ORTEC

Model 437A Time to Pulse Height Converter

Operating and Service Manual

This manual applies to instruments
"Rev. 12" (on rear panel)

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STANDARD WARRANTY FOR ORTEC INSTRUMENTS

ORTEC warrants its instruments other than preamplifier FET input transistors, vacuum tubes, fuses, and batteries to be free from defects in workmanship and materials for a period of twelve months from date of shipment provided that the equipment has been used in a proper manner and not subjected to abuse. Repairs or replacement, at ORTEC option, will be made on in-warranty instruments, without charge, at the ORTEC factory. Shipping expense will be to the account of the customer except in cases of defects discovered upon initial operation. Warranties of vacuum tubes and semiconductors made by their manufacturers will be extended to our customers only to the extent of the manufacturers' liability to ORTEC. Specially selected vacuum tubes or semiconductors cannot be warranted. ORTEC reserves the right to modify the design of its products without incurring responsibility for modification of previously manufactured units. Since installation conditions are beyond our control, ORTEC does not assume any risks or liabilities associated with methods of installation or with installation results.

QUALITY CONTROL

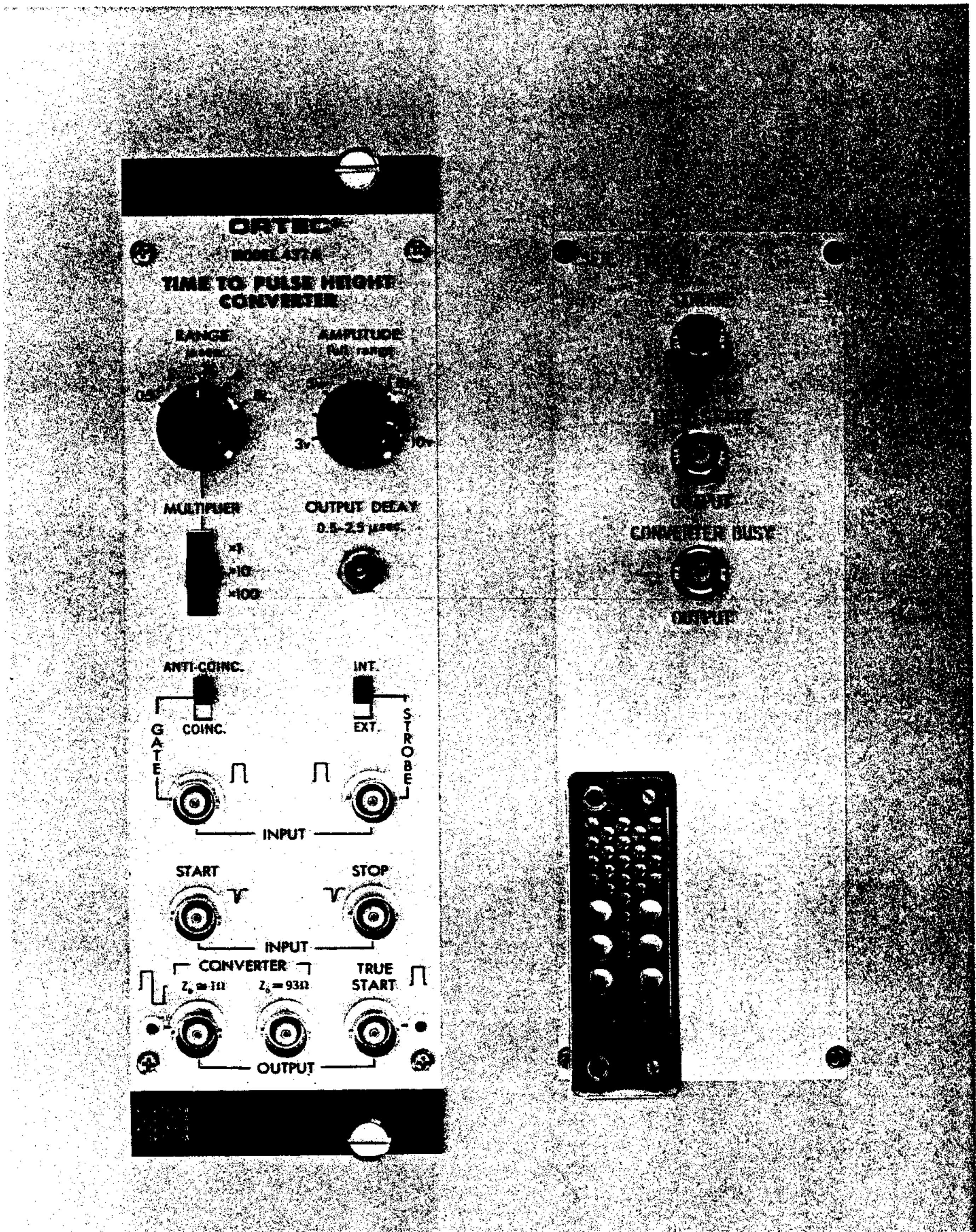
Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

REPAIR SERVICE

If it becomes necessary to return this instrument for repair, it is essential that you contact our Customer Services in advance of its return. ORTEC must be informed, either in writing or by telephone [(615) 482-4411], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. Our standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped **PREPAID** via Air Parcel Post or United Parcel Service to the nearest ORTEC repair center. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty will be repaired at the standard charge unless they have been grossly misused or mishandled, in which case the user will be notified prior to the repair being done. A quotation will be sent with the notification.

DAMAGE IN TRANSIT

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that we may assist in damage claims and in providing replacement equipment if necessary.


ORTEC
TIME TO PULSE HEIGHT CONVERTER
RANGE
AMPLITUDE
3v
10v
MULTIPLIER
OUTPUT DELAY
0.5–2.5 μsec.
×1
×10
×100
ANTI-COINC.
COINC.
GATE
INT.
EXT.
STROBE
INPUT
START
STOP
INPUT
CONVERTER
TRUE START
OUTPUT
CONVERTER BUSY
OUTPUT

ORTEC 437A TIME TO PULSE HEIGHT CONVERTER

1. DESCRIPTION

The ORTEC 437A Time to Pulse Height Converter is a general purpose laboratory instrument that provides output signals with amplitudes proportional to the time differences between Start and Stop inputs. Design features of the ORTEC Converter permit unique versatility for a wide variety of experiments. The 437A combines excellent time resolution, temperature stability, linearity, and dc-coupling into a start-to-stop converter with a very wide dynamic range. The bipolar output signal features a continuously variable delay and step-selectable ranges for both maximum amplitude and time.

Start-to-stop conversion, with a stop recognition enabled only by a valid start, eliminates pulse ambiguity. Internal fixed-threshold tunnel diode discriminators permit direct use of photomultiplier outputs. The input count rate is limited only by input pulse width. All inputs are direct coupled and nonparalyzable. All timing references are based on the time when an input pulse triggers an input discriminator on the negative leading edge of the pulse.

The output signal is gated internally and is shaped into a bipolar signal to prevent baseline shifting in an ac-coupled analyzer or in any other circuit to which it may be furnished. Internal gating also prevents analysis of over-range signals and external pile-up. Either coincidence or anticoincidence gating can be selected with a front panel switch.

The range of time differences, full scale, is step-selectable. The full scale output amplitude can represent a time difference as short as 50 nsec or as long as 80 µsec or any of a variety of convenient intermediate intervals. The full scale amplitude is also switch-selectable from 3 through 10 V in 1-V increments.

When the instrument is strobed internally, the output signal is delayed by an adjusted time after the effective Stop. Delay adjustment is continuously variable between 0.5 and 2.5 µsec, using the control on the front panel. When it is strobed externally, an output pulse will occur at the strobe time.

The timing reference for an accepted Start signal is available from the True Start output. This signal can be delayed externally and furnished as an External Strobe to time-synchronize each output signal with its Start event.

A Converter Busy output signal on the rear panel is present through each conversion and reset period. The Strobe Input and True Start output connectors are duplicated on both front and rear panels.

The ORTEC 437A is a double-width NIM standard module, per TID-20893 (Rev.) (2.70 by 8.75 in.). Its operating power is obtained from one of the ORTEC 401/402 Series Bins and Power Supplies. The Bin and Power Supply is capable of providing rack space and distributing power for up to 12 module widths.

2. SPECIFICATIONS

PERFORMANCE

TIME RESOLUTION 10 psec FWHM, 50-nsec range; 0.01% of range for higher ranges.

TEMPERATURE STABILITY ≤±10 psec/°C, 50-nsec range; ≤±0.015%/°C, higher ranges.

DIFFERENTIAL NONLINEARITY ≤2%, 15 nsec to full range for 50-nsec and 100-nsec ranges; ≤2%, 10% to 100% for all higher ranges.

INTEGRAL NONLINEARITY ≤0.1%.

INPUT COUNT RATE Both Start and Stop inputs are direct-coupled and nonparalyzable.

Start Rate Max $\geq 3 \times 10^6$ counts/sec random rate. **Stop Rate** Max $\geq 30 \times 10^6$ counts/sec.

CONTROLS

TIME RANGE 5-position switch for 15 range choices: 0.05, 0.1, 0.2, 0.4, or 0.8 µsec, multiplied by X1, X10, X100.

TIME RANGE MULTIPLIER 3-position switch; X1, X10, or X100.

GATING MODE 2-position switch; Start input may be Coincidence or Anti-Coincidence gated.

STROBING MODE 2-position switch; Output may be strobed either Internal or External:

Internal Set by Output Delay control for Strobe to occur from 0.5 to 2.5 μsec after Stop input.
External Prompt at External Strobe input.

OUTPUT AMPLITUDE 8-position switch for full range of 3 V to 10 V in 1-V steps.

OUTPUT DELAY Single-turn potentiometer; range 0.5 to 2.5 μsec.

INPUTS

START Threshold ≃250 mV, dc-coupled, Z = 50Ω ±10%, protected to ±100 V, pulse width 2 nsec min. Time slewing ≃0.8 nsec from X2 to X20 threshold. Accepted only when 437A is not busy. Front panel BNC connector.

STOP Same as Start, but enabled only by a valid Start. Stop signal must be accepted within the conversion time range to generate an Output signal. Front panel BNC connector.

GATE +2 V min, dc-coupled, Z ≃1 kΩ, protected to ±30 V. Gates the Output pulse when Strobe Mode switch is set at External. A delayed True Start output pulse will normally be used for this input, and should be delayed no less than the selected time range for proper operation. Front and rear panel BNC connectors.

EXTERNAL STROBE +2 V minimum, dc-coupled, Z ≅ 1 kΩ, protected to ±30 V. Gates the Output pulse when Strobe Mode switch is set at Ext.

OUTPUTS

CONVERTER OUTPUT Two identical pulses, furnished through two different output impedances, 1Ω and 93Ω. Bipolar, positive leading edge, constant pulse shape independent of range or amplitude. Each pulse amplitude is proportional to a Start-to-Stop time difference. Open circuit full range amplitude is 3 V to 10 V in 1-V increments, to represent switch-selected full range of time. Front panel BNC connector.

TRUE START +5-V nom (+4-V min) signal for each accepted Start input signal; the output will be present from each accepted Start until the beginning of the subsequent reset. Z_0 <10Ω, dc-coupled. Front and rear panel BNC connectors.

CONVERTER BUSY +5-V nom (+4-V min) signal; the output will be present from each valid start until the end of the subsequent reset. Z_0 <10Ω, dc-coupled. Rear panel BNC connector.

ELECTRICAL AND MECHANICAL

POWER REQUIREMENTS

+24 V, 75 mA; +12 V, 105 mA;
-24 V, 110 mA; -12 V, 100 mA.

WEIGHT (Shipping) 4.5 lb (2.1 kg).

WEIGHT (Net) 2.5 lb (1.1 kg).

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

RELATED EQUIPMENT

The 437A can accept Start and Stop signals from fast discriminators, the timing output of a photomultiplier base, or an instrument such as the ORTEC 453 Constant Fraction Timing Discriminator. Typical ORTEC Fast Discriminators include the 260 and 436. ORTEC PM Bases with timing outputs include the 265, 269, 270, and 271. The 437A output has a standard bipolar shape and is a linear pulse with a selected full scale amplitude which can be normalized for input to all ORTEC analog processing modules and to all available multichannel ADC's. All input and output signals conform to the Preferred Practices of AEC Report TID-20893 (Rev.).

3. INSTALLATION INSTRUCTIONS

3.1. GENERAL

An ORTEC 401/402 Series Bin and Power Supply, from which the 437A will obtain its operating power, is intended for rack mounting. Therefore if any vacuum tube equipment is operated in the same rack, there must be sufficient cooling air circulation to prevent any localized heating of the all-transistor circuits in the 437A and in the other modules and the 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 437A should not be subjected to temperatures in excess of 120°F (50°C).

3.2. CONNECTION TO POWER

Always turn off the power for the Bin before inserting or removing any modules. If all of 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. If, however, 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, to determine that none of the four power levels have been reduced by an overload.

3.3. CONNECTION INTO A SYSTEM

Furnish the Start and Stop input signals into the 437A through 50Ω coaxial cables. This provides an impedance match for the 50Ω input impedance for each of these circuits.

Use 93Ω coaxial cable for all other input or output connections. When the 1Ω Output connector is used to transfer the output pulses from the 437A into the analyzer, the output amplitudes will retain the selected full range values, 3 to 10 V set with the front panel switch. When the 93Ω Output connector is used and the cable is terminated in 93Ω at the analyzer, all signals will be reduced to 50% of the indicated amplitude (1.5 to 5 V full scale).

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 437A will then measure time difference T from origin to response and will 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 for time.

In any experiment in which the two count rates will 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 437A. This assures that the 437A dead time will be minimized, because it analyzes a time difference only after a Start signal is accepted. When the response is used as a Start signal, furnish the signals from the origin of events through a delay line into the Stop input, and adjust the delay to match the selected full scale time of the 437A. At each Start input signal the 437A will analyze the time until its related origin signal is furnished to the Stop input. The time measured is then delay time minus T, and produces a so-called inverted time spectrum.

The purpose for this type of system connection is to reduce the number of conversions and the corresponding dead time during the experiment. For each signal accepted through the Start input there must be a conversion; but for each signal through the Stop input there need not be a conversion. For each Start signal not followed by a Stop within the selected time full range, the converter measures a time equal to the range, even though no output pulse is generated.

3.4. LINEAR OUTPUT SIGNAL CONNECTIONS AND TERMINATING IMPEDANCE

The source impedance of the 0- to 10-V standard linear outputs of most ORTEC 400 Series modules is approximately 1Ω. For these circuits the interconnection of linear signals does not require critical checking of the input impedance in the circuits to which these signals are transferred. Normally, paralleling several loads on a single output will still not reduce the 0- to 10-V signal span.

Short cable lengths (up to approximately 4 ft) need not be terminated. When longer cable lengths are required for transfer of a linear signal, the cable should be terminated in a resistive load equal to the cable impedance to prevent reflections and oscillations in the cable. Oscillation suppression can be effected by either a series termination at the sending end of the cable or by a shunt termination at the receiving end. For convenience a BNC tee can usually accommodate both the cable and a mating terminator at the input of the receiving instrument. These units are available commercially, including BNC terminators at nominal values of 50, 100, and 1000Ω. ORTEC stocks a limited quantity of all but the 1000Ω terminators for your convenience:

BNC tee connector	ORTEC C-29
50Ω terminator	ORTEC C-28
100Ω terminator	ORTEC C-27

When a shunt termination at the receiving end of the cable is impractical, consider series termination at the sending end. For a series termination the full signal amplitude span is available at the receiving end only if the input impedance there is many times the characteristic impedance of the cable. For series termination install the correct resistance between the actual amplifier output, on the etched circuit board, and the output connector. Effectively, the terminating resistance is in series with the input impedance of the receiving instrument and may result in some loss in signal amplitude. For example, if the series terminator is 93Ω and the driven load is 900Ω, the available signal span will be only about 90% of the maximum signal amplitude for each pulse. The termination of 93Ω cable in a 93Ω load will cause a 50% loss for the signal.

4. OPERATING INSTRUCTIONS

There are six front panel controls on the 437A. Two of these, the Range and its Multiplier, determine the full scale limit for time conversion. Any of 15 combinations may be selected, as follows:

Full Scale Time Limit	Switch Settings	
	Range	Multiplier
50 nsec	.05	X1
100 nsec	.1	X1
200 nsec	.2	X1
400 nsec	.4	X1
500 nsec	.05	X10
800 nsec	.8	X1
1 μsec	.1	X10
2 μsec	.2	X10
4 μsec	.4	X10
5 μsec	.05	X100
8 μsec	.8	X10
10 μsec	.1	X100
20 μsec	.2	X100
40 μsec	.4	X100
80 μsec	.8	X100

For example, with the Range switch set at .05 and the Multiplier switch at X100, the full scale time range is 5 μsec. Any Stop signal that occurs within 5 μsec after a Start signal will indicate the generation of an output pulse through both Converter Outputs. The output pulse will not be furnished through these circuits until it is strobed; it is delayed until after the Stop signal.

When the output does occur, its amplitude indicates the ratio of measured Start-to-Stop time to the selected full range time by the fact that it is the same proportional part of a selected full scale Amplitude. The 8-position Amplitude switch permits a full scale voltage to be any level from 3 through 10 V in 1-V increments. For example, a time difference of 20 nsec, measured with 50 nsec full scale for time, will cause a 4-V pulse amplitude if the Amplitude switch is set at 10.

A cascaded dependency eliminates output pulse ambiguity. No output pulse is furnished unless a Stop signal is accepted within the selected full scale time range. A Stop signal is not effective unless it is preceded by a Start signal. For further control either a Coincidence or Anti-Coincidence mode can be selected to determine when a Start signal will be accepted.

To eliminate gating for the Start signals, set the Gating Mode switch at Anti-Coincidence and leave the Gate Input open circuited. With the same switch setting a 2-V input through the Gate Input connector will inhibit acceptance of Start signals, and is effective until it is removed.

For Coincidence gating set the switch at Coincidence and furnish a 2-V signal through the Gate Input when Start signals are to be accepted. No Start signal can be accepted in this mode unless the Gate Input is held at 2 V through a time which overlaps the Start signal.

The Gate Input circuit is dc-coupled and can be used to block 437A conversions while an ADC is busy measuring a previous output pulse. Furnish either the Busy or $\overline{\text{Busy}}$ signal from the ADC (whichever is the positive-true output) to the Gate Input of the 437A, and set the mode switch at Anti-Coincidence. Although this will not provide an overall system advantage, since most presently available ADC units include reliable linear gates for self-gating themselves, it could reduce the total work load for the 437A enough to be a possible advantage.

The Strobe switch determines which of two sources will be used to signal when an output pulse can be furnished. The switch selects either an Internal or External mode of operation. When it is set at Internal, each accepted Stop signal creates a delayed Strobe pulse in the 437A, and the delayed leading edge triggers the output pulse. The amount of internal delay is determined by the setting of the front panel Output Delay control, within the range of 0.5 to 2.5 μsec. When the Strobe switch is set at External, an input pulse must be furnished through the associated Strobe connector to signal an Output; there is no delay time in the 437A for the External Strobe mode of operation. Logically, an External Strobe must be furnished after a Stop signal or there will be no available output to be triggered. Avoid a long delay, i.e., greater than 100 μsec, to assure that the amplitude of the resulting output pulse is not degraded. A True Start output pulse from the 437A may be delayed slightly longer than the selected time range and used as an External Strobe; this can establish a time relationship between the Start Input signal and its resultant Converter Output signal.

The 437A Time to Pulse Height Converter is reset at the end of each Converter Output pulse. From the recognition of a Start signal until reset, the instrument is busy with the conversion of a time interval and cannot respond to any new Start signals that may arrive during the busy time. For those Start signals which are not accompanied by a Stop signal within the full range time limit, the busy time is equal to range time plus 4 μsec. The Busy output signal from the 437A rises to a nominal 5 V through the duration of each busy interval. This function may be applied to inhibit an event from generating a Start signal until it can be accepted, where the experiment can be so controlled. The Busy function is used internally in the 437A to prevent acceptance of any extraneous Start signals that may occur during an active conversion period.

5. CIRCUIT DESCRIPTION

See Dwgs. 437A-0101-S1, 437A-0101-B1, and 437A-0102-B1 and Figs. 5.1–5.5 for graphic details relating to this discussion.

The circuit that contains diode D1, transistor Q52, and resistors R1 through R4 forms a voltage limiter to limit the base voltage of Q1 to 700 mV for input signals up to 100 V. A 250-mV, or larger, negative input signal, amplified by Q1 and Q2, causes tunnel diode D4 to switch from its low voltage state to its high voltage state of about -0.5 V. The tunnel diode remains in its high voltage state until a reset signal is furnished from Q25, and applies the -0.5-V signal to the base of Q3.

With the base of Q3 at -0.5 V, the current of Q4 through Q3 is switched to provide two functions. One is to drive the True Start output circuit, Q48 through Q51, for an external timing signal keyed to an accepted and valid Start input. The second function is to reverse the state of current switch Q5 and Q6 so that the Q6 current flows through Q5.

While current is flowing through Q5, Q9 is held in cutoff, and the constant current from Q35 charges the selected timing capacitor (C9, C10, C11, or C12) linearly. The voltage at the base of Q9 is limited to about -3 V by the circuitry associated with Q7. Because of this, the maximum voltage toward which the capacitor will be charged is limited to -3.6 V. The amplifier (Q10 to Q14) furnishes two outputs. One is a positive voltage at the collector of Q14 and is used to control the over-range trigger. The other output is a negative voltage at the gate of Q11, and this is

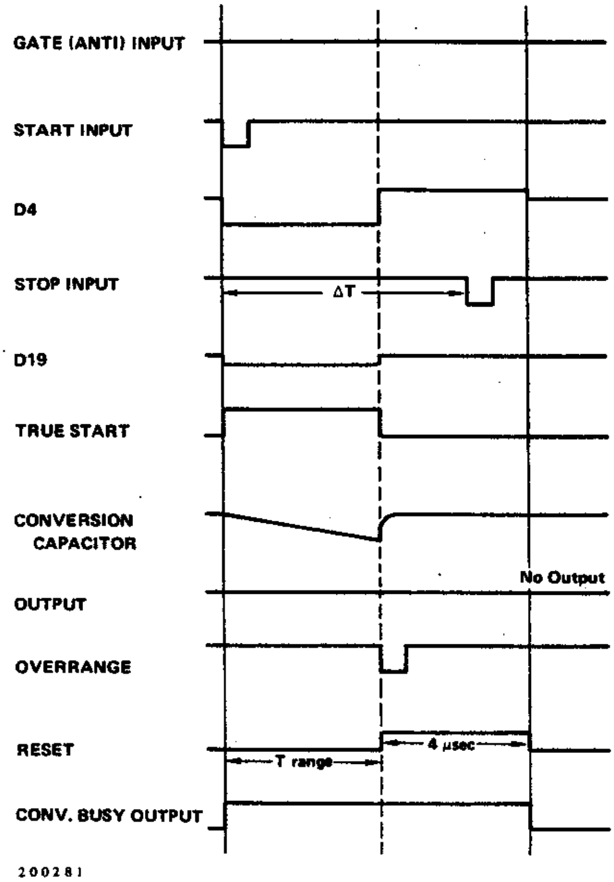


Fig. 5.2. Timing Diagram ($\Delta T > T_{range}$) Using Internal Strobe.

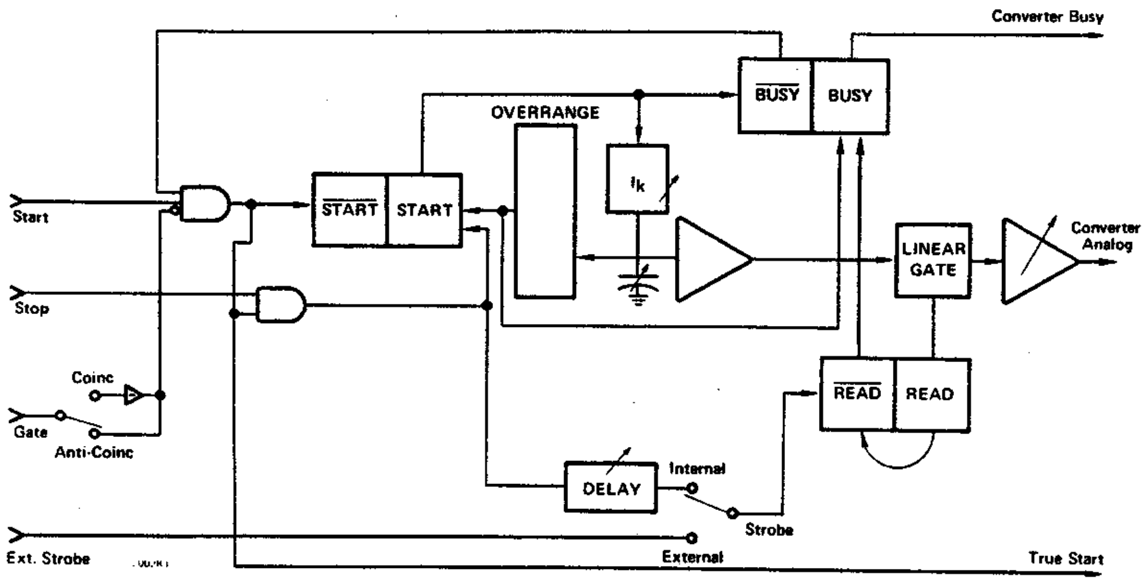


Fig. 5.1. Simplified Functional Block Diagram of ORTEC 437A Time to Pulse Height Converter.

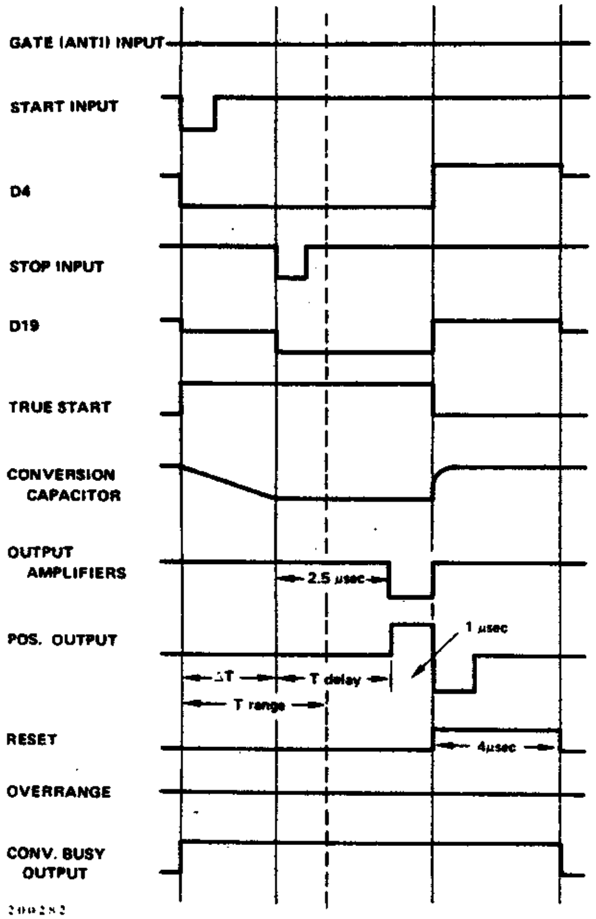


Fig. 5.3. Timing Diagram ($\Delta T < T_{range}$) Using Internal Strobe.

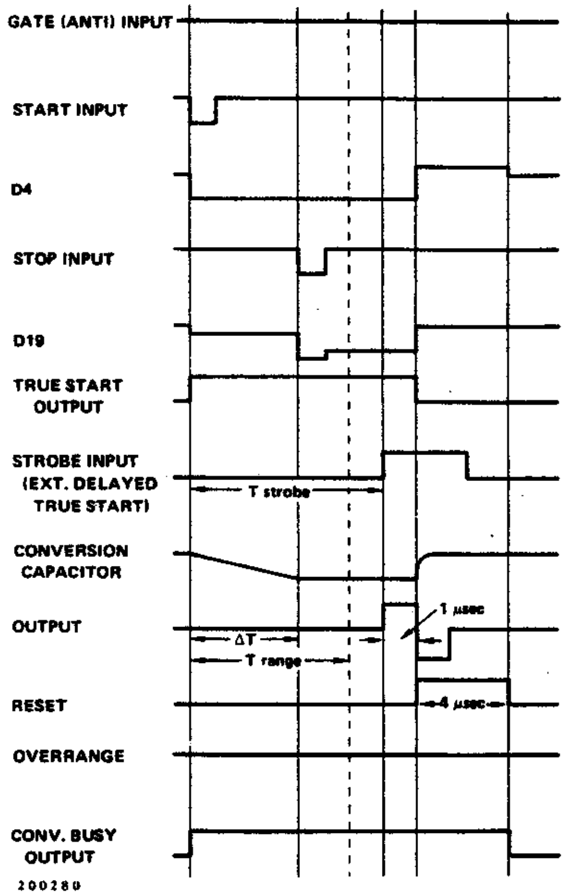


Fig. 5.4. Timing Diagram ($\Delta T < T_{range}$) Using External Strobe.

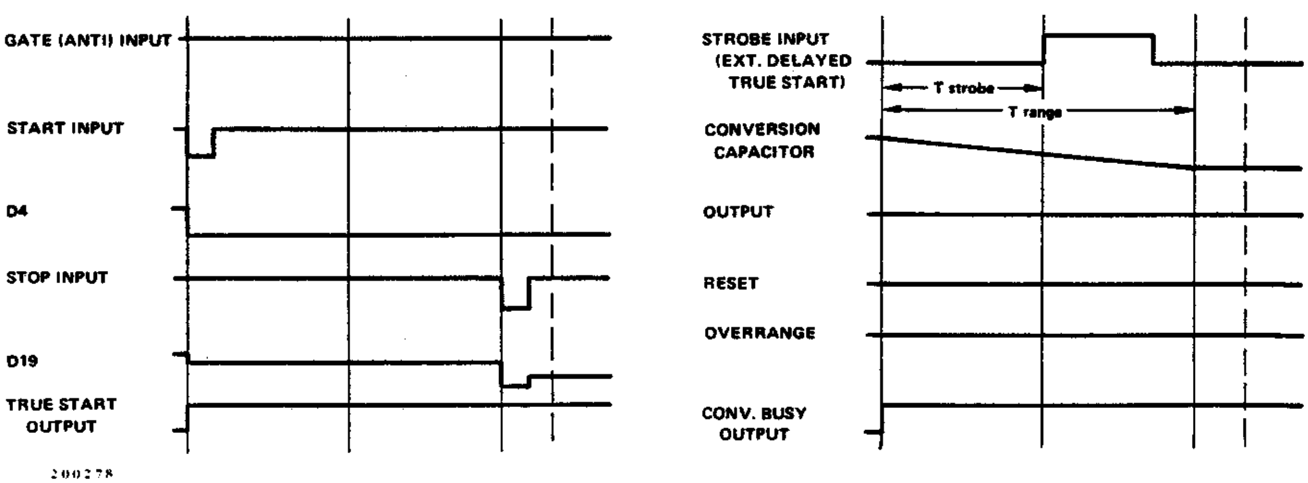


Fig. 5.5. Timing Diagram Using External Strobe with Insufficient Delay.

amplified and shaped by the output amplifiers if there is a timely Stop signal. The closed-loop voltage gain from Q10-G to Q11-G is unity.

Assuming that a Stop signal is not furnished within the selected time range, the Schmitt trigger (Q27 and Q28) fires at about 3.0 V. Thus, when the charge on the selected timing capacitor has increased to -3 V without interruption from an external Stop signal, an over-range is identified. The over-range triggers the reset switch, Q23 to Q26. The reset switch causes the tunnel to return to its low state. No output pulse will be generated.

If an external Stop signal is received prior to the over-range identification, the process stops charging the capacitor and enables an output to be generated, the output pulse amplitude will be derived from the charge on the capacitor at the time of interruption. Diode D16 and resistors R84 to R88 form a limiter circuit for the Stop input circuit. A Stop pulse through transistor pair Q29 and Q30 forces tunnel diode D20 to its high voltage state if a conversion is actually in process as a result of a Start signal having been furnished previously within the selected time range. With the tunnel diode in its high state, transistor pair Q32 and Q33 switch to perform two functions. First, Q34 is cut off and the constant current is routed through Q35. The selected time range capacitor, C9, C10, C11, or C12, is not charged any further and has no discharge path; so it holds the voltage to which it has been charged. The second function, used only for the Internal strobe mode, is to furnish a trigger to read timer Q37 to Q40. Transistor pair Q32 and Q33 can be switched by the external Stop signal if the Strobe switch is set at Internal. It will then trigger the read timer through Q46, and the trigger pulse is delayed 0.5 to 2.5 μsec by the setting of the Output Delay control, R153. If the Strobe switch is set at External, an external Strobe input signal will trigger the read timer, Q37 to Q40, promptly through Q47.

The read timer, Q37 through Q40, performs two functions: to open the linear gate, Q15, and to trigger reset through Q26. Timing for Q37-Q38 is calibrated by Gate Width control R120 at about 1 μsec. The linear gate is open through this period, and reset occurs at the end of the period. At reset, tunnel diode D4 is switched to its low state and cannot be switched to high again for about 4 μsec, which prevents pile-up. Resetting D4 forces Q3, Q4, Q5, Q6, and Q31 to switch tunnel diode D20 to its low state.

The Converter Busy signal is furnished from IC-4 and Q51 and the associated circuitry. This switches to true at a signal from the True-Start from Q3-Q4 through Q48 and Q49 and remains true until the reset switch, Q23 to Q26, switches it back to false.

Linear gate Q15 has an input amplitude equal to the charge stored on the selected timing capacitor, proportional to the time from the Start to Stop input signals. When the linear gate is opened by the signal through Q40, this amplitude is fed to the output amplifier. Transistor Q16 is an emitter follower furnishing high impedance at the linear gate. A feedback amplifier, Q17 to Q19, inverts the signal with unity gain and drives the 1-μsec delay, DL1. The input to the amplifier is added to the delayed inversion to form the pulse used to drive the output amplifier, Q41 through Q45.

The gain of the output amplifier, Q41 through Q45, is switch-selected by S4 within the range from unity to 3.3. The result is to furnish each output signal as a pulse with an amplitude proportional to Start-to-Stop time, based on a selected full scale amplitude of 3 to 10 V in 1-V steps.

Logical gating provides an additional control on the Start tunnel diode, D4. A Gate input signal must exceed 2 V to be effective, and is limited to 3 V (protected to 100 V) by the limiter circuit including diode D9 and resistors R55 to R59. Either Coincidence or Anti-Coincidence mode is selected by switch S3. When S3 is set at Anti-Coincidence, Q20 is normally cut off and Q22 conducts, and tunnel diode D4 can accept a Start input. If a positive signal greater than 2 V is furnished through the Gate input connector, Q20 and Q22 are switched to inhibit tunnel diode D4 from switching to its high state. When S3 is set at Coincidence, Q22 is normally cut off and Q21 conducts, and this inhibits switching for tunnel diode D4. For this mode a positive signal of 2 V or more through the Gate input will switch Q21 and Q22 and permit tunnel diode D4 to respond to a Start input signal through the duration of the Gate input signal.

6. MAINTENANCE INSTRUCTIONS

6.1. TESTING PERFORMANCE

The following test procedures are furnished as a guide for installation and checkout of the 437A.

Test Equipment The following test equipment is recommended. Each test procedure refers to this list by the unit identification number for the required item(s) of test equipment. An equivalent unit may be substituted for any item in the list.

1. Hewlett-Packard 222A Pulse Generator
2. ORTEC 436 Fast Discriminator
3. ORTEC 416A Gate and Delay Generator
4. ORTEC 408 Biased Amplifier
5. ORTEC 260 Time Pickoff Unit
6. ORTEC 403A Time Pickoff Control
7. ORTEC 434 Digital Ratemeter
8. Tektronix Type 585 Oscilloscope
9. Multichannel Pulse Height Analyzer
10. Fan-in Unit

Preliminary Procedures At the time of installation, the following preliminary steps should be taken:

1. Check the module visually for possible damage.

2. With power off, install 437A in a standard Bin and Power Supply such as one of the ORTEC 401/402 Series.

3. Check for proper mechanical alignment.

4. Switch ac power on, and check the dc power voltages at the test points on the 402 Power Supply control panel.

Conversion Tests Use the typical test setup shown in Fig. 6.1, and supply a Start and Stop pair of signals of known time difference into the 437A. Observe the Converter Output, with the Strobe switch set at Internal and the Gate switch at Anti-Coincidence.

1. Adjust the delay for the Stop input to about 0.4 μsec.

2. Set the Time Range selector of the 437A at .05, and the Multiplier switch at X10. Time full range is then 0.5 μsec.

3. Set the Amplitude Full Range switch at 10. The Output pulse amplitude should be approximately 8 V.

4. Turn the Time Range selector through .1, .2, .4, and .8, and observe the pulse amplitude at each setting; each successive switch position should decrease the pulse amplitude to half of the amplitude for the previous setting.

5. Return the Time Range selector to .05, and set the Multiplier switch at X100. The Output pulse amplitude should now be about 0.8 V.

6. Set the Multiplier switch at X1. This should eliminate the Output pulses because each Stop pulse is furnished after the completion of the 50-nsec interval and will not generate any output.

Resolution Tests See Fig. 6.2 for the typical test setup used for resolution checks. The Start and Stop pulses used for this test must have fast rise time and be jitter free. The minimum delay recommended for the Stop pulses is 20 nsec. The resolution of any scale can be measured with this setup, and the main consideration is that each Stop signal delay must be within the linear region of the selected time range.

1. Adjust the delay for the Stop input to a basic setting of 30% to 50% of the selected time range.

2. Operate the system and obtain a timing spectrum. Normalize the Output amplitude full range for the normally digitized full range of the ADC in the Analyzer.

3. Use the Biased Amplifier to position the peak into a group of channels nearer the lower end of the total channel range used in the Analyzer.

4. After an adequate spectrum accumulation to assure statistical accuracy of photopeak measurements, identify

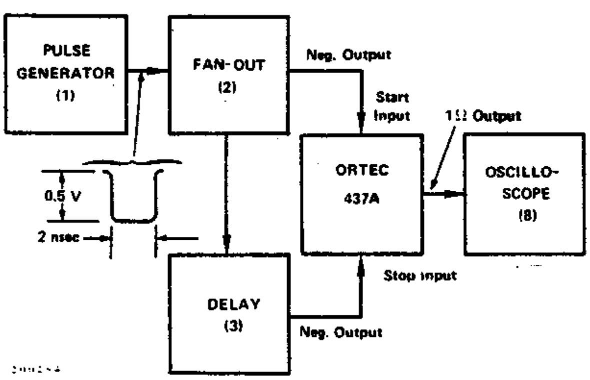


Fig. 6.1. Test System for Checking Conversion.

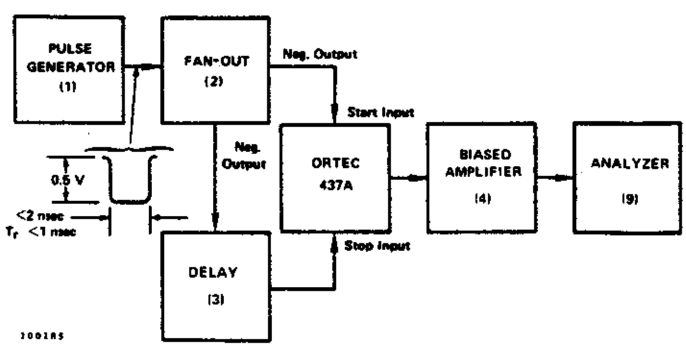


Fig. 6.2. Test System for Checking Converter Resolution.

the peak channel number and measure the FWHM channel number limits. Log these for reference.

5. Increase the delay for the Stop signal by a fixed and known amount. This may be done by insertion of a fixed delay line cable or by careful adjustment of the Delay unit controls. The total delay for the Stop signal must still be less than 100% of the selected time full range.

6. Without changing the Biased Amplifier and Analyzer calibrations, accumulate a spectrum for this measurement of increased time intervals.

7. Observe the relocated photopeak in the timing spectrum, and record its peak channel number and its FWHM channel number limits.

8. Subtract the peak channel number in step 4 from the peak channel number in step 7. This is the number of channels which represents the time variation injected at step 5.

9. Calculate time resolution effective for the established system calibration:

Δt per channel = (stop delay increased) ÷ (channel shift).

10. Calculate the converter resolution, using the FWHM channel width from either step 4 or step 7; these widths should be the same at either peak location:

Time resolution (FWHM) = FWHM channel width X Δt per channel.

Count Rate Tests In many applications it is important for a time to pulse height converter to handle high count rates, both external and internal. Since the Start input is gated internally and the conversion circuits are all direct-coupled, the limit for its external count rate capability is determined solely by the input pulse width, and there are no pile-up effects. The limit on the internal count rate is imposed by the conversion and reset process, where the Start input is disabled through a Converter Busy interval following each accepted Start signal. A Converter Busy interval is the measured time plus approximately 7 μsec for Start-Stop intervals within the selected time range, or the selected time range plus 4 μsec if no Stop signal is furnished within the time range.

The following test, using the systems connection shown in Fig. 6.3, permits accumulation of a basic timing spectrum for the Start-Stop input pulses at 60 Hz. As the external count rate for Start only is increased by regulating the random pulse generator, the internal pulse rate in the 437A is increased, and a ratemeter will monitor the resulting rate at which the internal capability is impaired.

1. The 260 and 403A may be used as a random pulse generator, triggered by noise. Use an initial sensitivity setting above the noise level for a zero output pulse rate.

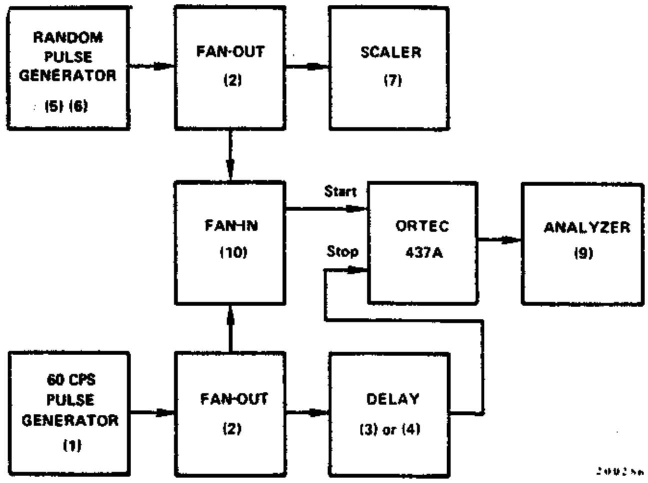


Fig. 6.3. Test System for Checking Count Rate.

2. Adjust the delay for the Stop input to about 0.4 μsec.

3. Select the 0.5 μsec Time Range with the 437A.

4. Adjust the system for a timing spectrum, accumulated for the 60-Hz input pulses.

5. Decrease the sensitivity carefully for the 260 – 403A (if used) to generate random Start signals with no corresponding Stop signals. Monitor the random rate with the ratemeter.

6. Observe the timing spectrum as the random input rate is gradually increased. Watch for interference in the accumulated spectrum.

Differential Linearity Measurements A system for testing differential linearity of the 437A is shown in the block diagram in Fig. 6.4. In this system the random pulse generator is used as the source for Start signals, and a pulse generator with a fixed rate is used for Stop signals. The measurable time interval between a Start and Stop is a random value, with equal probability that it will be any time difference up to the periods between the regular Stop signals. For an infinite number of Converter Outputs

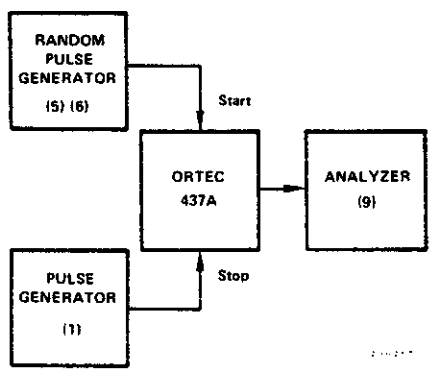


Fig. 6.4. Test System for Checking Differential Linearity.

the count levels for each channel of the analyzer should be equal. After the test has been run long enough to assure statistical accuracy (e.g., >25,000 counts/channel), the spectrum should be similar to those illustrated in Fig. 6.5. Any deviation from a straight line represents a differential nonlinearity, and the percent of deviation is the difference between this count level and the average divided by the average count level.

1. Select the 437A Time Range to be tested.

2. Calculate the maximum Stop pulse repetition rate for the selected Time Range. This should be slightly lower than the reciprocal of the range time. For example, for the 1-μsec Time Range the reciprocal is 1 x 10^6, and a pulse generator rate of 7 to 9 times 10^5 should be satisfactory. A lower rate increases the time required to run the test, while a faster rate will reduce the upper channel responses.

3. Operate the system, and observe the analyzer's dead time indication. Regulate the random Start rate to cause the analyzer dead time to be approximately 20%.

4. Clear the analyzer to zero, and operate the system until the average count level for each channel is sufficient to assure statistical accuracy.

5. Compare any nonlinearity indications to the specifications listed in Section 2. Some nonlinearity can be expected in the lower channels for any range, as shown in Fig. 6.5.

Checking External Strobing Mode The system for checking the External Strobing Mode is shown in Fig. 6.6. This system can also be used to verify the principles of operation of the 437A.

1. Set the Delay for the Stop signal at about 0.4 μsec.

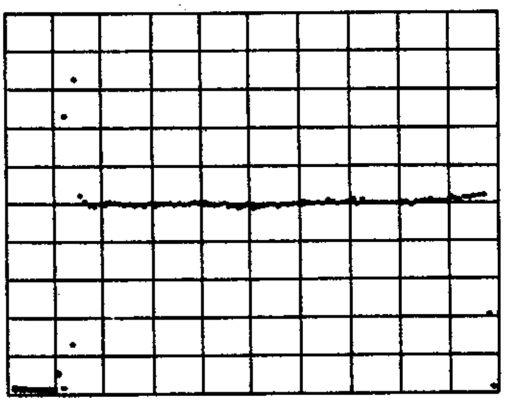
2. Set the 437A Time Range for 0.5 μsec.

3. Use the Internal Strobe Mode for the 437A. Adjust the oscilloscope sweep as required to identify the bipolar Converter Output pulse.

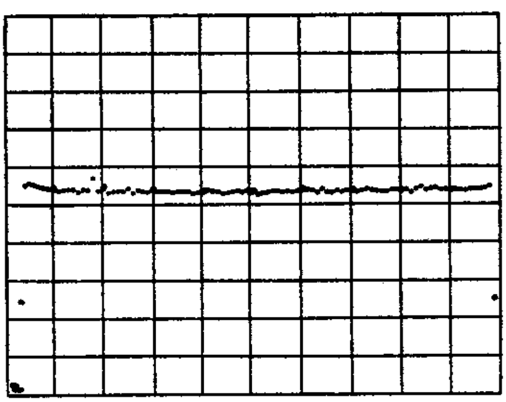
4. Set the Delay for the Strobe signal greater than 0.5 μsec to assure that it will occur later than the Full Range Time.

5. Switch the 437A to its External Strobing Mode and observe the Converter Output pulse. It should be identical to the pulse observed in step 3, except for the time at which it occurs.

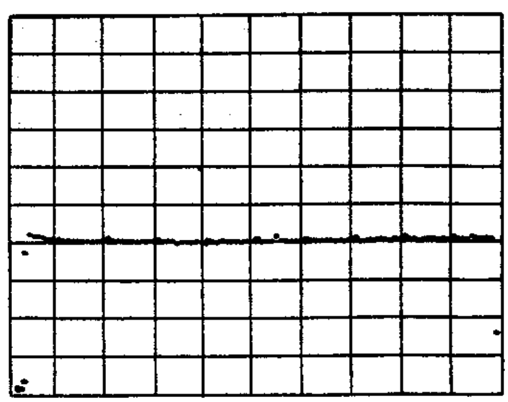
6. Vary the Stop delay setting and observe the effect on the Converter Output pulse. It should occur at a constant



Range .1 } 1 μsec
Multiplier = X10
(Vert): Full Scale = 5 x 10^4 counts
(Horiz): Full Scale = 105% range



Range .1 } 100 nsec
Multiplier = X1
(Vert): Full Scale 5 x 10^4 counts
(Horiz): Full Scale = 105% range



Range .1 } 10 μsec
Multiplier = X100
(Vert): Full Scale = $X10^5$ counts
(Horiz): Full Scale = 105% range

Fig. 6.5. Differential Linearity for Three Different Time Ranges.

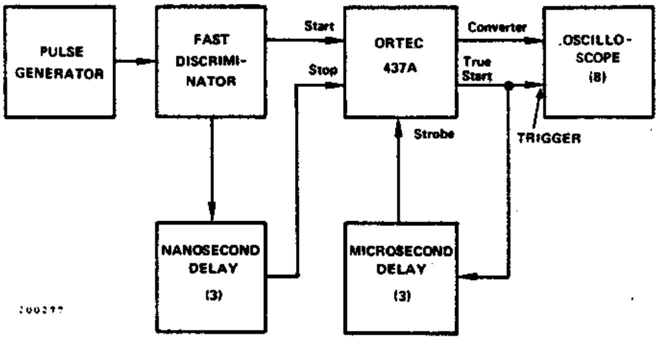


Fig. 6.6. Test System for Checking External Strobing Mode.

time but vary in amplitude. If the Stop delay is increased beyond 0.5 μsec, there will be no output pulse.

6.2. CORRECTIVE MAINTENANCE

Clean the surfaces of the printed circuits, the connectors, and all chassis parts periodically to prevent accumulated dust from forming leakage paths between the circuit components. The 437A should require maintenance only rarely, as indicated by a malfunction in its performance under known conditions.

If the instrument is suspected of a malfunction, use the performance tests of Section 6.1 to aid verification. When incorrect operation is identified, disconnect the 437A from its position in the system and perform routine diagnostic tests with a pulse generator and oscilloscope. Use the Timing Diagrams (Figs. 5.2–5.5) to isolate the problem, and use schematic diagram 437A-0101-S1 at the end of the manual to localize the malfunction.

Calibration The discriminators for the Start input and Stop input are calibrated to trigger at a level of approximately -250 mV. Control R75 is adjusted for the Start input, and control R98 is for the Stop input. Note that a response cannot be triggered for the Stop discriminator unless the Start discriminator has been triggered at least 20 nsec, but less than the selected Time Range, before the Stop signal.

For dc and over-range zero calibration, set the Time Range to 0.8 μsec, and monitor TP-1 with a sensitive voltmeter. Then adjust R28 for a dc zero at TP-1 (≤±0.002 V). Now monitor TP-2 with the voltmeter, and adjust R31 for an over-range zero at TP-2 (≤±0.002 V).

Note: Any adjustment of R28 will affect the level at TP-2, and requires a readjustment of R31 as a final step.

Troubleshooting After a malfunction has been identified and the associated portions of the 437A circuits have been located, check the typical dc voltages for the suspected components by comparison to the list in Table 1. Note that these are typical levels, observed under standard conditions for Time and Amplitude Range settings with no input signals.

TABLE 1. TYPICAL DC VOLTAGES

Note: Time Range = 0.2 μsec (0.2, X1); Amplitude full range = 3 V; no input signals.

CHECKPOINT	TYPICAL DC VOLTAGE	CHECKPOINT	TYPICAL DC VOLTAGE
Q1B	-0.01	Q28C	+8.14
Q1E	-0.74	Q29B	-0.02
Q2E	-0.68	Q29E	-0.76
Q2C	+1.07	Q30E	-0.66
Q3B	-0.06	Q30C	+1.07
Q4B	-0.20	Q31B	-0.63
Q9C	+1.42	Q32B	0
Q9E	0	Q33B	-0.20
Q10G	0	Q34E	-10.88
Q11G	0	Q35B	-10.27
Q12E	+11.66	D21A	-20.44
Q12C	+5.25	Q37B	0
Q13B	+4.61	Q37C	-5.30
Q14C	-0.16	Q39B	-0.95
Q15B	-0.70	Q39C	-0.13
Q15E1	0	Q40B	+0.74
Q16E	+0.40	Q40C	+0.10
Q16B	+1.03	Q41B	-11.40
Q17B	+0.06	Q41E	-12.01
Q17E	+0.66	Q42B	-12.68
Q18B	-9.48	Q43B	+13.26
Q18E	-8.87	Q44C	+15.11
Q19B	-0.58	Q44B	+1.04
Q19E	+0.06	Q44E	+0.42
Q20B	+0.03	Q45B	-0.20
Q21B	+1.74	Q46E	-10.28
Q21E	+1.04	Q46C	0
Q22B (Anti-coinc)	+0.73	Q47B (Ext)	-0.7
Q22B (Coinc)	-0.51	Q48C	+9.86
Q23B	+10.36	Q49C	-0.20
Q23E	+11.0	Q50C	+10.88
Q24B	+11.61	Q51B	+0.12
Q24C	0	Q51C	+10.88
Q25B	-10.36	IC-4-2	+2.25
Q25E	-11.04	IC-4-5	-0.20
Q26B	-10.92	IC-4-7	+0.12
Q27B	+3.41	IC-4-8	+4.50
Q27E	+2.73		

6.3. FACTORY SERVICE

The 437A may be returned to ORTEC for repair service at nominal cost. Our standard procedure requires that each repaired instrument receive the same extensive quality control tests that a new instrument receives. Please contact our Customer Service Department, (615) 482-4411, before returning the instrument for repairs.

7. APPLICATIONS

7.1. TIME TO PULSE HEIGHT CONVERTER IN A DIFFERENTIAL COINCIDENCE SYSTEM

A time to pulse height converter in conjunction with a single-channel analyzer forms a differential coincidence system with variable coincidence time. This coincidence time may be selected by simple variation of the single-channel window position and width. The resolution is limited only by the detector and/or time converter resolution. The advantage is that the fast coincidence is performed by slow linear circuitry. One side of a fast coincidence system of this type is shown in block diagram form in Fig. 7.1.

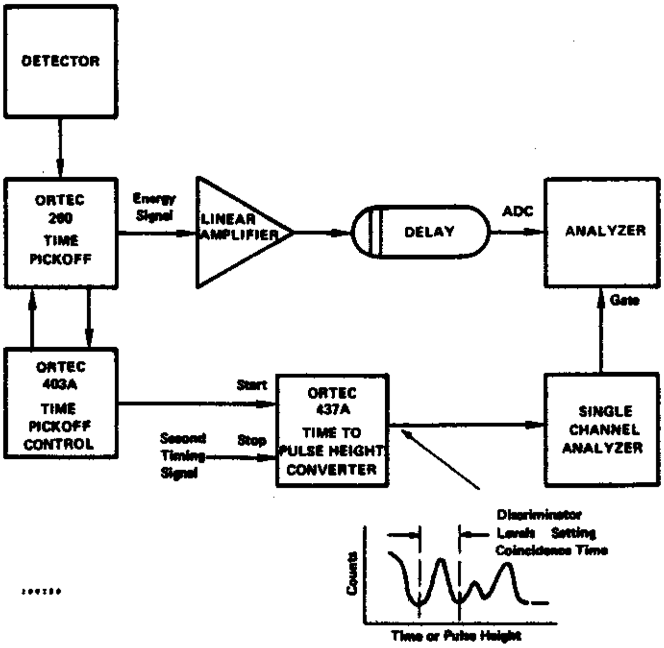


Fig. 7.1. Block Diagram of Differential Coincidence System.

7.2. CORRELATED TIME-ENERGY MEASUREMENTS

Much use of multiparameter analyzers has been in connection with correlated time-energy studies.[1-3] The advent of the ORTEC 260 Time Pickoff, in conjunction with the ORTEC 437A Time to Pulse Height Converter and multiparameter analyzers, opens up a new realm of exploration in charged particle spectroscopy by allowing simultaneous high-resolution energy analysis versus subnanosecond time resolution of charged particles. By this method, particle breakup and mass-energy relationships may be studied in detail. A system for identifying charged particles from a pulsed accelerator is shown in the block diagram in Fig. 7.2.

7.3. PULSE SHAPE DISCRIMINATION

The extraction of important information contained in a pulse is quite often difficult, but in many cases the additional information is worth the trouble required for its extraction. In the case of pulse shape discrimination the information may be associated with the sum of multiple pulses or with the sum of differing time components of a single pulse. There are many applications of this principle. Some of these applications are:

1. scintillation counter pulse shape discrimination, such as neutron-gamma identification, etc., and photomultiplier noise background reduction,

2. charged particle identification in semiconductors,

3. inspection for pile-up reduction.

In all the applications that follow, the basic method of pulse discrimination is that of detecting the time variation between the leading edge of the pulse and the crossover point of the pulse. (Double-delay-line pulse shaping is presumed.) The leading edge is identified by a 260 Time Pickoff installed at the detector, and the crossover point is identified by a crossover pickoff circuit following the double line amplifier. These two events actuate the Start and Stop inputs of the 437A Time to Pulse Height Converter, with the resultant generation of output pulses whose individual height identifies the shape characteristic of the original detector pulse. Single or multichannel pulse height analysis of the converter output pulses is then utilized to effect the desired analysis of the chosen detector events.

Scintillation Counter Pulse Shape Discrimination[4,5] In this type of pulse shape discrimination the pulse is formed of a component with a short decay time plus a component with a long decay time. In neutron-gamma identification the energy contained in the long-term decay component from the phosphor is quite different for the same incident energy. When this is integrated and differentiated by two differentiating networks, i.e., double-delay-line clipping, etc., the crossover point is different for the neutron and the gamma ray.

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[1] C.W. Williams, W.E. Kiker, and H.W. Schmitt, ***Rev. Sci. Instr.*** **35**, 116 (Sept. 1964).

[2] D.S. Gemmell, ***IEEE Trans. Nucl. Sci.*** **NS-11**(3), 409 (June 1964).

[3] ***The Single-Photon Technique for Measuring Light Intensity and Decay Characteristics***, ORTEC Application Note 35 (1971).

[4] R.W. Peelle and T.A. Love, p. 146 in ***Instrumentation Techniques in Nuclear Pulse Analysis***, National Academy of Sciences — National Research Council Pub. 1184 (1964).

[5] D. Landis and F.S. Goulding, p.143 in ***Instrumentation Techniques in Nuclear Pulse Analysis***, National Academy of Sciences — National Research Council Pub. 1184 (1964).

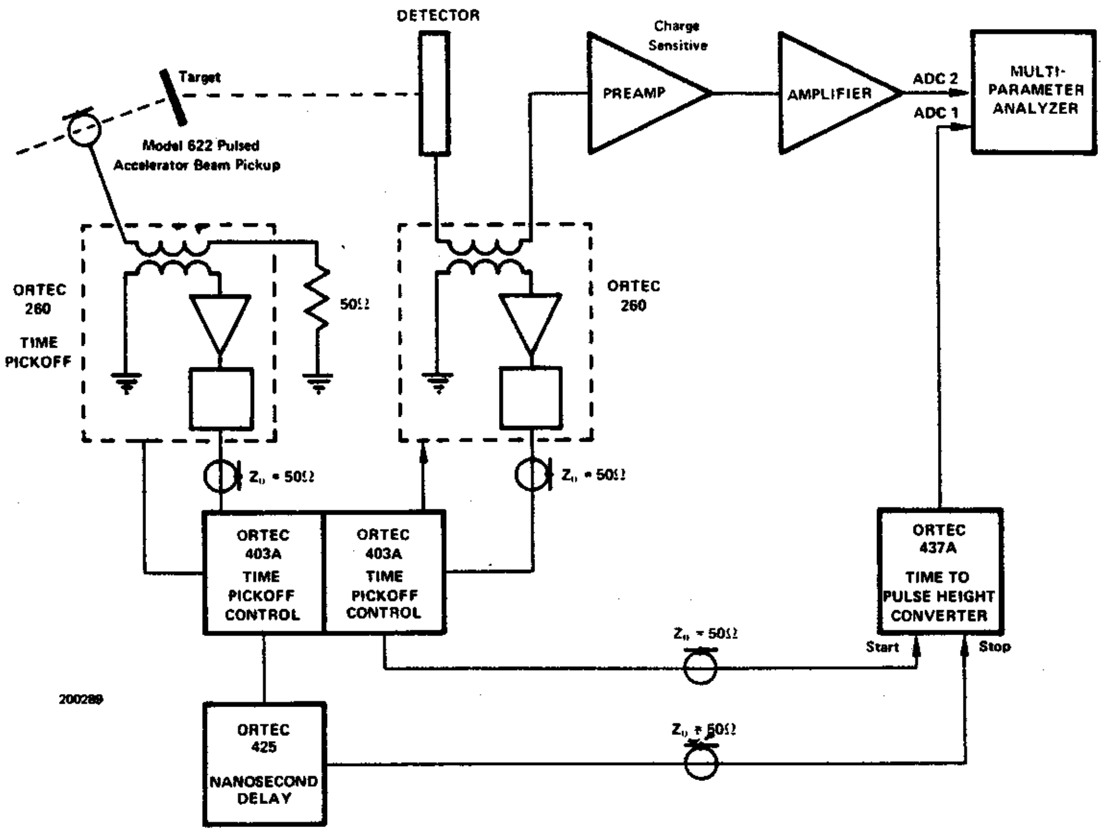


Fig. 7.2. Block Diagram for Correlated Time-Energy Measurements.

These same conditions exist in the case of photomultiplier noise and scintillations. The decay of a signal created by photoelectrons that do not result from scintillation in a phosphor will have only one decay time component, whereas the decay light from a phosphor adds a second component to all scintillation signals.

A block diagram showing a typical experimental setup for neutron-gamma discrimination is shown in Fig. 7.3. The same method may be directly applied to PM noise reduction. Some of the advantages of this method are:

1. high count rate capability ($\geqslant 2 \times 10^4$ cts/sec),
2. wide dynamic range (E_n min >20:1; >400:1, using two amplifiers and single channel analyzers),
3. low neutron threshold (E_n <300 keV),
4. simple to set up and monitor,
5. may be performed with a 10-stage photomultiplier.

Charged Particle Identification in Semiconductors The method of pulse shape discrimination described above may be applied to the identification of charged particles when used with a semiconductor detector. Essentially, the block diagram is the same as that shown, with only the detector changed. In the identification of particles of the same energy but of differing range (e.g., alphas in the presence of protons), the depletion depth may be adjusted to stop the alphas but not the protons. Proton pulses will then consist of a fast portion, corresponding to collection of signal deposited in the depletion zone, and a slow portion, corresponding to signal collected by diffusion from the field-free undepleted region. The alpha pulses will have only a fast portion associated with them. Identification of the particles can be performed by this means.

Inspection for Pileup Reduction A different type of pulse shape is of interest here, but the method of identification is again essentially the same. When two pulses are summed in the linear amplifier because they arrive within the resolving time of the amplifier, the crossover time is shifted as before, though not by the same process. This shift of crossover time for a double delay line shaping amplifier will be equal to or greater than[6]

$$(T_r/2)\,(E_2/E_1),$$

where T_r is the amplifier rise time, and E_2 is the amplitude of the pulse that is piled upon E_1.

The pileup event is distorted, of course, and since its time of zero crossing is shifted, it may be inhibited before analysis. Approximate limits on the use of this method of inspection may be determined from the available resolution of the crossover pickoff used, since an accurate leading edge trigger is now available.

[6] C.W. Williams, H.W. Schmitt, F.J. Walter, and J.H. Neiler, *Nucl. Instr. Methods* **29** 205-12 (1964).

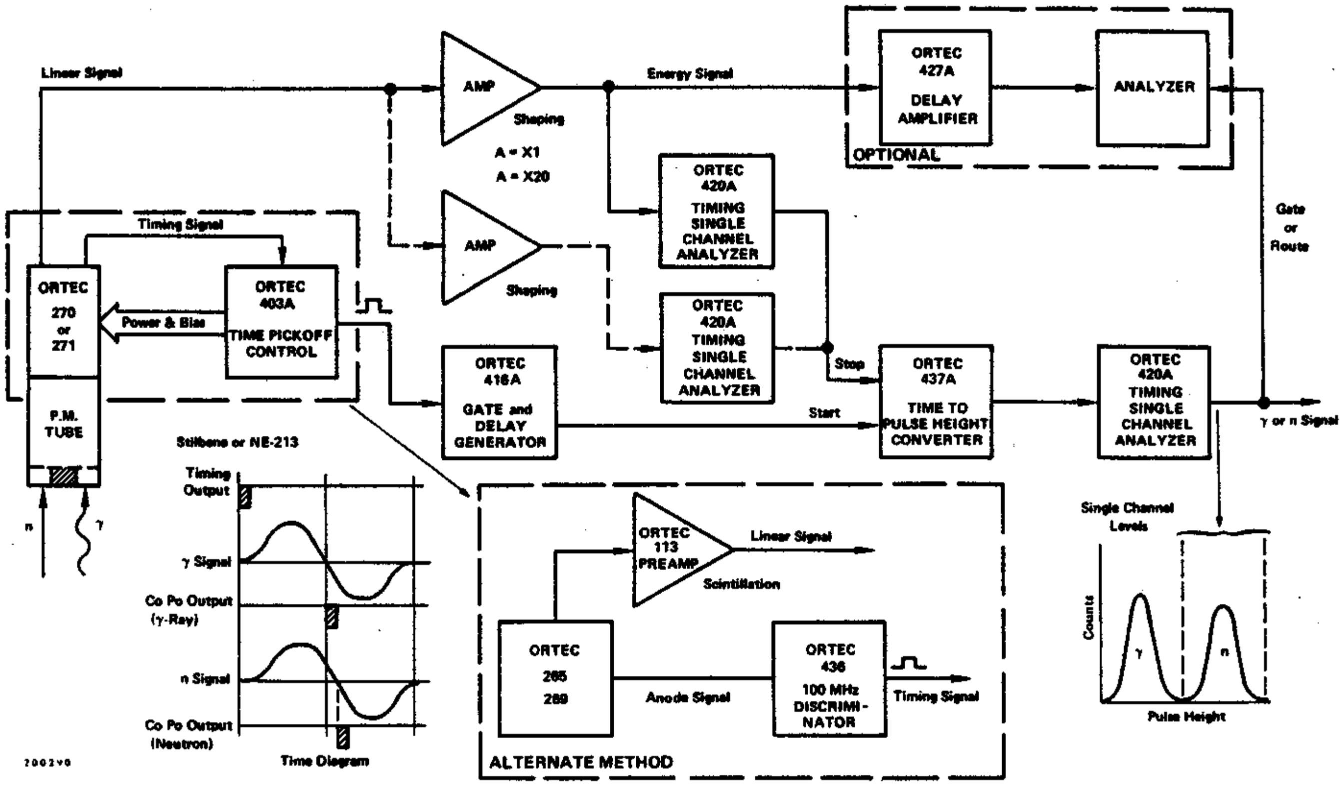


Fig. 7.3. Pulse Shape Discrimination by Crossover Timing.

When semiconductor detectors are in use or when the dynamic range of energies is large (20:1), a more suitable method of pile-up rejection may be had by using the 260 Time Pickoff merely to identify the leading edges of all detector events, and then, by means of a suitable circuit, rejecting from analysis all pulse pairs that fall within the resolving time of the amplifier system. Such an inspector system is available as the ORTEC 404A Pile-Up Inspector.

APPENDIX

REPLACEABLE PARTS

ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is $25.00.

ORDERING INFORMATION FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

The solid-state-device (diodes, transistors, and integrated circuits) types installed in your instrument may differ from those shown in the schematic diagram and parts list. In such cases, necessary replacements can be made with either the type shown or the type actually installed in the instrument.

Replaceable Parts List

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0100	5004 46304			
22	9107 41408	Jack, Banana	83330	#101 HHS
C57	9059 41701	10 pf 5% 500V Mica.	84171	#DM15-100J ARC
CN-1	9097 41339	Connector, UG1094/U	95712	DGE
CN-2	9097 41339	Connector, UG1094/U	95712	DGE
CN-3	9097 41339	Connector, UG1094/U	95712	DGE
CN-4	9097 41339	Connector, UG1094/U	95712	DGE
CN-5	9097 41339	Connector, UG1094/U	95712	DGE
CN-6	9097 41339	Connector, UG1094/U	95712	DGE
CN-7	9097 41339	Connector, UG1094/U	95712	DGE
CN-8	9097 41339	Connector, UG1094/U	95712	DGE
CN-9	9097 41339	Connector, UG1094/U	95712	DGE
CN-10	9097 41339	Connector, UG1094/U	95712	DGE
R146	9027 40589	93.1 Ω 1/8W 1% MF	IRC	CEA
R147	9015 40219	470 Ω 1/4W 5% C	01121	CB ABC
R148	9015 40219	470 Ω 1/4W 5% C	01121	CB ABC
R153	9051 40811	10 K 1/2W 1T Pot.	44655	#RV6LAYSA103A (MIL) OHM
R165	9027 40509	464 Ω 1/8W 1% MF	IRC	CEA
R166	9027 40511	562 Ω 1/8W 1% MF	IRC	CEA

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0100	5004 46304			
cont'd.				
R167	9027 40512	619 Ω 1/8W 1% MF	IRC	CEA
R168	9027 40513	681 Ω 1/8W 1% MF	IRC	CEA
R169	9027 40514	750 Ω 1/8W 1% MF	IRC	CEA
R170	9027 40508	909 Ω 1/8W 1% MF	IRC	CEA
R171	9027 40515	1 K 1/8W 1% MF	IRC	CEA
S1	9094 41289	Switch, Rotary, SP5T	71450	#18-296-1 CTS
S2	9094 44449	Switch, Slide, DP3T	82389	#46313L SWC
S3	9094 42677	Switch, Slide, DPDT	79727	#G-126 CWE
S4	9094 44444	Switch, Rotary, SP12T	OAK	#399-217-A
S5	9094 42677	Switch, Slide, DPDT	79727	#G-126 CWE
437A-0200	5007 46305			
C3	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101K104M SPR
C4	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101K104M SPR
C5	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101K104M SPR
C6	9055 40855	0.01 uf 20% 50V Disc.	80183	#C023K101F103M SPR
C7	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C8	9059 40883	22 pf 2% 500V Mica.	84171	#DM15-220G ARC
C9	9057 40872	100 pf NPO Disc.	80183	#C030H102L101J SPR
C10	9059 40891	430 pf 5% 500V Mica.	84171	#DM15-431J ARC
C11	9059 40895	1000 pf 2% 500V Mica.	84171	#DM15-102G ARC
C12	9059 41699	15,000 pf 5% D.M.	84171	#DM30-153J ARC
C13	9065 40950	22 uf 20% 15V Tan.	80183	#150D226X0015B2 SPR
C14	9065 40950	22 uf 20% 15V Tan.	80183	#150D226X0015B2 SPR
C15	9065 40942	1 uf 20% 35V Tan.	80183	#150D104X0035A2 SPR
C16	9059 41705	82 pf 2% 500V Mica.	84171	#DM15-820G ARC
C17	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C18	9057 40868	15 pf NPO Disc.	80183	#C030K102E150J SPR
C19	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C20	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C21	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C22	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C23	9059 40886	100 pf 2% 500V Mica.	84171	#DM10-101G ARC
C24	9059 40895	1000 pf 2% 500V D.M.	84171	#DM15-102G ARC
C25	9057 40867	10 pf 5% NPO Disc.	80183	#C030K102E100J SPR
C26	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C27	9059 40883	22 pf 2% 500V Mica.	84171	#DM15-220G ARC
C28	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C29	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C30	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR
C31	9061 40918	0.002 uf 5% 200V Myl.	80183	#192P20252 SPR
C32	9055 40846	0.1 uf 20% 50V Disc.	80183	#C023K101L104M SPR

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0200	5007 46305			
cont'd.				
C33	9067 40971	35 uf 25V El.	80183	#30D356G25CB4 SPR
C34	9055 40846	0.1 uf 20% 50V Disc.	80183	#CO23K101L104M SPR
C35	9055 40846	0.1 uf 20% 50V Disc.	80183	#CO23K101L104M SPR
C36	9055 40846	0.1 uf 20% 50V Disc.	80183	#CO23K101L104M SPR
C37	9059 41698	620 pf 5% Mica.	84171	#DM15-621J ARC
C38	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C39	9059 41701	10 pf 5% 500V Mica.	84171	#DM15-100J ARC
C40	9065 40950	22 uf 20% 15V Tan.	80183	#150D226X0015B2 SPR
C41	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C42	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C43	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C44	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C45	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C46	9065 40950	22 uf 20% 35V Tan.	80183	#150D226X0015B2 SPR
C47	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C48	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C49	9059 40895	1000 pf 2% 100V Mica.	84171	#DM15-102G ARC
C50	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C51	9055 40840	0.002 uf 1KV Disc.	80183	#CO23K102F202P SPR
C52	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C53	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C54	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C55	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C56	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C57	9055 40846	0.1 uf 20% 50V Disc.	80183	#CO23K101L104M SPR
C60	9055 40855	0.01 uf 20% 50V Disc.	80183	#CO23K101F103M SPR
D1	9080 41100	Diode - MSD-6100	80211	MOT
D3	9080 41125	Diode - 1N4009	14433	ITT
D4	9080 42484	Diode - TD-253	24446	GEC
D6	9080 41125	Diode - 1N4009	14433	ITT
D7	9080 41125	Diode - 1N4009	14433	ITT
D8	9080 41098	Diode - 1N270	24446	GEC
D9	9080 41100	Diode - MSD-6100	80211	MOT
D11	9080 41125	Diode - 1N4009	14433	ITT
D12	9080 41125	Diode - 1N4009	14433	ITT
D13	9080 41125	Diode - 1N4009	14433	ITT
D14	9080 41125	Diode - 1N4009	14433	ITT
D15	9080 41125	Diode - 1N4009	14433	ITT
D16	9080 41100	Diode - MSD-6100	80211	MOT
D18	9080 41125	Diode - 1N4009	14433	ITT
D19	9080 41125	Diode - 1N4009	14433	ITT

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.	
437A-0200	5007 46305				
cont'd.					
D20	9080 42484	Diode - TD-253	24446		GEC
D21	9080 41125	Diode - 1N4009	14433		ITT
D22	9080 41110	Diode - 1N936 (Zener)	12954		DCK
D23	9080 41125	Diode - 1N4009	14433		ITT
D24	9080 41125	Diode - 1N4009	14433		ITT
DL-1	9113 41502	1 μsec. Delay Line	92912	#602-10F-HS	BFI
L1	9092 41238	27 μh Deciductor	72259	#DD-27.0	NTC
Q1	9078 41082	Transistor - 2N3564	13715		FSC
Q2	9078 41082	Transistor - 2N3564	13715		FSC
Q3	9078 41063	Transistor - 2N4917	13715		FSC
Q4	9078 41063	Transistor - 2N4917	13715		FSC
Q5	9078 41086	Transistor - 2N3646	13715		FSC
Q6	9078 41086	Transistor - 2N3646	13715		FSC
Q7	9078 41086	Transistor - 2N3646	13715		FSC
Q8	9078 41082	Transistor - 2N3564	13715		FSC
Q9	9078 41082	Transistor - 2N3564	13715		FSC
Q10,Q11	9078 43656	Transistor - 3242 (FET)	32293	(Matched)	INT
Q12	9078 41080	Transistor - 2N3638A	13715		FSC
Q13	9078 41080	Transistor - 2N3638A	13715		FSC
Q14	9078 41080	Transistor - 2N3638A	13715		FSC
Q15	9078 41054	Transistor - 3N116	80183		SPR
Q16	9078 41080	Transistor - 2N3638A	13715		FSC
Q17	9078 41080	Transistor - 2N3638A	13715		FSC
Q18	9078 41083	Transistor - 2N3643	13715		FSC
Q19	9078 41080	Transistor - 2N3638A	13715		FSC
Q20	9078 41086	Transistor - 2N3646	13715		FSC
Q21	9078 41086	Transistor - 2N3646	13715		FSC
Q22	9078 41086	Transistor - 2N3646	13715		FSC
Q23	9078 41080	Transistor - 2N3638A	13715		FSC
Q24	9078 41080	Transistor - 2N3638A	13715		FSC
Q25	9078 41086	Transistor - 2N3646	13715		FSC
Q26	9078 41086	Transistor - 2N3646	13715		FSC
Q27	9078 41086	Transistor - 2N3646	13715		FSC
Q28	9078 41086	Transistor - 2N3646	13715		FSC
Q29	9078 41082	Transistor - 2N3564	13715		FSC
Q30	9078 41082	Transistor - 2N3564	13715		FSC
Q31	9078 41049	Transistor - 2N709	86684		RCA
Q32	9078 41063	Transistor - 2N4917	13715		FSC
Q33	9078 41063	Transistor - 2N4917	13715		FSC
Q34	9078 41083	Transistor - 2N3643	13715		FSC
Q35	9078 41083	Transistor - 2N3643	13715		FSC
Q36	9078 41083	Transistor - 2N3643	13715		FSC
Q37	9078 41078	Transistor - 2N3640	13715		FSC
Q38	9078 41078	Transistor - 2N3640	13715		FSC

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0200	5007 46305			
cont'd.				
Q39	9078 41078	Transistor - 2N3640	13715	FSC
Q40	9078 41086	Transistor - 2N3646	13715	FSC
Q41	9078 41083	Transistor - 2N3643	13715	FSC
Q42	9078 41080	Transistor - 2N3638A	13715	FSC
Q43	9078 41083	Transistor - 2N3643	13715	FSC
Q44	9078 41083	Transistor - 2N3643	13715	FSC
Q45	9078 41080	Transistor - 2N3638A	13715	FSC
Q46	9078 41086	Transistor - 2N3646	13715	FSC
Q52	9078 41086	Transistor - 2N3646	13715	FSC
R1	9015 40251	22 K 1/4W 5% C	01121	CB ABC
R2	9015 40251	22 K 1/4W 5% C	01121	CB ABC
R3	9015 40285	56 Ω 1/4W 5% C	01121	CB ABC
R4	9015 40278	11 K 1/4W 5% C	01121	CB ABC
R6	9027 40486	82.5 Ω 1/8W 1% MF	IRC	CEA
R7	9027 40508	909 Ω 1/8W 1% MF	IRC	CEA
R8	9027 40590	3.92 K 1/8W 1% MF	IRC	CEA
R9	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R10	9015 40271	51 Ω 1/4W 5% C	01121	CB ABC
R11	9027 40535	5.62 K 1/8W 1% MF	IRC	CEA
R12	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R13	9027 40584	825 Ω 1/8W 1% MF	IRC	CEA
R14	9015 40212	200 Ω 1/4W 5% C	01121	CB ABC
R15	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R16	9015 40210	120 Ω 1/4W 5% C	01121	CB ABC
R17	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R18	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R19	9027 40531	3.83 K 1/8W 1% MF	IRC	CEA
R20	9027 40516	1.15 K 1/8W 1% MF	IRC	CEA
R21	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R22	9027 40532	4.22 K 1/8W 1% MF	IRC	CEA
R23	9015 40222	680 Ω 1/4W 5% C	01121	CB ABC
R24	9015 40279	39 Ω 1/4W 5% C	01121	CB ABC
R25	9015 40265	22 M 1/4W 5% C	01121	CB ABC
R26	9027 40533	4.64 K 1/8W 1% MF	IRC	CEA
R27	9027 40522	2 K 1/8W 1% MF	IRC	CEA
R28	9051 40793	200 Ω Pot.	73138	#78P-R200 BEK
R29	9027 40529	3.16 K 1/8W 1% MF	IRC	CEA
R30	9027 40538	7.5 K 1/8W 1% MF	IRC	CEA
R31	9051 43761	500 Ω 10T Pot.	73138	#79P-R500 BEK
R32	9027 40533	4.64 K 1/8W 1% MF	IRC	CEA
R33	9027 43720	4.99 K 1/8W 1% MF	IRC	CEA
R34	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R35	9027 40535	5.62 K 1/8W 1% MF	IRC	CEA
R36	9027 40539	8.25 K 1/8W 1% MF	IRC	CEA

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0200	5007 46305			
cont'd.				
R37	9015 40241	6.8 K 1/4W 5% C	01121	CB ABC
R38	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R39	9015 40245	10 K 1/4W 5% C	01121	CB ABC
R40	9015 40245	10 K 1/4W 5% C	01121	CB ABC
R41	9015 40238	4.7 K 1/4W 5% C	01121	CB ABC
R42	9027 40515	1 K 1/8W 1% MF	IRC	CEA
R43	9027 40515	1 K 1/8W 1% MF	IRC	CEA
R44	9015 40286	130 Ω 1/4W 5% C	01121	CB ABC
R45	9015 40229	1.5 K 1/4W 5% C	01121	CB ABC
R46	9015 40234	2.7 K 1/4W 5% C	01121	CB ABC
R47	9027 40578	1.21 K 1/8W 1% MF	IRC	CEA
R48	9015 40224	820 Ω 1/4W 5% C	01121	CB ABC
R49	9015 40287	1.3 K 1/4W 5% C	01121	CB ABC
R50	9015 40237	3.9 K 1/4W 5% C	01121	CB ABC
R51	9015 40222	680 Ω 1/4W 5% C	01121	CB ABC
R52	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R53	9027 40510	511 Ω 1/8W 1% MF	IRC	CEA
R54	9027 40510	511 Ω 1/8W 1% MF	IRC	CEA
R55	9015 40246	12 K 1/4W 5% C	01121	CB ABC
R56	9015 40246	12 K 1/4W 5% C	01121	CB ABC
R57	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R58	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R59	9015 40229	1.5 K 1/4W 5% C	01121	CB ABC
R60	9015 40287	1.3 K 1/4W 5% C	01121	CB ABC
R61	9015 40287	1.3 K 1/4W 5% C	01121	CB ABC
R62	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R63	9015 40245	10 K 1/4W 5% C	01121	CB ABC
R64	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R65	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R66	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R67	9015 40237	3.9 K 1/4W 5% C	01121	CB ABC
R68	9027 40493	162 Ω 1/8W 1% MF	IRC	CEA
R69	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R70	9015 40212	200 Ω 1/4W 5% C	01121	CB ABC
R71	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R72	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R73	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R74	9027 40515	1 K 1/8W 1% MF	IRC	CEA
R75	9051 43761	500 Ω 10T Pot.	73138	#79P-R500 BEK
R76	9015 40274	560 Ω 1/4W 5% C	01121	CB ABC
R77	9015 40250	20 K 1/4W 5% C	01121	CB ABC
R78	9027 40523	2.15 K 1/8W 1% MF	IRC	CEA
R79	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA
R80	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R81	9027 40578	1.21 K 1/8W 1% MF	IRC	CEA
R82	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R83	9027 40527	2.61 K 1/8W 1% MF	IRC	CEA
R84	9015 40251	22 K 1/4W 5% C	01121	CB ABC
R85	9015 40251	22 K 1/4W 5% C	01121	CB ABC

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0200	5007 46305			
cont'd.				
R86	9015 40285	56 Ω 1/4W 5% C	01121	CB ABC
R87	9015 40278	11 K 1/4W 5% C	01121	CB ABC
R88	9015 40201	430Ω 1/4W 5% C	01121	CB ABC
R89	9027 40508	909 Ω 1/8W 1% MF	IRC	CEA
R90	9027 40486	82.5 Ω 1/8W 1% MF	IRC	CEA
R91	9027 40532	4.22 K 1/8W 1% MF	IRC	CEA
R92	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R93	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R94	9015 40276	1.6 K 1/4W 5% C	01121	CB ABC
R95	9027 40493	162 Ω 1/8W 1% MF	IRC	CEA
R96	9015 40271	51 Ω 1/4W 5% C	01121	CB ABC
R97	9027 40517	1.47 K 1/8W 1% MF	IRC	CEA
R98	9051 43761	500 Ω 10T Pot.	73138	#79P-R500 BEK
R99	9015 40212	200 Ω 1/4W 5% C	01121	CB ABC
R100	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R101	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R102	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R103	9015 40210	120 Ω 1/4W 5% C	01121	CB ABC
R104	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R105	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R106	9027 40515	1 K 1/8W 1% MF	IRC	CEA
R107	9027 40522	2 K 1/8W 1% MF	IRC	CEA
R108	9027 40591	4.02 K 1/8W 1% MF	IRC	CEA
R109	9027 40592	8.06 K 1/8W 1% MF	IRC	CEA
R110	9027 40579	16.2 K 1/8W 1% MF	IRC	CEA
R111	9015 40212	200 Ω 1/4W 5% C	01121	CB ABC
R112	9027 40539	8.25 K 1/8W 1% MF	IRC	CEA
R113	9027 40489	100 Ω 1/8W 1% MF	IRC	CEA
R114	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R115	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R116	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R117	9015 40225	910 Ω 1/4W 5% C	01121	CB ABC
R118	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R119	9027 40540	8.66 K 1/8W 1% MF	IRC	CEA
R120	9051 40791	5 K Pot.	73138	#78P-R5K BEK
R121	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R122	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R123	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R124	9015 40236	3.3 K 1/4W 5% C	01121	CB ABC
R125	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R126	9027 40595	4.75 K 1/8W 1% MF	IRC	CEA
R127	9027 40595	4.75 K 1/8W 1% MF	IRC	CEA
R128	9015 40219	470 Ω 1/4W 5% C	01121	CB ABC
R129	9015 40230	1.8 K 1/4W 5% C	01121	CB ABC
R130	9027 40578	1.21 K 1/8W 1% MF	IRC	CEA
R131	9027 40597	9.31 K 1/8W 1% MF	IRC	CEA
R133	9015 40240	5.6 K 1/4W 5% C	01121	CB ABC
R134	9015 40222	680 Ω 1/4W 5% C	01121	CB ABC

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0200	5007 46305			
cont'd.				
R135	9027 40547	12.1 K 1/8W 1% MF	IRC	CEA
R136	9027 40537	6.81 K 1/8W 1% MF	IRC	CEA
R137	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R138	9015 40229	1.5 K 1/4W 5% C	01121	CB ABC
R319	9027 40580	17.8 K 1/8W 1% MF	IRC	CEA
R140	9015 40222	680 Ω 1/4W 5% C	01121	CB ABC
R141	9015 40246	12 K 1/4W 5% C	01121	CB ABC
R142	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R143	9015 40224	820 Ω 1/4W 5% C	01121	CB ABC
R144	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R145	9015 40222	680 Ω 1/4W 5% C	01121	CB ABC
R149	9015 40202	10 Ω 1/4W 5% C	01121	CB ABC
R150	9015 40202	10 Ω 1/4W 5% C	01121	CB ABC
R151	9015 40202	10 Ω 1/4W 5% C	01121	CB ABC
R152	9015 40202	10 Ω 1/4W 5% C	01121	CB ABC
R154	9015 40209	100 Ω 1/4W 5% C	01121	CB ABC
R155	9015 40271	51 Ω 1/4W 5% C	01121	CB ABC
R174	9015 40228	1.2 K 1/4W 5% C	01121	CB ABC
R176	9027 40541	9.09 K 1/8W 1% MF	IRC	CEA
R177	9027 40592	8.06 K 1/8W 1% MF	IRC	CEA
R178	9027 43706	31.6 Ω 1/8W 1% MF	IRC	CEA
3	9097 41327	Socket, Miniature	00779	#2-33080-7 AMP
8	9090 41223	Ferrite Bead	02114	#56-590-65/4B FEX
437A-0300	5007 46306			
C58	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C59	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
D24	9080 41125	Diode - 1N4009	14433	ITT
IC-1	9079 41814	Int. Circuit - 914	13715	#U8A991428X FSC

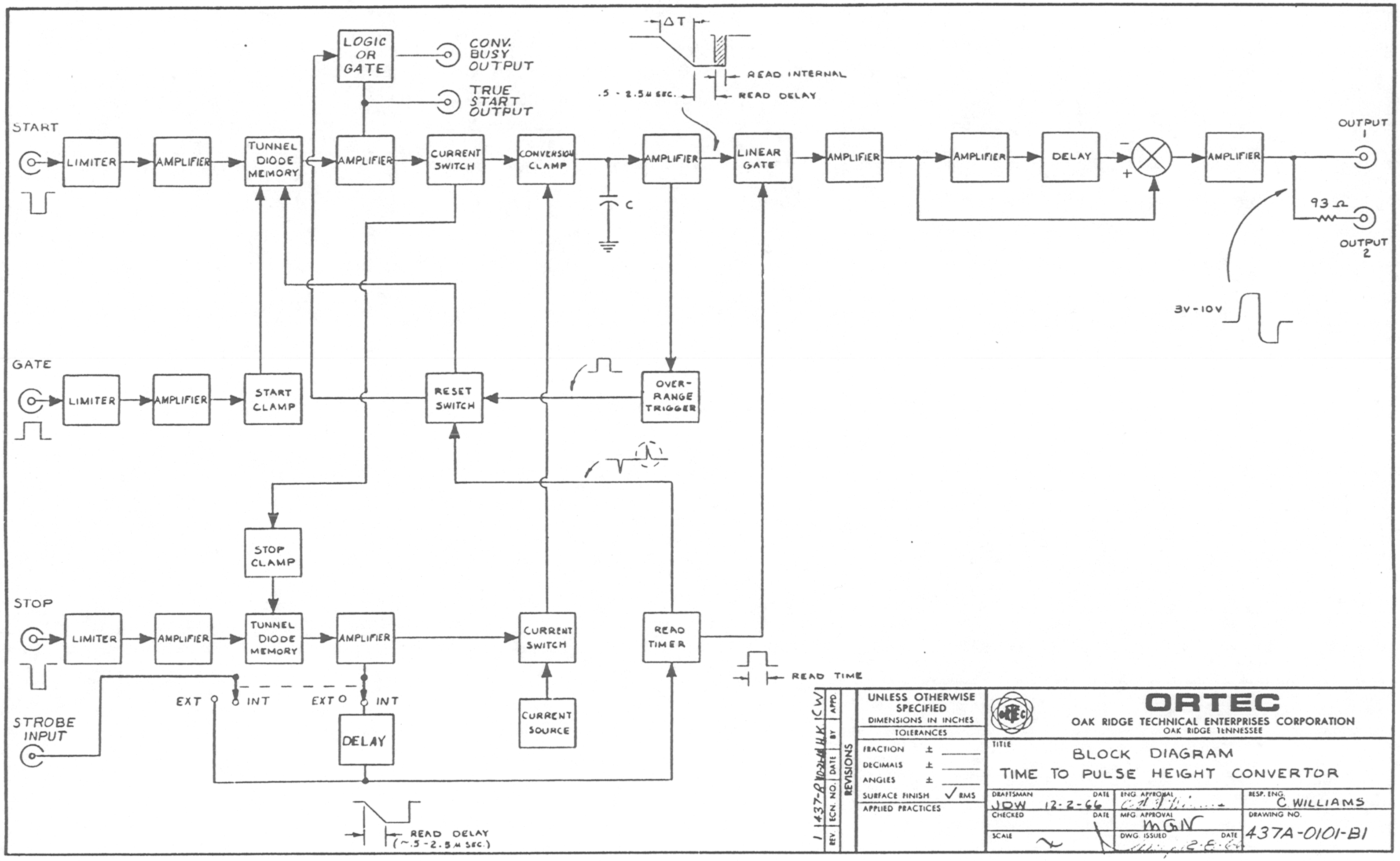
Replaceable Parts List (continued)

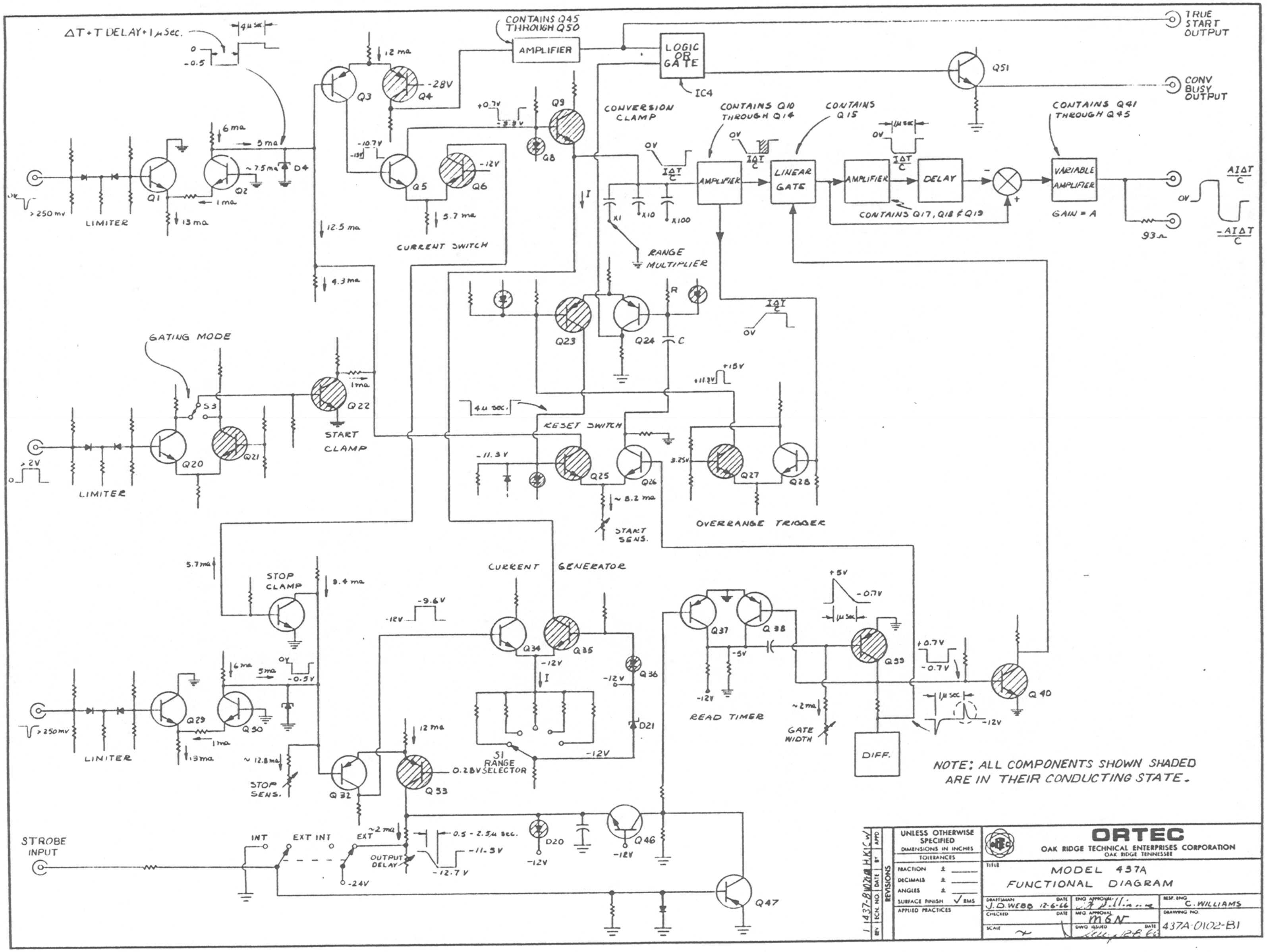
REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
437A-0300	5007 46306			
cont'd.				
Q47	9078 41080	Transistor - 2N3638A	13715	FSC
Q48	9078 41083	Transistor - 2N3643	13715	FSC
Q49	9078 41063	Transistor - 2N4917	13715	FSC
Q50	9078 41083	Transistor - 2N3643	13715	FSC
Q51	9078 41083	Transistor - 2N3643	13715	FSC
R156	9015 40220	510 Ω 1/4W 5% C	01121	CB ABC
R157	9015 40278	11 K 1/4W 5% C	01121	CB ABC
R158	9015 40224	820 Ω 1/4W 5% C	01121	CB ABC
R159	9015 40259	6.2 K 1/4W 5% C	01121	CB ABC
R160	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R161	9015 40271	51 Ω 1/4W 5% C	01121	CB ABC
R162	9015 40271	51 Ω 1/4w 5% C	01121	CB ABC
R163	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R164	9015 40221	620 Ω 1/4W 5% C	01121	CB ABC
R172	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R173	9015 40245	10 K 1/4W 5% C	01121	CB ABC
R175	9015 40201	430 Ω 1/4W 5% C	01121	CB ABC

BIN/MODULE CONNECTOR PIN ASSIGNMENTS FOR AEC STANDARD NUCLEAR INSTRUMENT MODULES PER TID-20893

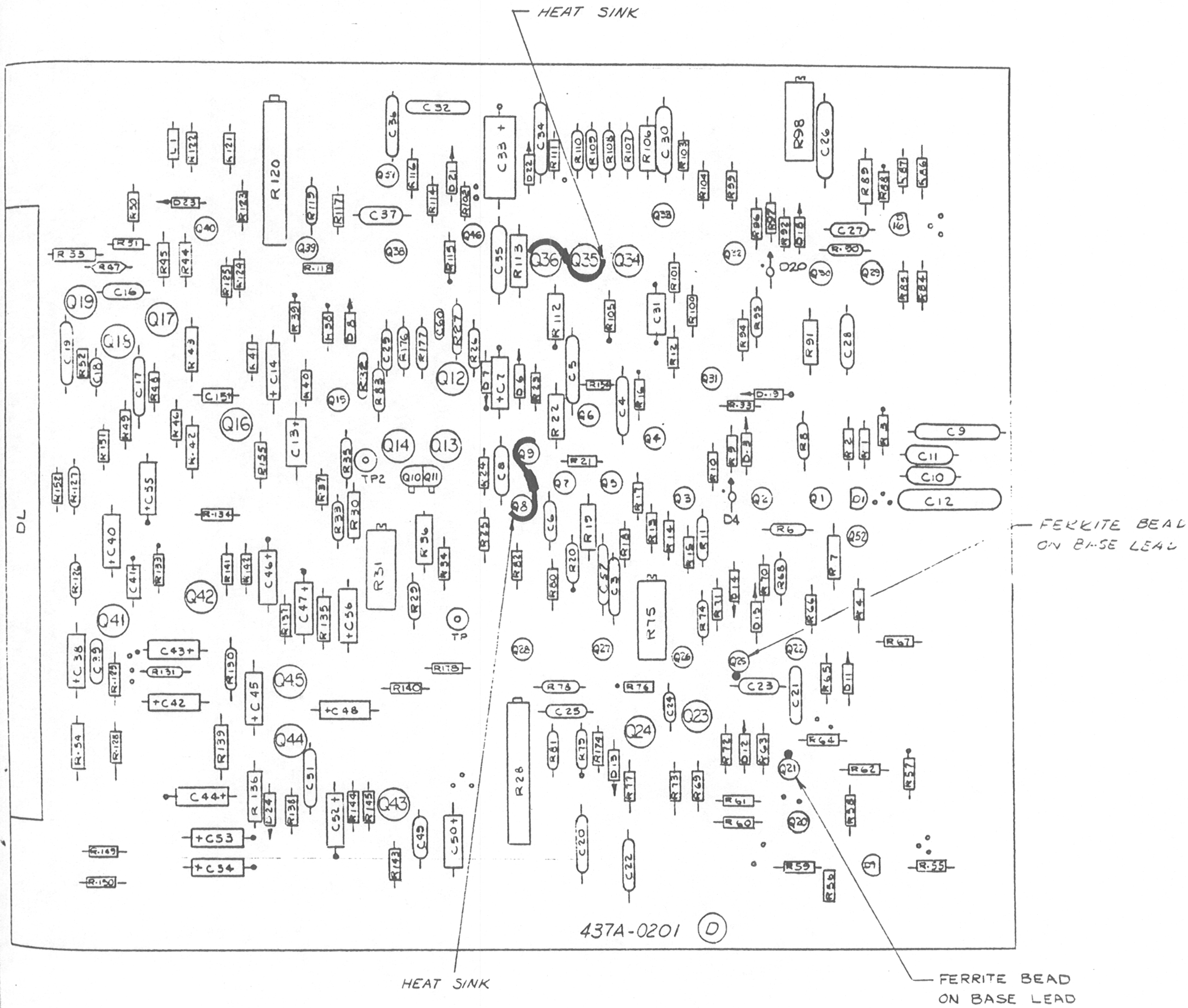
Pin	Function	Pin	Function
1	+3 volts	23	Reserved
2	−3 volts	24	Reserved
3	Spare Bus	25	Reserved
4	Reserved Bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 volts
7	Coaxial	*29	−24 volts
8	200 volts dc	30	Spare Bus
9	Spare	31	Spare
*10	+6 volts	32	Spare
*11	−6 volts	*33	115 volts ac (Hot)
12	Reserved Bus	*34	Power Return Ground
13	Spare	**35	Reset (Scaler)
14	Spare	**36	Gate
15	Reserved	**37	Reset (Auxiliary)
*16	+12 volts	38	Coaxial
*17	−12 volts	39	Coaxial
18	Spare Bus	40	Coaxial
19	Reserved Bus	*41	115 volts ac (Neut.)
20	Spare	*42	High Quality Ground
21	Spare	G	Ground Guide Pin
22	Reserved		

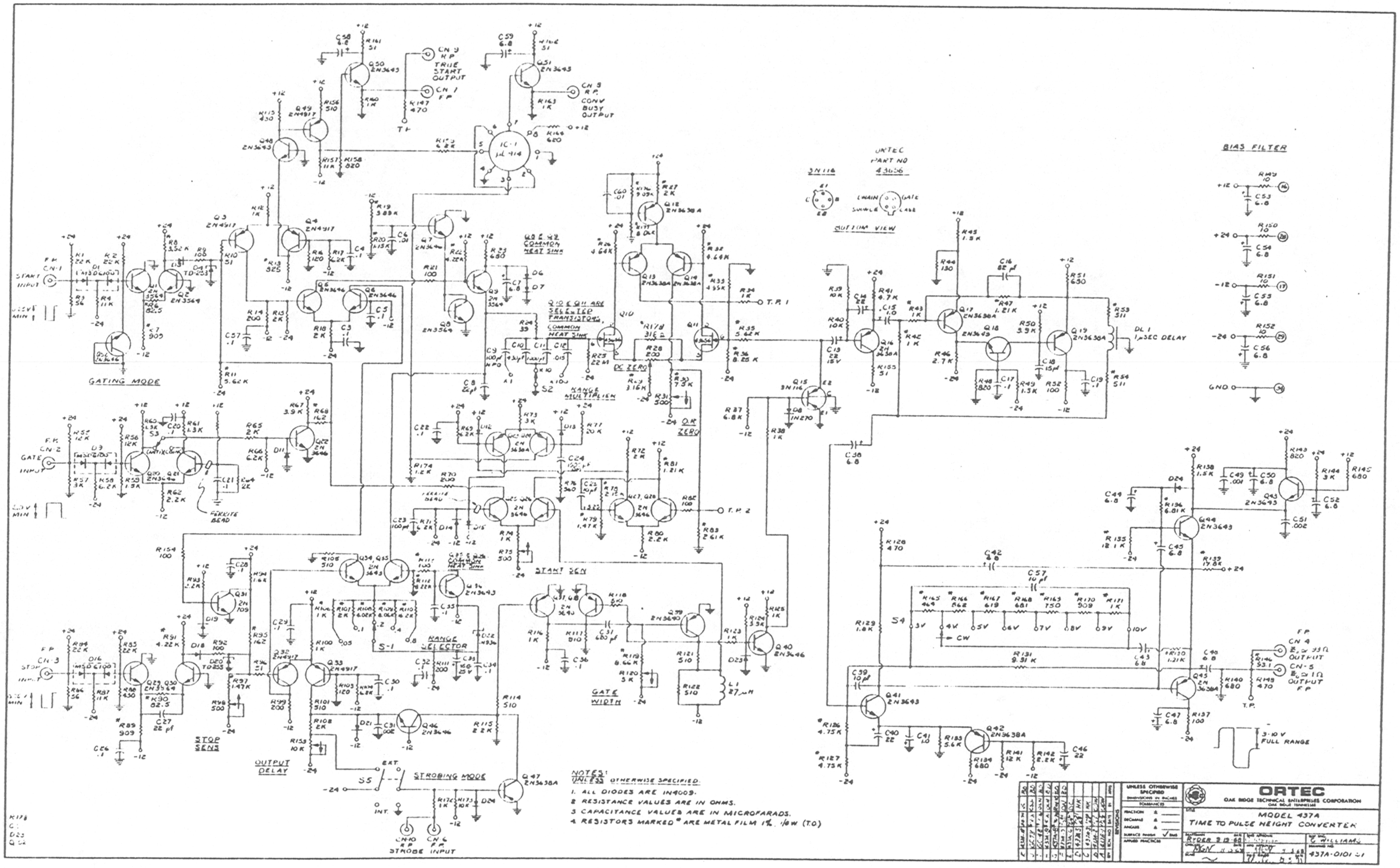
Pins marked (*) are installed and wired in ORTEC 401A and 401B Modular System Bins.
Pins marked (*) and (**) are installed and wired in EG&G/ORTEC–HEP M250/N and M350/N NIMBINS.


START
GATE
STOP
STROBE INPUT
LIMITER
AMPLIFIER
TUNNEL DIODE MEMORY
START CLAMP
STOP CLAMP
LOGIC OR GATE
CONV. BUSY OUTPUT
TRUE START OUTPUT
CURRENT SWITCH
CONVERSION CLAMP
RESET SWITCH
CURRENT SOURCE
READ TIMER
OVER-RANGE TRIGGER
LINEAR GATE
DELAY
C
ΔT
.5 - 2.5 μ SEC.
READ INTERNAL
READ DELAY
READ TIME
READ DELAY (~.5 - 2.5 μ SEC.)
EXT
INT
93 Ω
OUTPUT 1
OUTPUT 2
3V - 10V
UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES
FRACTION ±
DECIMALS ±
ANGLES ±
SURFACE FINISH √ RMS
APPLIED PRACTICES
REVISIONS
REV
ECN NO.
DATE
BY
APPD
ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
OAK RIDGE TENNESSEE
TITLE
BLOCK DIAGRAM
TIME TO PULSE HEIGHT CONVERTOR
DRAFTSMAN
JDW
DATE
12-2-66
ENG. APPROVAL
RESP. ENG.
C WILLIAMS
CHECKED
MFG. APPROVAL
DRAWING NO.
437A-0101-B1
SCALE
DWG. ISSUED



ΔT+T DELAY+1μSec.
CONTAINS Q45 THROUGH Q50
AMPLIFIER
LOGIC OR GATE
IC4
TRUE START OUTPUT
CONV BUSY OUTPUT
CONVERSION CLAMP
CONTAINS Q10 THROUGH Q14
CONTAINS Q15
LINEAR GATE
AMPLIFIER
DELAY
CONTAINS Q17, Q18 & Q19
CONTAINS Q41 THROUGH Q45
VARIABLE AMPLIFIER
GAIN = A
LIMITER
CURRENT SWITCH
RANGE MULTIPLIER
GATING MODE
START CLAMP
RESET SWITCH
START SENS.
OVERRANGE TRIGGER
STOP CLAMP
CURRENT GENERATOR
S1 RANGE SELECTOR
STOP SENS.
READ TIMER
GATE WIDTH
DIFF.
OUTPUT DELAY
STROBE INPUT
INT
EXT INT
EXT
NOTE: ALL COMPONENTS SHOWN SHADED ARE IN THEIR CONDUCTING STATE.
ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
OAK RIDGE TENNESSEE
MODEL 437A
FUNCTIONAL DIAGRAM
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES
TOLERANCES
FRACTION ±
DECIMALS ±
ANGLES ±
SURFACE FINISH √ RMS
APPLIED PRACTICES
DRAFTSMAN J.D. WEBB 12-6-66
C. WILLIAMS
437A-0102-B1
REVISIONS


HEAT SINK
FERRITE BEAD ON BASE LEAD
DL
437A-0201 (D)
HEAT SINK
FERRITE BEAD ON BASE LEAD


ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
MODEL 437A
TIME TO PULSE HEIGHT CONVERTER
437A-0101
NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL DIODES ARE IN4009.
2. RESISTANCE VALUES ARE IN OHMS.
3. CAPACITANCE VALUES ARE IN MICROFARADS.
4. RESISTORS MARKED * ARE METAL FILM 1%, 1/8W (TO)
BIAS FILTER
GATING MODE
STOP SENS
OUTPUT DELAY
STROBING MODE
STROBE INPUT
RANGE SELECTOR
RANGE MULTIPLIER
START SEN
GATE WIDTH
DC ZERO
OK ZERO
TRUE START OUTPUT
CONV BUSY OUTPUT
1 μSEC DELAY
FULL RANGE
OUTLINE VIEW