INSTRUCTION MANUAL

MODEL 6169

ION CHAMBER INTERFACE

KEITHLEY INSTRUMENTS

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EFFECTIVE WITH S/N 48562A

FIFTH PRINTING, NOVEMBER 1980, CLEVELAND, OHIO U.S.A.

SPECIFICATIONS

ION CHAMBER BIAS VOLTAGE: Approximately + or - 300 volts. Five internally mounted 67.5V batteries (NEDA 217): life is essentially shelf-life (approximately 1 year).

SUPPRESSION: Bipolar, + 3.0 x 10^{-13} ampere to -3.0 x 10^{-13} ampere. Uses one 8.4V mercury battery (NEDA 1604M); life is approximately one year.

INPUT CONNECTORS: P.E.T. Type; triaxial mate for Farmer probes, BNC style triaxial, and dual BNC (coaxial).

OUTPUT: Captive cable and connector mates with input of Model 616 Electrometer.

DIMENSIONS, WEIGHT: Style M 3-1/2 in. half-rack overall bench size 4 in. high x 8-3/4 in. wide x 15-3/4 in. deep (100 x 220 x 400 mm). Net weight, 5 pounds (2,4 kg).

ACCESSORIES SUPPLIED: Hardware necessary to join Models 616 and 6169 as a single unit in stacked configuration; top cover with carrying handle.
Banana plug to BNC adapter.

SECTION 1. GENERAL INFORMATION

1-1. GENERAL. The Model 6169 is an adapter box for converting an Electrometer to a dosimeter system. The Model 6169 is specifically designed to be used in conjunction with the Keithley Model 616 Digital Electrometer, but can be used with any floatable feedback electrometer such as the Keithley 602. The 6169 incorporates a well shielded ultra low leakage ion chamber interconnection system with a switchable bipolar bias supply (batteries) and a background suppression circuit.

1-2. CONTROLS AND TERMINALS.

a. Bias Controls

1) Triax - BNC-Selects triax or BNC mode of operation.

2) Polarity - Center off switch selects proper bias polarity for positive or negative readout on 616.

b. Background

1) On/Off - Connects/disconnects background (bucking) current.

2) Adjust - Provides continuous adjustment background (bucking) current.

c. Connectors

1) BNC Triax - For use with Keithley and other ion chambers in triax mode.

2) P.E.T. Triax - For use with Farmer ion chambers in triax mode.

3) BNC Input - For use with collector electrode of ion chambers in BNC mode.

4) Alternate Bias - Provides bias potential for bias electrode of ion chambers in BNC mode.

5) Output - Provides output to Floating electrometer.

WARNING

Up to 350 volts may be present at various terminals on the Model 616 and 6169. Place the Model 6169 BIAS switch (POS, OFF, NEG) to OFF position before connections are made to any terminals.

SECTION 2. INITIAL PREPARATION

2-1. GENERAL. This section provides information needed for incoming inspection and preparation for use.

2-2. INSPECTION. The Model 6169 was carefully inspected both mechanically and electrically before shipment. Upon receiving the instrument, check for any obvious damage which may have occurred during transit. Report any damages to the shipping agent. To verify the electrical specifications, follow the procedures given in Section 4.

2-3. PREPARATION FOR USE. For installation in conjunction with a 616 Digital Electrometer, refer to drawings 26946C and 26947C.

CAUTION

LO to GND link on Rear Panel of the Model 616 must be removed; failure to do so will damage bias batteries.

In TRIAX mode, all binding posts are floating at the +300V ion chamber bias voltage.

The 6169 can be used in conjunction with other floating feedback electrometers, such as the Keithley 602, observing the above cautions.

WARNING

1. Electrical SHOCK HAZARD up to 350 volts is possible whenever the BIAS switch on the Model 6169 is in POS or NEG position. Always set the BIAS switch to off position (center) whenever connections are made to the Model 6169 or electrometer. Do not place BIAS to POS or NEG until all connections and handling of cables, etc. are completed.

2. The 6169 and electrometer should be connected to "earth ground or safety ground" through the third wire of the power cord on the electrometer. Since the electrometer may be floated up to 1000 volts above earth ground, care should be taken when handling connectors and cables connected to either the electrometer or 6169. See Figure 2 for typical interconnections for BNC and TRIAX modes.

3. Do not connect an alternate bias supply to the 6169 in an attempt to boost the bias voltage.

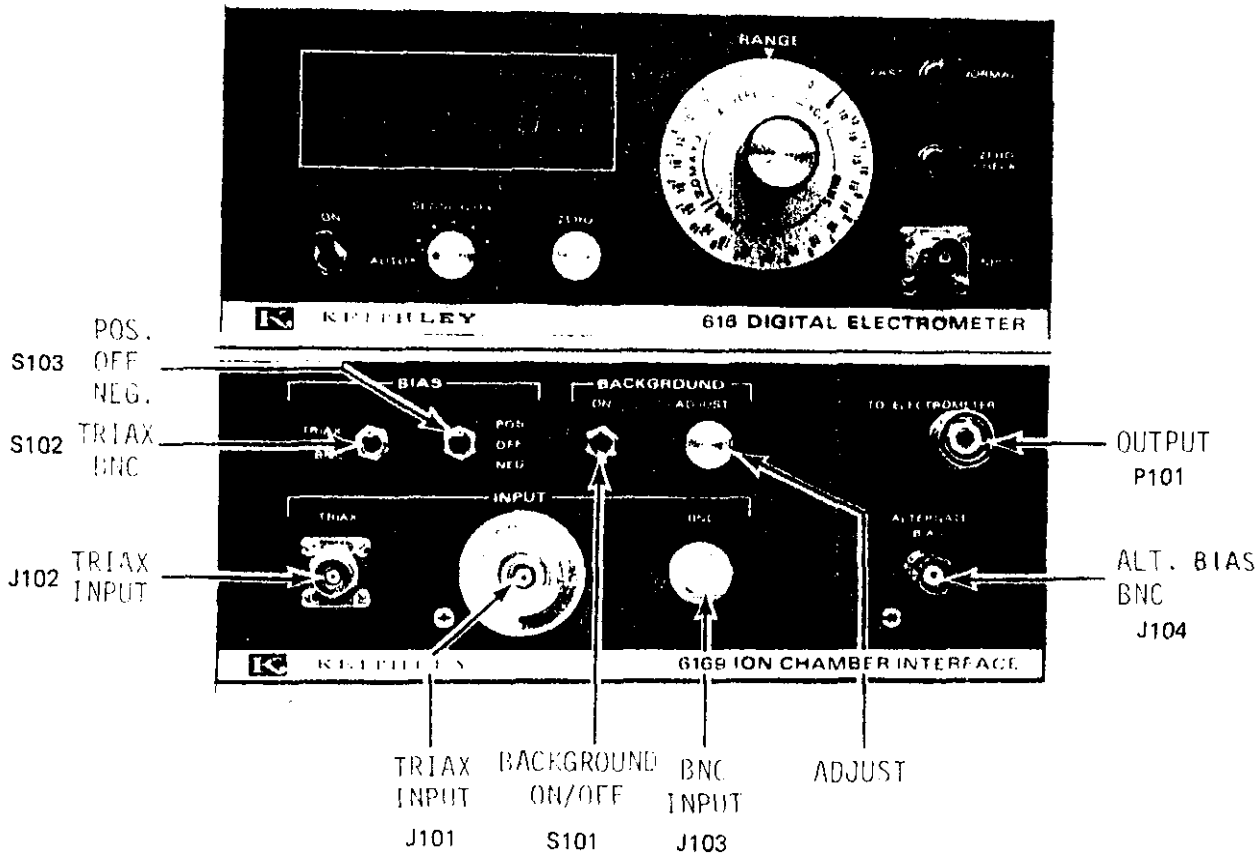


FIGURE 1. Model 616/6169 Dosimeter System

SECTION 3. OPERATING INSTRUCTIONS

3-1. OPERATION.

a. Connection of Ion Chambers.

1. The two modes of operation of the 6169 are shown in Figure 2.

2. Triax mode is used with chambers having BNC type triax or P.E.T. type triax connectors.

3. The BNC type triax connector is compatible with:

a) Keithley 96020A, 96035, 96070, 96050,96060, 9609, and Keithley Supplied Therapy Chambers.
b) Victoreen 666 series chambers

c) Capintec ion chambers

d) and others

4. The P.E.T. Type triax connector is compatible with:

a) Farmer ion chambers and others.

5. BNC mode is used with chambers having two separate cables for bias and signal. Adapters are commercially available to connect banana, pin, UHF and miniature coax connectors to the 6169's BNC connectors. Instructions for connecting several commonly available ion chambers are as follows:

a) Keithley 96010: Connect center connector to BNC input, and the offset connector to alternate bias.

b) PTW Chambers (some models): Connect BNC connector to BNC input, and the banana plug via an adapter supplied to the alternate bias.

c) Victoreen 555 series chambers except solid state probe: Connect black cable via an adapter to BNC input and the other cable via an adapter to alternate bias.

3-2. GENERAL CHAMBER CONNECTION PRECAUTIONS. Chambers which have outer electrodes connected to case must be connected in triax mode, such as the Keithley 96020A. All connecting cables and adapters should be fully shielded. Adapters and connectors should be low leakage teflon type and all exposed insulator surfaces must be kept clean. Cables should be low noise (graphite lubricated) and should be isolated from vibration or flexing during radiation measurements.

a. Only one chamber should be connected at a time.

b. Always turn off bias before changing connections to or from the 6169 to prevent possible shock and damage to the 616 from shorting the high potentials.

3-3. OPERATIONAL CONTROL SETTINGS.

a. Model 616 Control Settings (consult Electrometer manual for operation of other electrometers). Electrometer must have fast feedback mode.

1. Set Model 616 Power to ON.

2. Set Fast/Normal Switch to FAST.

3. Set current range or charge (coulomb) range to appropriate full range desired.

4. Set Sensitivity to X1 or other appropriate setting. (If used in Autorange mode, the Model 616 will automatically set sensitivity over five decades.)

5. Set Zero Check to CHECK position until measurement is to be performed.

6. Adjust zero before each measurement if necessary.

CAUTION

LO to GND link on the Model 616 must be removed; failure to do so will damage bias batteries.

In TRIAX mode, all binding posts on the back of the 616 are floating at the 300V ion chamber bias voltage.

b. 6169 Control Settings (Refer to Figure 2).

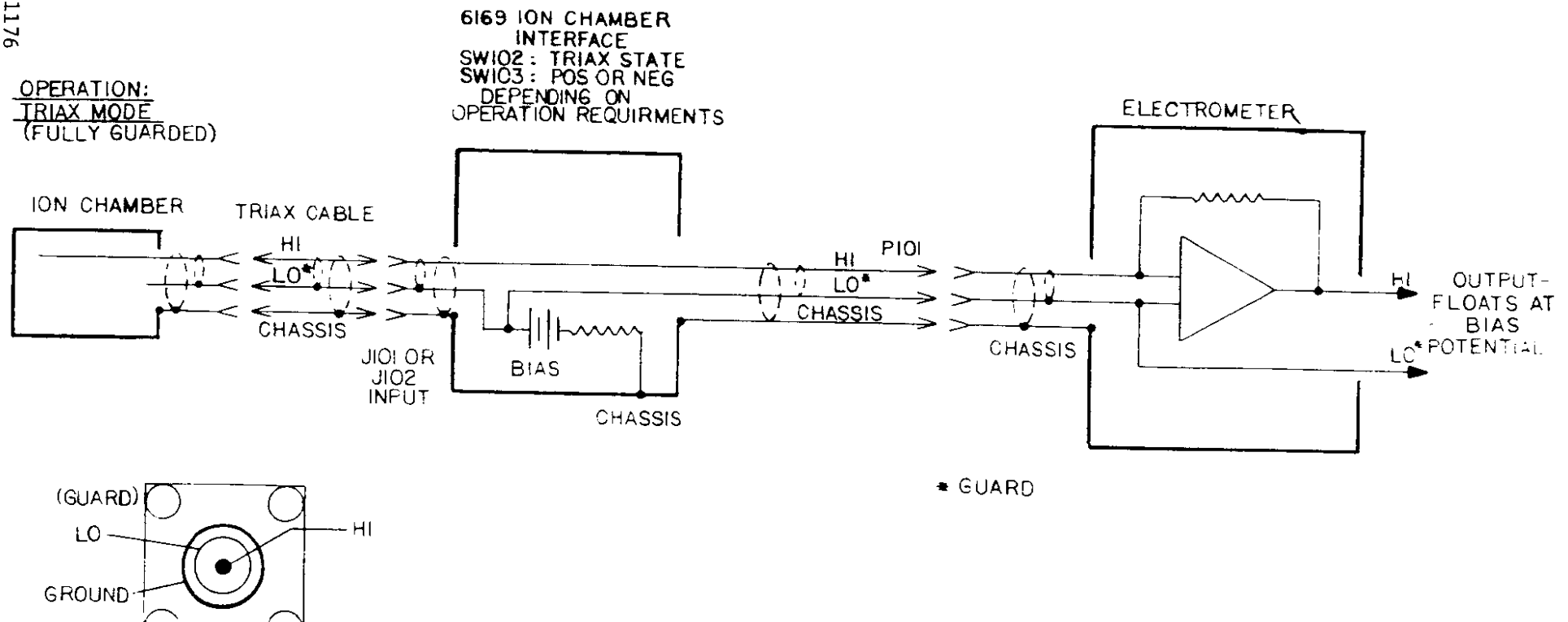
1. Set Triax/BNC switch to appropriate mode.

2. Set polarity switch for positive or negative bias and readout.

3. If there is significant ion chamber leakage or background radiation, turn on background switch and adjust background control for zero reading in current mode, or a stable reading in charge mode.

NOTE

Cap all unused connectors. Allow several minutes for system stabilization after turn on, before making low level measurements.



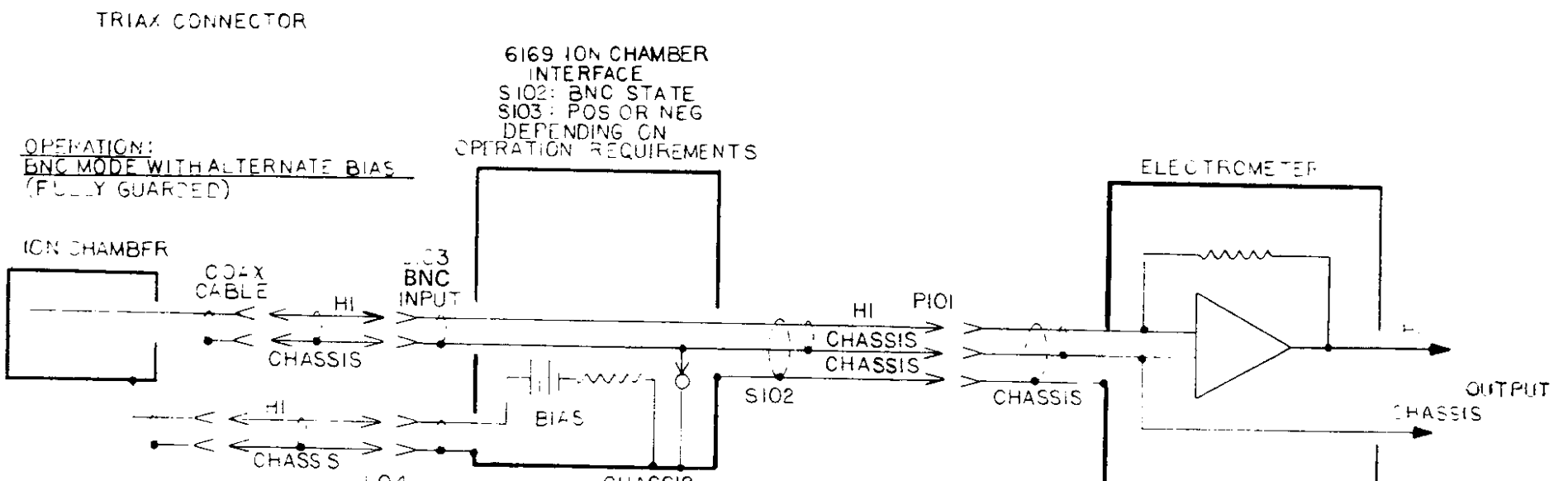


FIGURE 2. OPERATING MODES

NOTE:
THE MODEL 6169 ION CHAMBER INTERFACE AND THE ELECTROMETER ARE NOT CONNECTED TO EARTH GROUND UNLESS CONNECTED THROUGH THE THIRD WIRE OF THE POWER CORD TO THE ELECTROMETER, OR ANOTHER CONNECTION PROVIDED SEPARATELY.

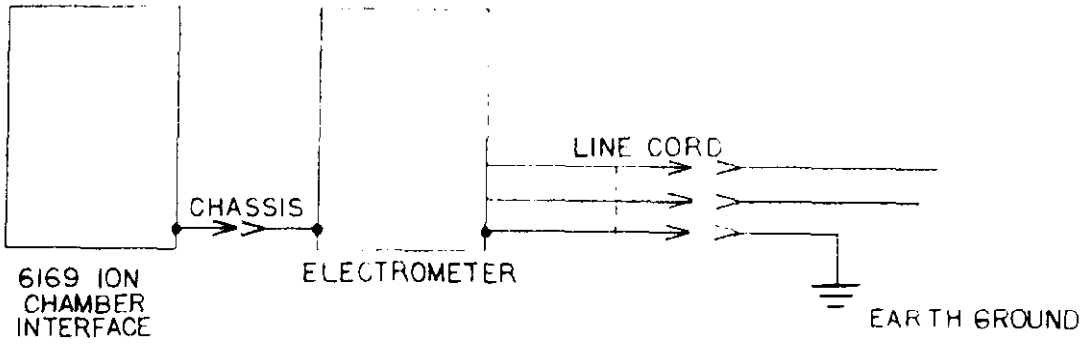


FIGURE 3. GROUNDING OF CASE

SECTION 4. MAINTENANCE

4-1. GENERAL. This section contains information necessary to maintain the instrument. Included are procedures for electrical Performance Checks, Calibration, Troubleshooting, and Battery Replacement.

4-2. ION CHAMBER BIAS SUPPLY.

a. +300V Battery

1. Check Bias at Alternate Bias connector. Voltage should be greater than 300V as measured by 9MΩ or greater impedance voltmeter. Voltage is nominal 337-1/2 volts. Typical voltage is 357 to 360 volts using new batteries.

2. If battery voltage is low, obtain a new set of five 67-1/2V batteries (Keithley Part Number BA-20).

3. Remove bottom cover of 6169.

4. Carefully disconnect spade lugs on terminal strip to avoid accidental shorting of batteries (shock hazard).

5. Remove five batteries and replace with new batteries.

6. Replace connections to terminal strip.

7. Check for proper voltage.

8. Replace cover on Model 6169.

b. +8.4V Battery

1. Cap all input connectors, select positive bias.

2. Put in BNC mode, turn on background.

3. Turn adjust control fully counter clockwise.

4. 6169 output should be greater than 3.0×10^{-13} amperes.

5. If not, replace battery with Keithley BA-9 or equivalent 8.4V mercury cell.

4-3. IMPEDANCE CHECK.

a. Cap all input connectors.

b. Measure leakage current using Model 616 or equivalent picoammeter.

c. Current should be less than 1×10^{-14} A.

Model 6169 Replaceable Parts

Circuit Desig.	Description	Mfr. Code	Mfr. Desig.	Keithley Part No.
J101	Receptacle, Triaxial	K-I	--	26952A
J102	Receptacle, Triaxial	DAG	33050-2NT34	CS-181
J103	Guarded, BNC	K-I	--	CS-358
J104	Receptacle, BNC (UG-1094A/U)	APH	31-2221	CS-249
R101	Resistor, $10^{12}\Omega$	VIC	RX-1-$10^{12}\Omega$	R20-V-1T
R102	Potentiometer, 1MΩ	K-I	--	26950A
R103	Resistor, 3MΩ, 1%, 1/2W	IRC	DCC-3MΩ	R12-3M
R104	Resistor, 3MΩ, 1%, 1/2W	IRC	DCC-3MΩ	R12-3M
R105	NOT USED			
R106	Resistor, 100KΩ, 10%, 2W, Comp	A-B	HB-100K-10%	R3-100K
R107	Resistor, 5M, 1%, 1/2W, Comp	IRC	DCC-5MΩ	R12-5M
R108	Resistor, 5M, 1%, 1/2W, Comp	IRC	DCC-5MΩ	R12-5M
S101	Toggle Switch	C&K	U21	SW-271
S102	Toggle Switch	C&K	MSTL05D	SW-236
S103	Toggle Switch	K-I	---	26949
BT-1	Battery, 67-1/2V, Type B (with snap-on terminals)	BUR	UX45	BA-20
BT-2	Battery, 67-1/2V, Type B (with snap-on terminals)	BUR	UX45	BA-20
BT-3	Battery, 67-1/2V, Type B (with snap-on terminals)	BUR	UX45	BA-20
BT-4	Battery, 67-1/2V, Type B (with snap-on terminals)	BUR	UX45	BA-20
BT-5	Battery, 67-1/2V, Type B (with snap-on terminals)	BUR	UX45	BA-20
BT-6	Battery, 8.4V mercury	U-C	E146X	BA-9

TABLE
Cross-Reference of Manufacturers

CODE	NAME AND ADDRESS	CODE	NAME AND ADDRESS
A-B	Allen Bradley Corp. Milwaukee, WI 53204	DAG	Dage Elect. Company Inc. Franklin, IN
ALC	Alco Elec. Prod. Inc. North Andover, MA 01845	IRC	IRC Division Burlington, IA 52601
APH	Amphenol Broadview, IL 60153	K-I	Keithley Instruments, Inc. Cleveland, Ohio 44139
BUR	Burgess, Inc. Freeport, IL. 61032	VIC	Victoreen Instruments, Inc. Cleveland, Ohio 44104
C & K	C & K Comp, Inc. Watertown, MA. 02172	U-C	Union Carbide Corp. New York, NY 10017

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B	5319	[illegible]	[illegible]
C	5853	REVISED	2-22-[illegible]

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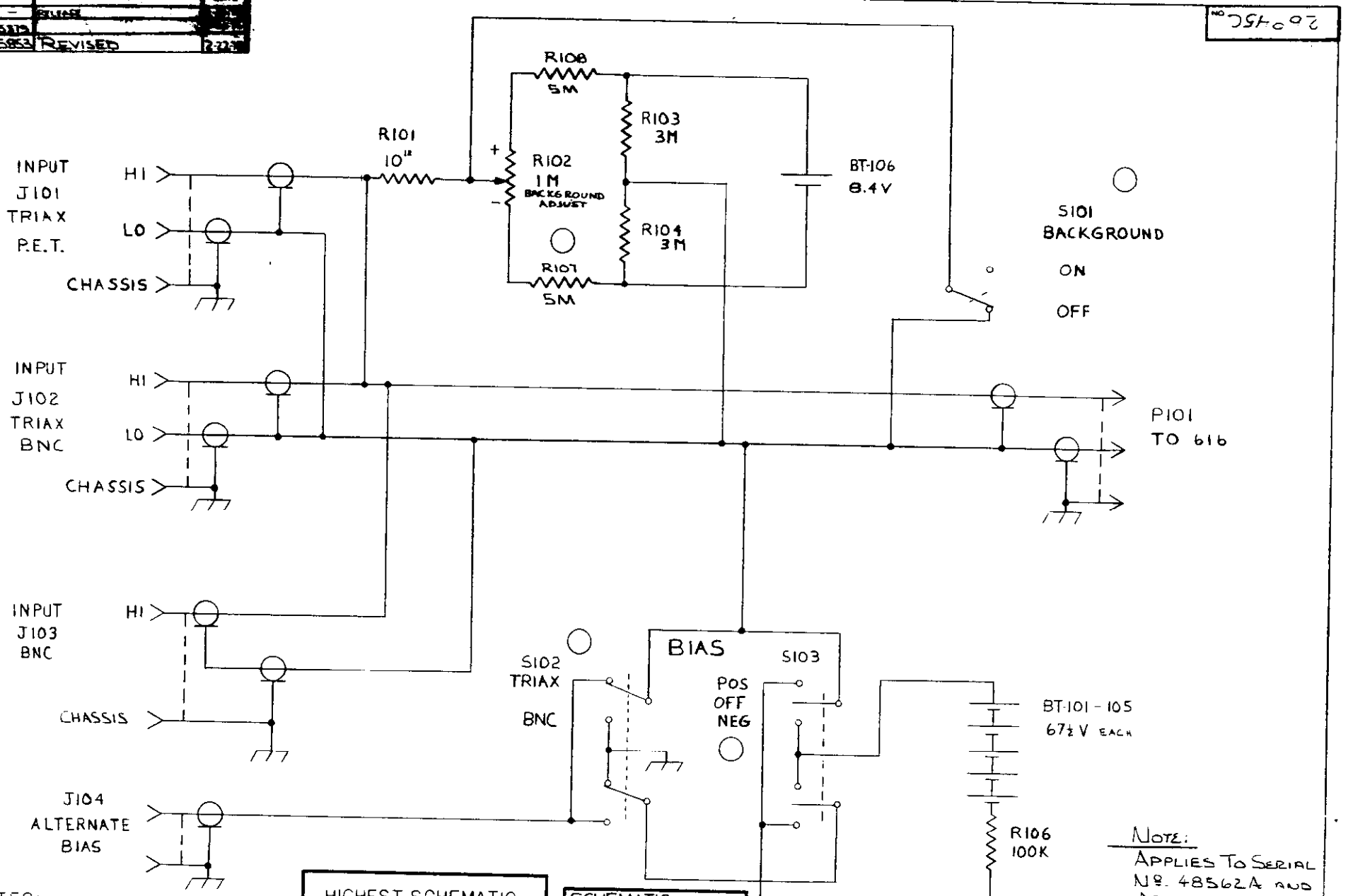

NOTES:
1. ⏚ DENOTES CHASSIS CONNECTION
2. ○ DENOTES FRONT PANEL CONTROL

HIGHEST SCHEMATIC DESIGNATIONS USED		
R108	S103	P101
J104	BT106	

SCHEMATIC DESIGNATIONS NOT USED		
R105		

Note:
Applies To Serial No. 48562A and Above.

6169		
MODEL	NEXT ASSEMBLY USED ON	QTY

DO NOT SCALE THIS DRAWING

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ± .015 ANG. = ± 1°
XXX = ± .005 FRAC. = ± 1/64
SURFACE MAX. 63

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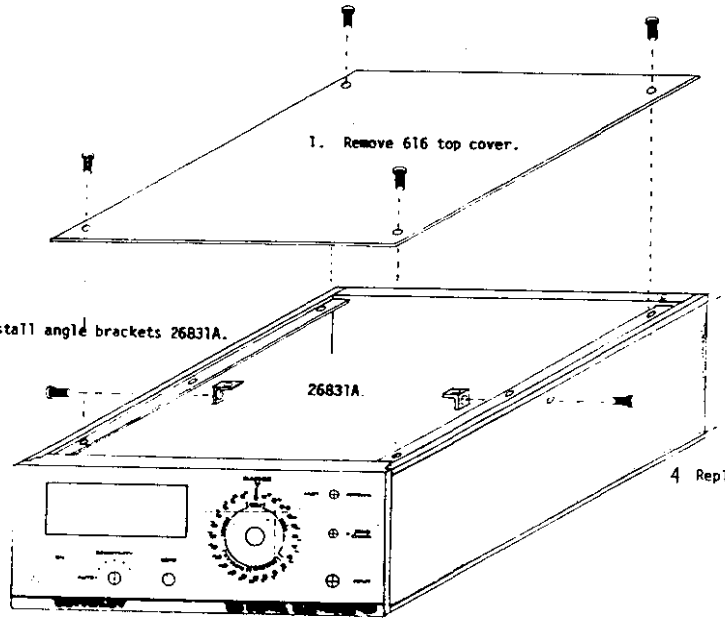
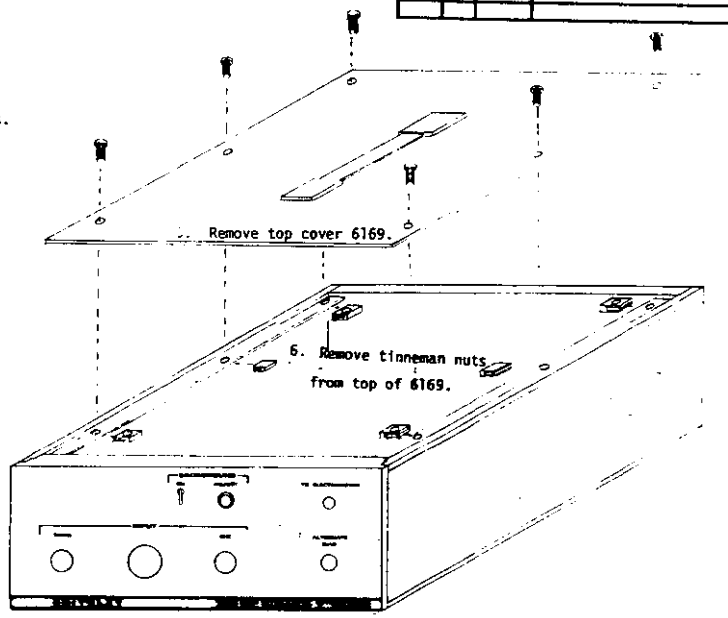
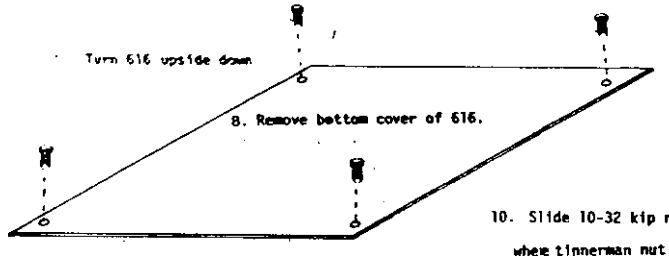
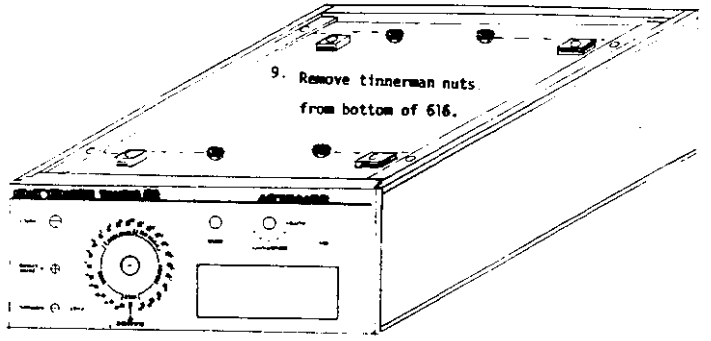
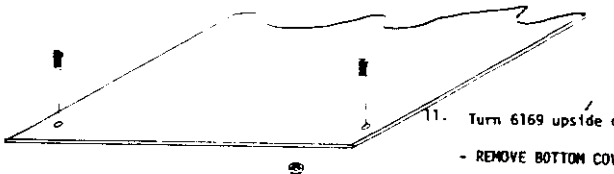




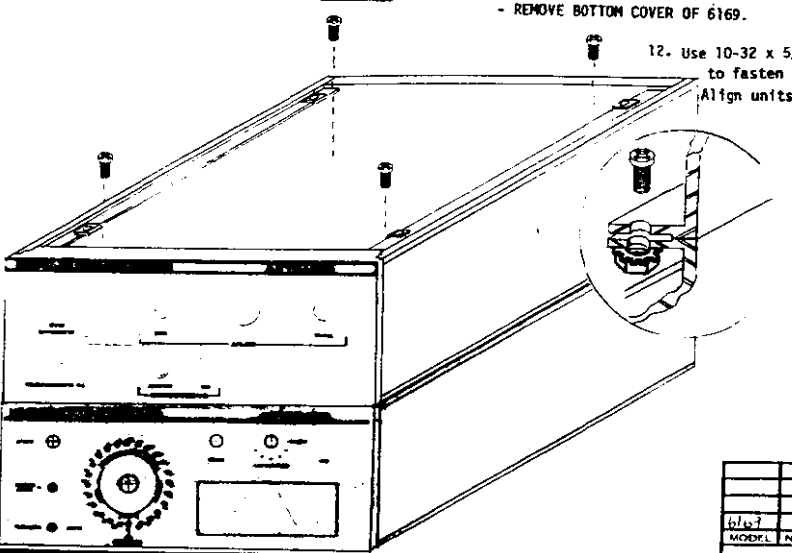




10. Slide 10-32 kip nut under hole where tinnerman nut came from.



11. Turn 6169 upside down and place on 616
- REMOVE BOTTOM COVER OF 6169.



12. Use 10-32 x 5/8 phillips screw to fasten units together. Align units before tightening.

MODEL	NEXT ASSEMBLY	QTY
6169		
USED ON		

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
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XXX = ± .005 FRAC = ± 1/64
SURFACE MAX 63

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TITLE 6169 ASSEMBLY

NO 26946 C

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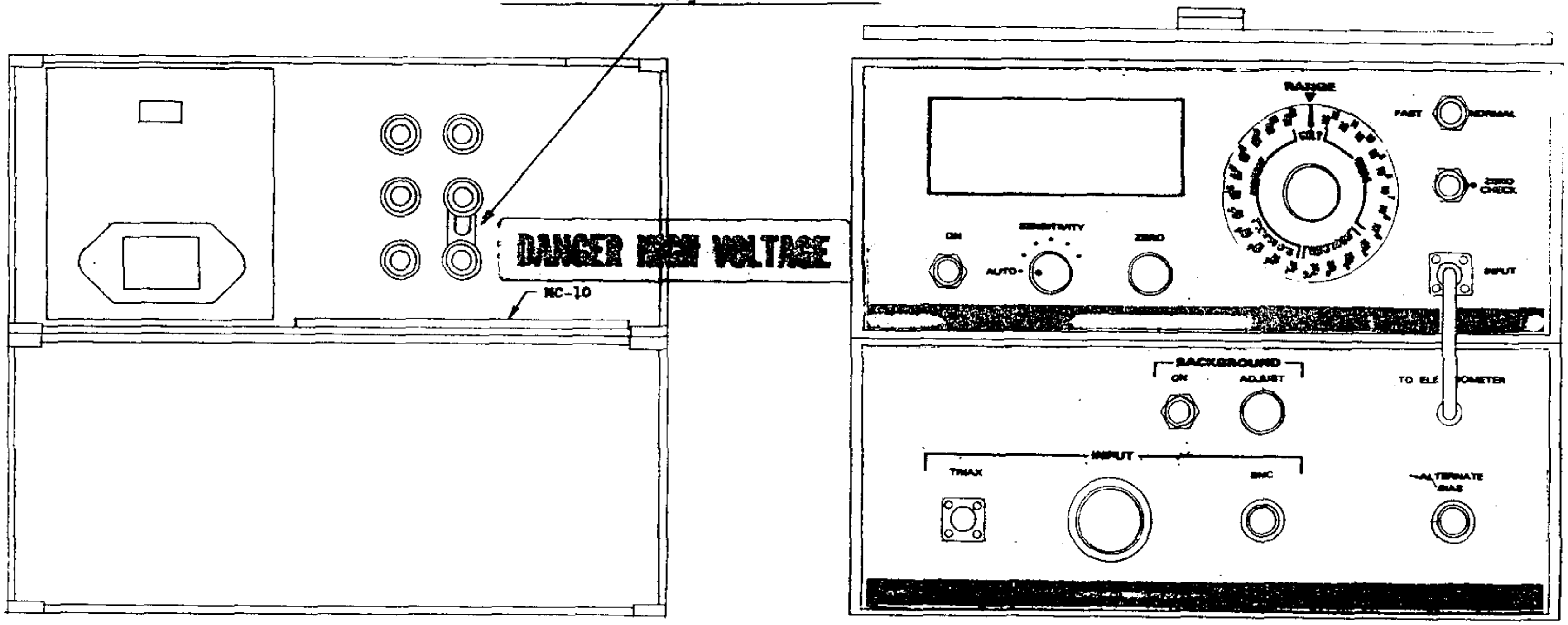
14. Add MC-10 to rear panel of 616.
IMPORTANT - Remove [illegible] link from binding posts of 616. Failure to do so will destroy batteries.

13. Install top cover with handle taken from 6169

15. Plug triax cable into input of 616.



16. Replace bottom cover of 6169.

MODEL	NEXT ASSEMBLY	QTY
6169		

USED ON

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DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
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XXX = ±.005 FRAC. = ±1/64
SURFACE MAX

DATE 11-6-74 SCALE 1:1
DRN EJD ENG APPR
MATERIAL
FINISH

TITLE 6169 ASSEMBLY

NO. 26947 C

KEITHLEY

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