552
Pulse-Shape Analyzer/Timing SCA

- Pulse-height analysis, timing signal derivation, and pulse-shape analysis
- Trailing-edge constant-fraction timing with two independent timing channels
- Walk <±250 ps for a 10:1 dynamic range
- DC-coupled
- Resolves shape variations over a 200:1 dynamic range
- Adjustable delay 0.1 to 1.1 µs
- Provision for external baseline sweep

The ORTEC Model 552 Pulse-Shape Analyzer and Timing Single-Channel Analyzer is a valuable instrument for experimentalists performing pulse-height analysis, timing signal derivation, and determination of pulse shapes. The single-width NIM module offers many features normally requiring the use of several separate instruments. A patented* trailing-edge constant-fraction (CF) timing technique is used, providing excellent timing on either unipolar or bipolar signals and giving better results than are possible with conventional leading-edge discriminators. Two independent CF time-derivation channels are used to evaluate the shape of the input waveform. When, for example, these discriminators are set to 10 and 90% fractions, the time interval between the two outputs thus generated will be a measure of the input signal fall time.

The versatility of the Model 552 is evidenced by the three functions it can be used for: time derivation, pulse-height analysis, and adjustable output delay.

Time derivation is an important parameter in many experiments. With SCAs that utilize leading-edge timing, the rise time of the input pulses causes degradation of time resolution due to their amplitude variations. Trailing-edge constant-fraction timing, on the other hand, compensates for varying amplitudes and essentially eliminates this time shift, giving consistently better results. Figure 1 shows that walk with the Model 552 is <±250 ps for a 10:1 dynamic range when the output of the main amplifier is being directly analyzed. A built-in input attenuator is provided so that the front-panel walk controls can be adjusted rapidly and precisely, to achieve excellent timing performance.

Pulse-height analysis with the Model 552 can be done in three different basic operating modes: as a high-resolution, narrow (0 to 10%) window, single-channel analyzer; as a wide-window SCA in which the upper-level and lower-level controls are independently variable from 0 to 10 V and an output is generated for pulses analyzed between the levels; and as a wide-dynamic-range integral discriminator for leading-edge timing or pulse routing via the separate rear-panel LL OUT and UL OUT outputs.

Another feature that makes the Model 552 a versatile instrument is a continuously adjustable output delay, which allows output signals with actual time differences to be aligned without the need for additional delay devices or modules. Alternatively, an external strobe input can be used to produce an SCA output at the desired time.

When it is desirable to scan an entire spectrum, a rear-panel connector can be used to provide an external baseline sweep input. With the lower-level REF switch in the EXT position, the baseline (lower-level threshold) on which a window is riding can be swept through an energy range and the count rate recorded as a function of energy.

Analysis of the amplifier pulse shape can be useful in separating the detected events from different types of radiation. The best known example is the difference in the neutron and gamma-ray response in some scintillators. In these cases, stringent conditions are imposed on the electronics because of the nonlinear response of the scintillator as a function of neutron energy. For example, for neutrons with energies from 200 keV to 10 MeV the response of an NE-213 scintillator can vary over a 500:1 range. The Model 552, in conjunction with the ORTEC Model 457, 566, or 567 Time-to-Amplitude Converter, will satisfactorily resolve shape variations over a 200:1 dynamic range in such neutron-gamma applications.

Other applications for this feature of the Model 552 are its use with gaseous detectors for particle identification, with large germanium detectors to help optimize their energy resolution, and for determining the position of interaction in a position-sensitive proportional counter.

In all cases, the Model 552 provides a measurement of the input signal shape by evaluating its timing at two different fractions.

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*U.S. Patent No. 3,714,464.

PERFORMANCE

INPUT DYNAMIC RANGE 200:1.

PULSE-PAIR RESOLVING TIME Output pulse widths plus Delay (as selected by the front-panel Delay potentiometer), plus 200 ns for negative NIM output or plus 740 ns for positive NIM output. Minimum resolving time for negative output 260 ns; for positive output 800 ns.

THRESHOLD TEMPERATURE INSTABILITY ≤±0.005%/°C of full scale, 0 to 50°C.

DISCRIMINATOR NONLINEARITY ≤±0.25% of full scale (integral) for both discriminators.

DELAY TEMPERATURE INSTABILITY ≤±0.01%/°C of full scale, 0 to 50°C.

TIME SHIFT vs PULSE HEIGHT (Walk) (Specified for Channels A and B at 50% fraction.)

Input Dynamic Range	Walk (ns)	
	System I*	System II*
10:1	±0.5	±2.0
50:1	±1.5	±2.5
100:1	±2.0	±3.0
200:1	±2.5	±8.0

CONTROLS

LOWER LEVEL Front-panel 10-turn potentiometer adjustable from 40 mV to 10 V. The potentiometer determines the threshold setting for the lower-level discriminator when the rear-panel LL REF mode switch is set on. When the LL REF mode switch is in the EXT position, this control is ineffective.

UPPER LEVEL OR WINDOW Front-panel 10-turn potentiometer determines the window width (0 to +1 V) when the operating mode switch is set at WIN or the upper-level (0 to +10 V) threshold when the operating mode switch is set at NORM. This control is disabled when the operating mode switch set at INT.

INT/NORM/WIN Front-panel 3-position locking toggle switch selects one of three operating modes:
INT In this position, the lower-level threshold is set, from 0 to +10 V, and the upper-level discriminator is disabled.
NORM In this position, the upper-level and lower-level controls can both be adjusted independently, from 0 to +10 V.
WIN In this position, the lower-level control defines the baseline and can be set from 0 to +10 V, and the upper-level control defines the window width, from 0 to +1 V.

B-FRACTION Front-panel switch selects the B discriminator fraction from 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, to 0.9 for trailing-edge constant-fraction timing with unipolar or bipolar inputs. In the BI mode, zero-crossing timing is performed on bipolar inputs.

*Using an ORTEC Model 460 Amplifier, single delay line mode, integrate 0.1 µs with 1-µs delay line.
**Using an ORTEC Model 572 Amplifier, unipolar output, 0.5-µs shaping.

WINDOW WIDTH CONSTANCY Variation ≤±0.1% of full-scale window width over the linear range 0 to 10 V.

MINIMUM INPUT THRESHOLD 40 mV for lower-level discriminator.

INPUTS

INPUT Front-panel dc-coupled BNC connector accepts positive unipolar or bipolar signals, 0 to +10 V linear range, ±12 V maximum; width 100 ns; 1000-Ω input impedance.

LL REF IN When the rear-panel LL REF mode switch is on EXT, the rear-panel LL REF IN BNC connector accepts the lower-level biasing (an input of 0 to –10 V on this connector corresponds to a range of 0 to + 1 0 V for the lower-level discriminator setting); input protected to ±24 V.

STROBE IN When the rear-panel Strobe locking toggle switch is in the EXT position, the rear-panel STROBE IN BNC connector accepts a positive NIM-standard input, nominally +5 V, 500 ns wide, to cause an output to occur from the SCA. The external strobe should be given within 10 µs of the linear input. At the end of this period, the Model 552 resets its internal logic without producing an output signal.

OUTPUTS

OUTPUT B (SCA, Positive)/SCA OUT Front and rear-panel BNC connectors provide positive NIM-standard outputs for channel B, nominally +5 V; 500 ns wide; ≤10-Ω output impedance. For internal strobe, the outputs occur at the selected fraction point of the linear input trailing edge plus the output Delay as selected by the front-panel control. For external strobe the outputs occur at the time of the strobe signal.

A-FRACTION A printed wiring board (PWB) jumper selects the A discriminator fraction from 0.1, 0.2, or 0.5 for trailing-edge constant-fraction timing with unipolar or bipolar inputs; jumper is factory-set at 0.1 fraction.

ATTN X1, X10, X100 Front-panel switch selects attenuation factor of high-quality built-in attenuator network for precise walk adjustment setting. Note: The normal operating mode is the X1 position.

DELAY Front-panel screwdriver 10-turn potentiometer for continuous adjustment of output delay over a 0.1- to 1.1-µs range.

WALK ADJ Two front-panel screwdriver adjustments for precise setting of walk compensation for timing channels A and B.

LL REF Rear-panel 2-position locking toggle switch (INT/EXT) selects either the front-panel lower-level potentiometer or the voltage signal applied to the rear-panel LL REF EXT connector as the lower-level-discriminator reference threshold.

STROBE Rear-panel 2-position locking toggle switch (INT/EXT) selects either internal or external source for the SCA output-signal strobe function. The automatic reset time is ~10 µs.

ELECTRICAL AND MECHANICAL

POWER REQUIRED +24 V, 90 mA; –24 V, 90 mA; +12 V, 190 mA; –12 V, 190 mA.

WEIGHT
Net 1.1 kg (2.5 lb).
Shipping 2.25 kg (5.0 lb).

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

RELATED EQUIPMENT

The Model 552 input is compatible with all amplifiers having a 0 to 10-V positive linear output range. The outputs are compatible with ORTEC's timing and counting equipment.

OUTPUTS (SCA, Negative) Two front-panel BNC connectors provide negative NIM-standard outputs for timing channels A and B respectively; nominally –16 mA (–800 mV on 50-Ω load); rise time ≤5 ns; width ≤20 ns. The A Output occurs at the selected fraction point of the linear input trailing edge; the B output occurs at the selected fraction point of the linear input trailing edge plus the output Delay as selected by the front-panel control.

LL OUT Rear-panel BNC connector provides positive NIM-standard output, nominally +5 V, 500 ns wide; ≤10-Ω output impedance. Output occurs as leading edge of linear input crosses the lower-level threshold.

UL OUT Rear-panel BNC connector provides NIM-standard output, nominally +5 V, 500 ns wide; ≤10-Ω output impedance. Output occurs as leading edge of linear output crosses the upper-level threshold.

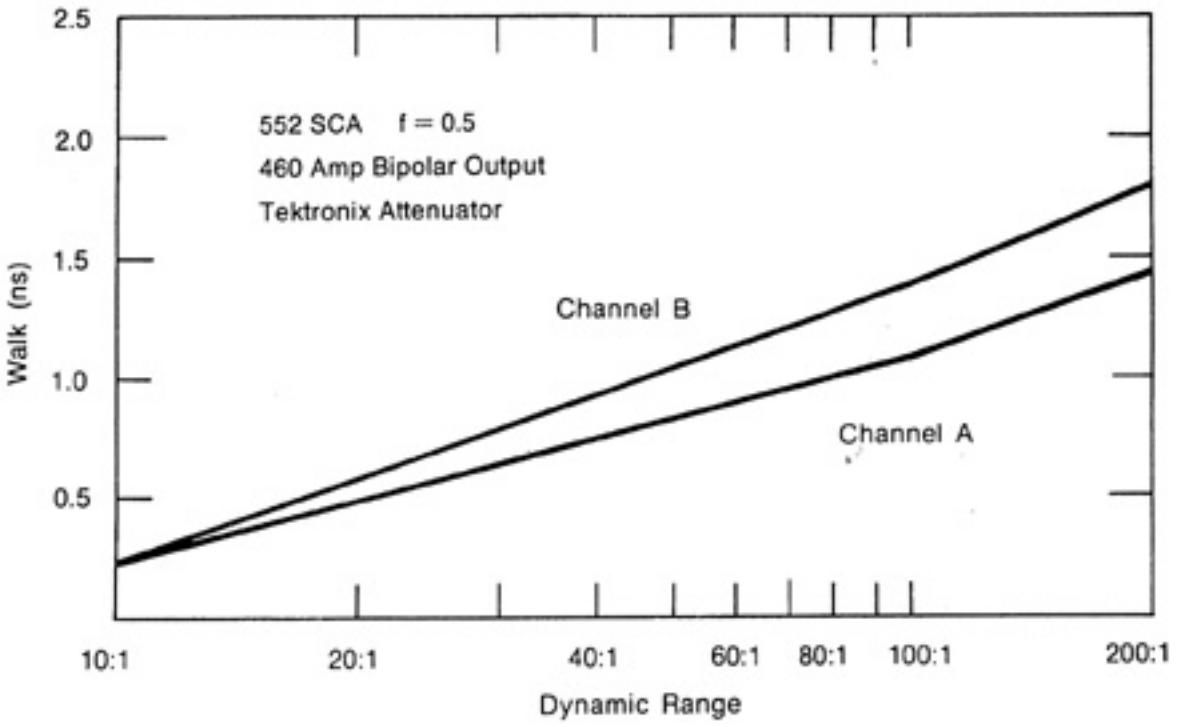

Fig. 1. Typical Walk vs. Dynamic Range.