Model 2037A
Edge/Crossover Timing Single Channel Analyzer

Features

- Leading edge or crossover-type timing derivation
- Dynamic range 100:1
- Pileup rejection logic
- Exceptional stability – dc-coupled input
- Positive and negative timing SCA outputs
- Source matched logic outputs
- Variable delay of up to 11 µs

Description

The Canberra Model 2037A analyzes the peak amplitude of energy pulses from nuclear pulse shaping amplifiers for compliance with energy levels determined by front panel controls, and generates logic outputs which are time derived by the leading edge or crossover techniques. The unit thus combines the conventional single channel analyzer function with that of an excellent but economical timing analyzer.

The leading edge timing technique finds best application in fast-shaped unipolar signals of a fairly narrow energy (pulse height) range. The crossover technique exploits the amplitude-insensitive zero voltage crossing of a bipolar pulse to provide a stable timing reference for a broad energy range. A front panel Mode switch allows selection of either timing derivation.

ENERGY

The logic output (SCA) is provided as both positive and negative NIM-level pulses for input analog pulses whose peak amplitude is between the levels determined by the Lower Level (E) and Window (ΔE) front panel ten-turn controls.

Energy discrimination in the Model 2037A is sharp, precise and stable (drift is less than ±0.005%/°C, full scale). The dc coupled input allows excellent baseline stability limited only by the shaping amplifier's restorer. These significant features permit excellent amplitude discrimination, even in high count rate spectra.

The LOWER LEVEL (E) threshold is calibrated by reference to the regulated NIM supply voltages, and is usable in a range from +0.1 to +10.0 V dc. Linearity of control is limited only by the specified ±0.25% maximum integral nonlinearity of the front panel potentiometer.

The Window (ΔE) threshold is also calibrated by reference to the regulated NIM supply voltages, and is usable in a range from the Lower Level (E) setting to +10.0 V dc. A front panel ΔE Range switch allows use of a 1.0 V full scale range for very fine adjustments of the desired energy window.

TIMING

For the leading edge mode, a true low level leading edge technique is employed to minimize timing jitter. To simplify setup and adjustment, the threshold level for the leading edge timing discriminator is set to track the Lower Level (E) control at 50%, up to a limit of 200 mV dc. For reasonably large input pulse heights, then, timing is referenced to the 200 mV dc level. To simplify adjustment of timing dwell for the rise time of the input pulse, that function has been incorporated in an extended range DELAY control. The user can simply set the selected delay for the

known time-to-peak of the input pulse (or at least 2X the shaping time constant used in a near-Gaussian pulse) without the need for tedious oscilloscope trimming.

For the crossover mode, a bridge circuit timing discriminator is used to sense the true zero crossing of the bipolar energy pulse as superimposed on a dc offset of up to ±100 mV dc. A front panel Walk Adjustment is provided to trim walk over the dynamic range used.

Another important feature of the Model 2037A is the pulse lockout logic for the crossover mode. Internal gating prevents the timing cycle (including the front panel selected Delay) from being initiated on events below the selected LLD threshold, which minimizes dead time. Events recognized above the ULD setting are accepted and processed through the full timing cycle so that the ULD can provide timing data. In addition, the lockout logic rejects energy pulses which arrive after the first valid signal (that is, above the LLD) but prior to reset at the end of a normal timing cycle. This prevents a second, possibly higher, energy signal from changing the data latches and causing an erroneous output (timed to one event and energy gauged to a second). Further, the lock out logic prevents timing aberrations due to pileup by responding only to the next full event following a timing cycle instead of the

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potentially long tail of a pulse arriving at or near the end of one timing cycle. These features enhance the performance of the unit in the crossover mode by eliminating the pulse ambiguities described. Unfortunately, the same lock out logic can not be used to prevent potentially erroneous outputs in the leading edge.

The pulse outputs may be delayed by up to 11 µs relative to a prompt output by use of the front panel linear Delay control. Two ranges are provided: 0.1-1.1 µs added delay, and 1-11 µs. The selected delay, and the output pulse width plus reset time, determine the pulse pair resolution under any given circumstances. Optimum performance is about 800 ns unless a shorter positive output is acceptable.

The positive output logic signal is adjustable in peak amplitude for compatibility with interfacing instruments. The output is source-matched with a 50 Ω series resistive termination to prevent ringing due to reflections on unterminated cables, and the resulting multiple counting frequently experienced. The instrument is shipped with a socketed resistor which limits the output to +5 V nominal (open circuit) for direct interface with common TTL circuitry. The user may remove the resistor as desired to obtain a +8 V nominal open circuit voltage for instruments requiring the NIM pulse level, or +4 V nominal into the 50 Ω load termination which some other instruments provide. This flexibility allows the user to adapt the output signal to his needs without risking the problems encountered with improperly driven cables and critical timing pulses.

The negative SCA output is a NIM standard 16 mA current pulse designed to yield a nominal -800 mV pulse across a 50 Ω load termination. Source matching here again guarantees a clean, stable pulse output even with a load mismatch.

Careful attention has been paid to minimize reflections of the fast logic pulses onto the analog input. Thus all logic outputs are isolated from chassis to prevent circulating pulse currents in the instrument Bin.

Specifications

INPUTS

SIGNAL INPUT – Accepts +0.1 to +10.0 V dc, unipolar or bipolar (positive lobe leading) pulses from shaping amplifier; dc coupled. Z_{in} = 1 kΩ, nominal; shaping time constant range, 0.1 to 10 µs; front panel BNC.

OUTPUTS

SCA (+) – Positive logic +5 V nominal pulse amplitude; adjustable to +8 V nominal pulse by removing socketed resistor; Z_{out} = 50 Ω; nominal; pulse width 0.5 µs, nominal; rise time and fall time <25 ns; front panel BNC.

SCA (–) – Negative logic 16 mA current pulse; Z_{out} = 50 Ω; nominal; pulse width 20 ns, nominal; rise time <5 ns; front panel BNC.

CONTROLS

LOWER LEVEL (E) – Front panel ten-turn locking dial potentiometer to set lower discriminator threshold level.

WINDOW (ΔE) – Front panel ten-turn locking dial potentiometer to set window width (upper discriminator threshold level above lower level).

DELAY – Front panel ten-turn locking dial potentiometer to set delay of outputs.

ΔE RANGE – Front panel toggle switch to set full scale range of the WINDOW (ΔE) control as +1.0 V dc or +10.0 V dc.

DELAY RANGE – Front panel toggle switch to set full scale range of the DELAY control as 1.1 µs or 11 µs added delay.

MODE – Front panel toggle switch to select timing derivation from leading edge or crossover of input pulse.

PERFORMANCE

DISCRIMINATOR NONLINEARITY – <±0.25% of full scale.

DISCRIMINATOR STABILITY – ≥±0.005%/°C (±50 ppm/°C) of full scale, referenced to NIM class A supply +24 V dc line.

DISCRIMINATOR RANGE – 100:1.

DELAY NONLINEARITY – <±1% of full scale.

DELAY STABILITY – ≤±0.01%/°C (±100 ppm/°C) of delay range.

PULSE PAIR RESOLUTION – Output pulse width (positive) plus the DELAY selected plus 200 ns cycle time. Minimum resolving time 800 ns.

WALK – Referenced to 10.0 V full scale input.

A. For leading edge mode: with rise time <100 ns:

Dynamic Range	Walk (Maximum)
10:1	± 40 ns
50:1	±100 ns

B. For crossover mode: with bipolar input pulse with 0.5 µs near-Gaussian shaping:

Dynamic Range	Walk (Maximum)
10:1	±2 ns
50:1	±4 ns

C. For crossover mode, with DDL shaped input (1 µs delay line, rise time <100 ns):

Dynamic Range	Walk (Maximum)
10:1	±1 ns
50:1	±2 ns

Figure 1 shows typical walk behavior for other shaping time constants.

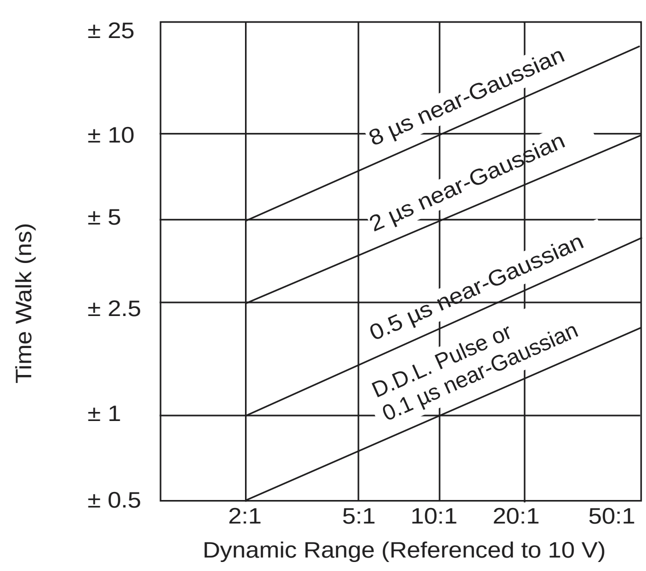

Figure 1
Nominal limits of time walk of SCA output vs. dynamic range for various input pulse shapings (bipolar)

Walk beyond a 50:1 range is limited by jitter due to amplifier noise effects. Detector and system noise, and other baseline anomalies, may restrict usable dynamic range for timing analysis purposes in a given experimental setup to less those quoted above.

CONNECTORS

All signal connectors are BNC type.

POWER

+24 V dc – 30 mA   +12 V dc – 145 mA
–24 V dc – 10 mA   –12 V dc – 55 mA

PHYSICAL

SIZE – Standard single width NIM module 3.43 x 22.12 cm (1.35 x 8.71 in.) per DOE/ER-0457T.

NET WEIGHT – 0.9 kg (1.9 lb).

SHIPPING WEIGHT – 1.8 kg (4.0 lb).

ENVIRONMENTAL

OPERATING TEMPERATURE – 0 to 50 °C.

OPERATING HUMIDITY – 0-80% relative, non-condensing. Tested to the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

CE

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