

SUM-INVERT AMPLIFIER

Model 1465A

NSCL-4510-170110

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WARRANTY

canberra nuclear instruments

This equipment is warranted by Canberra to be free from 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 this instruction manual. Repairs or replacement, at Canberra's option, will be made without charge at the Canberra plant during this warranty period. Except for the case of 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.

Canberra reserves the right to modify its products without incurring the responsibility for modifying previously manufactured products.

Canberra does not assume any liability for the results of particular installations, as these circumstances are not in our control.

SHIPPING DAMAGE

Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, notify Canberra and the carrier making delivery immediately, 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 damage claims.

REPAIRS

Any Canberra instrument no longer in its warranty period may be returned, freight prepaid, to our factory for repair and realignment. All such work will be done at the least possible expense to the customer. All equipment thus repaired or realigned will pass through our normal preshipment checkout procedure and will meet or surpass its original specifications when returned. Return shipping expense will, in this case, also be charged to the customer.



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MODEL 1465 SUMMING AMPLIFIER

1.0 GENERAL

1.1 Description

The Model 1465 Summing Amplifier provides a linear output signal proportional to the algebraic sum of up to four linear unipolar or bipolar input signals, typically from linear amplifiers such as the Canberra Model 1410. The Model 1465 also serves to mix up to four inputs for presentation to a single input such as on a multichannel analyzer.

Two simultaneous outputs are provided: one prompt, and one delayed by three microseconds for delivery to a multichannel analyzer after energy and timing analysis has been completed.

A gain control on the front panel permits selecting any gain factor from 0.1 to 1.1, to ensure that the output sum signal will remain below the 10 volt output limitation, regardless of the actual input sum.

By front panel switch, either normal or inverted outputs may be selected. Each output is driven by an emitter follower output with an output impedance of less than 1 ohm.

1.2 Applications

The Model 1465 has several applications in nuclear spectroscopy systems. As a summing amplifier, it may be used to yield sum spectra from up to four independent detectors. The resulting sum spectrum would be stored in a single multichannel analyzer, giving the combined spectral peaks detected by all of the system detectors.

As a linear delay amplifier, the Model 1465 will provide a nominal three microsecond analog storage of signals, preserving desired signals for energy analysis while time and/or energy coincidence determinations are made.

As a mixer, the Model 1465 provides a means of storing the pulses from two to four detectors in different portions of multichannel analyzer, when routing or gating is performed by associated discriminators. In this mode, the Model 1465 serves as a "fan-in", to permit entering several signals into a single multichannel analyzer input.

As an inverter, the Model 1465 provides a means of obtaining negative linear signals when positive are available, or vice versa, without degrading the energy information contained in the input signals.

2.0 SPECIFICATIONS

2.1 Performance

- Integral Nonlinearity: less than 0.15%
- Output Stability: better than 0.01%/°C
- Noise: less than 5 millivolts RMS added to the input signals
- Signal Delay: less than 60 nanoseconds through unit

2.2 Controls, Inputs, Outputs

2.2.1 Gain: 0.1 to 1.1 times linear sum of input signals, front panel ten-turn control

Output Mode: normal or inverted with respect to inputs, front panel switch selected

2.2.2 Inputs: Four 0 to ± 10 volt bipolar or unipolar; input impedance 1000 ohms each

2.2.3 Output Prompt: 0 to ± 10 volt algebraic sum of inputs, unipolar or bipolar; output impedance less than 1 ohm

Output Delayed: same as Prompt, delayed by three microseconds

3.0 INITIAL OPERATION

3.1 Setup

- Insert module in AEC compatible base unit/power supply such as Canberra Model 1400; turn on power switch
- Connect output from pulse shaping amplifier such as Canberra Model 1410 to input connector A of module; using a "tee" connector simultaneously observe amplifier output on oscilloscope (1v/cm, 1usec/cm), or observe output on multichannel analyzer
- Set output switch on Model 1465 to NORMAL
- Connect Prompt Output of Model 1465 to oscilloscope

3.2 Initial Checkout

- Rotate GAIN control until the output signal from Model 1465 is identical to the input signal. The gain reading should be 1.0 when the input and output signals are equal
- Upon increasing and decreasing the setting of the GAIN control, the output signal should be changed in proportion to the setting
- Set the gain back to 1.0
- Switch the output switch into the INVERT position; input signal should now be inverted at the output
- Switch Output back to NORMAL
- Change the Output connection from the Prompt to the Delayed output. The input signal should appear at the output, delayed 3 microseconds with respect to the input. Used in this fashion the module acts as a simple linear delay unit
- Set connector back to Prompt output
- Set the Linear Amplifier output to 2 volts
- Keeping the prompt bipolar output of the amplifier connected to the Channel A input of the 1465, connect the prompt unipolar output of the Linear Amplifier to input Channel B. If using an amplifier without two simultaneous outputs use a "tee" connector from the amplifier for the two inputs, or use two amplifiers to get the two input signals
- Output signal will now be the sum of the two input signals
- Increase the amplifier output to 4 volts; output signal should now be 8 volts or the sum of the two input signals
- Increase the amplifier output to 6 volts; output signal will be saturated at 10 volts
- Reduce the gain setting from 1.0 to 0.5
- Output signal will now be halved or about 6 volts (1/2 of the linear sum of the two 6 volt input signals)

- The output signal is proportional to the sum of the input signals. Further increases or decreases in the two input signals will result in corresponding linear changes in the output signal
- Set gain back to 1.0
- Using two Linear Amplifiers inject a 4 volt positive unipolar signal into Channel A and a 2 volt negative-going unipolar signal into Channel B
- Output signal should now be 2 volts
- Switch output to INVERT; output signal should be inverted to negative 2 volts
- Connect Delayed output to oscilloscope; output signal should appear delayed 3 microseconds with respect to input
- Regardless of whether using the Model 1465 as a mixer (one input at a time) or for summing purposes, the output signal can be inverted or delayed
- Repeat the above steps using Channels B, C and D in any combination. Up to 4 input signals can be summed or mixed at one time in the Model 1465

4.0 MODULE OPERATION

4.1 Control Functions

- Gain Potentiometer: a ten-turn potentiometer used primarily to ensure that the output sum signal remains below the 10 volt output limitation. The output (the algebraic sum of the input signals) signal is attenuated linearly by the gain setting in a proportional relationship
- Output Switch: normal, output signal is the linear sum of the input signals; inverted, output signal is the inverted sum of the input signals

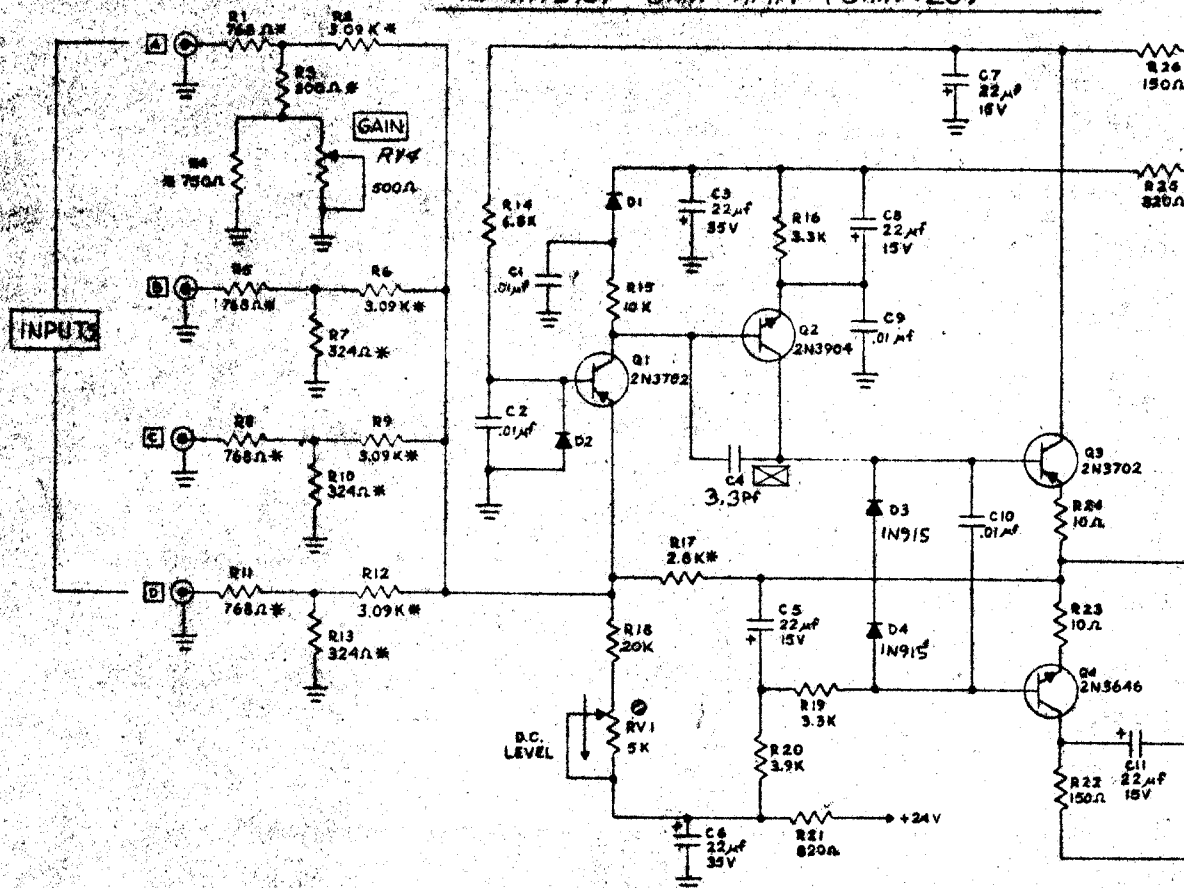
4.2 Input Requirements

- Signal: up to four 0 to ± 10 volt bipolar or unipolar signals; input impedance 1000 ohms each, from associated amplifiers, RC or delay line shaped; BNC connectors

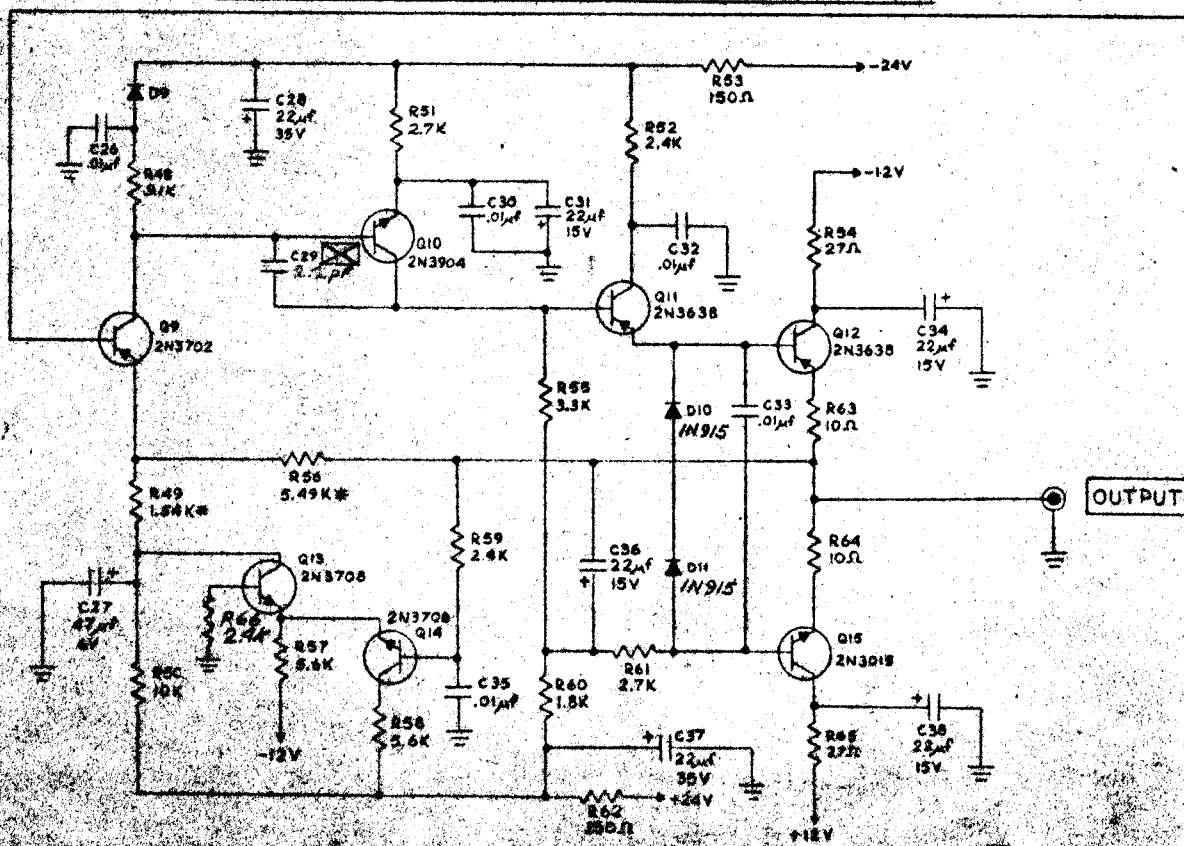
4.3 Output Specifications

- Prompt: 0 to ± 10 volt algebraic sum of inputs, unipolar or bipolar; output impedance less than 1 ohm; rise time typically less than 25 nanoseconds or equal to input rise time
- Delayed: same as Prompt, delayed by three microseconds; rise time typically 700 nanoseconds or equal to input rise time

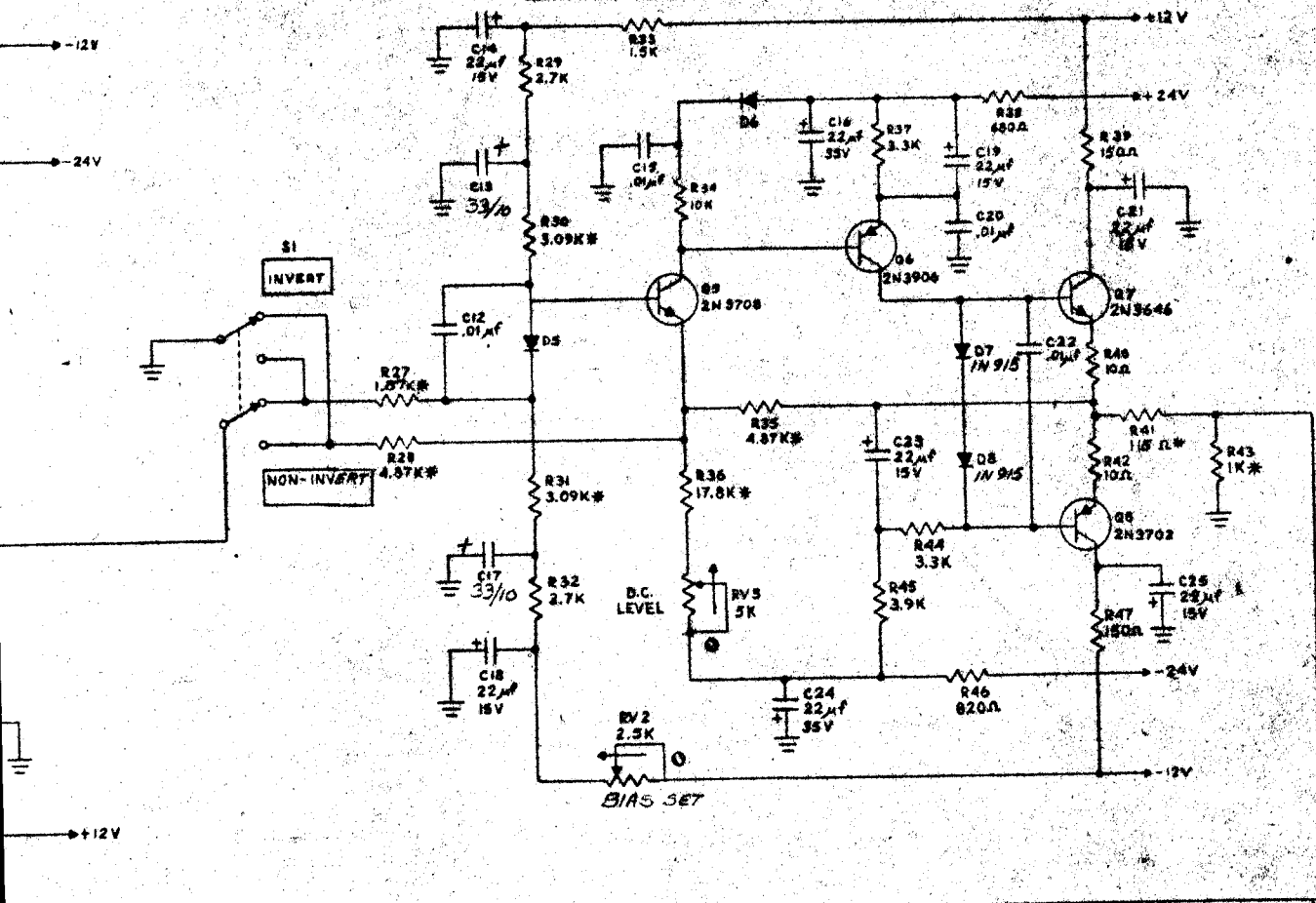
K1 INVERT GAIN AMP. (GAIN -25)



K3 NON-INVERT AMP (GAIN 4)



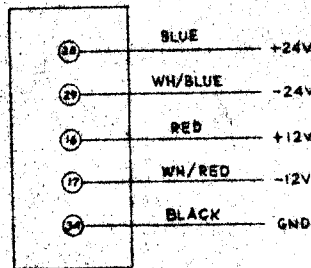
K2 INVERT/NON-INVERT AMP. (GAIN 2)



NOTES:

1. ALL UNMARKED RESISTORS 1/4W, 5% CARBON
2. ALL UNMARKED DIODES 1N914
3. * = RN 60C.
4. = FRONT PANEL CONTROL
5. = TCZ CAP.

LAST REFERENCE DESIGNATIONS	
RESISTORS	R 5 G
VARIABLE RESISTORS	RV G
CAPACITORS	C 38
TRANSISTORS	Q 7 5
DIODES	D 1 1



POWER CONNECTOR

A	C4, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88, C89, C90, C91, C92, C93, C94, C95, C96, C97, C98, C99, C100	D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, D43, D44, D45, D46, D47, D48, D49, D50, D51, D52, D53, D54, D55, D56, D57, D58, D59, D60, D61, D62, D63, D64, D65, D66, D67, D68, D69, D70, D71, D72, D73, D74, D75, D76, D77, D78, D79, D80, D81, D82, D83, D84, D85, D86, D87, D88, D89, D90, D91, D92, D93, D94, D95, D96, D97, D98, D99, D100
REVISION	CHANGE	DATE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES	TITLE	SCHEMATIC
DECIMAL ± .005		SUM-INVERT
FRACTIONAL ± .010		MODEL 1454A
ANGLE ± .5°	APPROVED	CANBERRA INC.
	DATE	BY SERVICE ENGINEER
		INSPECTION DATE
		8-11-57