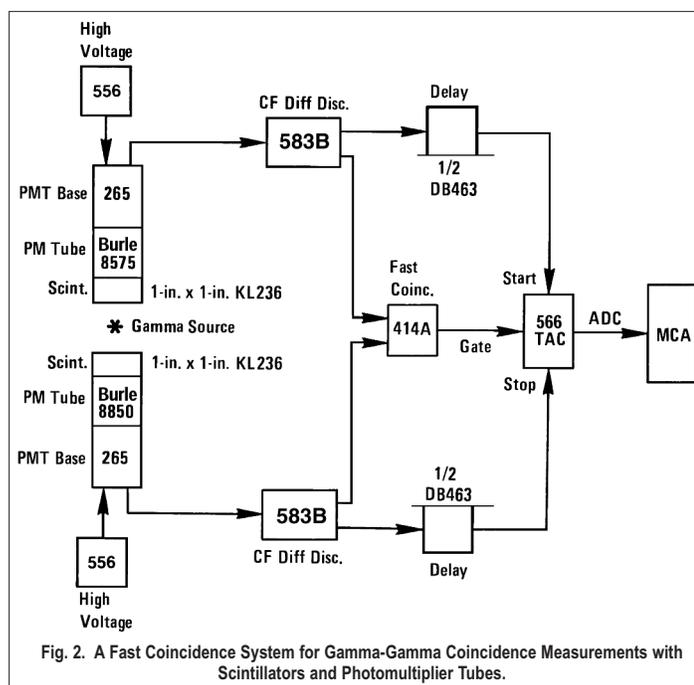

Fig. 2. A Fast Coincidence System for Gamma-Gamma Coincidence Measurements with Scintillators and Photomultiplier Tubes.

WIDTH ADJUST Front-panel 20-turn screwdriver adjustment to set the width of the pulse at the blocking output; variable from ≤15 to ≥1000 ns.

INPUT

Front-panel BNC connector accepts negative input signals from 0 V to –10 V without saturation; 50 Ω, direct-coupled; input protected against overloads; reflections ≤10% for input rise time ≥2 ns.

OUTPUTS

TIMING Two front-panel BNC connectors provide simultaneous NIM-standard fast negative logic signals.

BLOCKING (BK) Front-panel BNC connector provides a NIM-standard fast negative logic signal that occurs simultaneously with the Timing Outputs; inhibits further timing pulses from being generated during the blocking period; variable from ≤15 to ≥1000 ns.

POSITIVE SCA Rear-panel BNC connector provides a NIM-standard slow positive logic signal. Occurs simultaneously with timing outputs.

UPPER LEVEL (UL) Rear-panel BNC connector provides a NIM-standard fast negative logic signal. Occurs as the leading edge of the input signal crosses the UL threshold.

ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V, 120 mA; –12 V, 80 mA; +24 V, 0 mA; –24 V, 0 mA; +6 V, 0 mA; –6 V, 650 mA.

WEIGHT
Net 0.85 kg (1.9 lb).
Shipping 1.85 kg (4.1 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
583B	Constant-Fraction Differential Discriminator/SCA

ORTEC®

www.ortec-online.com
Tel. (865) 482-4411 • Fax (865) 483-0396 • ortec.info@ametek.com
801 South Illinois Ave., Oak Ridge, TN 37830 U.S.A.
For International Office Locations, Visit Our Website

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