

January 1971

The ORTEC 458 Pulse Shape Analyzer accepts inputs from any shaping amplifier, **RC, active-filter, or delay-line**, and produces an output with an amplitude that is proportional to the shape of the input signal. This output is independent of the amplitude of the input and depends only on the **shape (waveform) of the input signal as a function of time.**

The shape of the main shaping amplifier output varies, depending on certain experimental conditions. Although there are several examples of such variations, perhaps the best known is the neutron and gamma response in certain scintillators. The conditions on the electronics in this case are stringent because of the nonlinear response of the scintillator as a function of neutron energy. 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 458 can operate satisfactorily over a **400:1 dynamic range** in these neutron-gamma applications, and this has not been possible heretofore.

This unit is also applicable for use with **gaseous detectors** for particle identification. Gaseous detectors are designed so that the charge collection time (and therefore the resulting pulse shape) is influenced by the location of the interaction within the detector, and the interaction site is related to the interacting particle type.

Another application of pulse-shape analysis is with **large Ge(Li) semiconductor detectors.** With the 458 events that

interact within the desired portion of the detector can be selected, and those that occur in low electric-field-strength regions can be rejected, thereby optimizing the energy resolution of the system.

Still another application is the determination of the position of interaction in a position-sensitive proportional counter. With a low-conductivity center wire the shape of the collection of the charge pulse is proportional to the distance from the end of the counter to the interaction site. Thus analysis of the pulse shape will determine the position of interaction.

The input signal from the main amplifier covers the **0- to 10-V range.** The **input discriminator** covers the complete range from 20 mV to 10 V. The input will be approximately symmetrical for delay-line and active-filter inputs. For classical RC filtering, the fall time will be substantially longer than the rise time. For all inputs, the time range switch should be set to be equal to or greater than the fall time of the input. Time ranges from **0.2 to 10 μ sec** are selectable.

A pulse-shape analysis "**time window**" is provided for selection of a time region within the time range. With this window a logic gating pulse can be provided for all input pulses that have a preselected shape within this time region. In this way, for example, all neutron events can generate a control function through the window output, whereas the gamma-ray events will produce no control outputs.

SPECIFICATIONS

PERFORMANCE

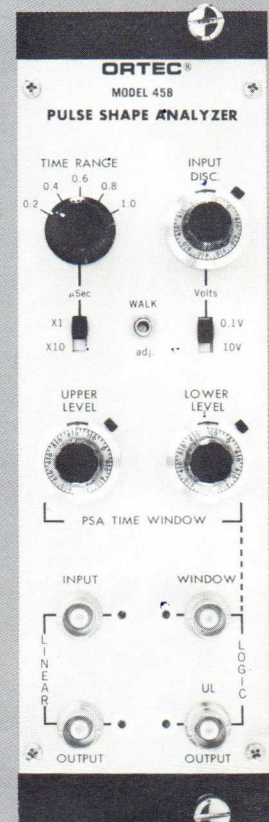
DYNAMIC RANGE 25 mV to 10 V (400:1) input pulse amplitude range.

TIME MEASUREMENT ERROR $\leq 5\%$ for the amplitude range 25 mV to 10 V.

TIME RANGE NONLINEARITY $\leq 2\%$ of the time range plus the effect of the rise time of the input amplifier (~ 100 nsec).

TIME RESOLUTION $\leq 2\%$ of the selected time range for any input pulse amplitude within the range 25 mV to 10 V.

- Accepts inputs from RC, active-filter, or delay-line shaping amplifiers
- Linear output proportional to shape of the input signal
- 400:1 dynamic range for n- γ discrimination
- Usable with semiconductor and gaseous detectors
- 0- to 10-V input range with discriminators
- Accommodates input pulse shapes from 0.2 to 10 μ sec
- Internal SCA "time window" to monitor linear output



458 TECHNICAL DATA

TEMPERATURE STABILITY

Input Discriminator $\leq 0.05\%/^{\circ}\text{C}$.
Upper Level $\leq 0.05\%/^{\circ}\text{C}$.
Lower Level $\leq 0.05\%/^{\circ}\text{C}$.

NONLINEARITY

Input Discriminator $\leq 1\%$.
Upper Level $\leq 0.25\%$.
Lower Level $\leq 0.25\%$.

CONTROLS

TIME RANGE 5-position front-panel switch to select time range of 0.2, 0.4, 0.6, 0.8, or 1.0 μsec . A 2-position multiplier is provided to select X1 or X10 of the selected time as desired.

INPUT DISC 10-turn precision control with 1000-division locking direct-reading dial to select the minimum-amplitude input to be analyzed. A 2-position range switch selects either a 10-mV to 100-mV range or a 100-mV to 10-V range.

PSA TIME WINDOW A time window can be selected within the Time Range with the Lower Level and Upper Level controls; e.g., on the 1- μsec time range with the Upper Level set at 500 and the Lower Level set at 300, any input with 90% to 10% fall times within 300 to 500 nsec will produce Window logic output pulses.

UPPER LEVEL 10-turn precision control with 1000-division locking direct-reading dial to select the maximum time of interest within the time window. The 10 turns cover the entire selected time range.

LOWER LEVEL 10-turn precision control with 1000-division locking direct-reading dial to

select the minimum time of interest within the time window. The 10 turns cover the entire selected time range.

WALK ADJ 20-turn control to minimize changes in output for changes in input amplitude while keeping the shape constant.

INPUT

LINEAR INPUT 0 to 10 V, either positive unipolar or bipolar with positive lobe leading, from any shaping amplifier such as delay-line, active-filter, or classical RC pulse shapes from 0.2 to 10 μsec ; type BNC connector on front panel.

OUTPUTS

LINEAR OUTPUT 0 to 10 V bipolar signal with amplitude proportional to the 90% to 10% time of the linear input; +12 V max; $Z_0 \leq 1\Omega$, dc-coupled and short-circuit protected; type BNC connector on front panel.

PSA TIME WINDOW

Window A +5-V 500-nsec output pulse is provided when the input pulse shape is between the limits set by the Upper Level and Lower Level discriminators; $Z_0 \leq 10\Omega$, dc-coupled; type BNC connector on front panel.

UL Output A +5-V 500-nsec pulse is provided when the input pulse has a 90% to 10% fall time greater than that set by the Upper Level discriminator; $Z_0 \leq 10\Omega$, dc-coupled; type BNC connector on front panel.

INPUT DISC A +5-V 500-nsec signal is provided when the input amplitude exceeds the input discriminator set point; $Z_0 \leq 10\Omega$, dc-coupled; type BNC connector on rear panel.

ELECTRICAL AND MECHANICAL

POWER REQUIRED

+24 V, 158 mA; +12 V, 240 mA;
-24 V, 136 mA; -12 V, 225 mA.

WEIGHT (Shipping) ~5.75 lb (~2.6 kg).

WEIGHT (Net) ~3.75 lb (~1.7 kg).

DIMENSIONS Standard NIM double-width module (2.70 by 8.714 in.) per TID-20893 (Rev.).



REAR PANEL