



NUCLEAR DATA, INC.  
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IM86-5021-00  
INSTRUCTION MANUAL  
ND509 PREAMPLIFIER,  
AMPLIFIER, DISCRIMINATOR

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## WARRANTY

Nuclear Data warrants its products to be free from defects in workmanship and materials for a period of twelve months from date of shipment, provided that the products have been used in a manner consistent with good practice, and not subjected to abuse, modification or alteration. Repair or replacement will be made at Nuclear Data's option without charge. Shipping expense to Nuclear Data will be borne by the customer; Nuclear Data will absorb charges on return shipment.

All peripheral equipment associated with Nuclear Data products and not manufactured by Nuclear Data is subject only to the warranty stated by the supplying manufacturer.

Nuclear Data reserves the right to modify or alter the design of its products at its option without incurring responsibility for modification of previously manufactured products.

Nuclear Data does not assume any risk or liabilities for any handling or conditions beyond our control.

## DAMAGE IN TRANSIT

Shipments should be examined immediately upon receipt. If evidence of damage is found, the carrier making delivery should be notified at once and a report of the damage made; since the carrier is normally liable for damage in shipment. Waybills and other documentation, including packing materials, should be preserved to aid in establishing claims. Nuclear Data should also be notified of the circumstances so that we may assist in establishing the claim and in providing, if necessary, replacement equipment.

## QUALITY CONTROL

Each Nuclear Data instrument is required to pass a severe and rigid series of quality tests prior to approval for shipment. These tests are designed to expose any flaws in materials or workmanship. Permanent records of these tests are filed in our Customer Service Department for use in warranty control and as a source of statistical information.

## SERVICE

Nuclear Data instruments not in warranty may be returned to the factory for repairs or checkout at modest expense to the customer. Out-of-warranty instruments serviced at our factory are required to pass the same quality control standards as those used for new production instruments. We request that you contact our Customer Service Department for instructions prior to shipping any equipment.

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## GENERAL DESCRIPTION |

Nuclear Data's ND509 contains a charge sensitive preamplifier, a gain of 400 linear amplifier and an integral discriminator. The gain and pulse shaping time constants have been optimized for scintillation counting. The ND509 is ideally suited for applications ranging from simple scintillation counting systems to multiple detector multiplex systems where routing is required.

The preamplifier-amplifier section accepts the negative charge output of scintillation detectors and provides a positive RC clipped (1  $\mu$ sec) output voltage pulse. Output pulse shape and gain are independent of detector capacitance and interconnecting cable length.

The discriminator provides a +6V, 500 nsec wide pulse for all amplifier output signals which exceed its threshold. A single turn front panel potentiometer varies discriminator threshold over a 100 mV to 10V dynamic range.

## TECHNICAL SPECIFICATIONS |

Input: Front panel BNC (UG 1094 A/U) accepts negative charge signals from scintillation and gas proportional counters.

### Outputs:

AMP OUT - Front panel BNC (UG 1094 A/U) provides positive monopolar output, ac coupled, from 50 ohms impedance. Dynamic range is +12 V saturated, +10 V linear. |

DISC OUT - Front panel BNC (UG 1094 A/U) provides a +6 V, 500 nsec wide pulse for all amplifier output pulses that exceed the desired threshold. Impedance is 50 ohms and is dc coupled ground referenced.

### Controls:

Coarse Gain - Front panel switch 32:1 range in 2:1 steps.

Fine Gain - Front panel single turn potentiometer provides 2:1 range.

Threshold - Front panel single turn potentiometer selects from 100 mV to 10V sensitivity.

Charge Gain: 12 V/picocoulomb. |

Gain Stability: 0.015%/°C. |

Rise Time: 150 nsec.

Pulse Shaping: 1.0  $\mu$ sec single RC clipped.

Integral Linearity: 0.1% to +10 V.

Threshold Stability: 0.1%/°C.

Power Requirements: +24 Vdc @ 20 mA. -24 Vdc @ 20 mA. +12 Vdc @ 60 mA. -12 Vdc @ 60 mA.

Dimensions: 8.71 in. h. x 1.34 in. w. x 9.7 in. d. (NIM compatible single width module).

Weight: 5 lbs.

Part Number: 86-5021. 18-in. Signal Cable (BNC to BNC) - 86-5081.

## INSTALLATION AND OPERATION

### General Considerations

The ND509 when used in conjunction with the ND152 Instrument Bin and Power Supply is intended for rack mounting so care must be taken to prevent localized heating of components. If vacuum tube equipment is employed in the same rack it is necessary to insure that air circulation provides sufficient cooling. The temperature of rack mounted equipment can easily exceed the recommended maximum unless precautions are taken. The ND509 should not be subjected to temperatures in excess of 50°C.

### Connection to Power

The ND509 containing no internal power supply must obtain power from a standard NIM bin and power supply such as the ND152. It is recommended that the bin power supply be turned off when inserting or removing modules. Nuclear Data modules have been designed so that it is not possible to overload the bin's power supply with a full complement of modules (excluding high voltage supplies) in the bin, however, this may not be true if the bin contains modules of other than Nuclear Data design. The ND152 Instrument Bin and Power Supply has test points on the front panel to monitor dc voltages.

When using the ND509 outside the bin and power supply, be sure that the jumper cable employed properly accounts for the power supply grounding circuits provided in accordance with the AEC standard TID-20893. A power return ground connection is provided to insure proper reference voltage feedback into the power supply, and must be preserved in remote cable installations. Care must also be exercised to avoid ground loops when the module is not physically in the bin.

## FUNCTIONAL DESCRIPTION

In this section of the manual the circuit operation of each functional section of the PAD will be discussed. Reference to the instruments' schematic is necessary at this time.

### Preamplifier

The charge sensitive preamplifier section consists of transistors T1 and T2 and associated components. T1 and T2 form an inverting feedback pair in which the feedback element is a capacitance (C5). The input to T1 appears as a virtual ground, such that all the input current charges C5 the feedback capacitor. The output voltage pulse appearing at the emitter of T2 has a magnitude equal to input charge (Q) divided by feedback capacitance (33 pf), or 30 mV/picocoulomb. The output of T2 drives the main amplifier through the coarse gain attenuator switch S1. The output pulse shape of the preamplifier is a positive tail pulse with 1  $\mu$ sec tail time constant. The time constant is set by R3 and C5.

### Amplifier

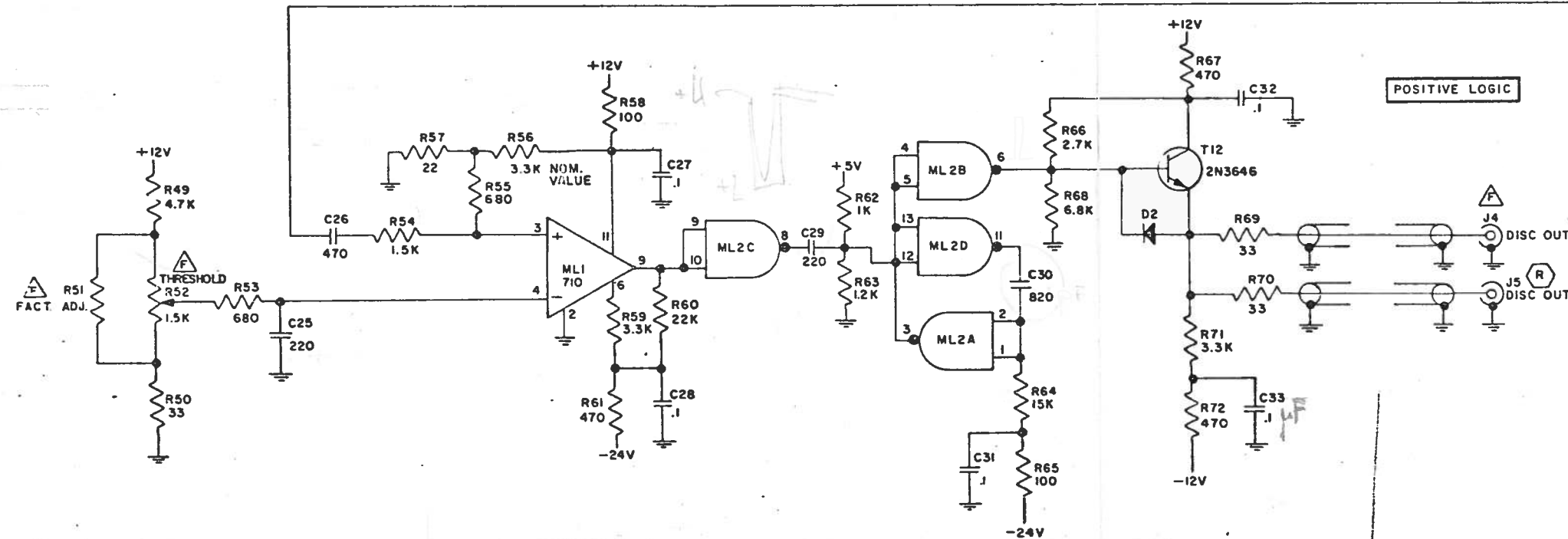
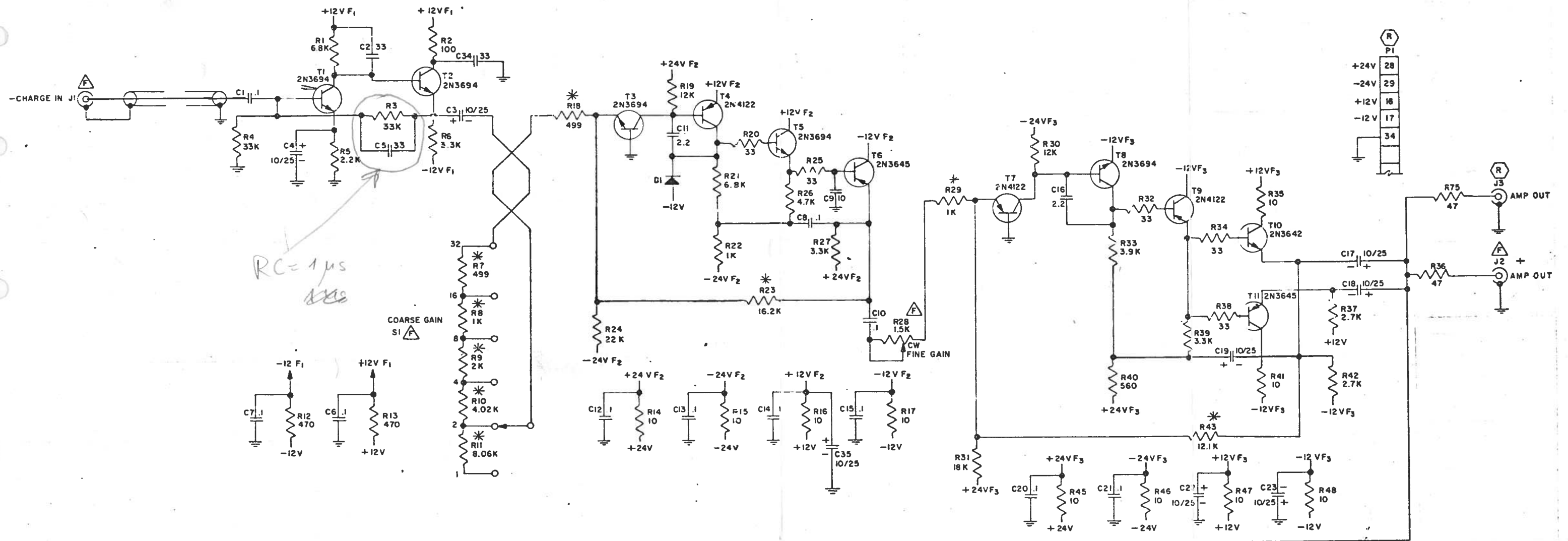
The amplifier portion of the ND509 consists of two functional groups. The first, a four transistor negative feedback loop, provides gain selection via S1 in binary steps spanning the range from 1 to 32. Cascaded emitter followers T4-T6 buffer the inverting gain stage T4 and provide low output impedance. The second amplifier section differs from the first in that the output includes complimentary emitter followers for greater-line driving capability. The gain of the second feedback group is controlled by the fine gain control, spanning the range from approximately 5 to 12. The output of this group drives front and rear panel BNC connectors as well as the internal discriminator. The amplifier section provides no additional pulse shaping such that the output is a positive 1  $\mu$ sec tail pulse.

### Discriminator

The discriminator section of the ND509 is short time constant coupled to the main amplifier section via C26. The time constant is approximately 1  $\mu$ sec. This short time constant coupling eliminates base line shift at the discriminator.

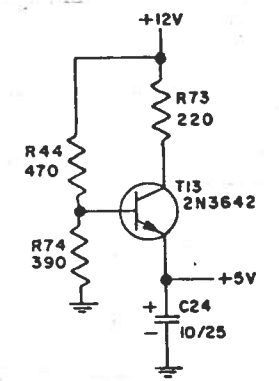
Amplitude discrimination is performed by ML1, an integrated circuit comparator, which compares the pulse presented to its input with the threshold voltage as set by the front panel threshold control. All signals which exceed threshold appear as a positive output at Pin 9 of ML1 and are further amplified by NAND Gate ML2C. A second differentiator (100 nsec) couples this signal to the shaping mono ML2 A & D. The monostable period is set by C30 and the current source comprised of R64 and R65 to approximately 1  $\mu$ sec. This rectangular pulse inverted by ML2B and buffered by T12, appears at the front and rear panel discriminator outputs as a positive 6 V, 1  $\mu$ sec pulse. Operating voltage for the integrated circuits in the discriminator is provided by T13 and its associated voltage divider. T13 provides the 5 V power necessary for their operation.





POSITIVE LOGIC

UNLESS OTHERWISE NOTED:  
 RESISTORS 1/4 W 5%  
 CAPACITORS, VALUES LESS THAN 1.0 IN MICROFARADS,  
 VALUES GREATER THAN 1.0 IN PICOFARADS.  
 POLARIZED CAPACITORS IN MICROFARADS.  
 \* INDICATES 1% METAL FILM RESISTOR.  
 DIODES IN914.  
 ML2 IS SN740CN, +5V PIN 14, GND PIN 7.  
 △ INDICATES FRONT PANEL LOCATION.  
 ○ INDICATES REAR PANEL LOCATION.  
 LAST NO USED: R75, C35, D2, T13, J5, ML2, SI, P1.  
 ML2C-3  
 ———— PI1 NO.  
 ———— ELEMENT NO.  
 ———— INTEGRATED CKT.



ND509 Schematic Diagram.



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