ORTEC

Model 436
100MHz Discriminator

Operating and Service Manual

Printed in U.S.A.

1163 02C 0871 00

ORTEC 436 100 MHz DISCRIMINATOR

Manual Change Sheet

January 3, 1972
ECN 1

On Schematic 436-0101-S1, please make the following changes:

Add the designation (FP) to connector CN4 INPUT.

Add the fact that the lower end of R7 is the CCW end of the potentiometer.

Change Q6 from a type MPS2369 to a 2N3563.

Change the designation of the 56Ω resistor between the collector of Q6 and the primary winding of T1 from R22 to R23.

On R34, add a double asterisk (**) to show that this is a 1/4W, 1%, MF resistor.

On C17 and C23, add DM to indicate that these are dipped mica capacitors.

Change the value of R47 from 33 to 75 ohms.

Change the value of R62 from 5.1K to 3.3K.

Change the value of R63 from 2K to 1K.

On C33, add DM to indicate that this is a dipped mica capacitor.

Change the value of R79 from 30 to 47 ohms.

Change the value of R92 from 33 to 47 ohms.

Change the values of the power level filter capacitors C36, C47, C49, and C51 from 0.02 μF, 30V, to 1 μF, 35V.

Change the value of C25 from 30 pF DM to 20 pF DM.

Change the type designation of diode D12 from MS1305 to 6734.

Add a capacitor, C35, 0.02 μF, 30V, in parallel with C52.

Change the value of R80 from 100 to 75 ohms.

Change the value of R58 from 33 to 47 ohms.

Change the value of R85 from 36 to 47 ohms.

Change the value of R94 from 33 to 47 ohms.

Change the value of C45 from 0.02 μF, 30V, to 1000 pF DM.

March 8, 1972
ECN 2

On Schematic 436-0101-S1, please make the following changes:

Remove the indicated connection between the base of Q28 and the +12 V source.

Change each of the following transistors from type 2N5179 to type FT117: Q20, Q21, Q22, and Q23.

TABLE OF CONTENTS

BLOCK DIAGRAM AND SCHEMATIC

LIST OF FIGURES

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.

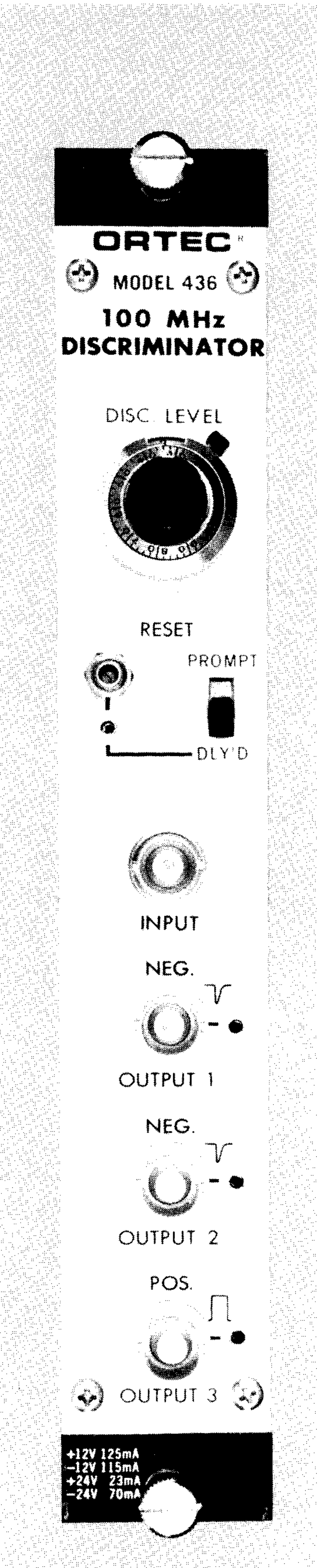
QUALITY CONTROL

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.

ORTEC must be informed in writing of the nature of the fault of the instrument being returned and of the model and serial 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 Postor United Parcel Service to the nearest ORTEC repair center. Instruments 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
MODEL 436
100 MHz
DISCRIMINATOR
DISC. LEVEL
RESET
PROMPT
DLY'D
INPUT
NEG.
OUTPUT 1
NEG.
OUTPUT 2
POS.
OUTPUT 3
+12V 125mA
−12V 115mA
+24V 23mA
−24V 70mA

ORTEC 436 100 MHz DISCRIMINATOR

1. DESCRIPTION

The ORTEC 436 100 MHz Discriminator is a time derivation unit designed primarily for use with photomultiplier tubes but versatile enough to be used as a timing trigger or pulse shaper with any input signal shape from dc to 100 MHz. The discriminator circuit is dc-coupled to eliminate any count rate effects. An optional Prompt or Delayed Reset provides the equivalent of pulse stretching when analyzing pulses of various widths. It generates only one signal for each input pulse, regardless of input pulse width. The 436 produces two isolated fast negative-logic outputs for use with fast timing circuits and one slow positive-logic output for use with scalers and coincidence circuits. The 436 is a single-width NIM-standard module.

2. SPECIFICATIONS

PERFORMANCE

DISCRIMINATOR THRESHOLD RANGE 50 mV to 500 mV.

CONTROL LINEARITY ≤±2%.

TEMPERATURE STABILITY ≤0.5 mV/°C.

MAXIMUM COUNTING RATE 100 MHz pulse or continuous wave.

WALK ≤1.5 nsec from X2 to X20 threshold.

CONTROLS

DISC LEVEL 10-turn control with 1000 divisions, adjustable from 50 mV through 500 mV.

RESET SWITCH Two-position switch selects either prompt or delayed reset of the input discriminator.

RESET CONTROL Multiturn control adjusts the delay of the reset of the input discriminator range 0.5 to 5 μsec.

INPUT

Accepts negative input signals greater than adjusted threshold; dc-coupled; protected to ±200 V for a 1-μsec transient; Z_{in} = 50Ω; width 3 nsec to dc above threshold; type BNC connector.

OUTPUTS

OUTPUT 1 Negative current pulse of 16 mA through Z_0 ~200Ω; width 4 nsec; rise time 1.4 nsec; decay time constant 2 nsec (nominal values); type BNC connector.

OUTPUT 2 Identical to and buffered from Output 1.

OUTPUT 3 Positive voltage pulse, +5 V nominal; width 500 nsec; Z_0 ~10Ω; type BNC connector.

ELECTRICAL AND MECHANICAL

POWER REQUIREMENTS

+12 V, 125 mA; −12 V, 115 mA;
+24 V, 23 mA; −24 V, 70 mA.

WEIGHT (Shipping) ~4 lb (1.8 kg).

WEIGHT (Net) ~2 lb (0.9 kg).

DIMENSIONS Standard NIM single-width module (1.35 by 8.714 in.) per TID-20893 (Rev.).

3. INSTALLATION

3.1. GENERAL

The 436 is used in conjunction with the 401A/402A Bin and Power Supply and is intended for rack mounting; therefore if vacuum tube equipment is used in the same rack, there must be sufficient circulating air to prevent any localized heating of the all-solid-state circuitry used throughout the 436. Precautions should be taken to see that the 436 is not subjected to temperatures in excess of 120°F (50°C).

3.2. CONNECTION TO POWER

The 436 contains no power supply and must therefore obtain power from a NIM Bin and Power Supply, such as the ORTEC 401A/402A. It is recommended that the Bin power supply be turned off when modules are inserted or removed. The ORTEC 400 Series is designed so that it is not possible to overload the Bin power supply with a full complement of modules in the Bin. Since, however, this may not be true when the Bin contains modules other than those of ORTEC design, power supply voltages should be checked after modules are inserted. The ORTEC 401A/402A has test points on the Power Supply control panel to monitor the dc voltages.

3.3. CONNECTING INTO A SYSTEM

The input and output connections to the 436 are front-panel BNC connectors. When the unit is used in a timing setup utilizing photomultiplier tubes, the input signal should be connected from the anode of the PM tube to the input of the 436 by good-quality 50Ω coaxial cable, e.g., RG-8/U. If the length is short, cable of lesser quality, such as RG-58/U, is permissible. To illustrate, pulses transmitted through coaxial cables suffer both attenuation and distortion. In most cables commonly used for pulse work, skin-effect losses in the conductor are the predominant losses for frequency components below approximately 1000 MHz. Skin-effect losses result in high-frequency attenuation which, expressed in decibels, increases as $\omega^{1/2}$. An ideal step-function pulse impressed on the line appears at the (matched) far end with the shape shown in Fig. 3.1, in which time T_0 is defined as the interval measured from the start of the output pulse to the point at which $E_{out} = 0.5\ E_{in}$. The rise time from 0 to X% can be expressed as multiples of T_0, where T_0 is the 0 to 50% rise time. Some rise time conversion factors are listed in Table 3.1.

In Fig. 3.2 T_0 is plotted against the cable delay length in nanoseconds. For RG-58A/U cable, whose decible attenuation varies as $\omega^{1/2}$ for frequencies between about 100 MHz

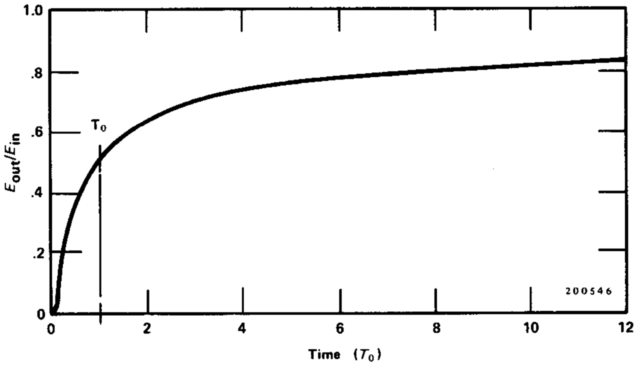


Fig. 3.1. Step-Function Response of Transmission Lines for Which Decibel Attenuation Varies as the Square Root of Frequency.

Table 3.1

Percent (X) of Pulse Height	0 to X% Rise Time
10	0.17
20	0.28
50	1.0
70	3.1
80	7.3
90	29.0
95	110.0

10% to 90% rise time = (29.0 − 0.17) T_0 = 28.83 T_0.

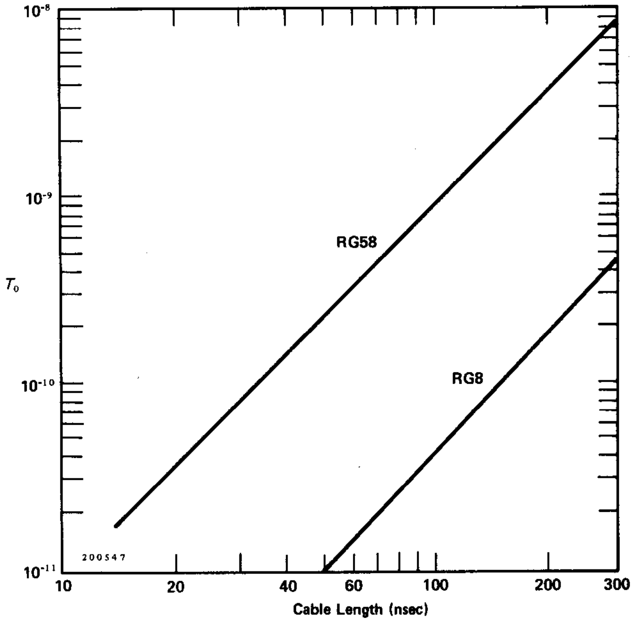


Fig. 3.2. Calculated Variation of T_0 with Cable Length for RG-58A/U and RG-8/U.

and 1000 MHz, it is convenient to calculate T_0 by

$$T_0 = 3.0 \times 10^{-16} A^2 L^2 \text{ sec},$$

where A is the commonly tabulated attenuation at 1000 MHz expressed in db/100 ft (8.0 to 9.0 for RG-8/U and 20 to 24 for RG-58A/U and L is the length in nanoseconds.

Since the rise time is proportional to the square of the length, if two equal lengths of a given type of cable are cascaded, the rise time of the combination is four times the rise time of either length alone. This is in contrast to the familiar case of amplifiers of Gaussian frequency response, in which the rise time varies as the square root of the number of identical sections. For this reason and also because the characteristic step-function responses of cables and of Gaussian devices are so different, the overall rise time of combinations cannot be calculated from the square root of the sum of squares of individual rise times, either with cables alone or with cables combined with Gaussian elements. Instead, the overall response of a system with cables and other elements may be obtained graphically or with convolution integrals, using either step or impulse (obtained from the derivative of the function plotted in Fig. 3.1) function responses.

Coupling from the output of the 436 to other equipment such as fast coincidence units or time to pulse height converters may be performed with poor-quality cable without timing degradation, because the output signal is standardized in both amplitude and width. The only requirement is that the input circuit which is driven have a stable triggering threshold.

4. OPERATING INSTRUCTIONS AND APPLICATIONS

4.1. FRONT-PANEL CONTROLS

The 436 has two front-panel controls: the Discriminator Level control and the Reset Selector switch. The Discriminator Level control sets a dc bias on the discriminator element (a tunnel diode) which determines at what level of input voltage the unit will trigger. The dial is normalized to the low end reading of 50 mV. The curve of the discriminator dial versus input voltage is essentially linear, but the slope may vary by as much as 10%. This means that 50 dial divisions are equal to 50 mV but that 1000 dial divisions equal 1 V to only approximately ±10%.

The Reset Selector switch is used when the input pulse is to be stretched. When used with a PM tube and plastic phosphor, the switch should be set to the Prompt position. This ensures maximum count rate capability. When used with a phosphor such as NaI(Tl) or CsI(Tl), the switch should be set to the Delayed position. This inserts a Delayed reset variable from 0.5 to 5 μsec to eliminate multiple pulsing on these long-tailed signals.

When using the 436 with a PM setup, it is advisable to view the linear output of the PM-amplifier complex with an oscilloscope that is triggered from the output of the 436 being adjusted. This will ensure correct setting of the discriminator level with respect to the input signal.

4.2. TIMING WITH PHOTOMULTIPLIERS

Timing with photomultipliers involves a coincidence measurement. This measurement may be performed with standard coincidence circuits such as the pulse overlap type, which are essentially single-channel time analyzers, or with time to pulse height converters, which are differential or multichannel time analyzers.

The response of the coincidence system to a prompt cascade always has finite width, which comes from a variety of sources. The most important of these are the following:

1. variation of time of interaction of radiation with the scintillator and the amount of energy deposited therein,
2. finite decay time of light-emitting states in the phosphor and variation of times of photon arrival at the cathode of the photomultiplier,
3. variation of transit time of photoelectrons in the photomultiplier due to different path lengths and to variation of initial energy and angle of the secondary electrons,
4. jitter and uncertainties of times of triggering of the associated electronics.

The variation in the time of interaction can be minimized by appropriate geometry and small scintillators at a corresponding loss in efficiency and average energy deposition.

For a complete discussion of timing with photomultipliers, the reader is referred to some of the excellent literature available on the subject.[1-3]

---

[1] A. Schwarzschild, ***Nucl. Instr. Methods*** **21**, 1-16 (1963).

[2] G. Present ***et al., Nucl. Instr. Methods*** **31**(1), 71-6 (1964).

[3] F. Gatti and V. Svelto, ***Nucl. Instr. Methods*** **30**, 213-23 (1964).

4.3. APPLICATIONS

The different specific applications for the 436 are essentially limitless, but since the unit was designed primarily for timing with photomultipliers, a number of system block diagrams for this type of usage are given. Some typical resolution curves for three of the systems are given separately, from which operational characteristics of other systems may be implied.

Typical Fast-Slow Coincidence System Using Plastic Scintillators. Figure 4.1 is a block diagram of a system that might be used to perform lifetime measurements or to study the time dispersion associated with some prescribed coincidence events. It does not represent an optimum system if clean slopes of the coincidence curves are required to four or five decades, but will give clean spectra to at least three decades at moderately high count rates. The time spectrum shown in Fig. 4.2 represents what may easily be obtained under laboratory conditions using the 436 and other appropriate equipment. It is important to remember that the resolution obtainable varies as $1/\sqrt{n}$, where n represents the number of photoelectrons created by the event and is therefore representative of the amount of energy deposited in the scintillating phosphor.

Typical Fast-Slow Coincidence Using NaI(Tl). The block diagram of Fig. 4.1 applies equally well here. The difference in the two systems is the scintillator and its decay characteristic. This decay time constant is 0.25 μsec, whereas the same time constant for Naton-136 is approximately 2 nsec. With NaI(Tl) much more total light is produced per equivalent energy event, but the collection of this light is over such a wide period of time, as indicated, that the time resolution is poorer than that of plastic. Figure 4.3 is a typical spectrum taken with 1½- x 1-in. NaI(Tl) on one side of the coincidence system.

Fast Coincidence Using Ge(Li) Detectors. Some recent experiments have been performed with 1- x 1-in. Naton in a gamma-gamma coincidence arrangement with an ORTEC Ge(Li) coaxial detector, as shown in Fig. 4.4. In this case, the radiant energy from the source was not collimated at all; so the time is given by collection from all parts of the detector. The source viewed one end of the germanium detector. The full time spectrum is given in Fig. 4.5. Comparison of this curve with published timing curves[4] indicates a far superior detector design for timing purposes.

A number of experimental systems are shown in Figs. 4.6–4.9 for the aid of the user.

---

[4] R. L. Graham *et al., IEEE Trans. Nucl. Sci.* **NS-13** (1), 72 (1966).

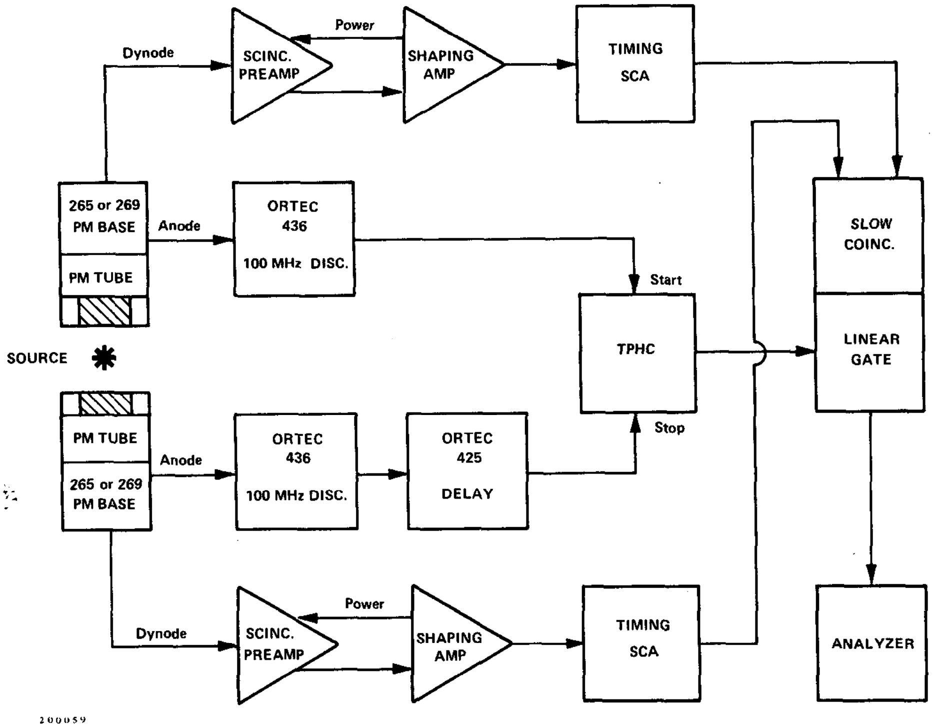


Fig. 4.1. Simple Fast-Slow Coincidence System.

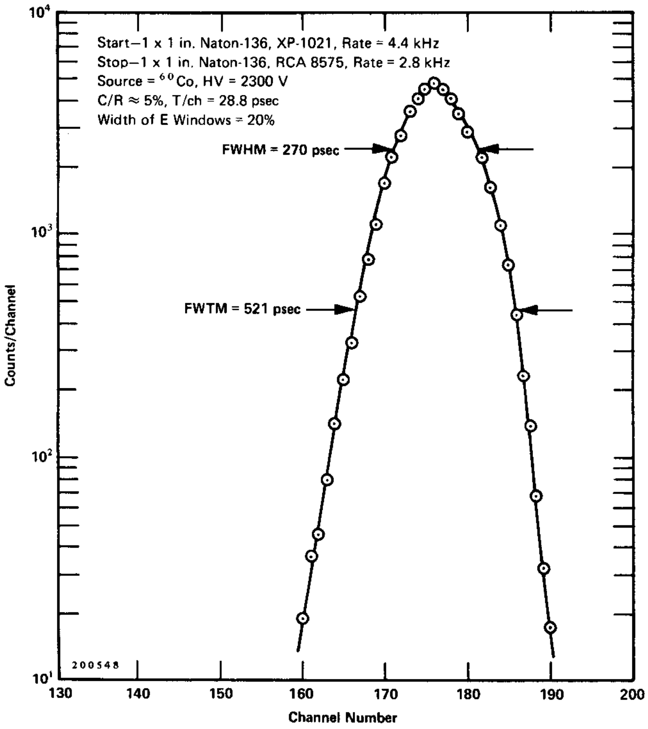


Fig. 4.2. Typical Coincidence System Using Plastic Scintillators. (C/R is the trigger level as a percent of the energy of interest in timing.)

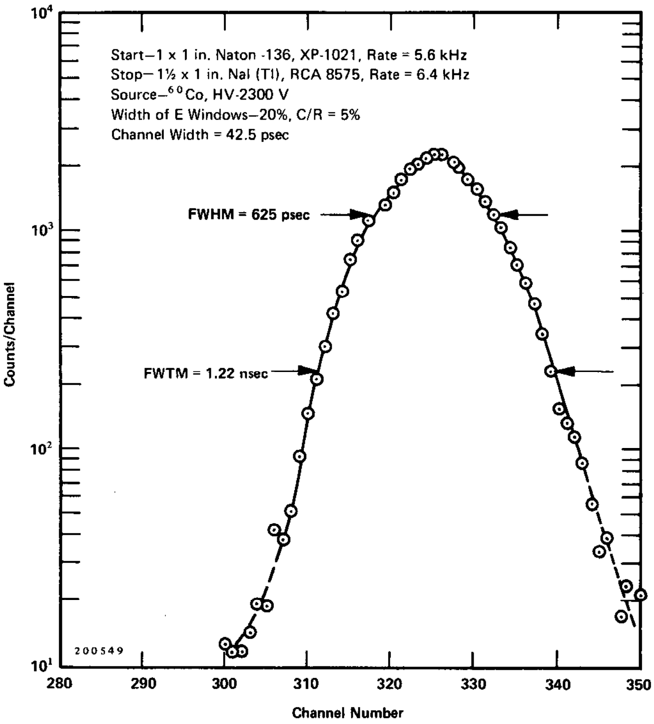


Fig. 4.3. Typical Coincidence Spectrum Using NaI(Tl) Scintillator.

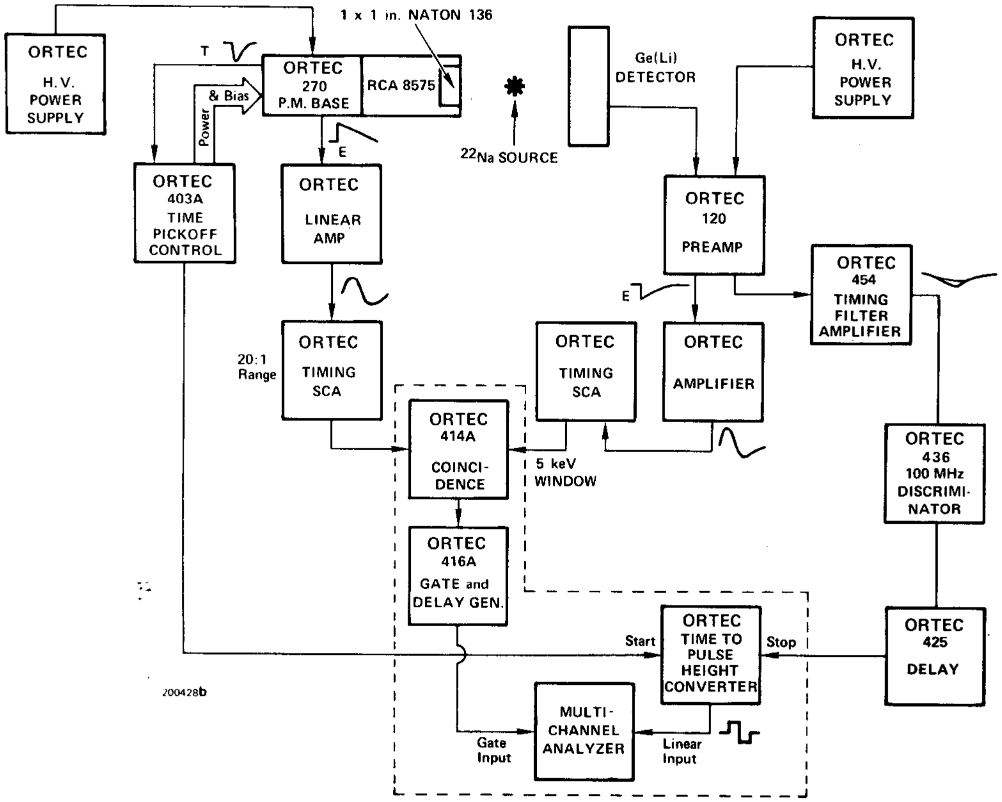


Fig. 4.4. Block Diagram of System Recommended for Leading-Edge Timing.

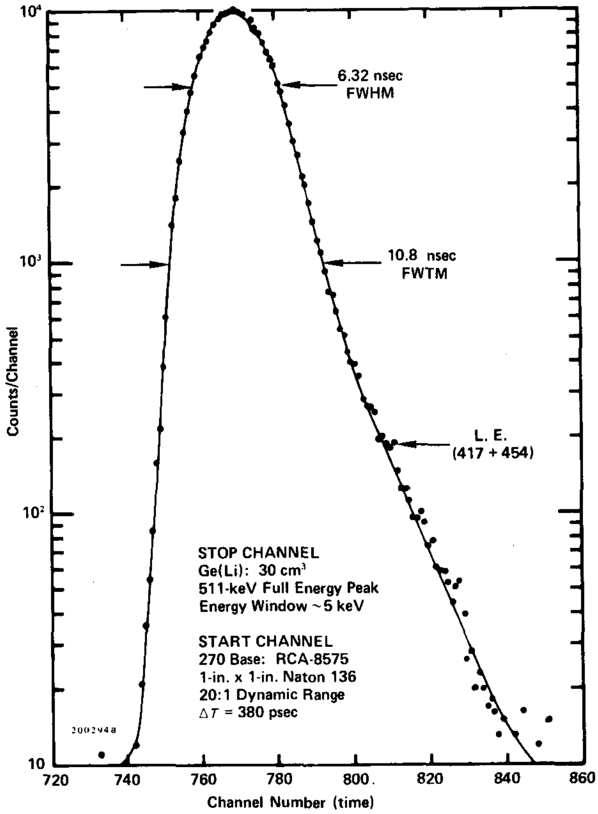


Fig. 4.5. Typical Timing Spectrum

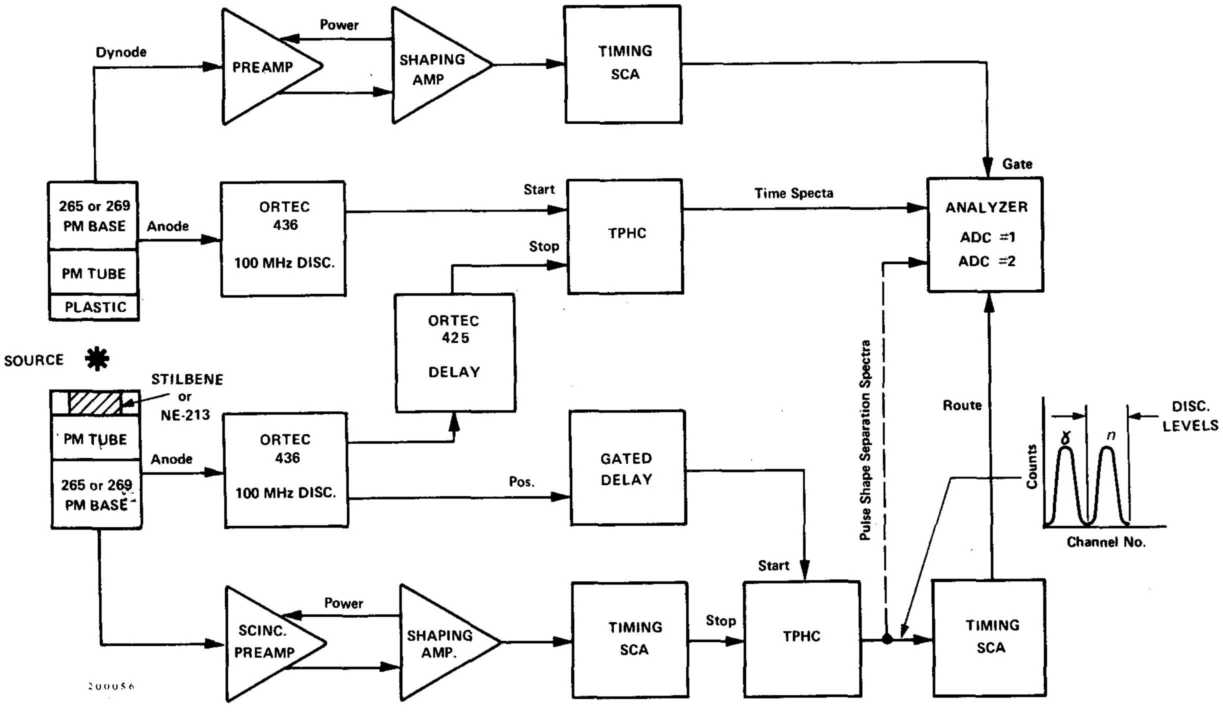
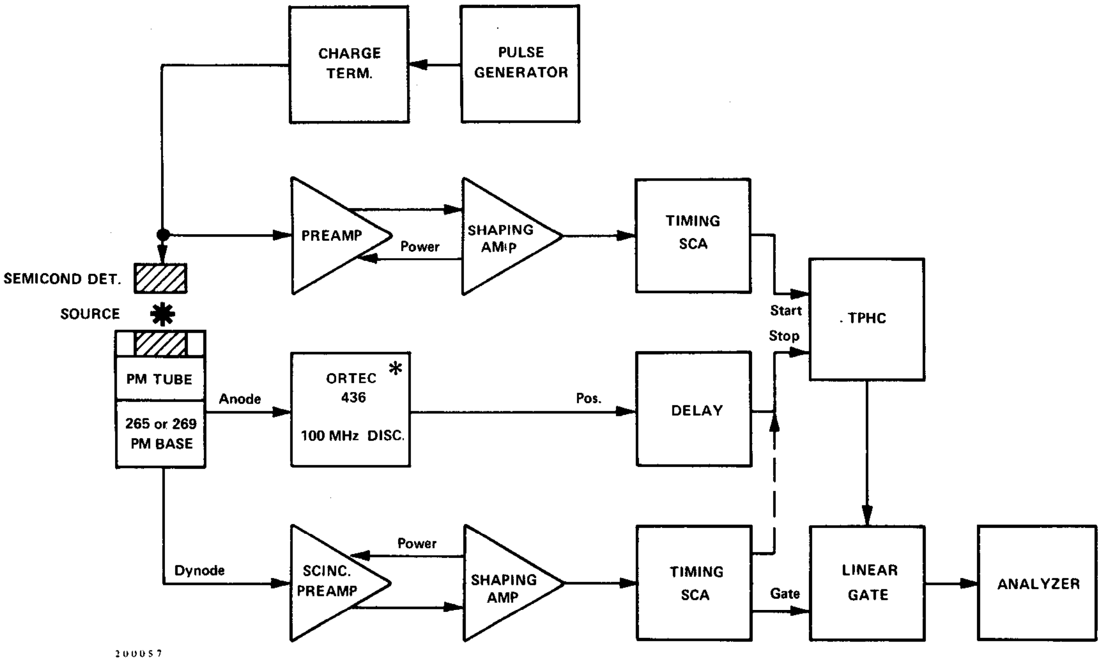


Fig. 4.6. Fast-Fast Coincidence (PMT) with Pulse Shape Discrimination.



* Optional – Not Needed if Crossover Timing is Chosen

Fig. 4.7. Fast Timing (Semiconductor Detector-PMT) for Coincidence Using Crossover Pickoff Technique.

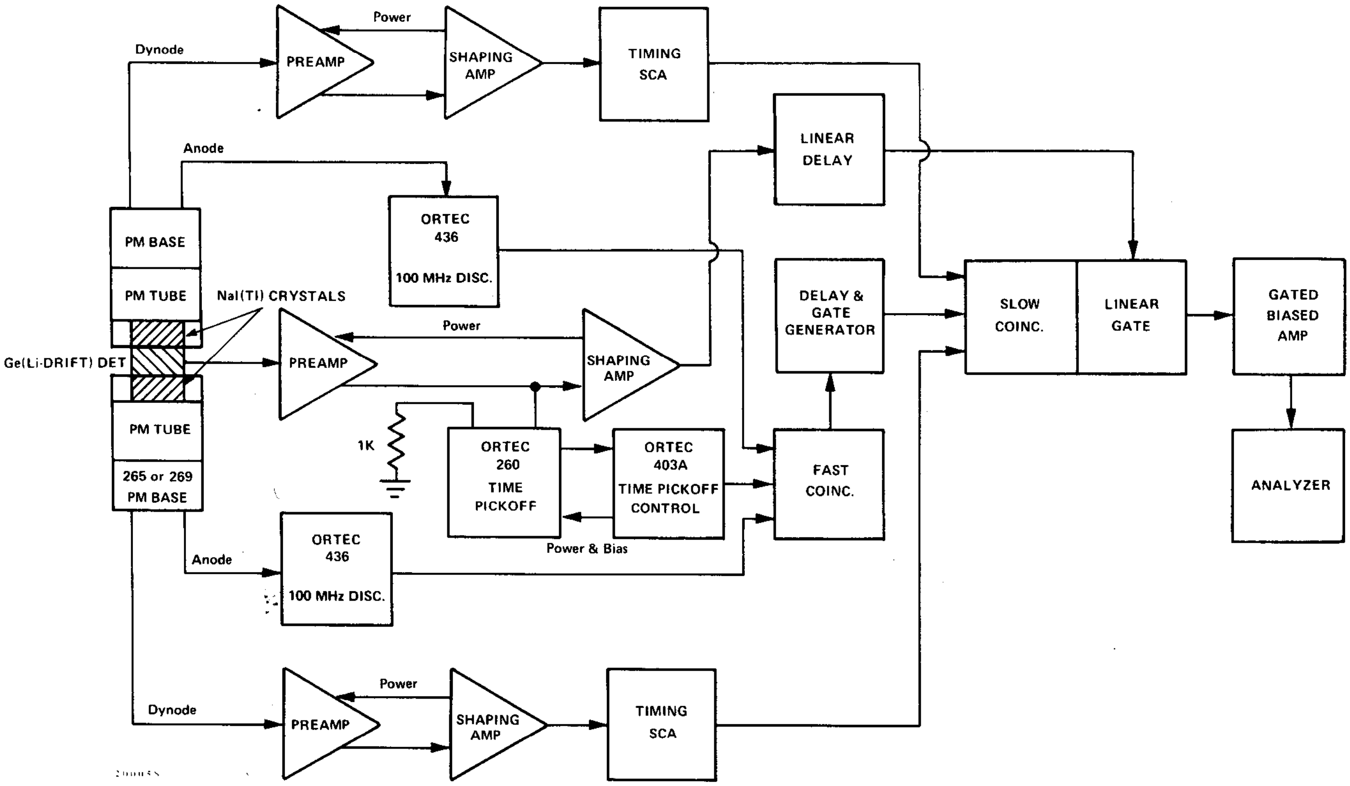


Fig. 4.8. Gamma-Ray Pair Spectrometer.

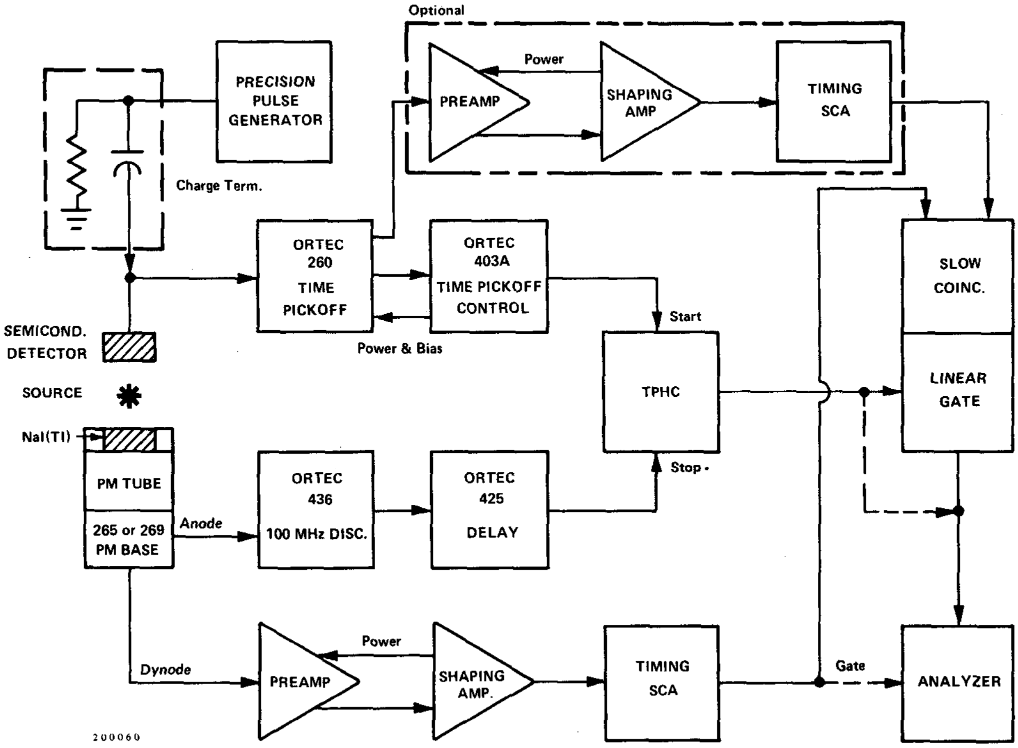


Fig. 4.9. Subnanosecond Timing System (Semiconductor-Photomultiplier Tube).

5. CIRCUIT DESCRIPTION

5.1. BASIC OPERATION

The sequence of operation is explained with aid of the block diagram 436-0101-B1 at the back of this manual. A negative input signal propogates through a wideband amplifier to the input tunnel diode discriminator D9. If this input exceeds the input level threshold set by Disc Level Control R7, D9 generates a logic signal which is propogated and inverted by transformer T1 through another fast amplifier. This signal is reshaped, amplified, and presented to the fast negative outputs through two similar fast current switches. This signal is also amplified, shaped, and presented to the positive output. If a delayed reset is selected by S1, a fast output will trigger a one-shot multivibrator which inhibits further outputs until after the one-shot recovery time, set by reset delay control R51. This function prohibits multiple outputs due to long or noisy inputs such as that furnished by NaI(Tl) detectors.

5.2. CIRCUIT DETAIL

Diodes D3 and D4 form an input limiter circuit that protects the unit from large overload signal conditions. The input is a grounded base configuration (Q3) that has low input impedance and a high bandwidth. The unit input impedance is thus largely determined by R4. The proper stable bias for Q3 is controlled by a transistor Q2 operating as a diode and current source Q1. This bias is factory-adjusted by the input zero adjust control R13. This adjustment is to set the open circuit input voltage to zero. The second stage amplifier Q6 amplifies the input current to be presented to the discriminator tunnel diode D9. The bias of Q6 is controlled by a current supplied by Q5. Q5's current is controlled by the setting of the lower level calibration control R17 and is factory adjusted. The discriminator tunnel diode (D9) is now presented with a current equal to the input current. D9 is normally biased in the low voltage state by the current sum of Q4, Q6, and Q7. When the input current exceeds the threshold, set by Discriminator Level control R7, D9 will switch to the high voltage state and produce a negative transition that is sharply differentiated by inductor L7. The reset time of D9 is controlled by the inductance of L7 and the resistance of the R32 and R33 combination, after the return of the input level below the threshold.

The pulse transformer T1 inverts the transition and drives the timing amplifier Q8 and Q9. The output of Q9 switches

Q10 off. Q10's current switches into Q11 to furnish enough current to D12 so that D12 switches to its high voltage state (positive).

D12 switching positive causes Q15 to cease conducting. The current normally conducted by Q15 now forward-biases Q12 and D11 to reset D12. The reset time of D12 is delayed by the capacitor C25.

This forward biasing of Q12 causes a positive voltage transition from the collector of Q12 to the bases of Q20 and Q22, switching these transistors to the conduction state and causing negative output signals to appear at outputs 1 and 2. When Q22 is turned on, the current normally in Q23 is switched to Q22, generating a positive pulse at the emitter of the common base transistor Q24. This positive signal is level-shifted by Q24 and appears at the base of Q28.

The positive excursion at the base of Q28 triggers a one-shot multivibrator Q28, Q27, Q29 which generates a positive output pulse through an emitter-follower Q26. The width of the positive output is determined by the time constant of C43 and R113. This sequence can recur at a repetition rate of $>10^6$ pulses/sec in the Prompt reset mode. If delayed reset is selected by switch S1, the following modification takes place:

When Q20 turns on, the current from Q21 is switched to Q20, generating a positive pulse on the base of Q19. This positive pulse switches Q19 on.

Q19 causes Q16 to turn on, which holds Q18 in the conducting state long enough to trigger the one-shot multivibrator IC 1. When Q16 turns on, it also causes Q13 to conduct, which inhibits any further signals from reaching D12 via Q11. The input to Q13 is a resistive OR gate formed by resistors R56 from Q16 and R54 from IC 1. The Reset time of the one-shot is determined by capacitor C27 and current source Q14. The current from Q14 may be front-panel adjusted by the reset time control R51, which adjusts the reset time from <0.5 μsec to >5 μsec. The reset time may be monitored on front-panel test point TP4.

6. MAINTENANCE

6.1. TESTING PERFORMANCE

The following test equipment is needed:

1. Pulse Generator, HPA-222A or equivalent
2. Tektronix Model 661 Sampling Oscilloscope or equivalent
3. Vacuum tube voltmeter

Preliminary Procedures

1. Visually check module for possible damage due to shipment.

2. Insert module into ORTEC 401A/402A Bin and Power Supply.

3. Switch on power to Bin.

4. Check Power Supply voltages if equipment of other than ORTEC design is in the Bin (see Section 3.2).

Connections

1. Set the pulse generator to negative output, pulse width approximately 20 nsec, amplitude approximately 200 mV, and connect to the input connector of 436 with 50Ω coaxial cable.

2. Set Discriminator Level adjust, R7, to minimum (50 divisions = 50 mV).

3. Connect output 1 to oscilloscope with 50Ω coaxial cable. There should now be a negative output of approximately 700 mV, 4 nsec wide.

4. Observe rise time, width, delay, etc.

5. Observe outputs 2 and 3. (Care should be taken to attenuate signal from output 3 to prevent oscilloscope damage.)

Adjustments and Calibrations

Input Offset

1. Allow the 436 to warm up for approximately 1 min.

2. Monitor the input dc offset voltage on CN4 and adjust the input zero control R13 to obtain 0 V ±3 mV.

Tunnel Diode Hysteresis

1. Set Reset switch to prompt. Set the Lo-Cal trim potentiometer R17 fully counterclockwise. Set the TD Hysteresis potentiometer R33 fully counterclockwise.

2. Adjust the pulse generator to obtain a negative 100-nsec pulse of 25-mV amplitude and 3- to 4-nsec rise time at the input of the 436.

3. Observe one of the outputs on a sampling oscilloscope with settings of 20 nsec/div and 200 mV/div and set for external trigger.

4. Vary the Disc Level control on the front panel to between 200 mV and 400 mV. Observe multiple pulse outputs within the input pulse duration.

5. Vary the Disc Level back and forth, while adjusting the tunnel diode hysteresis control R33, until the pulses appear only within a 10-mV span on the Disc Level dial. Note: this adjustment is quite critical for the proper operation of the 436.

Lower Level Discriminator Calibration

1. Adjust the pulse generator to obtain a negative 100-nsec-wide pulse of 50-mV amplitude and 3- to 4-nsec rise time at the input of the 436.

2. Set the Disc Level control dial to 50.

3. Adjust the Lo-Cal trim potentiometer for ~50% triggering on the input pulses. Note: two trigger points are on the Lo-Cal adjustment; the one more clockwise is the correct adjustment.

High Level Discriminator Calibration

1. Change the pulse generator amplitude to obtain 500-mV pulse at the input of the 436.

2. Set the Disc Level dial to 500.

3. Adjust the Hi-Cal control to obtain ~50% triggering on the input.

4. Recheck the Lo-Cal adjustment and touch up if necessary.

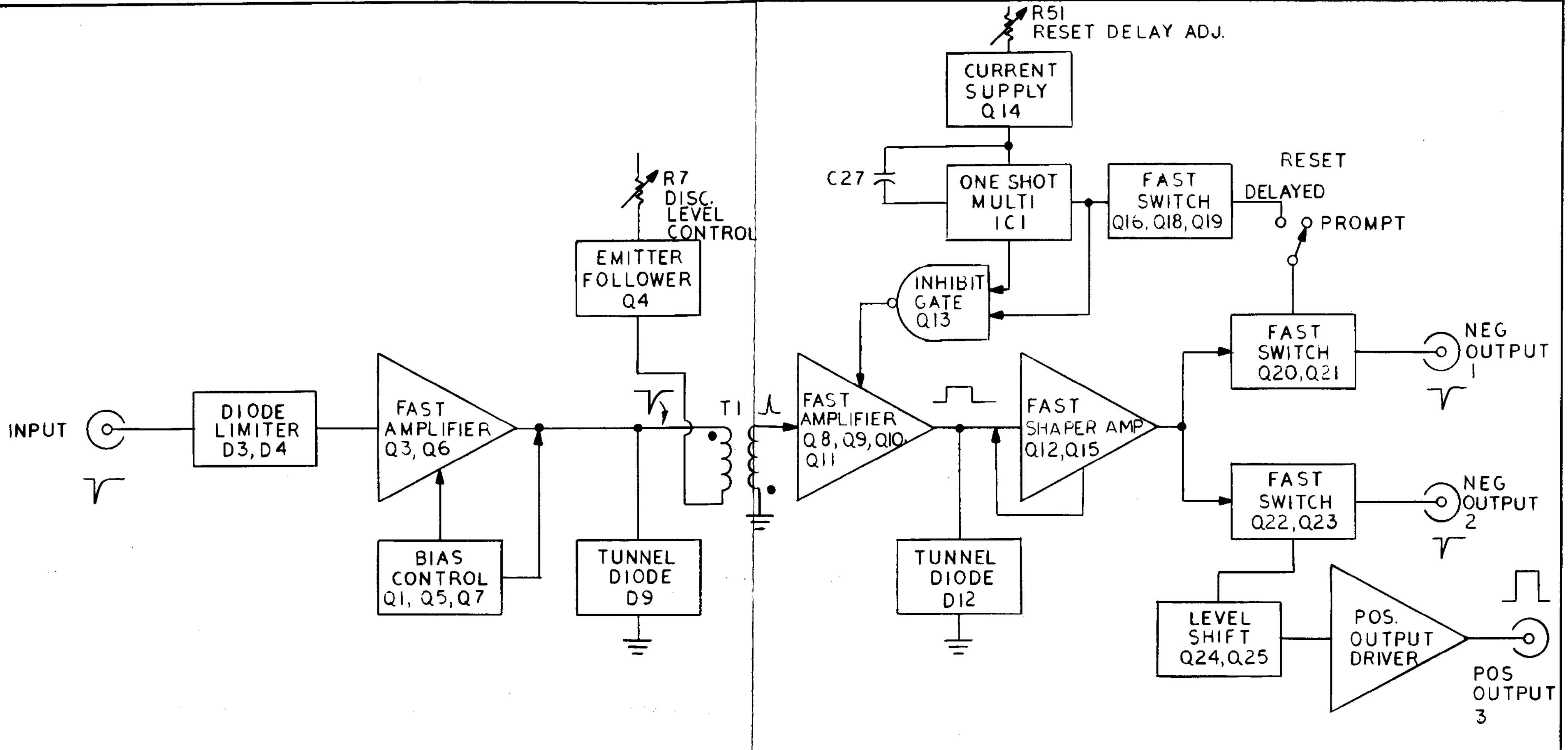
6.2. FACTORY SERVICE

The 436 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.

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
14	Spare	36	Gate
15	Reserved	37	Spare
*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		

**These pins are installed and wired in parallel in the ORTEC 401A and 401B Modular System Bins.*



REVISIONS
BY
DATE
SCN NO.
REV.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES

FRACTIONS	DECIMALS	ANGLES	FINISH
± 1/64	.XX ± .01 .XXX ± .005	± 0°30'	√ RMS

MATERIAL

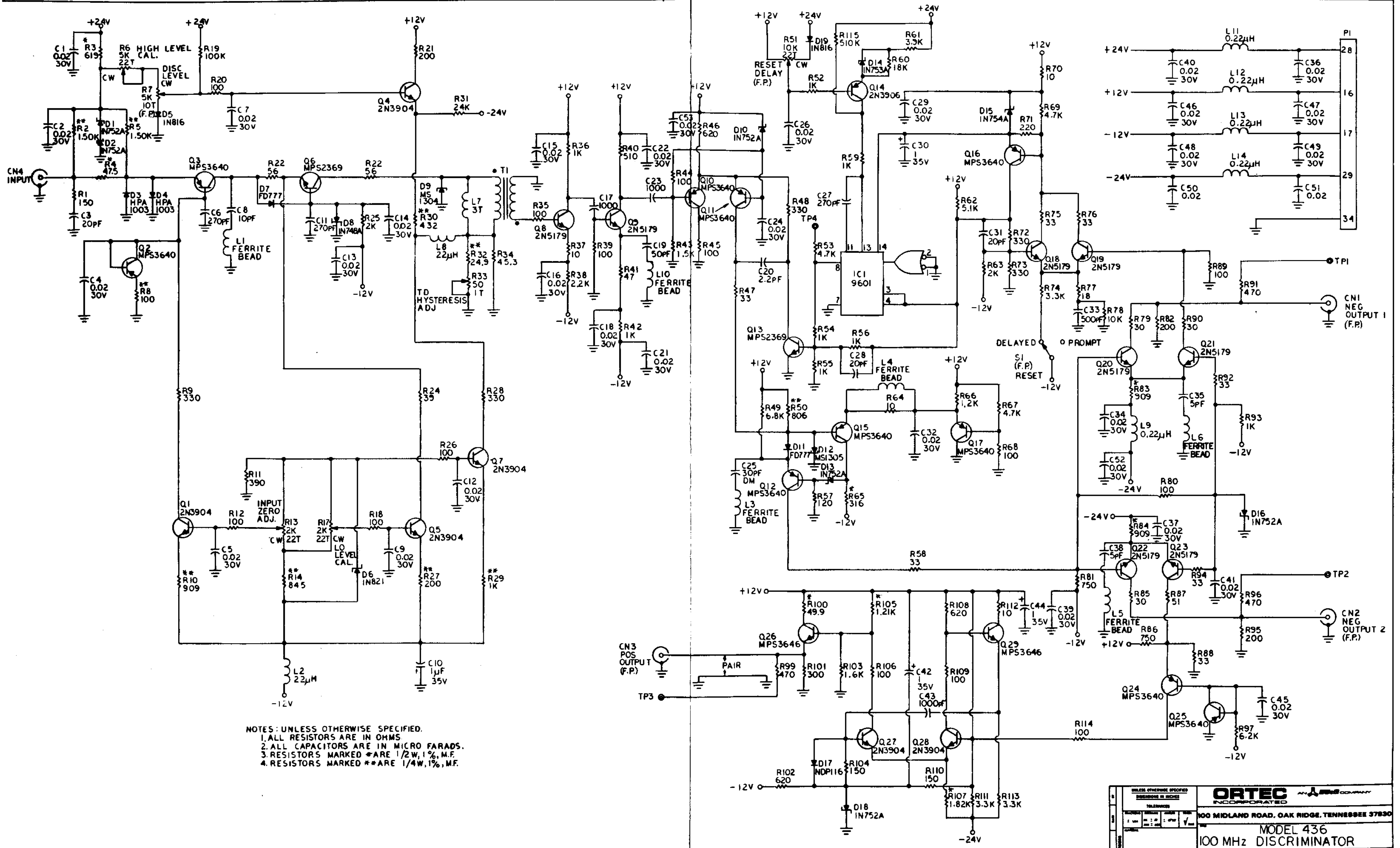
APPLIED PRACTICES

ORTEC INCORPORATED AN EG&G COMPANY

100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

TITLE
MODEL 436
BLOCK DIAGRAM

DRAFTSMAN D. WEBB DATE 2-3-71
RESPONSIBLE ENGINEER R. NUTT
REFERENCE/USED ON
CHECKED DATE
ENG. APPROVAL R. Nutt DATE 3/25/71
STOCK NO.
SCALE
MFG. APPROVAL B. D DATE 7-21-71
DRAWING NO. 436-0101-B1
DWG. ISSUED SH DATE 7-22-71
RELEASED FOR MFG. DATE



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS ARE IN OHMS.
2. ALL CAPACITORS ARE IN MICRO FARADS.
3. RESISTORS MARKED * ARE 1/2W, 1%, M.F.
4. RESISTORS MARKED ** ARE 1/4W, 1%, M.F.

ORTEC INCORPORATED
AN EG&G COMPANY

100 MIDLAND ROAD, OAK RIDGE, TENNESSEE 37830

MODEL 436
100 MHz DISCRIMINATOR

JDW 3 1 71
R NUTT
R. Nutt 3/23/71
7-21-71
436-0101-S1