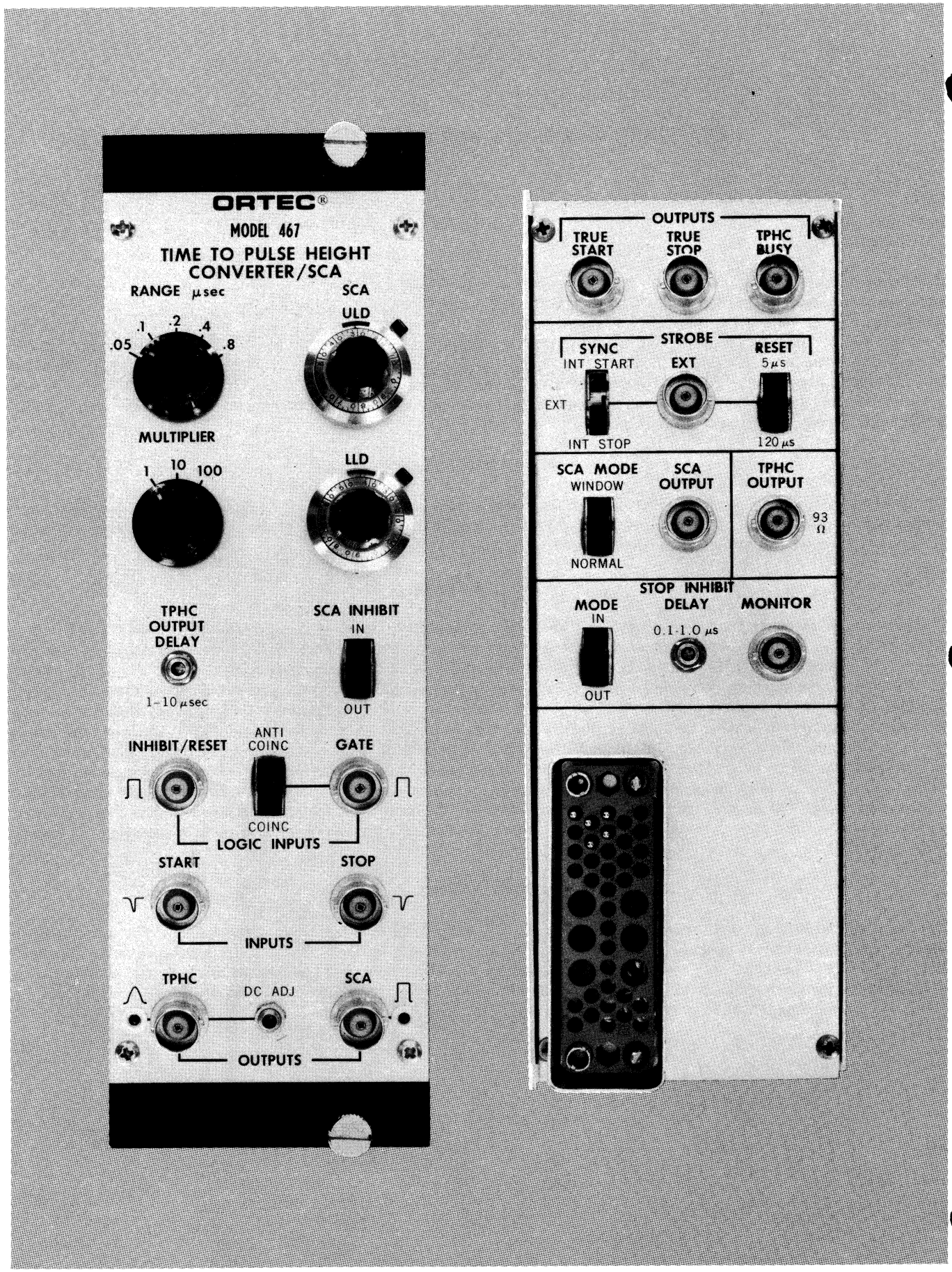
ORTEC®
MODEL 467
TIME TO PULSE HEIGHT CONVERTER/SCA
RANGE μsec
.05
.1
.2
.4
.8
MULTIPLIER
1
10
100
SCA
ULD
LLD
TPHC OUTPUT DELAY
1-10 μsec
SCA INHIBIT
IN
OUT
INHIBIT/RESET
ANTI COINC
COINC
GATE
LOGIC INPUTS
START
STOP
INPUTS
TPHC
DC ADJ
SCA
OUTPUTS
OUTPUTS
TRUE START
TRUE STOP
TPHC BUSY
STROBE
SYNC
INT START
EXT
INT STOP
RESET
5 μs
120 μs
SCA MODE
WINDOW
NORMAL
SCA OUTPUT
TPHC OUTPUT
93 Ω
STOP INHIBIT
MODE
IN
OUT
DELAY
0.1-1.0 μs
MONITOR

ORTEC 467
TIME TO PULSE HEIGHT CONVERTER AND SCA MANUAL

1. DESCRIPTION

1.1. PURPOSE AND FEATURES

The ORTEC 467 Time to Pulse Height Converter and Single Channel Analyzer (TPHC/SCA) measures the time interval between the leading edge of logic pulses furnished to its start and stop inputs and generates an analog output pulse that is proportional to the measured time through the TPHC output. The TPHC output pulses are appropriate for multichannel analysis to obtain timing spectra. They are also connected internally to the single channel analyzer to generate an SCA output logic pulse for each TPHC pulse with a peak amplitude within the adjusted single channel limits.

There are 15 full-scale time ranges that can be switch-selected with the 467, from 50 ns through 80 μs. Each TPHC output pulse has a peak amplitude that is proportional to the ratio of the measured time interval to the selected full-scale interval, and the range of these pulses is 0 through +10 V.

The 467 is an extremely accurate and versatile instrument. It is composed of a very stable gated time to pulse height converter, a low-droop stretcher, a strobed TPHC output, and a single channel analyzer that can be operated in either a normal or window mode.

The integrated assembly, in a NIM-standard double-width module, combines excellent time resolution over a broad dynamic range with excellent temperature stability and linearity. It is dc-coupled throughout to prevent pileup and count-rate distortion.

1.2. OPERATION

Start-to-stop time conversion is accomplished only after a valid start has been identified and after a stop pulse has arrived within the selected time range. The start input is disabled during the busy interval to prohibit pileup; the stop input is disabled after the first accepted stop signal. Unwanted stop signals that occur immediately after a start input, such as those in linear accelerator applications, for example, can be rejected by a Stop Inhibit Mode switch and a circuit that is time-adjustable from 0.1 to 1.0 μs. An inhibit/reset circuit also permits the operator to abort and cancel a measurement after a true start has been recognized. The input gate for the start circuit can be operated in either an anticoincidence or a coincidence mode.

Time ranges may be switch-selected for full-scale intervals from 50 ns to 80 μs. Each time measurement is analog-stored in a low-loss stretcher amplifier until a linear gate is opened by either an internal or an external strobe. The internal strobe can be obtained from either the start or the stop input pulse, and in either case occurs automatically at a selected delay following the reference. An external strobe can be used for a prompt output at the strobe time provided that a time measurement has been completed and reset has not occurred. A rear panel switch can select either 5 or 120 μs after stop for an automatic reset if no strobe has been furnished. If reset occurs before a strobe, no TPHC output signal is available. There are two other sources for reset: one occurs if the start-to-stop time interval exceeds the range that is selected and the other occurs as a result of an input pulse through the Inhibit/Reset Logic Input connector on the front panel. The normal setting for the rear panel switch is 120 μs; the 5-μs setting should be used only if the stop-strobe mode is used and the delay is adjusted to minimum, or if the external-strobe mode is used and the strobe will be furnished within the selected interval.

The peak amplitude of the TPHC signal is sampled by the SCA at the time of a true-stop input. If the amplitude is within the adjusted acceptance range of the SCA, an SCA logic output is generated. The width of the SCA output is from the stop input until the subsequent reset. Since this output occurs before the TPHC signal is used to generate its analog output, the SCA output can be used to inhibit a TPHC output, unless the analog signal is within the SCA window, and to thus limit the range of a timing spectrum as it is stored in the multichannel analyzer.

The single channel analyzer has a lower level discriminator that can be adjusted through the full linear range of the TPHC signals from 0 through 10 V. The range for its upper-level discriminator is also 0 through 10 V, but the zero reference point for the ULD must be selected on the rear panel with the Window/Normal switch. When the switch is set at Window, the zero reference for the ULD is the adjusted setting of the LLD control. When the switch is set at Normal, the zero reference for the ULD is ground zero and is equal to the LLD zero point.

1.3. LOGIC

An input can be accepted through the Start Input connector on the front panel unless the 467 is busy processing a previous set of information or the response is inhibited by a gate input condition. The acceptance of a start input is essential in order to initiate a response in the 467. When a start input is accepted, a positive logic signal is available through the rear panel True Start Output connector and is continued until the leading edge of a subsequent reset. The

reset can be caused by a TPHC output, by the sensing of an overrange condition, or by an inhibit/reset signal through the front panel BNC. The true-start signal permits the internal circuits to start measuring a time interval and enables the stop input circuit.

The Stop Input BNC can accept an input signal after it has been enabled by the true-start condition. It may be enabled immediately at true start, or the rear panel Stop Inhibit Mode switch can be set at In and there will be a delay from true start before the stop signal can be accepted; the delay range is 0.1 through 1.0 μs. When a stop input signal is accepted, this indicates that an interval has been measured and its analog equivalent is stored and available. A signal is furnished through the true-stop output that continues until the leading edge of a subsequent reset. If no stop input is accepted before an overrange condition is sensed or before an inhibit/reset input is furnished, the measurement will be aborted and no output signals for either SCA or TPHC will be generated.

At the true-stop time the SCA is enabled to sample the peak amplitude of the stored timing signal and to determine whether its peak amplitude is within the single-channel acceptance range. If the SCA responds, it generates an SCA output that goes high about 600 ns after the leading edge of the true stop and this signal continues until the trailing edge of the subsequent reset. If the SCA does not respond (because the amplitude is either less than the LLD or greater than the ULD), no SCA output is generated.

The front panel SCA Inhibit switch determines whether the SCA response is essential in order to generate a TPHC output. If the switch is set at In, a TPHC output is generated only if the SCA has responded. If the switch is set at Out, the generation of the TPHC output is independent of the SCA response.

The TPHC output must be strobed. The source of the strobe can be switch-selected from the true-start or true-stop signal or from an external signal. If true start is selected as the reference, the strobe occurs after a fixed delay that is selected by the Multiplier switch so that it will accommodate the maximum range time; if the switch is set at X1, the delay is 2 μs; for the X10 setting, the delay is 10 μs; and for the X100 setting, the delay is 100 μs. If true stop is selected as the reference, the strobe occurs after a delay that has been adjusted with the front panel TPHC Output Delay control, 1 to 10 μs after the leading edge of the true-stop signal. If the Strobe Sync switch is set at Ext, a signal must be furnished through the Strobe Ext BNC connector to strobe the output promptly.

The reset interval is 5 μs and no output can be strobed after the leading edge of the reset pulse. There should be no interference if the Strobe Reset switch is set at 120 μs unless external strobe is being used and the strobe input pulse does not arrive within the interval before reset. Reset can occur as the result of the completion of a read interval in which the TPHC signal is furnished as an output, or of an overrange indication where no significant peak amplitude is available, or of an inhibit/reset input that cancels the cycle at its leading edge and inhibits further response by the 467. The principal purpose for the automatic reset is to furnish this function if external strobe is being used and the input pulse is not furnished. If reset occurs for any reason before the TPHC output is completed, the TPHC output width is reduced by the reset.

A busy output starts at the leading edge of the true-start output and continues until the trailing edge of the subsequent reset. This can be used to control external equipment by indicating each interval during which no new start input can be accepted.

2. SPECIFICATIONS

2.1. PERFORMANCE

Time to Pulse Height Converter

Time Resolution <10 ps (10^{-11} s) FWHM on 50- and 100-ns ranges; <0.01% FWHM of full range for all other ranges.

Temperature Instability <±10 ps/°C for 50-ns range; <±0.015%/°C for higher ranges.

Differential Nonlinearity <±2% from 10 ns through full range for 50-ns range; <±2% from 5% range to full range for all higher ranges.

Integral Nonlinearity <±0.1% from 10 ns through full range for 50-ns range; <±0.1% from 5% range to full range for all higher ranges.

Single Channel Analyzer

Temperature Instability
ULD, <±0.01%/°C. LLD, <±0.01%/°C.

Nonlinearity Effectively determined by the 10-turn potentiometers. ULD, <±0.5% over 10-V range. LLD, <±0.5% over 10-V range.

2.2. CONTROLS

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

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 ns to 80 μs.

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

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

SCA ULD Front panel 10-turn potentiometer determines the window width or the upper-level discriminator setting; range, 0 to 10 V.

SCA 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.

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

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 μs after the start pulse when the Multiplier switch is in the X1 position, ~10 μs in the X10 position, and ~100 μs in the X100 position.
Ext In this position a positive pulse fed into the Strobe Ext 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 μs (adjustable by the TPHC Output Delay control) after a true-stop pulse.

Strobe Reset Rear panel 2-position switch that allows the converter to be reset either 5 μs or 120 μs after a true-stop pulse if a strobe pulse has not been received.

SCA Mode Rear panel 2-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 2-position slide switch:
In Rejects stop pulses that occur within 100 ns to within 1 μs (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 ns to ~1 μs after a true-start pulse.

2.3. INPUTS

Start Input Front panel BNC connector.
Amplitude −250 mV minimum; protected to ±100 V. Z_{in} = 50Ω, dc-coupled.
Rise Time No limit, but rise time should be as short as possible to provide maximum accuracy.
Pulse Width 3 ns at −250 mV; maximum limit, ~4 μs.

Stop Input Specifications same as for the Start Input.

Gate Logic Input Front panel BNC connector. Logic 0, <+2 V; logic 1, >+2 V; input protected to ±100 V. Gate signal must occur 10 ns before the start and must overlap the start input pulse. Impedance, ~1 kΩ, dc-coupled.

Inhibit/Reset Logic Input Front panel BNC 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 BNC connector.
Amplitude >+2 V; protected to >±25 V.
Rise Time No limit.
Pulse Width 10 ns minimum; ~4 μs maximum.
Impedance 1 kΩ dc-coupled.
Control Outputs Prompt with strobe input.

2.4. OUTPUTS

TPHC Outputs Front and rear panel BNC connectors. 100% protected from short circuit and excessive duty cycle.
Unipolar 0 to +10 V linear; <500 ns rise time.
Width Internally adjustable from ~1.0 to 2.5 μs.
Output Timing Prompt with either internal or external strobe.
Impedance <1Ω 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 connectors. 100% protected from short circuit and excessive duty cycle.
Amplitude ≅+4 V on positive logic if TPHC pulse is in the LLD-ULD window and 0 V if TPHC is not in the window.
Output Timing Pulse begins ~600 ns after a valid stop pulse and continues until TPHC resets.
Impedance 10Ω, dc-coupled.

True Start Output Rear panel BNC connector provides a positive logic timing output to indicate the interval from an accepted start input signal until reset.
Rise Time <100 ns.
Output Width The interval from the start input until reset time, which can occur at strobe time, overrange, or 120 μs after stop signal.
Impedance <10Ω, dc-coupled.

True Stop Output Rear panel BNC 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 ns.
Impedance ≅10Ω, 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 that the 467 is involved in a conversion; amplitude, +4 V; t_r <100 ns; Z_o, 10Ω, dc-coupled. Output width is equal to the interval from the start input to 5 μs after reset.

Stop Inhibit Monitor Rear panel BNC connector provides a positive 3.5-V pulse to indicate the time period during which stop signals are inhibited.
Rise Time <100 ns.
Output Width Variable from 100 ns to >1.0 μs 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 ~10Ω, dc-coupled.

2.5. ELECTRICAL AND MECHANICAL

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.

3. INSTALLATION

3.1. GENERAL

An ORTEC 401/402 Series Bin and Power Supply, or equal, in which the 467 will be installed, is intended for rack mounting. If vacuum tube equipment is operated in the same rack, there must be sufficient cool air circulating to prevent localized heating of the all-transistor circuits in the 467 and in the other modules in the Bin and Power Supply. Rack-mounted equipment subjected to the temperatures in vacuum tube equipment can exceed the maximum for which the transistorized circuits are designed unless this precaution is taken. The 467 should not be subjected to temperatures in excess of 120°F (50°C).

3.2. CONNECTION TO POWER

The 467 is designed per TID-20893 and accepts its operating power requirements through a mating power connector when it is installed in an ORTEC 401/402 Series Bin and Power Supply. As a safety precaution, always turn off the power for the Bin before inserting or removing any modules. If all the modules installed in the Bin are ORTEC 400 and/or 700 Series instruments, there will be no overload on any portion of the Power Supply. However, if any modules not designed by ORTEC are included in the Bin, this protection may not be effective; monitor the dc voltages at the test points on the control panel of the Bin after all modules have been installed and the power is turned on, in order to determine that none of the four power levels have been reduced by an overload.

3.3. CONNECTION INTO A SYSTEM

The 467 can accept both start and stop pulses from discriminators that furnish NIM-standard fast negative logic signals or from the timing output of a photomultiplier tube base. Typical ORTEC instruments that provide compatible signals are the 416A, 403A, 473, and 260 discriminators and the 265, 269, 270, and 271 Photomultiplier Tube Bases. The start and stop inputs will properly terminate 50Ω cable, and this type is recommended to ensure proper termination of the signals.

No input or output connectors need be terminated when they are not in use.

In any experiment in which it is reasonable to assume that the count rates for start and stop will be equal or nearly so, use the signal furnished from the origin of events into the start input and the signal furnished from the response into the stop input. The 467 will then measure the time difference T from origin to response and furnish an output amplitude that is some fraction of the selected full-scale amplitude, proportional to the ratio of T to the selected full-scale time range.

In any experiment in which the two count rates differ noticeably, such as one in which fewer responses than event origins can be expected, use the lower count rate as the start input to the 467. This assures that the 467 dead time will be minimized, because it analyzes the time difference