INSTRUCTION MANUAL
109A
PREAMPLIFIER

Serial No. ______________________________

Purchaser ______________________________

Date Issued ______________________________

ORTEC
AN EG&G COMPANY
100 MIDLAND ROAD
OAK RIDGE, TENN. 37830
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TWX —— 810-572-1078

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A NEW STANDARD TWO-YEAR WARRANTY FOR ORTEC ELECTRONIC INSTRUMENTS

ORTEC warrants its nuclear instrument products to be free from defects in workmanship and materials, other than vacuum tubes and semiconductors, for a period of twenty-four 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 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, as 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 other than specified in the instructions, or 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

ORTEC instruments not in warranty may be returned to the factory for repairs or checkout at modest expense to the customer. Standard procedure requires that returned instruments pass the same quality control tests as those used for new production instruments. Please contact the factory for instructions before shipping equipment.

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 109A PREAMPLIFIER
DET. INPUT
TEST PULSE
×1
×10
DET. BIAS
POWER
OUTPUT
ORTEC®
SER. NO.

NOTICE **SPECIAL**

This preamplifier has been shipped to you with its protection circuit connected into the circuit. The protection circuit makes it almost impossible to destroy the input FET under normal operating conditions and imposes an almost negligible resolution degradation. The preamplifier is thus immune to almost anything the operator is likely to do in the way of causing transients either at the Detector Input connector or at the Bias Input connector.

The protection circuit does not protect the detector, but even if the detector breaks down as a result of overvoltage, the preamplifier will survive the resulting large transients if the protection circuit is "in". This, of course, is not true if the protection circuit is "out", in which case the input FET is very susceptible to destruction by transients at the detector input connector.

109A TYPICAL RESOLUTION (keV fwhm)

Ext. Cap. pF.	Protection "out"		Protection "in"		T_{Rise} (10%–90%)	
	keV (Si)	keV (Ge)	keV (Si)	keV (Ge)	Protection "in"	Protection "out"
0	2.85	2.29	2.86	2.3	15 nsec	15 nsec
50	3.72	2.99	4.00	3.22	25 nsec	25 nsec
1000	30.4	24.4	39.5	31.7	250 nsec	250 nsec
Slope	0.0275 keV/pF	0.022 keV/pF	0.037 keV/pF	0.0294 keV/pF		

[illegible]

If this slight degradation cannot be tolerated, then the protection circuit can be removed by simply moving the plug-in jumper from in to out. The jumper is located on the printed board next to Q1.

Warranty is voided without the protection circuitry unless the following precautions are taken.

1. DO NOT connect a detector, cable, capacitor, or other capacitive device or low impedance to the DET. INPUT connector, shown in the Front View on page ii of this manual, unless the detector bias circuitry is COMPLETELY DISCHARGED. (Refer to explanation below).

2. Discharge the detector bias circuitry before making ANY connections to the DET. INPUT connector.

To discharge the detector bias circuitry requires that a low impedance (short circuit preferably) be connected across the DET. BIAS connector, shown in the Rear View on page ii, for at least 20 SECONDS.

The input transistor will be destroyed if the DET. INPUT connector is shorted, i.e., by connecting a detector, cable, capacitor, or other capacitive device such as a voltmeter probe, etc., while the detector bias components are charged. A short circuit, short-term or continuous, will cause the applied bias voltage (stored on C3) to be coupled via C3 directly to the input transistor, causing catastrophic breakdown. If this happens, the only recourse is to replace Q1 and perhaps Q2 also, depending on the failure mode of Q1.

If a variable bias supply is used, merely turning down the voltage control to zero and leaving it for at least 20 SECONDS will suffice, since the bias circuitry can discharge itself through the output impedance of the bias supply.

Sometimes it is necessary to simply disconnect the bias supply, such as when using batteries for bias. This situation leaves no discharge path, so a path must be provided by placing a short circuit or low impedance across the DET. BIAS connector on the rear panel of the unit.

DO NOT SHORT the DET. INPUT connector on the front panel.

ORTEC 109A PREAMPLIFIER

1. DESCRIPTION (See Block Diagram)

The 109A is an all-transistor preamplifier with pole-zero cancellation using a field-effect transistor in the input stage. The circuitry includes a charge-sensitive input loop, an amplifier stage with switch-selectable gain with a 10:1 ratio, and a cable driver stage. The preamplifier is inherently an inverting preamplifier; i.e., a negative input pulse yields a positive output pulse. No pulse shaping is accomplished in the preamp, except for a pole-zero cancelled 50-microsecond differentiation time constant immediately after the charge-sensitive loop, for the purpose of reduction of pulse pile-up at high count rate. System pulse shaping for optimization of signal-to-noise ratio will be accomplished in the subsequent main amplifier.

2. SPECIFICATIONS

Basis of Warranty: ≤0.025 keV/pF fwhm (Ge) slope, 2.5 keV fwhm (Ge) maximum at 0 pF input capacity. Typical performance is given below:

TYPICAL PERFORMANCE

Input cap. (pF)	Noise, with 2-μsec Single RC Main Amp			Preamp output pulse	
	keV (fwhm,Si)	keV (fwhm,Ge)	rms electrons	Relative amplitude	Rise time (nsec) 10%–90%
0	2.85	2.29	336	1.000	15
20	3.2	2.6	377	1.000	19
50	3.72	2.99	440	1.000	25
100	5.1	4.1	601	0.996	40
200	7.9	6.4	931	0.993	68
500	16.2	13.0	1910	0.982	175
1000	30.4	24.4	3580	0.963	250

OUTPUT PULSE SHAPE: Rise time as in table above; exponential fall with 50-μsec time constant

INTEGRAL NONLINEARITY: ≤0.1% for 0-5V output span with internal series termination.

TEMPERATURE COEFFICIENT: ±0.01% per °C

DETECTOR BIAS ISOLATION: 1000V dc

INPUT OPEN LOOP GAIN: >20,000

POWER REQUIRED: +24V dc at 36 mA, -24V dc at 36 mA; supplied from ORTEC main amplifier or from an ORTEC 115 Preamplifier Power Supply

CABLE REQUIRED: 10-foot compatible cable supplied with preamplifier, type 121-C1

POWER CONNECTOR: Amphenol 17-20090

SATURATED OUTPUT AMPLITUDE: 7V at end of several hundred feet of unterminated 93-ohm cable

OUTPUT SOURCE IMPEDANCE: Adjustable from 50 to 150 ohms

CHARGE SENSITIVITY: 150 mV/MeV (Si), 183 mV/MeV (Ge) in X10 gain position
15 mV/MeV (Si), 18.3 mV/MeV (Ge) in X1 gain position

DETECTOR, OUTPUT, AND TEST PULSE CONNECTORS: BNC

DETECTOR BIAS CONNECTOR: MHV

SIZE: 1.8 x 4 x 6 inches (4.5 x 10.2 x 15.3 cm)

WEIGHT: Net, 1.5 pounds (0.7 kg); gross, 2.3 pounds (1.1 kg)

TABLE OF COUNT RATE VS. ENERGY

Input Energy (Silicon Equivalent)	Count Rate with 1% Counting Losses (cts/sec)
100 keV	2×10^9
1 MeV	2×10^7
10 MeV	2×10^5

From the above table, it is obvious that in almost all cases,the count rate is limited by the shaping amplifier.

3. INSTALLATION INSTRUCTIONS

3.1 Connection to Detector

A direct connection with shielded coaxial cable should be made between the detector and the BNC connector labeled DETECTOR on the front panel.

The performance of the 109A Preamplifier, like that of all other such low-noise nuclear amplifiers, is degraded as the capacity at the input of the amplifier increases; for this reason, it is important that the length of coaxial cable used between the amplifier and the detector be kept at the minimum necessary. Also, it is preferable to use 93- or 100-ohm impedance cable rather than 75- or 50-ohm cable, since the capacity per foot is less for the higher-impedance cable. Type RG-62/U cable has 93-ohm impedance and a 13.5 pF per foot capacity; therefore, it is recommended. Type UG-260/U connectors fit both this cable and the BNC input connector. It is also suitable to use Microdot cables and fittings of the series stocked and supplied by ORTEC. The cable is of 100-ohm impedance, 13 pF per foot. An adapter, ORTEC No. C-17, may be used on the input BNC connector to permit use of the Microdot cables. See ORTEC Electronic Instrumentation Price List for a complete listing of compatible Microdot cables, connectors, and adapters.

Once the input cable installation has been made, the electronic noise performance of the preamp can be predicted by calculating the cable capacity from the above information, adding the capacity expected from the detector, and referring to the table of typical performance versus input capacity (section 2).

3.2 Connection to a Shaping Main Amplifier

The preamp can be used to drive long 93-ohm line to a shaping main amplifier and is designed to be directly compatible with the ORTEC transistor main amplifiers. It can be used with any shaping main amplifier if a power supply is used to power the preamp.

3.3 Input Power

Power for the preamp is supplied through the Amphenol connector (17-20090) on the rear of the chassis. Power may be supplied by a single 45-volt battery with a tap at 22.5 volts (the tap is used as ground, providing +22.5V and -22.5V; current drain is 36 mA), or any well filtered ±24V power supply such as the ORTEC 115 Preamplifier Power Supply.

If the preamp is used with ORTEC transistor main amplifiers, power for the preamplifier will automatically be supplied to the preamplifier from the main amplifier via the interconnecting cable supplied with the preamp.

3.4 Test Pulse

A voltage test pulse can be inserted at the TEST PULSE connector on the rear of the preamp without the use of an external charge terminator, since the preamp has a built-in charge terminator. The shape of this voltage pulse must have a fast rise (less than 10^{-8} seconds) followed by a slow exponential decay back to the baseline (2 to 4 x 10^{-4} seconds). The input amplitude can be set to any desired level with the knowledge that 46 mV amplitude at the TEST PULSE connector is equal to approximately 1 MeV energy loss in a silicon detector.

Also, the test pulse can be inserted into the DET. INPUT connector simultaneously with an operating detector by using an external charge terminator, provided the charge terminator will withstand the detector bias voltage.

NOTE: In most experimental situations the optimum signal-to-noise ratio occurs with the preamp gain switch in the X10 position. When this switch is in the X1 position, the signal-to-noise ratio at the preamplifier output is the same as that of the X10 position, but the signal level is only 1/10. At this low signal level, main amplifier noise contribution becomes more significant. The signal-to-noise ratio at the output of the main amplifier can be degraded by the amount of the main amp noise contribution and resolution sometimes suffers.

4. OPERATING INSTRUCTIONS

4.1 Detector Bias

Detector bias is applied to the Preamplifier through the high-voltage MHV connector (UG-931/U).

NOTE: The detector bias components and connectors are rated and tested at 1000 volts. Inside the preamp, the detector bias is applied to the DET. INPUT connector through a decoupling network consisting of R1 (1-megohm), R2 (100-megohm) and C1 (1500 pF) so that the total resistance in series with the detector bias is approximately 100-megohms. This resistance must be taken into account when considering the bias voltage actually applied to a leaky detector. The voltage dropped in this network will be 100 volts for each micro-ampere of detector leakage current. It will be necessary to increase the bias supply output voltage to compensate for this drop.

Example: It is desired to operate a detector at 100 volts bias. Detector leakage at 100 volts = 0.5 microampere. The drop in the bias network = $(100 \times 10^6)\ (0.5 \times 10^{-6}) = 50$ volts. Voltage required at bias supply = 100 + 50 = 150 volts.

PARALLEL BIAS RESISTOR

A 10 megohm resistor is provided, shipped in a plastic bag with the 109A, to be plugged into the two single pin sockets near the 100 megohm resistor (R2) on the printed circuit. Installation of this resistor will reduce the voltage required from the bias supply, but should be used only for very high leakage detectors. When it is installed in parallel with R2, the total series resistance between the Detector Bias connector and the Detector Input connector is reduced to 10 megohms, and the compensation is 10 volts per microampere of detector leakage current. However, this circuit will increase the zero pF noise by approximately 0.5 keV (silicon equivalent), and should not be used unless necessary.

4.2 Linear Output

The output of the preamp is a "step" of voltage of 150 mV/MeV with the gain switch in the X10 position, or 15 mV/MeV in the X1 position (silicon detector equivalents). The dynamic range of the output is 7 volts, either polarity, when the output is "sending-end" terminated. "Receiving-end" termination will result in a 3.5-volt dynamic range, but this may be preferable to sending-end termination. The integral nonlinearity in the preamp is specified at not greater than 0.1 percent over the 0 to 10 MeV range.

5. CIRCUIT DESCRIPTION (See Schematic Diagram 109A-0000-S1)

5.1 Charge-Sensitive Loop

The charge-sensitive loop consists of five transistors acting as an operational amplifier with capacitive feedback. Transistors Q1 and Q2 operate in cascade and drive Q3, Q4, and Q5 in a low impedance driver configuration for low output impedance and fast rise time. The rise time of the charge-sensitive loop output increases as the external input (detector) capacitance is increased.

5.2 Voltage Amplifier

The voltage amplifier is designed for fast rise time so as to faithfully reproduce the pulse from the charge-sensitive loop. In the X10 gain position the gain is 3.4 and in the X1 gain position the gain is 0.34 .

5.2.1 Pole-Zero Cancellation Network

The decay time constant of the output signal from the preamplifier is determined by C12 and the parallel combination of R17, R18, and R42. It is accurately set at 50 microseconds. R42, C12 is a 400 microsecond time constant in the proper configuration to provide a "zero" type frequency response which cancels out the 400 microsecond "pole" generated by the charge-sensitive loop feedback time constant. The purpose of this "Pole-Zero Cancellation" is to obtain a pulse response which has a step rise with a single 50 microsecond decay time constant back to the baseline without appreciable undershoot. This will allow accurate pole-zero cancellation in the shaping amplifier.

5.3 Cable Driver

The cable driver consists of Q8, Q9, Q10, and Q11 operating in a complementary Darlington connection. This circuit gives extremely good linearity and an output impedance of a few ohms. However, 51 ohms is inserted in series with each circuit, so that the minimum output impedance (R35 at 0Ω) is 51 ohms. The maximum output impedance is 150 ohms (R31 at 100Ω), so that cables in the range of 50 to 150 ohms can be series (sending-end) terminated.

6. MAINTENANCE INSTRUCTIONS

6.1 Testing Performance

As ordinarily used in a counting or spectroscopy system, the preamp is one part of a series system involving the source of particles to be analyzed, the detector, the preamp, the main amplifier, and the pulse height analyzer. In situations where proper results are not being obtained and tests for proper performance of the preamp and the other components are indicated, it is important to realize that rapid and logical testing is possible only when the individual components are separated from the series system. In proving the performance of the preamp, this consists of removing it from the system and dealing with it alone, by providing a known electrical input signal and testing for proper output signal with an oscilloscope.

6.1.1 Use a voltage pulse in the TEST PULSE jack, as outlined in section 3.4, or use a pulser with a charge terminator at the DET. INPUT jack.

The polarity of the test pulse signal should be in agreement with the expected signal input polarity from a detector.

6.1.2 If a suitable input signal has been obtained for the preamp as outlined in the preceding section, the performance of the instrument may be checked by observing the pulse waveform at the OUTPUT jack. If an input signal of 460 mV, corresponding to about 10 MeV, has been obtained as described above, one can expect an output pulse amplitude of about 1.5 volts with the gain switch in the X10 position,and 0.15 volt with the gain switch in the X1 position.

6.1.3 The noise contribution of the preamplifier may be verified by two basic methods. In either case, the normal capacity of the detector and associated cables should be replaced by a capacitor of equal value connected to the DET. INPUT jack. This is necessary because the noise contribution of the preamplifier is dependent upon input capacity, as can be seen from the noise specifications given in Section 2. The only meaningful statement of the noise level of the preamplifier is one that relates to the spread caused by the noise in actual spectra. This can be measured and expressed in terms of the full width at half maximum (fwhm) of a mono-energetic signal after passing through the preamplifier and main amplifier system. The noise performance referenced in Section 2 is stated in these terms, and verification methods will be described. If desired, the preamplifier can be tested with no external capacity on the DET. INPUT jack, in which case the noise width should be approximately that shown for zero external capacity. In any case, the input jack and capacitors, when used, should be completely shielded electrically. A wrapping of aluminum foil around the input jack will suffice for testing at zero capacity.

The preamplifier must be tested in conjunction with an associated main amplifier that provides the required pulse shaping. The typical noise performance given in Section 2 is based on main amplifier pulse shaping consisting of equal RC differentiation and integration of 2-microsecond time constant. For comparison to these tabulated values, it is preferable to test the preamplifier under identical pulse shaping conditions. It is also important to ensure that the noise level of the input stage of the associated main amplifier does not contribute materially to the total noise. This is usually no problem provided input attenuators, if any, on the main amplifier are set for minimum attenuation.

If a multichannel pulse height analyzer is used following the main amplifier, testing of the noise performance can be accomplished merely by using a calibrated test pulse generator with charge terminator, as outlined in section 6.1.1. With only the charge terminator connected to the DET. INPUT jack, the spread of the pulser peak thus analyzed will be due only to the electronic noise contribution of the preamplifier and main amplifier. The analyzer can be calibrated in terms of keV per channel by observing two different pulser peaks of known energy, and the fwhm of a peak can be taken directly from the analyzer readout.

It is also possible to determine the noise performance of the preamplifier by the use of a wide-bandwidth rms ac voltmeter such as the Hewlett-Packard 400D, reading the main amplifier output noise level and correlating with the expected pulse amplitude per keV of input signal under the same conditions. Again, a calibrated test pulse generator is required for an accurate measurement.

In this method, the preamplifier and main amplifier are set up as they would be used normally, but with a dummy capacitor (or no capacity) on the DET. INPUT jack, and with the ac voltmeter connected to the amplifier output. The noise voltage indicated by the meter, designated E_{rms}, is read and noted. Then, a test pulse of known energy, E_{in} (in keV), is applied to the input jack, and the amplitude of the resulting output pulse, E_{out}, is measured in volts with an oscilloscope. The noise spread can then be calculated from the formula

$$\text{fwhm (keV, Si det)} = \frac{2.66\ (E_{rms})\ (E_{in})}{E_{out}}$$

where E_{rms} is output noise in volts on the 400D meter, E_{in} is input signal in keV particle energy, E_{out} is output signal in volts corresponding to the above input. If one adjusts the gain of the shaping amplifier so that the output voltage is 2.66 volts, then the meter reading will be directly in keV fwhm except for a scale factor. (The factor 2.66 is the product of two relations: correction from rms to fwhm (2.35), and correction of the 400D meter from sinewave to white noise (1.13).)

The noise performance of the preamplifier, as measured by the above methods, should not differ significantly from that given in the specifications in Section 2.

6.1.4 When testing the preamplifier and detector, if the noise performance of the preamplifier has been verified as outlined in the preceding section, or is otherwise not suspect, a detector may be tested to some extent by duplicating the noise performance tests with the detector connected in place, and with normal operating bias applied. The resulting combined noise measurement, made either with an analyzer or by the voltmeter method, indicates the sum in quadrature of the separate noise sources of the amplifier and the detector. In other words, the total noise is given by $(N_{tot})^2 = (N_{det})^2 + (N_{ampl})^2$.

Each quantity is expressed in keV fwhm. The quantity N_{det} is known as the "noise width" of the detector, and is included as one of the specified parameters of each ORTEC semiconductor detector. By use of the above equation, with a knowledge of the noise of the preamplifier, the noise width of the detector can be determined. The significance of this noise width in evaluating the detector is subject to interpretation, but generally the actual resolution of the detector for protons or electrons will be approximately the same as the noise width; the resolution of the detector for alpha particles will be poorer than the noise width. The most useful application of determining the noise width of a detector is in the occasional monitoring of this quantity to verify that the detector characteristics have not undergone any significant change during use.

6.2 Suggestions for Troubleshooting

In situations where the preamp is suspected of malfunction, it is important to isolate the preamp and test it alone, not in a system involving other units such as a source of particles to be analyzed, the detector, the preamp, a main amplifier, and subsequent scalers and/or analyzers. Such logical isolation and individual testing of components will be the most productive approach.

6.2.1 Charge-Sensitive Loop

The function of the preamp is simple and lends itself to relatively easy scrutiny. The charge-sensitive loop performs a charge-to-voltage conversion on the input signal. It has an output signal that manifests itself as a fast rise (~15 nanoseconds at 0 pF external capacitance) step of voltage whose height is determined by the input charge, followed by a 400-microsecond decay back to the baseline. This signal can be observed at the emitter of Q4 while impressing a signal, as described in Section 3.4. The amplitude of this signal should be 45 mV per MeV equivalent input signal.

6.2.2 Voltage Amplifier

To reduce pulse pileup in the voltage amplifier and subsequent stages, the output signal from Q4 is differentiated with a 50-microsecond time constant by C12. Transistors Q6 and Q7 provide voltage amplification of 0.34 or 3.4 for the X1 or X10 gain switch positions, respectively. Accordingly, the output signal at the S1 wiper arm should be a fast rise with 50-microsecond time constant decay, with amplitude either 0.34 or 3.4 times greater than that at the Q4 emitter.

6.2.3 Cable Driver

The cable driver, consisting of Q8 through Q11, is simply an impedance converter, and the output signal should look exactly like the input signal. No gain is obtained in the cable driver.

6.2.4 Table of DC Voltages

The following table of voltages will help to locate defective components. Exercise extreme caution in making these measurements, because a probe shorting two points on the printed board can cause great damage.

Table 1. DC Voltage Measurements

Location		Actual DC Voltages
Jct. R15 & C9		+23.5
Jct. R28 & C16		+23.6
Jct. R29 & C15		-23.6
Jct. R16 & C11		-23.5
Q1 S		- 5.5
G		Do Not Measure
D		- 0.6
Q2 E		- 0.6
B		0
C		+ 10.1

Location			Actual DC Voltages
Q3	E		+12.2
	B		+10.1
	C		+16.9
Q4	E		+11.6
	B		+ 9.9
	C		+23.5
Q5	E		- 14.9
	B		- 14.2
	C		- 7.3
Q6	E		+ 1.3
	B		+ 1.9
	C		+10.7
Q7	E		+11.3
	B		+10.7
	C		- 0.1
Q8	E		+10.7
	B		+11.3
	C		+24.0
Q9	E		+10.1
	B		+10.7
	C		+24.0
Q10	E		- 10.6
	B		- 11.2
	C		- 24.0
Q11	E		- 9.9
	B		- 10.6
	C		- 24.0

Note: All voltages measured with vtvm from ground.

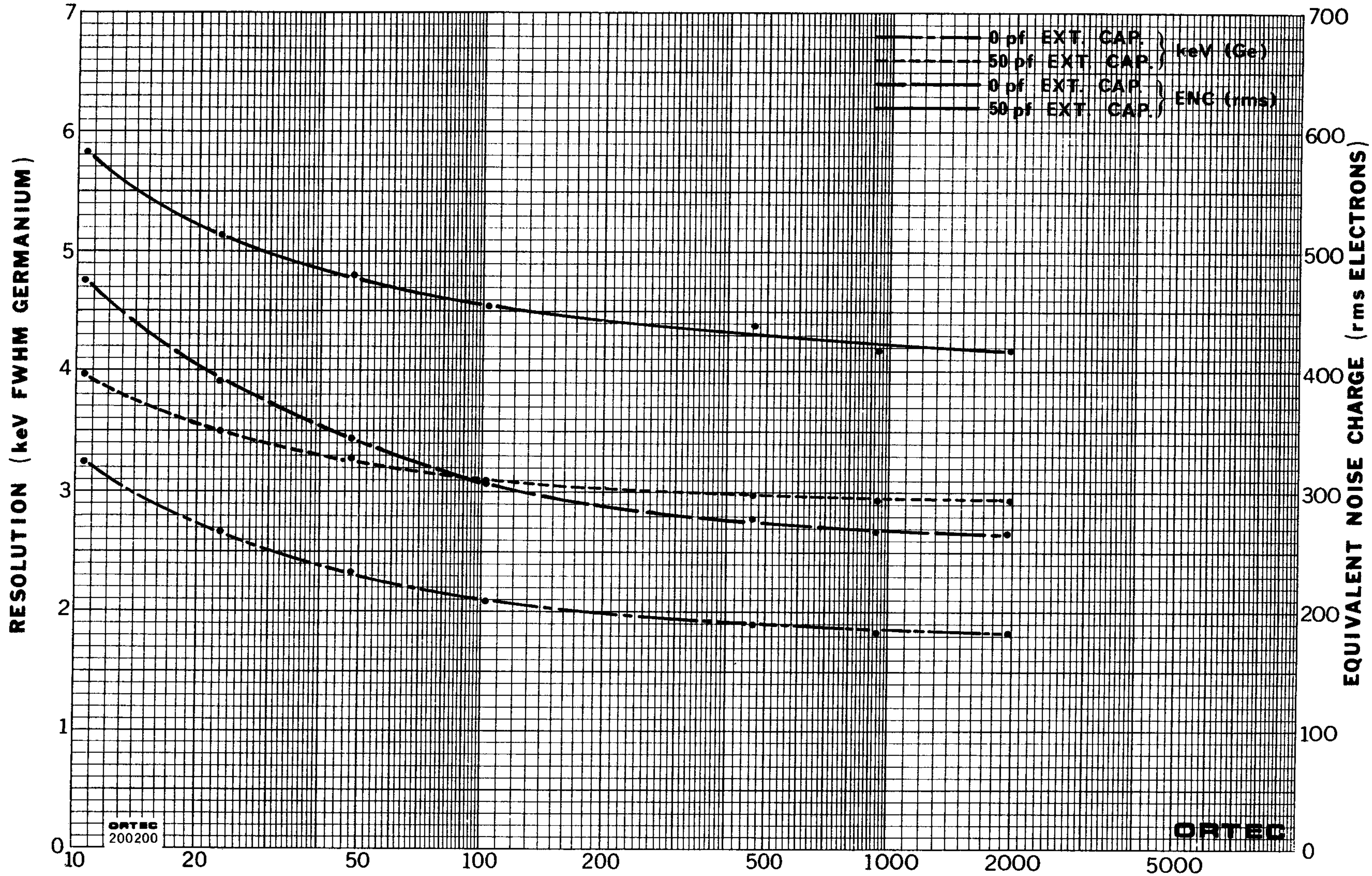


Figure 1. BIAS RESISTOR VALUE (MEGHOMS)

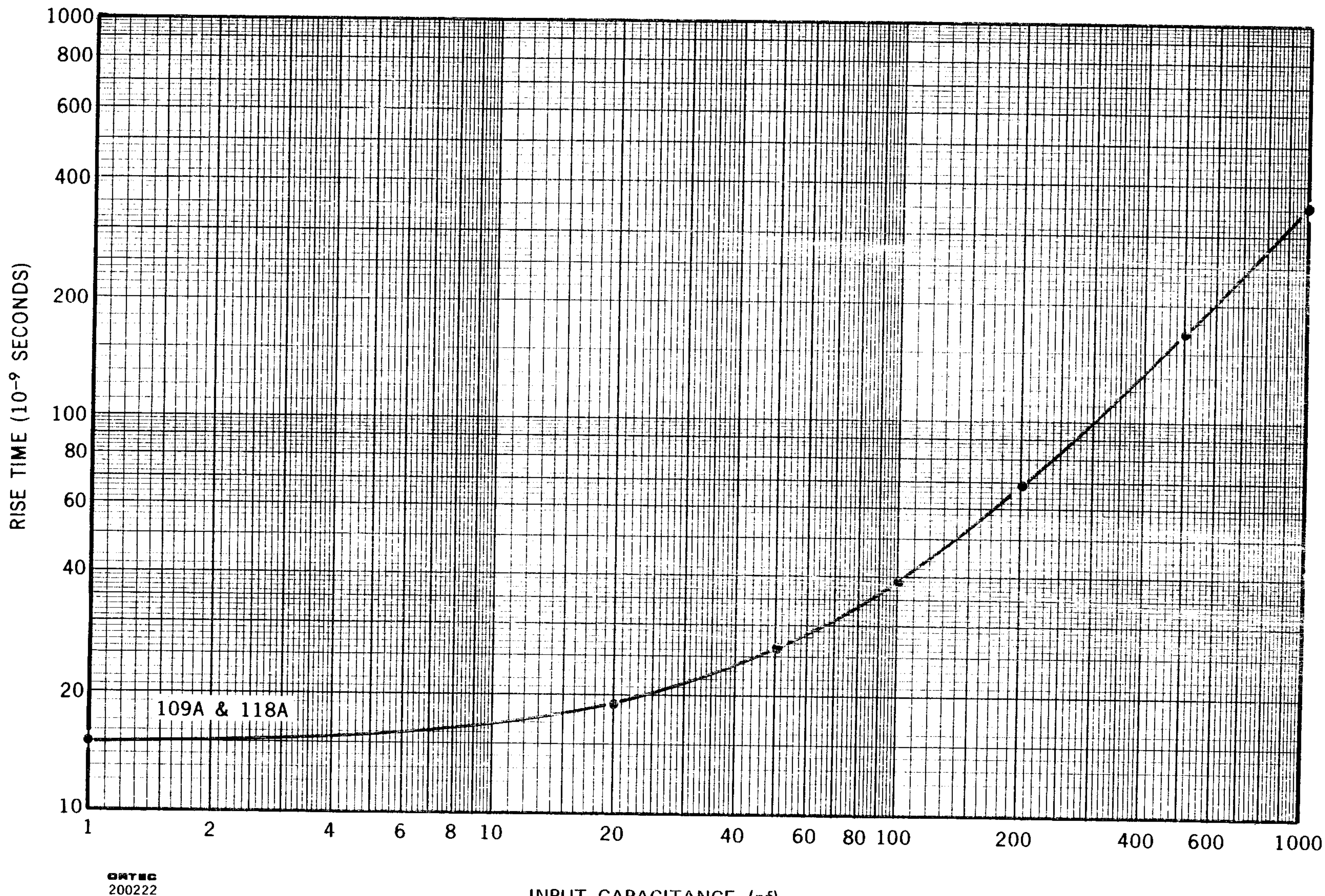
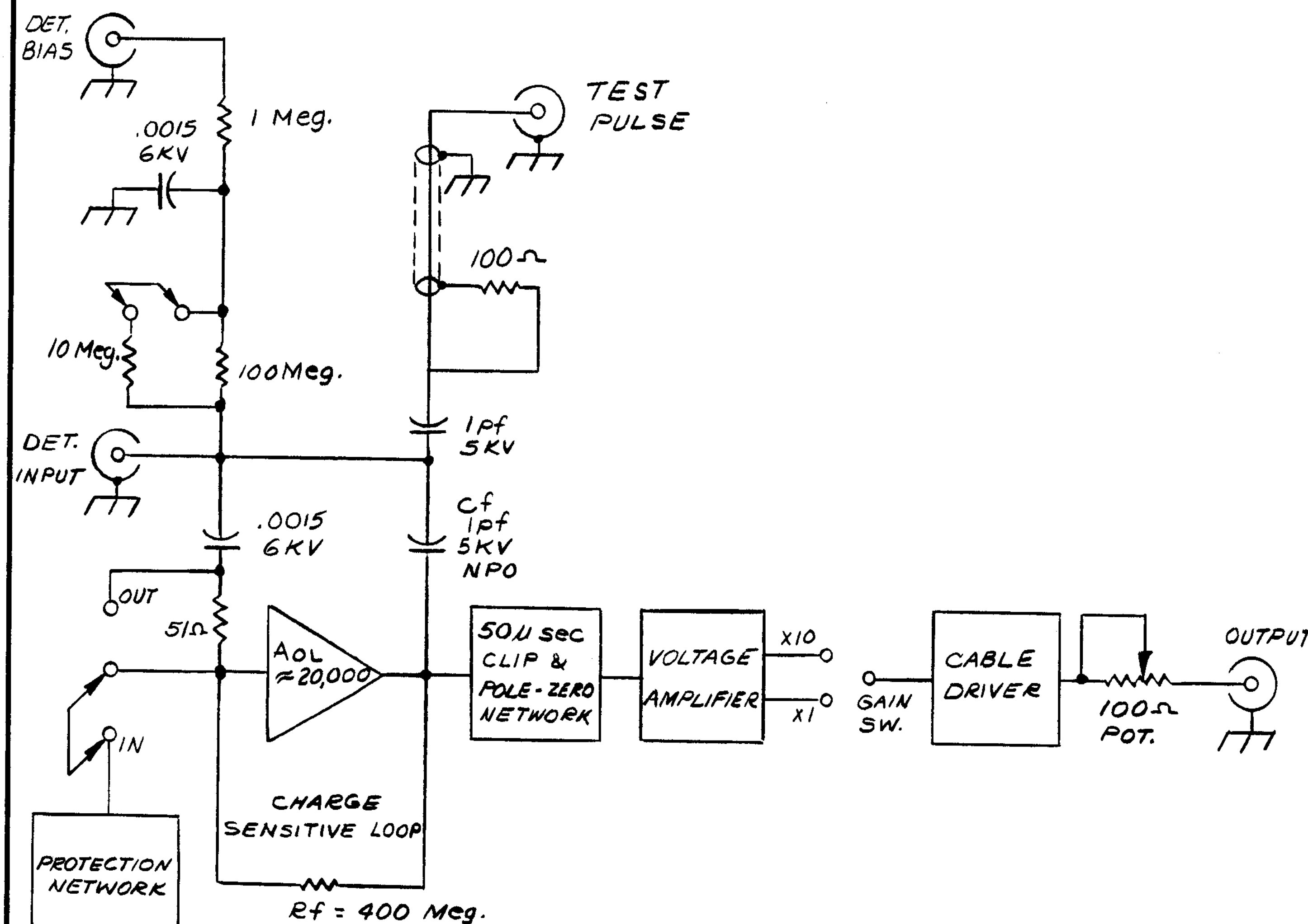


Figure 2. RISE TIME AS A FUNCTION OF INPUT CAPACITANCE



REVISIONS

REV.	ECN. NO.	DATE	BY	APPD.
A	109-7	11-22-66	JDW	
B	109A-9	10-18-66	UDW	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES

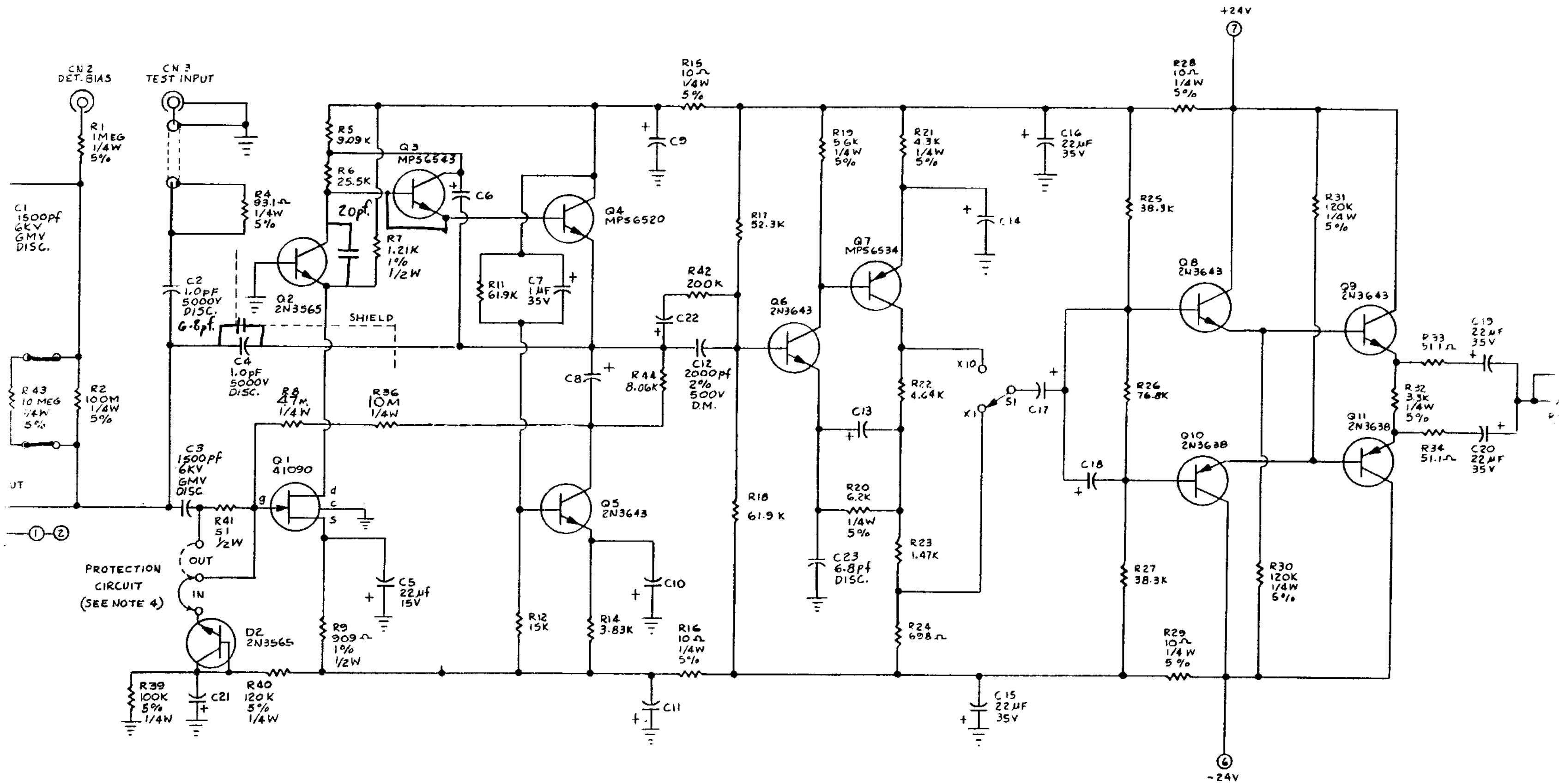
TOLERANCES
FRACTION ±
DECIMALS ±
ANGLES ±
SURFACE FINISH √ RMS
APPLIED PRACTICES

ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
OAK RIDGE TENNESSEE

TITLE
BLOCK DIAGRAM MODEL 109A PREAMPLIFIER

DRAFTSMAN U.D.W. DATE 11-22-66	ENG. APPROVAL J.B. Ayers	RESP. ENG. U.B. Ayers
CHECKED DATE	MFG. APPROVAL	DRAWING NO.
SCALE	DWG. ISSUED DATE	109A-0400-B1

The transistor types installed in your instrument may differ from those shown in the schematic diagram. In such cases, necessary replacements can be made with either the type shown in the diagram or the type actually used in the instrument.



NOTES:

1. ALL RESISTORS ARE METAL FILM, 1/8W, 1%, UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS ARE 6.8µF, 35V TANTALUM, UNLESS OTHERWISE SPECIFIED.
3. NUMBERS ① ② ⑥ ⑦ GO TO AMPHENOL CONNECTOR 17-20090.
4. PROTECTION CIRCUIT MAY BE REMOVED BY MOVING THE PLUG-IN JUMPER FROM "IN" POSITION TO "OUT" POSITION. (SEE INSTRUCTION MANUAL "NOTICE" PAGE)
5. D.M. INDICATES DIPPED MICA.

* 6. PARALLEL BIAS RESISTOR – SEE MANUAL 4.1

REV	ECN NO	DATE	BY
I	109A-10	2-26-69	HK
H	109A-7	8-20-68	JDW
G	109A-5	3-28-68	JDW
F	109A-4	3-26-68	JDW
E	109A-1	2-20-68	JDW
D	109-7	11-22-66	JDW
C	09-4	4-7-66	RP
B	09-3	3-17-66	JDW

REVISIONS

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES

MATERIAL

APPLIED PRACTICES

ORTEC INCORP

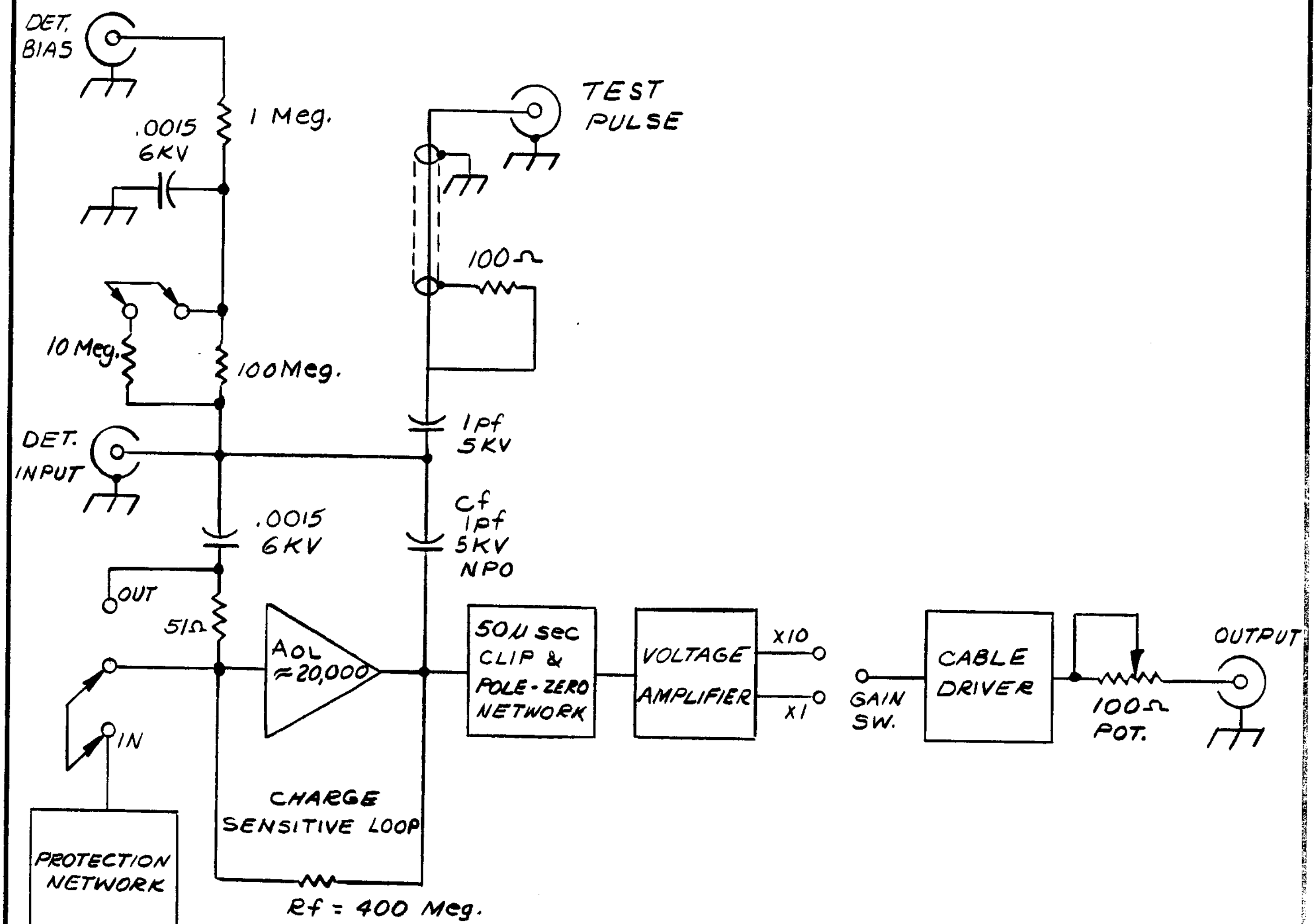
100 MIDLAND ROAD, OAK RIDGE, TENN

TITLE: SCHEMATIC-MODEL 109A PREA

DRAFTSMAN: D. WEBB DATE: 4-11-68
RESPONSIBLE ENGINEER: U AYERS
CHECKED: MGW 4-11-68
SCALE: ✓
DWG ISSUED: Marla 4-18-68
RELEASED FOR MFG: MGW 4-11-1

109

SPECIAL 36886



REVISIONS

REV.	ECN. NO.	DATE	BY	APPD.
B	109A-9	10-18-66	JDW	
A	109-7	11-22-66	JDW	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES

TOLERANCES

FRACTION ±
DECIMALS ±
ANGLES ±
SURFACE FINISH √ RMS
APPLIED PRACTICES

ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
OAK RIDGE TENNESSEE

TITLE
BLOCK DIAGRAM MODEL 109A PREAMPLIFIER

DRAFTSMAN J.D.W. DATE 11-22-66
ENG. APPROVAL J.B. Ayers
RESP. ENG. J.B. Ayers
CHECKED DATE
MFG. APPROVAL
DRAWING NO. 109A-0400-B1
SCALE
DWG. ISSUED DATE