

# SERVICE NOTE



412A-2A

## MODEL 412A DC VACUUM TUBE VOLTMETER

REPLACEMENT OF RANGE SWITCH ASSEMBLY  
STOCK NO. 412A-19W

### CAUTION

KEEP SWITCH CLEAN. WEAR A PAIR OF RUBBER GLOVES WHEN HANDLING SWITCH. MAKE SOLDER CONNECTIONS QUICKLY AND CLEANLY.

The Range Switch Assembly, Stock No. 412A-19W is a pretested, direct replacement switch for the cabinet mounted Model 412A DC Vacuum Tube Voltmeter. The assembly is supplied with all switch mounted components installed. Included are the RANGE, POLARITY, and FUNCTION switches as part of the prefabricated harness.

Installation procedures for your cabinet mounted instruments are different from those required for your instruments designed for rack mounting. Replacement procedures for rack mounted instruments are covered in Service Notes 412AR-1A. The Range Switch Assembly in both instruments, however, is identical except for cabling and lead lengths.

Replacement procedures require disconnecting input cable leads, removal of panel and old switches, and installation of new assembly. The panel is replaced and input leads reconnected. Calibration completes the procedure.

### COMPONENTS FURNISHED FOR RANGE SWITCH REPLACEMENT

Quantity	Description	Stock No.
1	Range Switch Assembly . . . .	412A-19W
1	Switch Nut, 5-40 x 1/4 inch. . .	0540-0001
1	Washer, internal lock #6 . . . .	2190-0007
4	Tinnerman Speed Nut #6 . . . .	0590-0005
4	Screw, 6-32 x 5/16 inch w/lockwasher . . . . .	2390-0007

### REPLACEMENT PROCEDURE FOR CABINET MODEL

- 1) Disconnect power. Remove two screws at rear and slide cabinet off instrument.
- 2) Refer to figure 1. Remove input circuit shield.
- 3) Disconnect support post screw from rear of chassis.
- 4) Unsolder blue and brown wires from meter terminals.
- 5) Loosen three bezel screws on one side. Remove three bezel screws on other side. Slide off bezel.
- 6) Detach power switch from panel (9/16 in. open end wrench). Leave wiring intact.
- 7) Detach pilot light from panel (7/16 in. open end wrench). Leave wiring intact.

### Note

To avoid damaging heat sensitive terminal points, and remove range switch with a minimum loss of connecting wire length, the following procedure for disconnecting wires (other than input cables) is recommended:

- a) Cut wires close to terminating points.
- b) Remove remaining short crimped end terminating point with a 45 to 50 watt soldering iron with a clean, well tinned tip.
- c) Clean remaining solder from terminating point.
- d) Strip back insulation on cut off wire 1/4 inch.

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COMPLETE COVERAGE IN  
ELECTRONIC MEASURING EQUIPMENT

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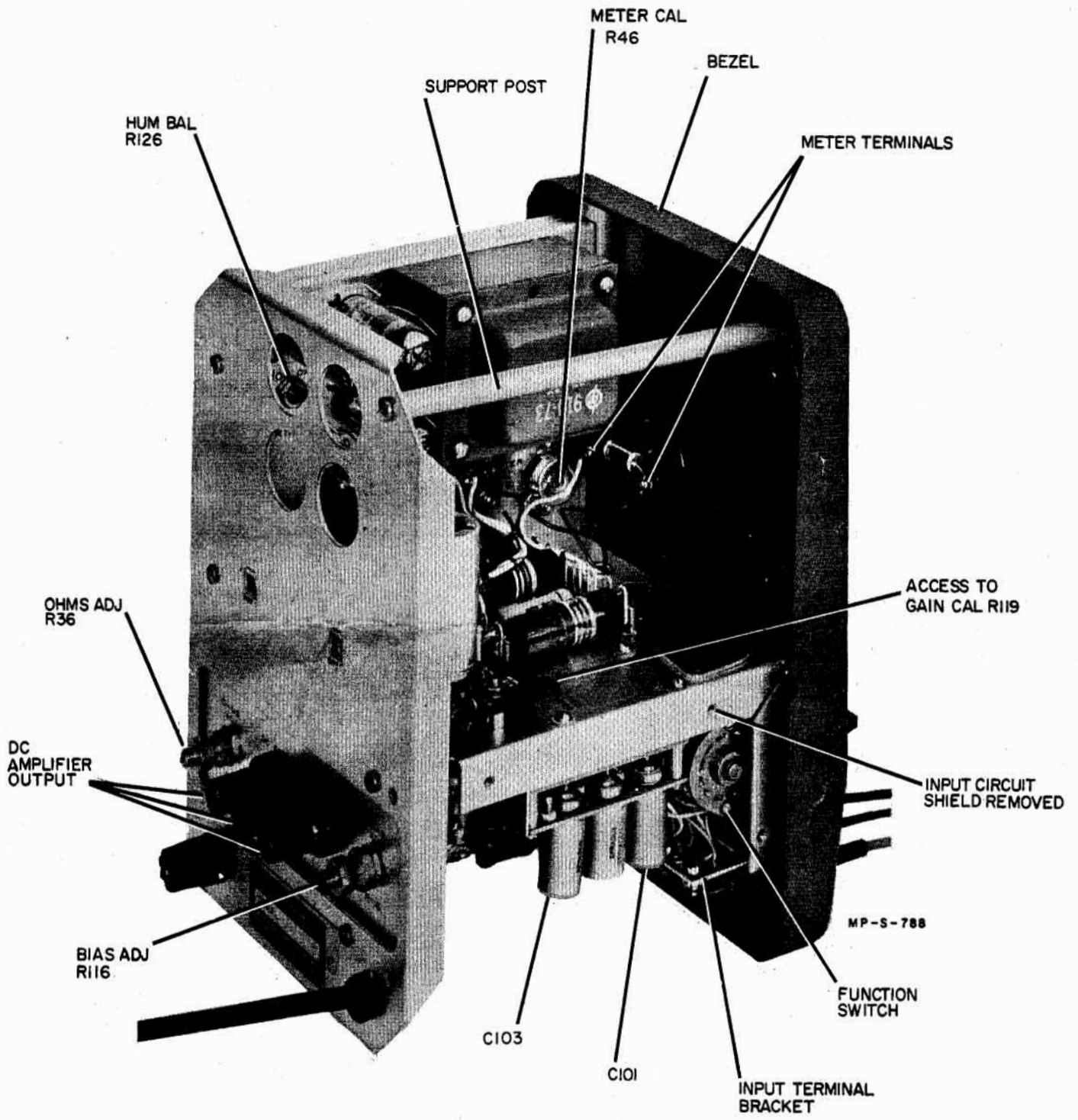


Figure 1. Model 412A Left Side View

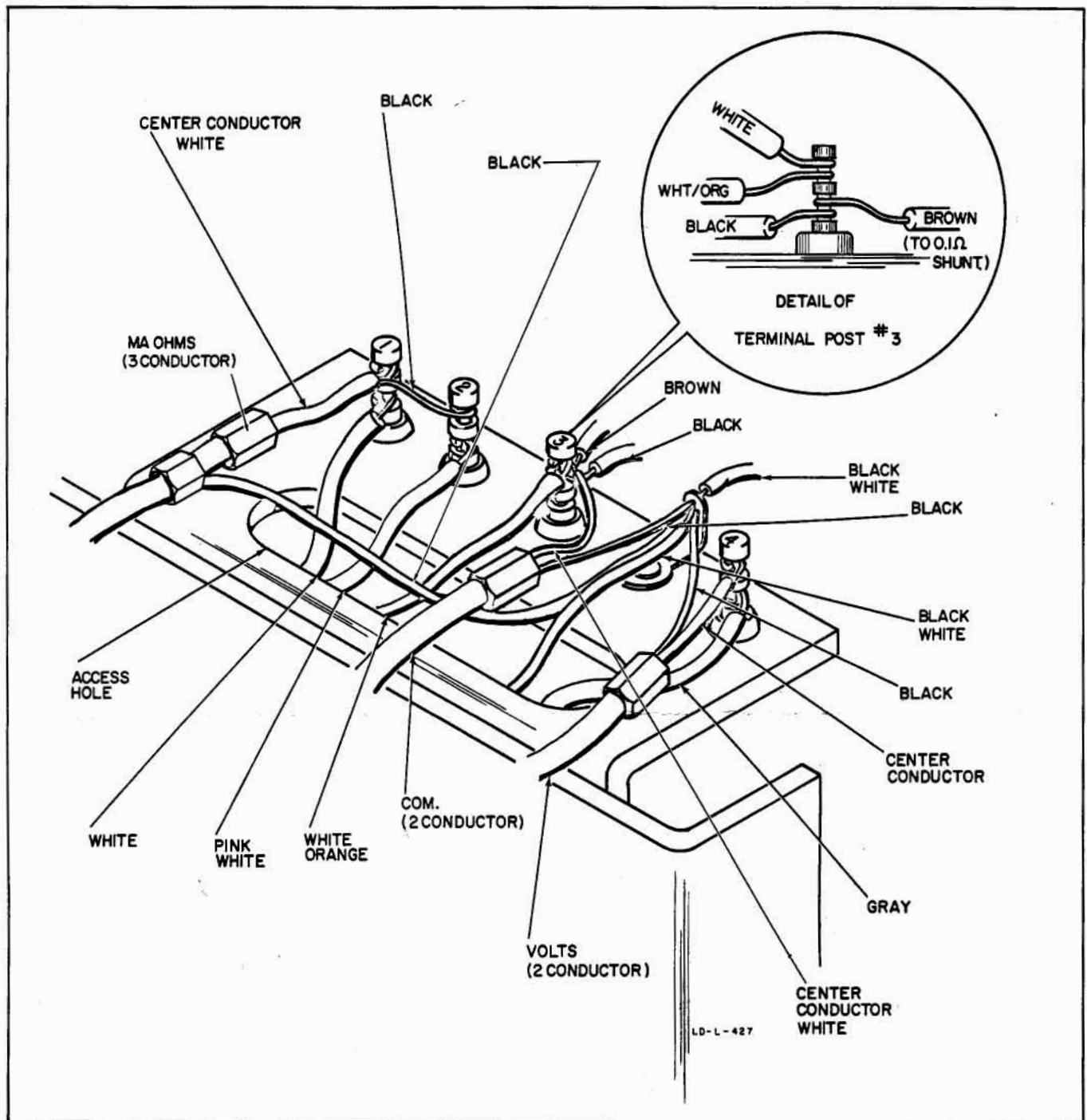


Figure 2. Connection Diagram for MA/OHMS, COM, and VOLTS CABLES  
(Cabinet Mounted Instrument Only)

8) Refer to figure 2. Very carefully unsolder VOLTS, MA/OHMS, and COM cables at input terminals. Do not shorten leads. Note that OHMS lead is three conductor cable.

9) Unsolder all wires from input terminals except black wire to terminal 3.

10) Remove knob from RANGE switch (#8 Allen). Loosen outside Allen set screws only and remove FUNCTION and POLARITY switch knobs.

11) Remove panel mounting screws (11/32 in. open end wrench) and hardware including black insulators. Note positioning of black insulators between panel and chassis. Remove panel and set aside. Detach input terminal bracket from chassis. Hang bracket to side with black wire.

12) Detach FUNCTION switch (no wires need be unsoldered yet).

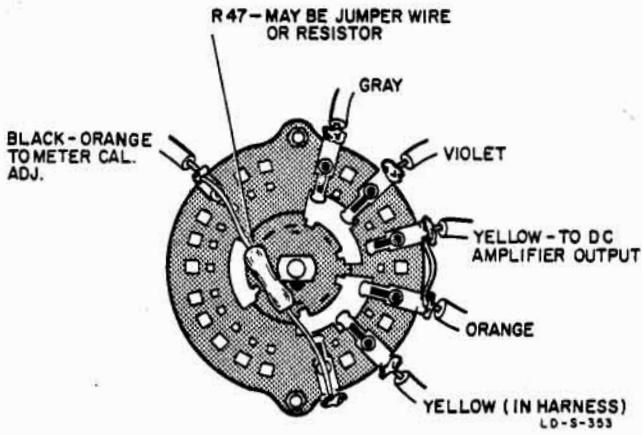


Figure 3. Polarity Switch Wiring

- ✓ 13) Detach POLARITY switch (no wires need be unsoldered yet).
- ✓ 14) Refer to figure 3. Unsolder yellow wire (to DC AMP terminals at rear) and black-orange wire (to R46 METER CAL control) from POLARITY switch.

- ✓ 15) Unlace black, black-white, and brown wires to RANGE switch.
- ✓ 16) Refer to figure 4-10 in Operating and Service Manual. Remove black wire from R19 (180 ohms) mounted on RANGE switch and leading to "B" input of modulator.
- ✓ 17) Refer to figure 4. Unsolder yellow-white wire from R28 (100 megohms) located near R116, BIAS ADJ control. Unsolder violet-white wires to RANGE switch from other end of R28.
- ✓ 18) Unsolder violet-orange wire from R33 (10K) and violet-white wire from R34 (136.7K) from R34. Both resistors are located on 7 lug terminal strip at rear of chassis.
- ✓ 19) Refer to figure 5. Unsolder brown-orange and pink-orange wires from rear wafer of RANGE switch. Note color code identification of these wires with respect to switch terminals.
- ✓ 20) Unsolder green wire at junction of capacitor C101 (.1 $\mu$ f) and resistor R101 (470K) which is the "A" input to the modulator.

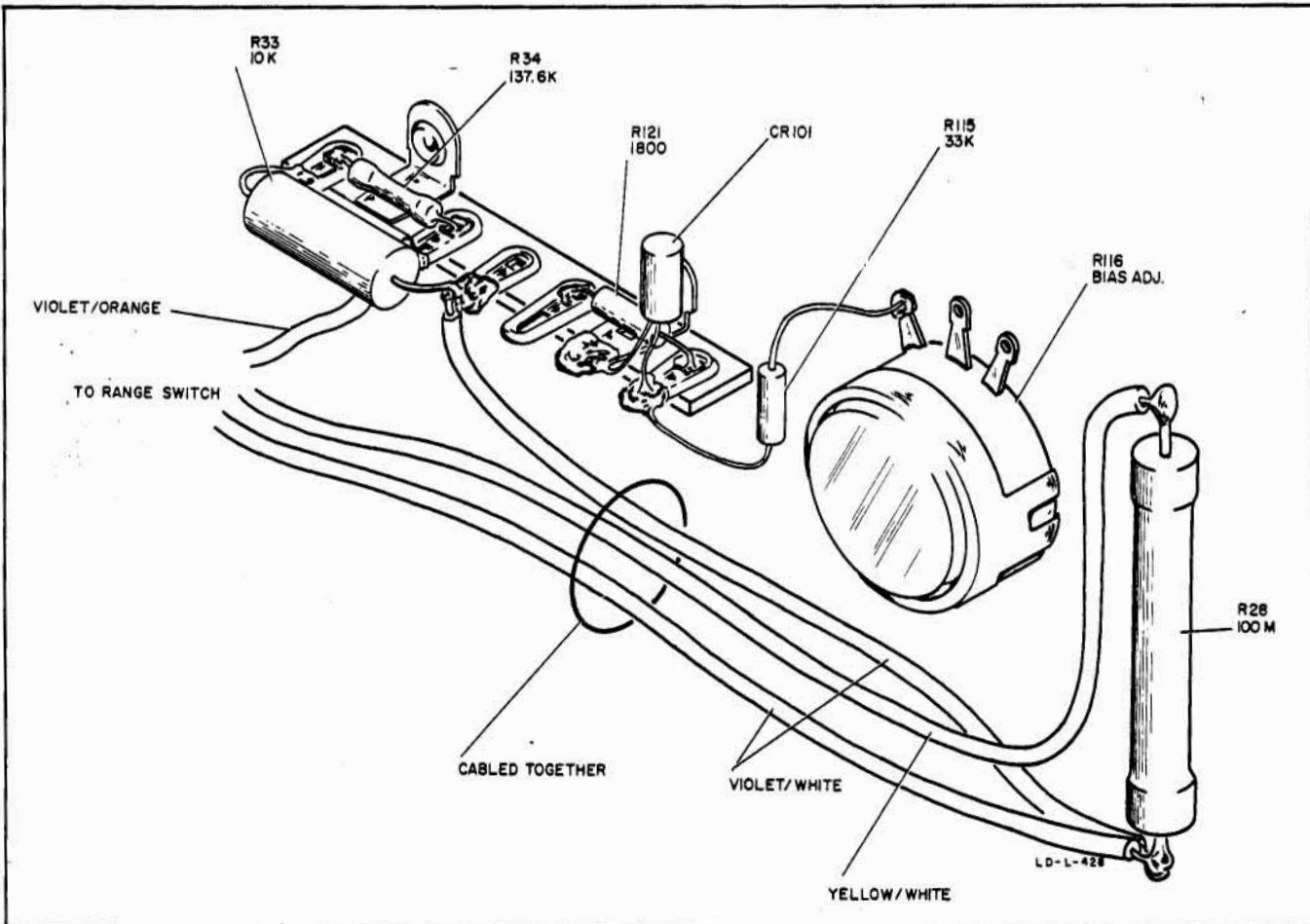


Figure 4. 7-Lug Terminal Strip Detail

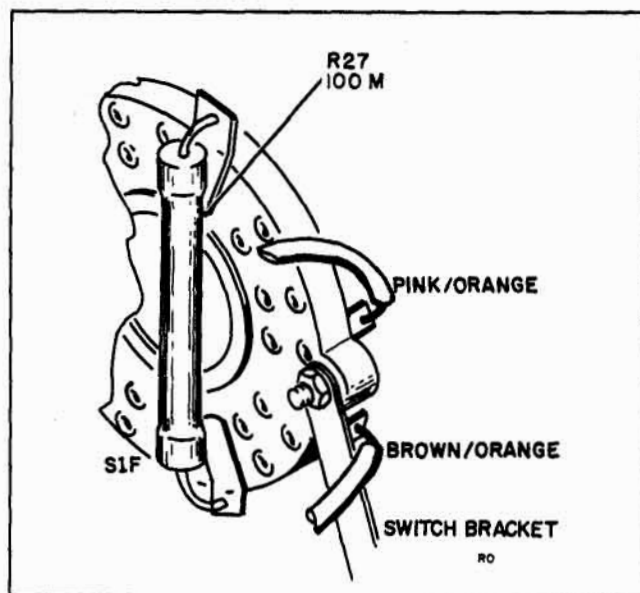


Figure 5. Range Switch Bracket Detail

- 21) Disconnect switch mounting bracket at rear of RANGE switch.
- 22) Remove RANGE switch panel mounting nut (1/2 in. nut driver) and washer.
- 23) Lift out old RANGE switch.
- 24) Strip and tin black-orange, yellow, pink-orange, brown-orange, and green chassis wires to be connected to new RANGE, POLARITY and FUNCTION switches.

## CAUTION

From this point on in procedure rubber gloves must be worn. Rubber gloves must be decontaminated before use, preferably by washing with Freon\* (type TF or PC) Solvent, and allowing them to air dry. After cleaning avoid contact with any substance other than replacement switch or clean hand tools.

- 25) Remove switch bracket from rear of old switch and install on new switch. Do not tighten bracket nut (3/16 in. open end wrench).
- 26) Loosely set new RANGE switch in position. Dress cabling to avoid binding.
- 27) Dress cabling to POLARITY and FUNCTION switches toward chassis.
- 28) Loosely fit FUNCTION switch in place. Dress leads to avoid binding. Dress pink-white, white-orange, black-white, and green wires toward panel and input terminal bracket. Dress gray and white

\*Freon Solvent, a product of The Dupont Company, Wilmington 98, Delaware, is chemically and thermally inert, with a very high purity rate.

wires on other side of switch and toward input terminal bracket.

- 29) Mount FUNCTION switch. Center lever in slot. Tighten screws (#6 x 5/16 in. binding head screws and #6 Tinnerman speed nut).
- 30) Orient RANGE switch and loosely install panel nut and washer (3/8 in. x 32 nut and 3/8 in. external lockwasher).
- 31) Loosely mount RANGE switch bracket to chassis (#6 x 1 in. binding head screw, #6 external lockwasher, and #6 hex nut w/lockwasher). Adjust final positioning of RANGE switch and tighten bracket screw. Tighten nut (3/16 in.) that holds bracket on switch. Tighten panel mounting nut (1/2 in.).
- 32) Push blue and brown meter wires thru cabling hole in chassis (with white-orange and black-orange wires).
- 33) Set POLARITY switch in position with switch terminal lugs pointing away from RANGE switch. Dress cabling for POWER switch and pilot light inside POLARITY switch bracket. Center lever in slot and tighten screws (#6 x 5/16 in. binding head screws and #6 Tinnerman speed nuts).
- 34) Solder green wire from terminal lug on FUNCTION switch to junction of capacitor C101 (.1 $\mu$ f) and resistor R101 (470K) which is the "A" input to the modulator.
- 35) Install input terminal bracket (#6 x 5/16 in. binding head screws w/lockwashers and #6 x 5/16 in. nuts).
- 36) Solder black wire from "B" input to modulator (junction of C103 and R105, etc.) to terminal lug on S1A that is junction of R19 and R10, 180 and 9 megohms, respectively.
- 37) Dress brown wire from R45 (.1 ohms) on S1C to terminal 3 of input terminal bracket. Do not solder. Do not shorten brown wire.
- 38) Solder brown-orange wire from junction of C114 (.051  $\mu$ f) and R117 (2.7 megohms) to terminal lug on RANGE switch wafer S1F to agree with figure 5.
- 39) Solder pink-orange wire from R116, BIAS ADJ control, to S1F to agree with figure 5.
- 40) Dress cabling from S1F wafer behind RANGE switch and close to chassis. Connect wires to 7 lug terminal strip at rear of chassis to agree with figure 4.
- 41) Solder yellow wire from DC amplifier OUTPUT terminal lug nearest R36 (OHMS ADJ. control) to POLARITY switch (see figure 3).
- 42) Refer to figure 3. Remove R47 from old POLARITY switch and install on new switch. Note: R47 may be a resistor or a jumper wire. See Service Notes 412A-1.
- 43) Solder black-orange wire from R46 (METER CAL control) and yellow wire from DC AMPLIFIER OUTPUT terminal to POLARITY switch to agree with figure 3.

44) Mount panel. Carefully install insulating spacers and tighten screws (#8 x 1 in.). Use 11/32 in. open end wrench. Connect support post with #8 x 1/2 in. binding head screw.

45) Mount pilot light (7/16 in. open end wrench). Mount power switch (9/16 in. open end wrench). Pilot light bulb may be removed for convenience.

46) Solder MA/OHMS, COM, and VOLTS cable leads and internal connecting wires to input terminals to agree with figure 2.

47) Solder blue (+) and brown (-) wires to meter terminals.

48) Scrape away accumulated flux from all solder joints, particularly in the input circuit. After flux

is removed from connecting terminals, wash area of each with Freon Solvent. Be careful not to allow solvent to contact Pyrofilm glass resistors on switch. These resistors are treated with a silicon "dry film" and should not be cleaned.

49) Install knobs.

50) Install bezel.

#### ADJUSTMENTS

1) Warm up instrument for at least 15 minutes.

2) Refer to Section IV of Model 412A Operating and Service Manual. Complete all procedures in paragraphs 4-14 under "Adjustments".