

**UNIVERSAL COINCIDENCE
Model 1446**

**Instruction Manual
March, 1979**

NSCL-ELECTRONIC

**CANBERRA INDUSTRIES, INC.
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BASIC WARRANTY

CANBERRA - MANUFACTURED EQUIPMENT

Equipment manufactured by Canberra Industries, Inc. is warranted against defects in materials and workmanship for a period of twelve months from date of shipment, provided that the equipment has been used in a proper manner as detailed in the instruction manuals. During the warranty period, repairs or replacement will be made at Canberra's option on a return to factory basis. The transportation cost, including insurance, to and from Canberra, is the responsibility of the Customer. Except for defects discovered upon initial operation, shipping expense to Canberra is to be paid by the customer; shipping expense to return the repaired equipment will be paid by Canberra.

The customer must obtain shipping instructions, including an Authorized Return Number (ARN), before returning any equipment to the Canberra factory. *Compliance with this provision by the customer shall be a condition of this warranty.* In giving shipping instructions, Canberra shall not be deemed to have assumed any responsibility or liability in connection with the shipment. If, upon receipt of the equipment, Canberra determines that such equipment is not defective within the terms of this warranty, the customer shall pay to Canberra, upon invoice, the cost of diagnosis at the then prevailing Canberra repair rate and the cost of return transportation.

The Canberra Basic Warranty applies only to equipment manufactured by Canberra which is returned to the factory. If equipment must be repaired at the customer's site, the actual repair labor and parts will be provided at no charge during the warranty period. However, travel expenses to and from the customer's site, and living expenses while on site, shall be paid by the customer unless an On-Site Warranty Option has been purchased. This option may only be purchased prior to shipment of the equipment to the customer.

This warranty shall not apply to Canberra equipment that has been modified or serviced by other than Canberra Service Personnel, or to failures of Canberra equipment caused by defective equipment not manufactured by Canberra.

The Express warranties set forth herein are the only warranties with respect to the products, or any materials or components purchased from others and furnished by Canberra, and there are no other warranties, expressed or implied. The warranty of merchantability is expressly limited as herein provided and all warranties of fitness are expressly disclaimed and excluded. Canberra shall have no liability for any special, indirect or consequential damages, whether from loss of production or otherwise, arising from any breach of warranty hereunder or defect or failure of any product or products sold hereunder.

EXCLUSIONS

Warranty service is contingent upon the proper use of all equipment and does not cover equipment which has been modified without Canberra's written approval or which has been subjected to unusual physical or electrical stress as determined by Canberra Service personnel. Canberra Industries shall be under no obligation to furnish warranty service (preventive or remedial): (1) if adjustment, repair or parts replacement is required because of accident, neglect, misuse, failure of electrical power, air conditioning, humidity control, transportation, or causes other than ordinary use; (2) if the equipment is maintained or repaired or if attempts to repair or service equipment are made by other than Canberra personnel without the prior approval of Canberra.

This warranty does not cover detector damage caused by warm-up or by neutrons or heavy charged particles. Damage from these causes is readily identifiable as described in the manual accompanying each detector.

EQUIPMENT NOT MANUFACTURED BY CANBERRA

Canberra's basic one-year warranty applies only to equipment manufactured by Canberra. Although Canberra may frequently supply, as part of systems, equipment manufactured by other companies, the only warranty that shall apply to such non-Canberra equipment is that warranty offered by the original manufacturer if any.

Canberra will, upon request, offer, as an option, warranty coverage for non-Canberra equipment such as computers and peripherals sold as part of a system supplied by Canberra. Quotations on this coverage may be obtained by contacting Canberra Nuclear Systems Division.

SOFTWARE

Canberra warrants proper system operation only with programs developed by Canberra using the operating system supplied to the customer. Canberra assumes no responsibility for user-written programs or programs published as part of information exchange in Canberra periodicals.

Engineering assistance for software development is available and can be contracted through the Canberra Nuclear Systems Division Sales Department.

INSTALLATION

Installation of equipment purchased from Canberra shall be the sole responsibility of the customer unless the installation is specifically contracted for at the prevailing Canberra field service rates. To insure timely installation after receipt of equipment, it is recommended that installation be contracted for at the time the equipment is ordered.

ON-SITE WARRANTY OPTION

The On-Site Warranty Option provides for free on-site warranty work (Canberra pays all travel and living expenses) within the first 90 days after delivery of equipment to the customer. If installation is ordered from Canberra, the 90 day period commences upon completion of the initial installation. After the 90 day period, labor and materials used on site will still be covered by the basic warranty, but the customer shall pay for all travel and living expenses incurred for any on-site service.

A maintenance contract may be purchased covering the period after the 90 days on-site warranty period, or after initial installation of the equipment. This is to be contracted through Canberra's Nuclear Systems Division.

REPAIRS

Any Canberra-manufactured instrument no longer in its warranty period may be returned, freight prepaid, to our factory for repair and realignment. When returning instruments for repair, contact the Customer Service Department for shipping instructions and an Authorized Return Number (ARN).

All correspondence concerning repairs should include Model Number and a description of the problem observed.

Once repaired, all equipment passes through our normal pre-shipment checkout procedure. Return shipping expense on out-of-warranty repairs will be charged to the customer.

For instruments out of warranty, the customer must supply a purchase order number for the repair before the item will be returned to him.

SHIPPING DAMAGE

Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, immediately notify Canberra and the carrier making delivery, as the carrier is normally responsible for damage caused in shipment. Carefully preserve all documentation to establish your claim. Canberra will provide all possible assistance in processing damage claims.

Due to the delicate nature of cooled detectors [Ge(Li) and Si(Li)] Canberra requires that delivery to and from air freight terminals be handled with special care. Do not ship such Detectors without first obtaining advice from our Traffic Department.

UNIVERSAL COINCIDENCE
Model 1446

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UNIVERSAL COINCIDENCE

Model 1446

Section 1 INTRODUCTION

The Canberra Model 1446 Universal Coincidence unit is a single-width module having five DC coupled inputs. Associated with each input is a three-position toggle switch to select coincidence (COINC), anticoincidence (ANTI), or out (OUT) mode. Coincidence analysis is of the overlap type, in which an output is generated when the inputs overlap in time.

The resolving time of input A is variable from 100 nanoseconds to 2 microseconds via a single-turn screwdriver-adjustable potentiometer. A test jack is provided to permit observation of the adjustment of the pulse at input A. Resolving times of the remaining four inputs are determined by their pulse's widths.

An output pulse is obtained whenever the number of coincident pulses meets or exceeds the number selected by the COINCIDENCE EVENTS REQD rotary switch. For example, if this switch is set at "3" position, and all five inputs are being utilized in the COINC mode, the output will fire whenever a coincidence occurs between any three of the inputs. If any one or more inputs are selected for anticoincidence, the output will be inhibited while such signals are present. Two output pulses are provided - one on the front panel, and one on the rear panel. Output width and amplitude are standardized, regardless of the input widths or amount of overlap.

Section 2 SPECIFICATIONS

2.1 INPUTS

SIGNAL INPUTS

Five, front panel BNC connectors
Amplitude: accept +4V to +10V pulses
Pulse width: 50 nanoseconds, minimum
Input impedance: 1000 ohms; DC coupled

2.2 OUTPUTS

OUTPUT

Two BNC connectors (one located on the front panel and one on the rear panel)
Amplitude: +10V
Pulse width: 1 to 5 microseconds (variable via an internal potentiometer)
Output impedance: 10 ohms; DC coupled

2.3 CONTROLS

INPUT CONTROLS

Five three-position toggle switches (one for each input) to select Coincidence, Anticoincidence or Out mode; selection of Out mode disables the respective input

R (Resolving Time, Input A)

A single-turn screwdriver adjustable potentiometer to adjust the resolving time of the signal at Input A over a range of 100 nanoseconds to 2 microseconds

COINCIDENCE EVENTS REQD

Front panel rotary switch to select the number of coincident events which must occur before an output pulse will be obtained

2.4 PERFORMANCE

OPERATING TEMPERATURE

0 to 50°C

2.5 CONNECTORS

SIGNAL INPUTS

Five front panel BNC UG-1094/U

OUTPUT

One front and one rear panel BNC UG-1094/U

2.6 POWER

+24V	-	0mA
-24V	-	0mA
+12V	-	130mA
-12V	-	70mA

2.7 PHYSICAL

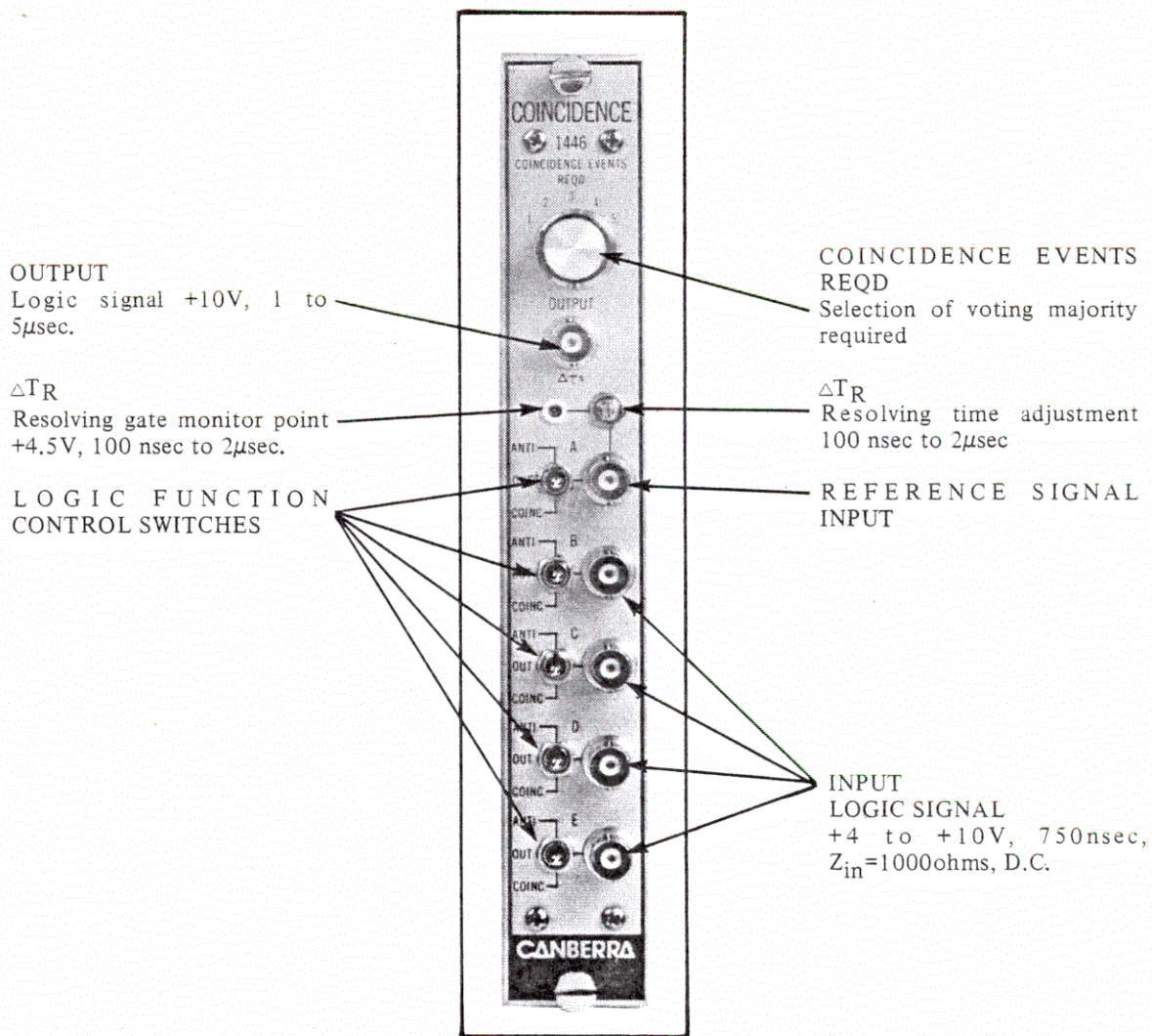
SIZE

Standard single-width module (1.35 inches wide)
per TID-20893 (Rev.)

WEIGHT

2 lbs. (0.9 kgs.)

CONTROLS AND CONNECTORS



Section 4 OPERATING INSTRUCTIONS

4.1 GENERAL

The purpose of this section is to familiarize the user with the controls of the Model 1446 Coincidence module and to verify that it is operating correctly. Since it is difficult to determine the exact system configuration in which the module will be used, explicit operating instructions cannot be given. However, if the following procedures are carried out, the user will gain sufficient familiarity with the instrument to permit its proper use in the system at hand.

4.2 INITIAL OPERATION

4.2.1 SETUP

1. Insert the Model 1446 Universal Coincidence unit into an AEC compatible base unit/power supply such as Canberra Model 2000. Set the Power switch to ON.
2. Connect a Data Pulser positive output to all 5 inputs on the Model 1446 by means of coax and "T" connectors and properly terminate this line with 50 ohms.
3. Set the Data Pulser to produce a positive pulse, $1\mu\text{sec}$ wide, at a rep rate of 10kHz, and an amplitude of 4V. Note that there is no output from the front panel output BNC.
4. Turn the input switch for Input A to COINC. Connect the 'scope to the front panel Δ TR test point. Adjust the Δ TR pot for a pulse width of $1\mu\text{sec}$.

4.3 PERFORMANCE CHECK

1. Set the Model 1446 controls as follows:

All input switches to OUT.

COINCIDENCE EVENTS REQUIRED switch to 1

Turn the input switch for Input A to COINC. Note that there is an output. Turn the COINC EVENTS REQD switch to 2 and note that the output disappears. Return input switch A to OUT and input switch B to COINC. Note that there is no output. Turn the COINC EVENTS REQD switch to 1 and note that the output appears. Return switch B to OUT and continue as above with C, D, and E. Each time note that there is an output when the COINC EVENTS REQD switch is in the 1 position, but no output for the 2 position.

2. Switch any two input switches to COINC; all others to OUT. Rotate the COINC EVENTS REQD switch through all 5 positions and note that there is an output for positions 1 and 2, but no output for 3, 4, and 5.
3. Switch any three input switches to COINC; all others to OUT. Rotate the COINC EVENTS REQD switch through all 5 positions and note that there is an output for positions 1, 2, and 3, but no output for 4 and 5.
4. Switch any four input switches to COINC, and the remaining input switch to OUT. Rotate the COINC EVENTS REQD switch through all 5 positions and note that there is an output for all positions except position 5.

Section 5 THEORY OF OPERATION

5.1 GENERAL

The Model 1446 will yield an output pulse only when the number of coincident pulses, as selected by the front panel controls, overlap by at least 50 nanoseconds. The coincidence unit is made up of nine sections; Input Circuits, Resolving Circuit, Unit Gates, Summing Amp., Level Discriminator, Anti Single Shot, Wired OR Anti Circuit, Output Single Shot, and the Output Drivers. The Block Diagram of the instrument is shown in figure 1.

5.2 INPUT CIRCUIT

There are five input circuits, one for each input. They are all identical; Input A's input circuit is made up of Q5; input B's of Q4; input C's of Q3; input D's of Q2; input E's of Q1. These input transistors are emitter followers; therefore their driving impedance is low. R1, R9, R16, and R30 provide the 1k input impedance for each input BNC. Diodes D1, D4, D7, and D10 are protection diodes by preventing the pulses to the following circuitry from exceeding 5 volts peak.

5.3 RESOLVING INPUT A

The pulse widths fed into the input BNC's are used in the overlap coincidence measurement. This is true of all inputs except input A whose width is controlled by the Resolving Single Shot. The input circuitry of input A (Q5), is fed into Q6, which inverts input A and feeds the Resolving Single Shot made up of A3A, A3D and Q7. The two gates alone (A3A and A3D) would make up a single shot, but Q7 was added to allow the range of pulse widths to be 20:1, i.e., 0.1 to 2.0 μ sec.

The output of the Resolving Single Shot at pin 3 of A3A is inverted by A3B and appears at the Δ TR test point on the front panel, and the wiper of S5. The width of this pulse is determined by the setting of the Δ TR pot and is independent of input pulse width.

5.4 UNIT GATES

With switches S1 through S5 in COINC position, the pulses are fed to the unit gates made up of A2A, A2B, A2C, and A3C. The outputs of these gates are held high (+4 volts) by the 8.2k resistor (R6, R13, R20, R27, and R40) on each gate input which is tied to -12 volts. An input pulse to one of these gates will cause the gate output to go low (0 volts). The gate outputs only swing to +4 volts in the high state because the two resistors tied to the output of each gate (R7 and 8 for instance) form a voltage divider from the +5 volt supply to virtual ground. Virtual ground is formed by the summing point of the summing amplifier (junction of R50 and R53).

5.5 SUMMING AMPLIFIER

The summing amplifier is made up of Q8, Q9, and Q17. The summing amplifier is a feedback amplifier. The voltage gain of a feedback amplifier is basically R_f/R_{in} . Where R_f is R53 which is 1k and R_{in} is each 3.9k (R8, 15, 22, 29, and 37). Therefore, the basic gain of the summing amplifier for one input is $R_f/R_{in} = 1k/4k$ (actually 3.9k) = 0.25. since the input swing, as mentioned earlier, is +4V to 0V, the output voltage swing is $4V \times 0.5 = 2V$ for two inputs.

The same is true for inputs 3, 4, and 5. That is, for each input we will have a 3.9k resistor in parallel. So, the voltage output of the summing Amp for N number of inputs is:

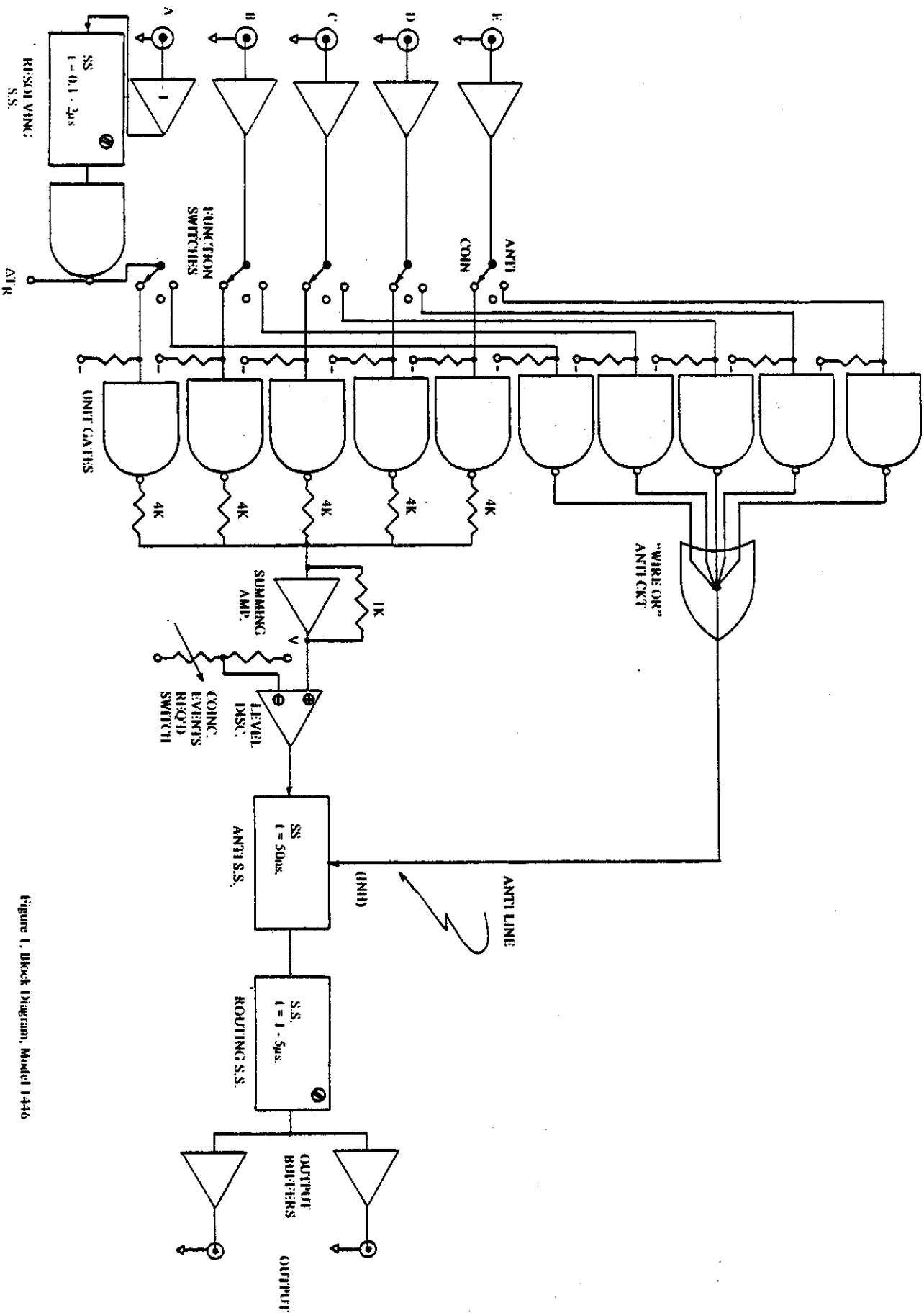


Figure 1. Block Diagram, Model 1446

CONDITIONS:

- a. 3 inputs applied
- b. Coinc. events Req'd switch set to 3.
- c. No Anti inputs.

DESCRIPTION

WAVEFORM

WAVEFORM

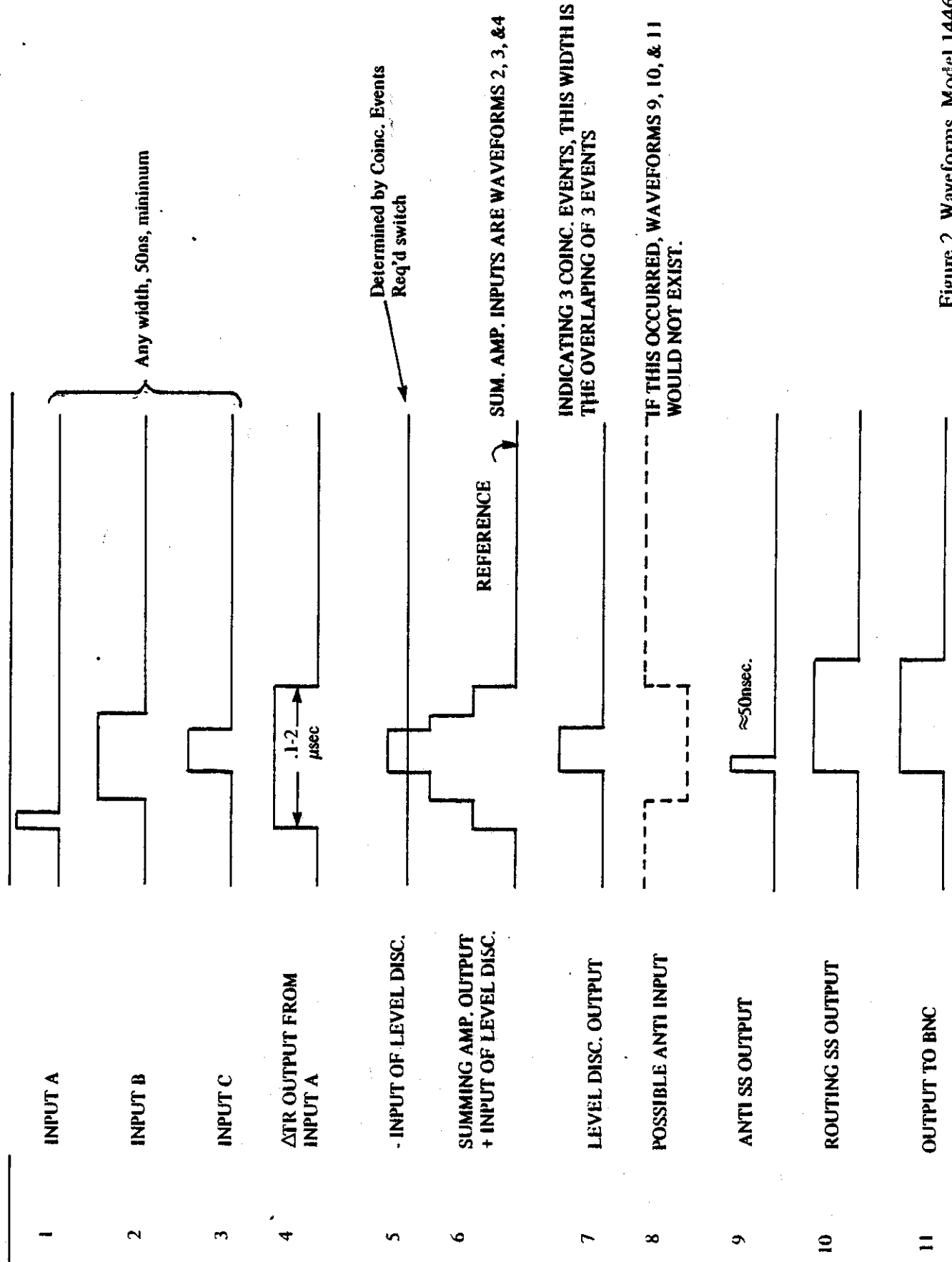


Figure 2. Waveforms, Model 1446.

from

$$E_{in} R_f / R_{in} = E_o$$

we get

$$4V \times (1k)(N)/4k = E_o$$

where N is the number of simultaneous inputs

Therefore

$$E_o = (N/4)4V = NV$$

That is

$$E_o = NV$$

Therefore each input produces a one volt change in the output of the summing Amp (TP2). The summing amplifier output is at - 5V with no input and goes 1V in the positive direction for each input pulse.

5.6 LEVEL DISCRIMINATOR

The level discriminator is made up of a 710 I.C. (A5). A5 compares its two inputs; the summing Amp output (TP2) and a DC level (TP4) selected by the COINC EVENTS REQD switch (S6). Whenever the + (Positive) input of the 710 (TP2) is greater than the - (negative) input (TP4), the 710 will produce a positive pulse out. Thus, we are able to select any number of coincident inputs to yield an output. The output of the level discriminator is inverted and shaped by A4D and then fed to the anti single shot (TP3).

5.7 ANTI SINGLE SHOT

The anti single shot is made up of A6C and A6D. This single shot has a very short ON time. It also has an anti input (TP1). If the anti input is positive approximately 5V, then the anti single shot will fire for every level discriminator pulse and generate a pulse to the output circuitry. However, if the anti input is held low during the time the level discriminator is triggering the anti single shot, then the anti single shot is inhibited from firing. The anti line performs this inhibit enable function.

5.8 WIRED "OR" ANTI CIRCUIT

This circuit is similar to the unit gates in that it is made up of 5 gates (A1A, A1B, A1C, A1D, and A4B) which are held off by 8.2k resistors to -12 volts (R4, R12, R19, R26, and R39). The outputs of these gates are high (approximately +5V). However, all the outputs are tied together in wired "OR" fashion. This means that any one input can be used to anti the coincidence circuit.

5.9 OUTPUT SINGLE SHOT

The output single shot is driven by the anti single shot. It is made up of A6A, A6B, and Q11. The width can be adjusted from 1 to 5 μ sec by means of RV1. The output of the single shot is only approximately 5V so Q12 increases the amplitude to 10 volts.

5.10 OUTPUT BUFFERS

The output buffers are used to drive the OUTPUT BNC's. They are made up to Q13 and Q14 for the front panel BNC and Q15 and Q16 for the rear panel BNC. These buffers exhibit very low output impedances and prevent output loading from effecting the amplitude and risetime of the output pulse.

Section 6
TROUBLESHOOTING

6.1 GENERAL

The purpose of this section is to provide the user with some guidelines for troubleshooting this instrument. It is not intended to be a comprehensive analysis of the circuit, but rather general outline of some quick tests that will aid a qualified technician locate a problem.

6.2 INITIAL CHECK

1. Measure the DC voltage output of the NimBin. The Model 1446 requires ± 12 volts for operation.
2. Inspect the Model 1446 for opens and/or shorts across the power input connectors. Examine all connectors to front and rear panel. Look for shorts or damaged components on the PC board.

6.3 ELECTRICAL CHECK

1. Apply power to the unit and measure the supply currents. They should be:

+12V	-	130mA	$\pm 10\%$
-12V	-	70mA	$\pm 10\%$

A significant increase in current indicates a shorted component. Less current is probably an open connection. Carefully check the decoupling networks L5, C22, C23, and L6, C24, C25.

2. Measure, with the digital voltmeter, the emitter of Q10 (2N2219). It should be:

+5V $\pm 0.5V$

This is the DC supply for all the integrated logic. The circuit consists of R69, R70, Q10, D23, D24, D25, C26 and C27.

3. Measure, with the digital voltmeter, Pin 6 of A5. It should be:

-6V $\pm 0.6V$

This voltage is provided to the computer by R68, D22, D24, C20, and C21.

4. Connect a pulse generator to all inputs as in Section 4.

5. Set all input switches to OUT. Rotate the COINC EVENTS REQD switch through all positions and measure, with the digital voltmeter, the voltage at TP4 for each switch position. The voltage at TP4 for each position should be:

COINC EVENTS REQD switch position	=	TP4 Volts
1	=	-4.62V \pm .323V
2	=	-3.63V \pm .323V
3	=	-2.64V \pm .323V
4	=	-1.66V \pm .323V
5	=	-.67V \pm .323V

If these voltages are in error, check voltage divider R60 through R65.

- Set the COINC EVENTS REQD switch to 5. Set the ΔTR pot to $2\mu\text{sec}$ width. Set all input switches to OUT and set the input pulse width and amplitude to $2\mu\text{sec}$ and $+10\text{V}$ peak. Measure, with 'scope, the level at TP2. Then switch input A to COINC and measure the positive peak on TP2. Now, add input B by switching its switch to COINC. This gives two inputs into the Model 1446.

Measure the positive peak on TP2. Then, add a third input and measure the positive peak on TP2; continue until the peak is measured for all 5 inputs. The following table lists the level for zero inputs and the level of the positive peaks on TP2 for various inputs:

No. of Inputs	=	TP2 Volts
0	=	$-5.20\text{V} \pm .35\text{V}$
1	=	$-4.21\text{V} \pm .35\text{V}$
2	=	$-3.22\text{V} \pm .35\text{V}$
3	=	$-2.23\text{V} \pm .35\text{V}$
4	=	$-.25\text{V} \pm .35\text{V}$

Refer to waveform timing diagram 6.

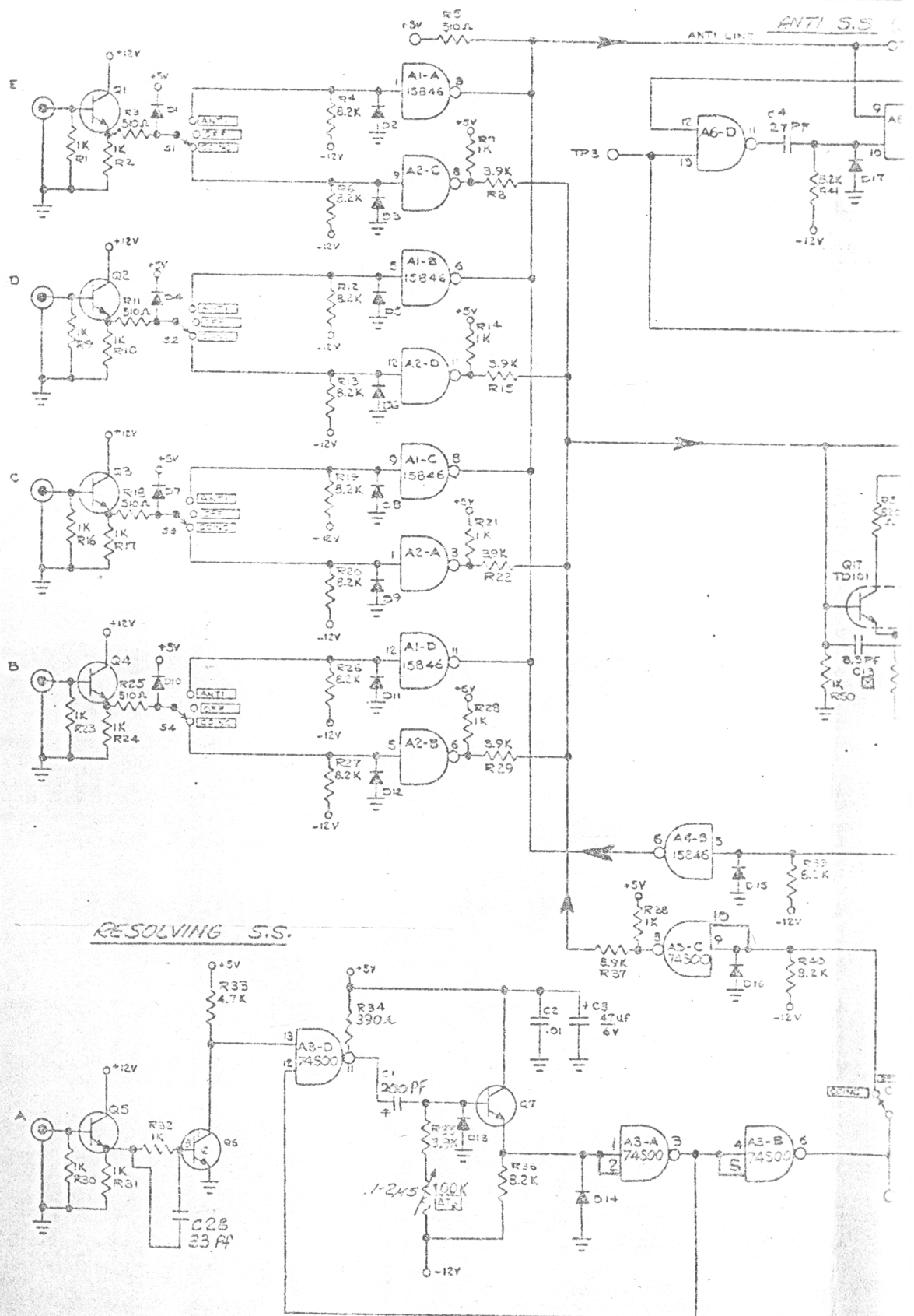
Malfunction here indicates failure of the summing amplifier or the input logic gates.

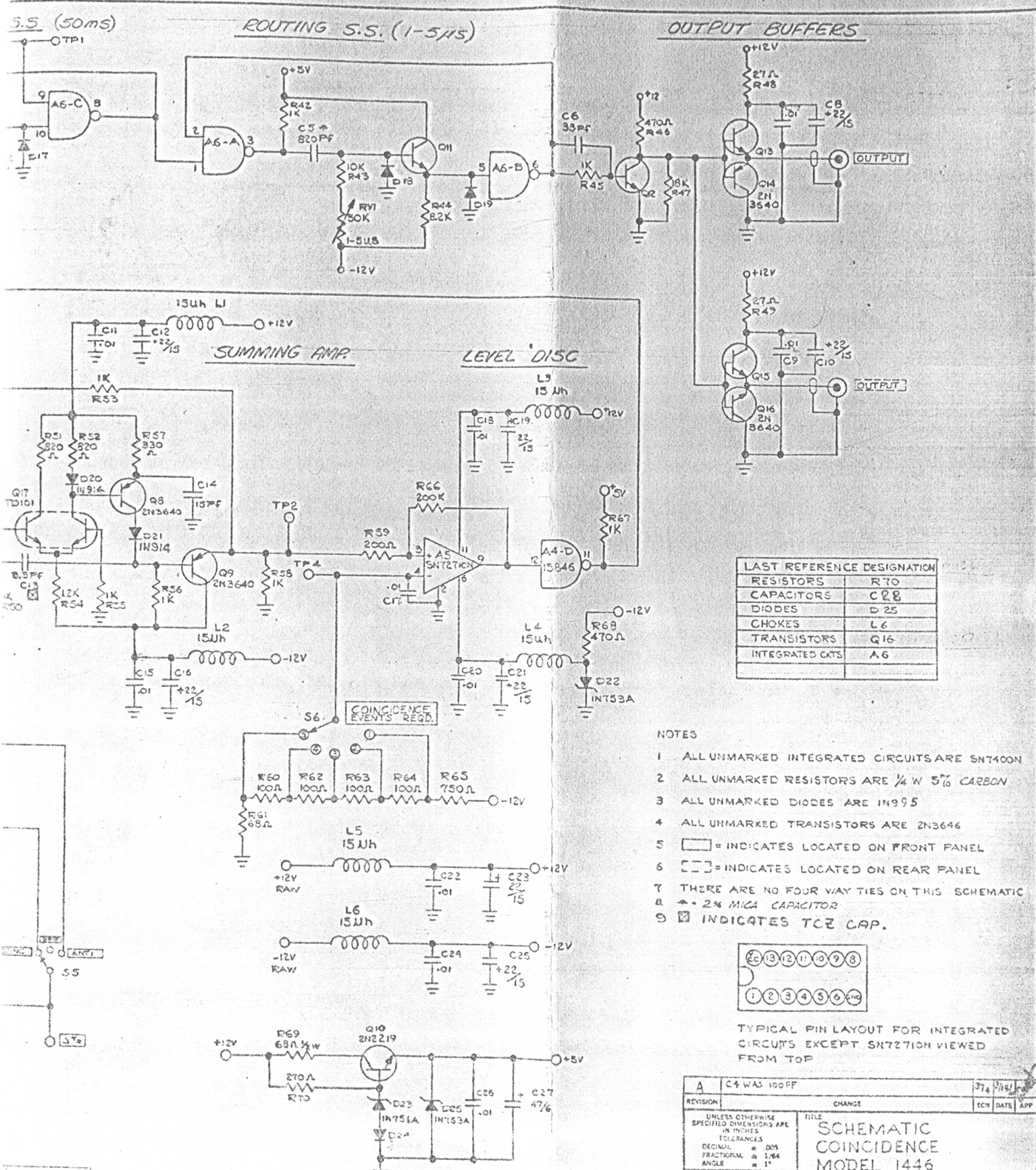
- Connect the 'scope to the front panel ΔTR test point. Adjust ΔTR pot from one extreme to the other. The width of the pulse at ΔTR should be $\leq 100\mu\text{sec}$ at one extreme and $\geq 2\mu\text{sec}$ at the other. The amplitude of the ΔTR pulse should go from $\leq +0.8\text{V}$ in the LOW state to $\geq +2.5\text{V}$ in the HI state. Set the ΔTR width to 100nsec . The ΔTR pulse is generated by the A input logic and single shot A3D, Q7, and A3A.
- Look, with the 'scope, at the front panel output BNC and terminate this output in 93 ohms. This output should have an amplitude $10\text{V} \pm 1\text{V}$ with a rise and fall time of less than 25nsec . Turn RV1 from one extreme to another and note that the output pulse width will vary from a minimum of $\leq 1\mu\text{sec}$ to a maximum of $\geq 5\mu\text{sec}$. Then, set the pulse width to $2.0\mu\text{sec}$. This signal is generated by the output Single Shot A6A, Q11, A6B, and Q12. Output drivers for the front panel are Q13 and Q14; for the rear panels, Q15 and Q16.
- Repeat the above for the rear panel output BNC, except for varying RV1.

6.4 RETURN INSTRUCTION

In the event that you are unable to troubleshoot this instrument, you may contact the factory for technical advice or you may wish to return the instrument. Please read our warranty policy before shipping the instrument. Be sure to include a detailed description of the problem. This will help us diagnose the failure and repair the instrument quickly. For information, contact -

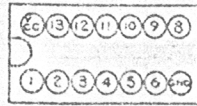
Customer Service Manager
 Canberra Industries, Inc.
 45 Gracey Avenue
 Meriden, Connecticut 06450
 (203) 238-2351





LAST REFERENCE DESIGNATION	
RESISTORS	R10
CAPACITORS	C28
DIODES	D25
CHOKES	L6
TRANSISTORS	Q16
INTEGRATED CTS	A6

- NOTES
- 1 ALL UNMARKED INTEGRATED CIRCUITS ARE SN7400N
 - 2 ALL UNMARKED RESISTORS ARE 1/4 W 5% CARBON
 - 3 ALL UNMARKED DIODES ARE 1N914
 - 4 ALL UNMARKED TRANSISTORS ARE 2N3640
 - 5 [] = INDICATES LOCATED ON FRONT PANEL
 - 6 [] = INDICATES LOCATED ON REAR PANEL
 - 7 THERE ARE NO FOUR WAY TIES ON THIS SCHEMATIC
 - 8 * = 2% MICA CAPACITOR
 - 9 [] INDICATES TCZ CAP.



TYPICAL PIN LAYOUT FOR INTEGRATED CIRCUITS EXCEPT SN7271ON VIEWED FROM TOP

REVISION	A	C4 WAS 100FF	374	1/14/78
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		TITLE		
TOLERANCES		SCHEMATIC		
DECIMAL = .005		COINCIDENCE		
FRACTIONAL = 1/64		MODEL 1446		
ANGLE = 1°		SCALE		
INVENTORY NO.		CANNBERRA IND.		
MATERIAL		50 SILVER ST.		
APPROVAL		MIDDLETOWN, CONN.		
DATE		2-11650 F		

17-25-78	ISOLATED R52	4	10	R34 WAS 510Ω	
12-5-77	FROM R53	9	10	R35 W 3.6K	
10/26/77	JUNCTION	3	69	81 2N007	
				10K AT 12V FOR	