

DESCRIPTION

The ORTEC 467 Time to Pulse Height Converter/SCA measures the time interval between pulses to its start and stop inputs, generates an analog output pulse proportional to the measured time, and provides **built-in single channel analysis** of the analog signal. Additional gating modules are not necessary with this unit, and timing experiments requiring **time ranges of 50 nsec to 800 μ sec** may be performed with single channel analysis, giving the experimenter unparalleled flexibility in analyzing random nuclear events that occur within a selected time range. Time ranges from 50 nsec to 80 μ sec are provided via the front panel controls. A simple internal modification, easily performed in the field by the customer, converts the X1 multiplier to X1000, thus giving ranges up to 800 μ sec.

A **built-in linear gating** (anticoincidence or coincidence) of the converter output eliminates unwanted events from the time spectra via externally imposed energy or timing restrictions. The 467 also incorporates a unique built-in single channel analyzer inhibit feature in which a TPHC output pulse falls within the window restrictions imposed by the single channel analyzer. This feature may be switched in or out by a convenient front panel switch.

In addition to its coincidence and anti-coincidence gating capabilities, the 467's output can be inhibited by a positive pulse or a dc level at the front panel Inhibit/Reset input connector. The TPHC circuitry will be reset at any point in the cycle and start pulses will be inhibited for the duration of the inhibit pulse.

True Start and True Stop Outputs are provided for each accepted start and stop input respectively. The duration of these

outputs indicates the interval from the accepted start or stop input until reset occurs.

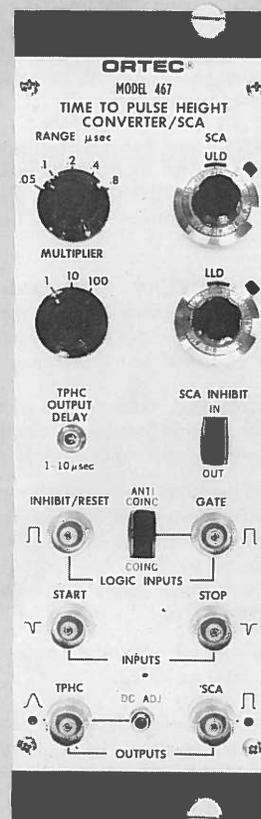
The **selectable TPHC output width and variable delay**, which are easily adjustable, further serve to make the 467 a flexible instrument, easily adapted into any time spectroscopy system. The **output** of the TPHC may be **synchronized with the start signal, the stop signal, or an external strobe signal** to further enhance its versatility.

The timing single channel analyzer section of the 467 allows the experimenter to place very specific time restrictions on the timing spectrum. The SCA may be operated in the Window position, where the upper level discriminator setting is added to that of the lower level discriminator, or in the Normal position, where the upper level discriminator and the lower level discriminator are operated independently of each other. The SCA output pulse width is equal to the time from the occurrence of the stop pulse until the end of the reset pulse. The synchronization of the SCA output with the stop input virtually eliminates any time walk in the SCA output.

Unwanted stop signals occurring immediately after a start input, which occur in some linear accelerator applications, are **rejected** by a Stop Inhibit Mode switch. Stop pulses occurring up to 1 μ sec after the start input may thus be rejected.

The 467 is **dc-coupled and gated** so that input count rates will not paralyze or otherwise hinder normal operation of the TPHC or the SCA sections. The TPHC output should be connected to the dc-coupled input of an MCA for optimum high-count-rate performance.

- 20 convenient time ranges, 50 nsec to 800 μ sec
- Built-in single channel analyzer
- True start and true stop outputs
- Selectable output delay and width, with the output synchronized with a start, stop, or external strobe signal
- Provision to reject unwanted stop input signals
- Built-in linear gate capability
- dc circuits for count rate independence and no pileup distortion



SPECIFICATIONS

PERFORMANCE

Time to Pulse Height Converter

TIME RESOLUTION <10 psec (10^{-11} sec) FWHM on 50- and 100-nsec ranges; $<0.01\%$ FWHM of full range for all other ranges.

TEMPERATURE INSTABILITY $\leq \pm 10$ psec/ $^{\circ}\text{C}$ for 50-nsec ranges; $\leq \pm 0.015\%$ / $^{\circ}\text{C}$ for higher ranges.

DIFFERENTIAL NONLINEARITY $\leq \pm 2\%$ from 10 nsec through full range for 50-nsec range; $\leq \pm 2\%$ from 5% range to full range for all higher ranges.

INTEGRAL NONLINEARITY $\leq \pm 0.1\%$ from 10 nsec through full range for 50-nsec range; $\leq \pm 0.1\%$ from 5% range to full range for all higher ranges.

Single Channel Analyzer

TEMPERATURE INSTABILITY ULD, $\leq \pm 0.01\%$ / $^{\circ}\text{C}$. LLD, $\leq \pm 0.01\%$ / $^{\circ}\text{C}$.

NONLINEARITY Effectively determined by the 10-turn potentiometers. ULD, $\leq \pm 0.5\%$ over 10-V range. LLD, $\leq \pm 0.5\%$ over 10-V range.

CONTROLS

RANGE Switch-selectable 15-range choices of .05, 0.1, 0.2, 0.4 or 0.8 μsec multiplied by X1, X10, or X100; the X1 position can be internally modified to be X1000 to extend time range capability to 800 μsec .

MULTIPLIER Front panel 3-position selector switch; settings select multiple factors for the selected time ranges of X1, X10, and X100, resulting in 15 time ranges from 50 nsec to 80 μsec .

TPHC OUTPUT DELAY Front panel 10-turn screwdriver potentiometer adjusts the output delay from the stop input to the internal stop strobe; range, <1 μsec to >10 μsec .

ANTICOINC/COINC Front panel slide switch selects either coincidence or anticoincidence logic for gating the start input circuit.

ULD Front panel 10-turn potentiometer determines the window width in Window mode or the upper level discriminator setting in Normal mode; ranges, 0 to 10 V minus LLD settings and 0 to 10 V respectively for Window and Normal modes.

LLD Front panel 10-turn potentiometer adjustable from 0 to 10 V.

SCA INHIBIT Front panel slide switch.

In In this position the TPHC output pulse is available only if the output level falls within the SCA window.

Out In this position the switch has no effect on the TPHC output.

STROBE SYNC Rear panel 3-position slide switch for selecting one of three modes:

Int Start In this position the information is strobed out ~ 2 μsec after the start pulse when the Multiplier switch is in the X1 position, ~ 10 μsec in the X10 position, and ~ 100 μsec in the X100 position.

Ext In this position a positive pulse fed into the Ext Strobe connector will strobe the information to the output if the strobe pulse has a magnitude of $+3$ V or larger.

Int Stop In this position the information is strobed out 1 to 10 μsec (adjustable by the TPHC Output Delay control) after a true stop pulse.

DC ADJ 20-turn potentiometer to adjust the dc level over the range ± 0.5 V.

STROBE RESET Rear panel two-position switch that allows the converter to be reset either 5 μsec or 120 μsec after a true stop if a strobe pulse has not been received.

SCA MODE Rear panel, two-position slide switch:

Normal Allows independent use of Upper Level Discriminator and Lower Level Discriminator.

Window ULD setting is added to LLD setting when switch is in this position.

STOP INHIBIT MODE Rear panel, two-position slide switch:

In Rejects stop pulses that occur within 100 nsec to within 1 μsec (adjustable by the Stop Inhibit Delay control) after a true start pulse.

Out In this position switch does not affect the operation of the instrument.

STOP INHIBIT DELAY A 20-turn trim potentiometer mounted on the rear panel allows the stop inhibit period to be adjusted from ~ 100 nsec to ~ 1 μsec after a true start pulse.

INPUTS

START INPUT Front panel BNC connector. **Amplitude** -250 mV minimum; protected to ± 100 V. $Z_{in} = 50\Omega$, dc-coupled.

Rise Time No limit, but rise time should be as short as possible to provide maximum accuracy. **Pulse Width** 3 nsec at -250 mV; maximum limit, ~ 4 μsec .

STOP INPUT Specifications same as for the Start Input.

GATE LOGIC INPUT Front panel BNC type of connector. Logic 0, $<+2$ V; logic 1, $>+2$ V; input protected to ± 100 V. Gate signal must occur 10 nsec before the start and must overlap the start input pulse. Impedance, ~ 1 k Ω , dc-coupled.

INHIBIT/RESET LOGIC INPUT Front panel BNC type of connector. Amplitude of >4 V resets circuit at any point in the cycle and inhibits start pulses for the duration of the pulse; input protected to $+12$ V.

STROBE EXT Rear panel type BNC connector.

Amplitude $>+2$ V; protected to $>+25$ V.

Rise Time No limit.

Pulse Width 10 nsec min, ~ 4 μsec max.

Impedance 1 k Ω , dc-coupled.

Control Outputs Prompt with strobe input.

OUTPUTS

TPHC OUTPUTS Front and rear panel BNC type of connectors. 100% protected from short circuit and excessive duty cycle.

Unipolar 0 to $+10$ V linear; <500 nsec rise time.

Width Internally adjustable from ~ 1.0 to 2.5 μsec .

Output Timing Prompt with either internal or external strobe.

Impedance $<1\Omega$ on front panel and 93Ω on rear panel, dc-coupled.

Output dc Level Adjustable from 0 to ± 0.5 V dc with front panel DC Adj screwdriver control.

SCA OUTPUTS Front and rear panel BNC type of connectors. 100% protected from short circuit and excessive duty cycle.

Amplitude $\cong +4$ V.

Output Timing Pulse begins ~ 600 nsec after a valid stop pulse and continues until TPHC resets.

Impedance $<10\Omega$, dc-coupled.

TRUE START OUTPUT Rear panel BNC type of connector provides a positive logic timing output to indicate the interval from an accepted start input signal until reset.

Rise Time <100 nsec.

Output Width The interval from the start input until reset time, which can occur at strobe time, overrange, or 120 μsec after stop signal.

Impedance $<10\Omega$, dc-coupled.

TRUE STOP OUTPUT Rear panel BNC type of connector provides a positive 4-V pulse to indicate valid stop and the interval from an accepted stop input signal until reset occurs.

Rise Time <100 nsec.

Impedance $\cong 10\Omega$, dc-coupled.

Output Width The interval from the stop input until reset time.

TPHC BUSY OUTPUT Via rear panel BNC connector to indicate the total time the 467 is involved in a conversion; amplitude, $+4$ V; $t_r < 100$ nsec; $Z_o < 10\Omega$, dc-coupled. Output width is equal to the interval from the start input to 5 μsec after reset.

STOP INHIBIT MONITOR Rear panel BNC type of connector provides a positive 3.5-V pulse to indicate the time period during which stop signals are inhibited.

Rise Time <100 nsec.

Output Width Variable from 100 nsec to >1.0 μsec with Stop Inhibit Delay trim potentiometer, beginning when a true start pulse is received. Stop pulses are rejected until this pulse returns to the baseline if the Stop Inhibit Mode switch is in the In position.

Impedance $>1000\Omega$, dc-coupled.

ORDERING INFORMATION

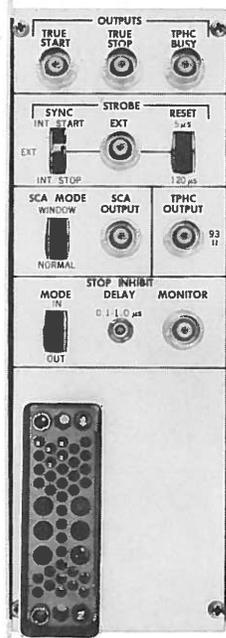
POWER REQUIRED

$+24$ V, 165 mA; -24 V, 120 mA;
 $+12$ V, 320 mA; -12 V, 140 mA.

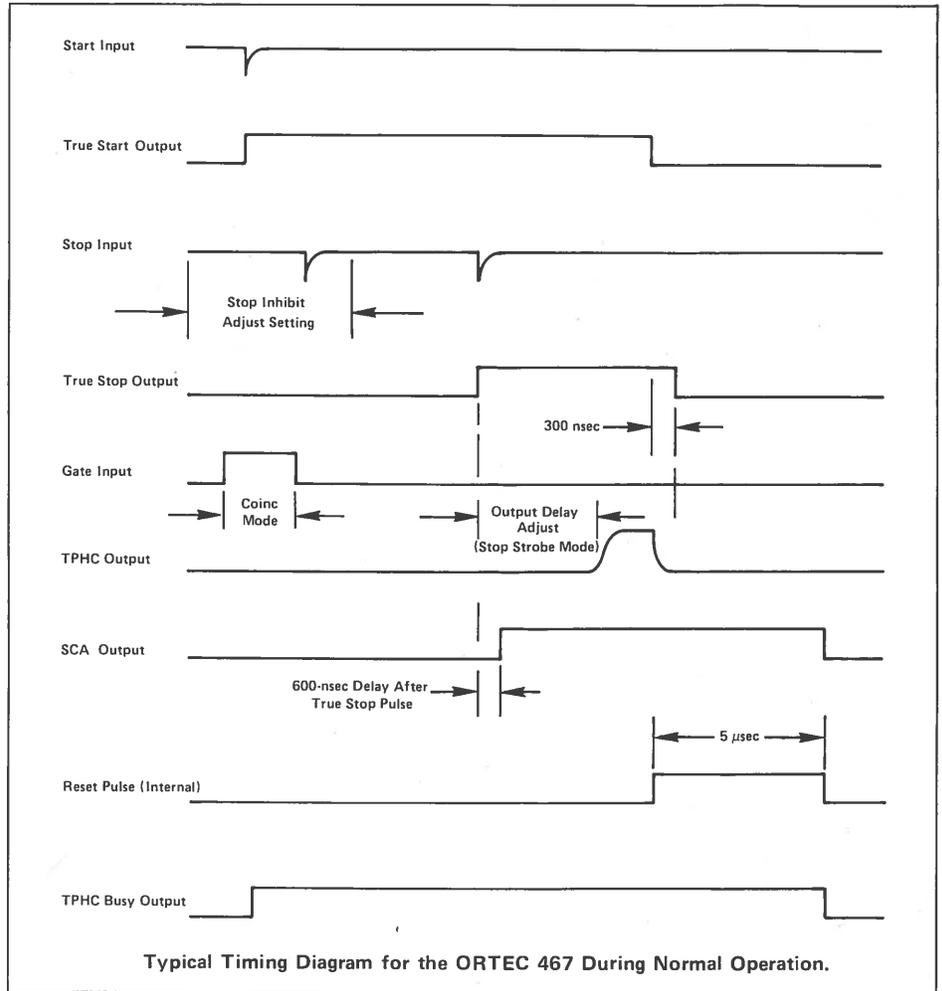
DIMENSIONS NIM-standard double-width module (2.70 in. wide by 8.714 in. high) per TID-20893.

WEIGHT

Shipping ~6 lb (~2.7 kg).
Net ~4 lb (~1.8 kg).



Rear Panel



Typical Timing Diagram for the ORTEC 467 During Normal Operation.

HOW TO CALIBRATE YOUR 467

For fast, easy calibration of the ORTEC 467 TPHC/SCA or any other time-to-amplitude converter, ORTEC offers the 462 Time Calibrator. Specifications for this Calibrator are given below.

PERFORMANCE

CALIBRATION PERIOD ACCURACY The absolute accuracy is ± 10 psec for 10-nsec period and $\pm 0.005\%$ of total period for all other selections; factory-calibrated against National Bureau of Standards WWV.

CALIBRATION PERIOD STABILITY Within < 10 ppm/ $^{\circ}$ C of selected period; 100 ppm/year.

CONTROLS

PERIOD μ sec 11-position switch selects the basic interval steps between Start and Stop Outputs; selections are 10, 20, 40, 80, 160, 320, and 640 nsec and 1.28, 2.56, 5.12, and 10.24 μ sec.

RANGE μ sec 11-position switch selects the total calibration time scale in binary multiples of 80 nsec; selections are 80, 160, 320, and 640 nsec and 1.28, 2.56, 5.12, 10.24, 40.96, and 81.92 μ sec.

RATE Single-turn front panel trim potentiometer adjusts the random Start-Stop rate from about 100 to 50,000 counts/sec.

ON/OFF Toggle switch disables the 462 output for the Off position or enables the output (except when gated off) for the On position; the adjacent lamp lights when the output is enabled.

DISPERSION Toggle switch marked Min and Max selects the internal circuit effect between the Input and Output of the Dispersion Amplifier. The Min position selects a reproduction of the Input with a gain of 1 at the Output. The Max position provides for the addition of semi-Gaussian noise to the Input before it is furnished through the Output; the purpose is to reduce the resolution of the spectrum in order to calculate the peak centroid within a fraction of one channel.

INPUTS

EXTERNAL ENABLE INPUT Rear panel type BNC connector accepts gating logic to control unit when On/Off switch is set at On; > 2.0 V or open enables; nominal ground disables.

DISPERSION AMPLIFIER INPUT Front panel type BNC connector accepts ± 10 -V linear signals, typically from a time-to-amplitude converter; $Z_{in} \sim 2$ k Ω .

OUTPUTS

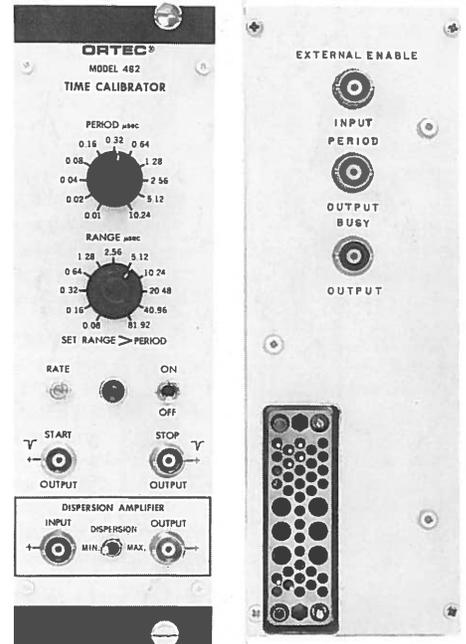
START OUTPUT Front panel type BNC connector furnishes a NIM-standard fast negative logic pulse, which occurs at a random time with respect to the preceding start pulse; Z_o 1 k Ω .

STOP OUTPUT Front panel type BNC connector furnishes a NIM-standard fast negative logic pulse, which occurs at an integral multiple (≥ 2) of the selected period following each Start output pulse; Z_o 1 k Ω .

BUSY OUTPUT Rear panel type BNC connector furnishes a signal that is at -0.8 V for a 50 Ω load during the interval from each start pulse until its subsequent stop pulse; Z_o 1 k Ω .

PERIOD OUTPUT Rear panel type BNC connector furnishes a NIM-standard fast negative pulse at a fixed rate of 1/Period; can be used to check calibration or as a stable external time base; Z_o 1 k Ω .

DISPERSION AMPLIFIER OUTPUT Front panel type BNC connector provides ± 10 -V linear output, same polarity as the Dispersion Amplifier Input; Dispersion switch selects whether signal is an exact reproduction of the input or has ~ 100 -mV FWHM random noise mixed with it; $Z_o < 1\Omega$.



ORDERING INFORMATION

POWER REQUIRED

+12 V, 110 mA; -12 V, 340 mA;
+24 V, 40 mA; -24 V, 110 mA.

WEIGHT

Shipping 6.5 lb (2.9 kg).
Net 3.5 lb (1.56 kg).

DIMENSIONS Double-width NIM-standard module (2.70 by 8.714 in.) per TID-20893.