Errata

Title & Document Type: **412A/AR DC Vacuum Tube Voltmeter Service Note**

Manual Part Number: **00412-90001**

Revision Date: **August 1969**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

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Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

412A/412AR-1C

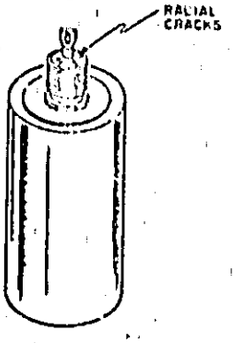
WN
AUG 1969

SUPERSEDES
412A/AR-1B

-hp- Model 412A/AR DC Vacuum Tube Voltmeter
(Serial Number 424-14482 and below)

RECOMMENDED REPLACEMENT FOR INPUT CIRCUIT ASSEMBLY (-hp- Part No. 412A-58A)

Capacitors C101, C102 and C103 (-hp- Part No. 0176-0030) in the Hewlett-Packard Model 412A/AR DC Vacuum Tube Voltmeter have been developing radial cracks (see Figure 1) which cause a zero offset indication on the meter with the instrument on the voltmeter function.



The radial cracks may be so small they can only be seen with a magnifying glass.

Figure 1

NOTE

The zero offset caused by the faulty capacitors decreases as the voltage range is increased. If your instrument has a constant zero offset, independent of range setting, see Service Note 412A-11A or 412AR-3.

A change of these capacitors to -hp- Part No. 0160-2928 necessitated a redesign of the input circuit board. The new input circuit board (-hp- Part No. 412A-58C) is a recommended replacement only if the capacitors are faulty. Hewlett-Packard Model 412A/AR's with serial number 424-14483 and above have the new input circuit board installed during manufacture.

Capacitors C101, C102 and C103 were changed again to -hp- Part No. 0160-2641 on -hp- Model 412A/AR's with serial number 424-14863 and above. On -hp- Model 412A/AR's with serial numbers from 424-14483 to 424-14862 capacitor -hp- Part No. 0160-2641 is the recommended replacement part and should be installed only if any of the capacitors C101, C102 or C103 fail.

Replacement board (412A-58C) has capacitor (-hp- Part No. 0160-2641) installed.

Table 1. Input Circuit Assemblies

INSTRUMENT SERIAL NO.	COMPLETE INPUT CIRCUIT ASSEMBLY (-hp- Part No.)	CHOPPER ASSEMBLY (-hp- Part No.)	INPUT CIRCUIT BOARD (-hp- Part No.)
424-14482 and below	412A-58A (Consists of 412A-05A plus input circuit board)	412A-95A	Not separately replaceable.
424-14483 to 424-14862	412A-30A (Consists of 412A-58C plus 00412-60502)	00412-60502	412A-58C Capacitor 0160-2928 was installed on 412A-58C; 0160-2641 is a recommended replacement part for 0160-2928.
424-14863 and above	412A-30A (Consists of 412A-58C plus 00412-60502)	00412-60502	412A-58C Capacitor 0160-2641 installed.

Note: Complete assembly 412A-30A can be used in all instruments.

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When installing -hp- Part No. 412A-58C in the -hp- Model 412A, the modulator shield (-hp- Part No. 412A-6B) can be discarded. The location of the Gain Cal variable resistor (R115) was also changed which will necessitate drilling a hole in the input circuit shield to make the Gain Cal adjustment accessible. See Figure 2.

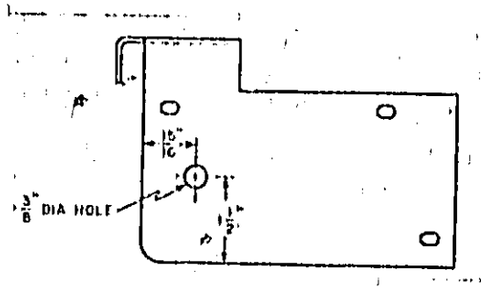

Figure 2

When installing the -hp- Part No. 412A-58C in the -hp- Model 412AR, replace the modulator shield (-hp- Part No. 412A-6C) with -hp- Part No. 412A-6D.

The Input Circuit Assembly (-hp- Part No. 412A-58A) includes C101, C102, C103, R101, R102, R103 and V110A/B. The Input Circuit Assembly with the replacement input circuit board (-hp- Part No. 412A-58C) is -hp- Part No. 412A-30A.

Correct the Replaceable Parts List in your Operating and Service Manual for the changes which apply to your instrument.

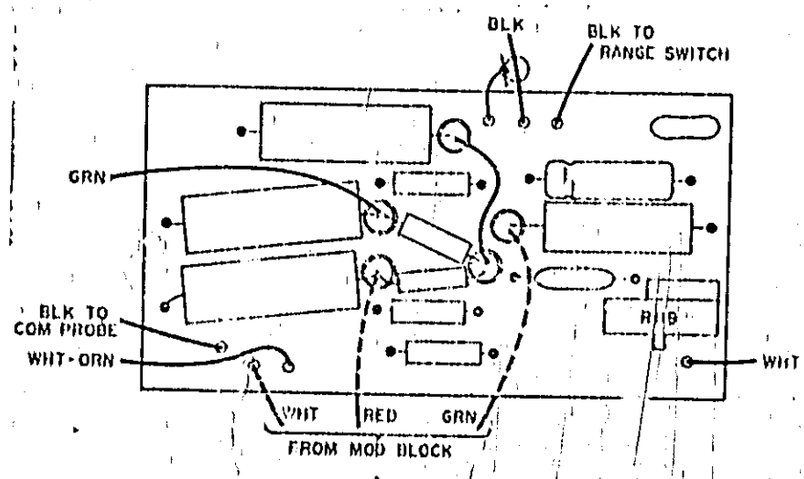

Figure 3. Wired for the -hp- Model 412A

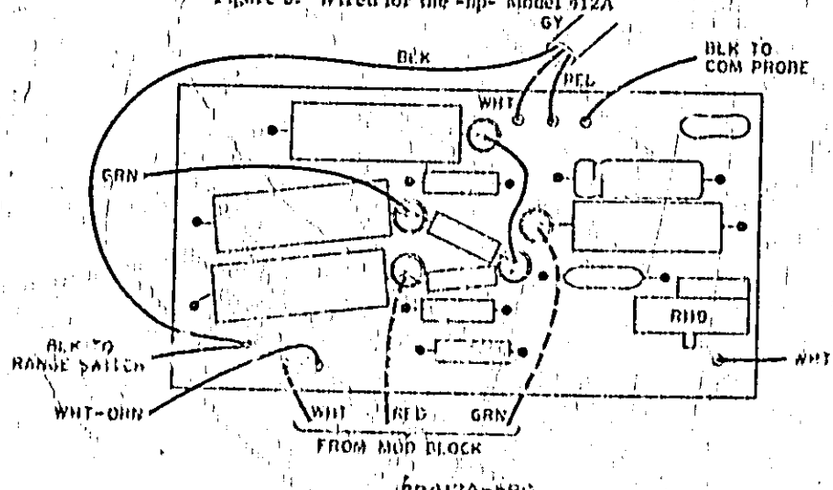

Figure 4. Wired for the -hp- Model 412AR

412A-2B

SERVICE NOTE

412A-2B

℔ MODEL 412A DC VACUUM TUBE VOLTMETER

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

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-19 A 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-1B. 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-19A
1	Nut, 1/2 inch	2950-0001
1	Washer, lkt. Lock, 11/16 inch	2190-0022
1	Washer, split lock #6.	2190-0018
5	Washer, 3/8 inch, brass . . .	3050-0066
1	Nut, hex #50-40 x 1/4 inch . .	0540-0004
4	Screw, Bind. Head SS.	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.

00308-3

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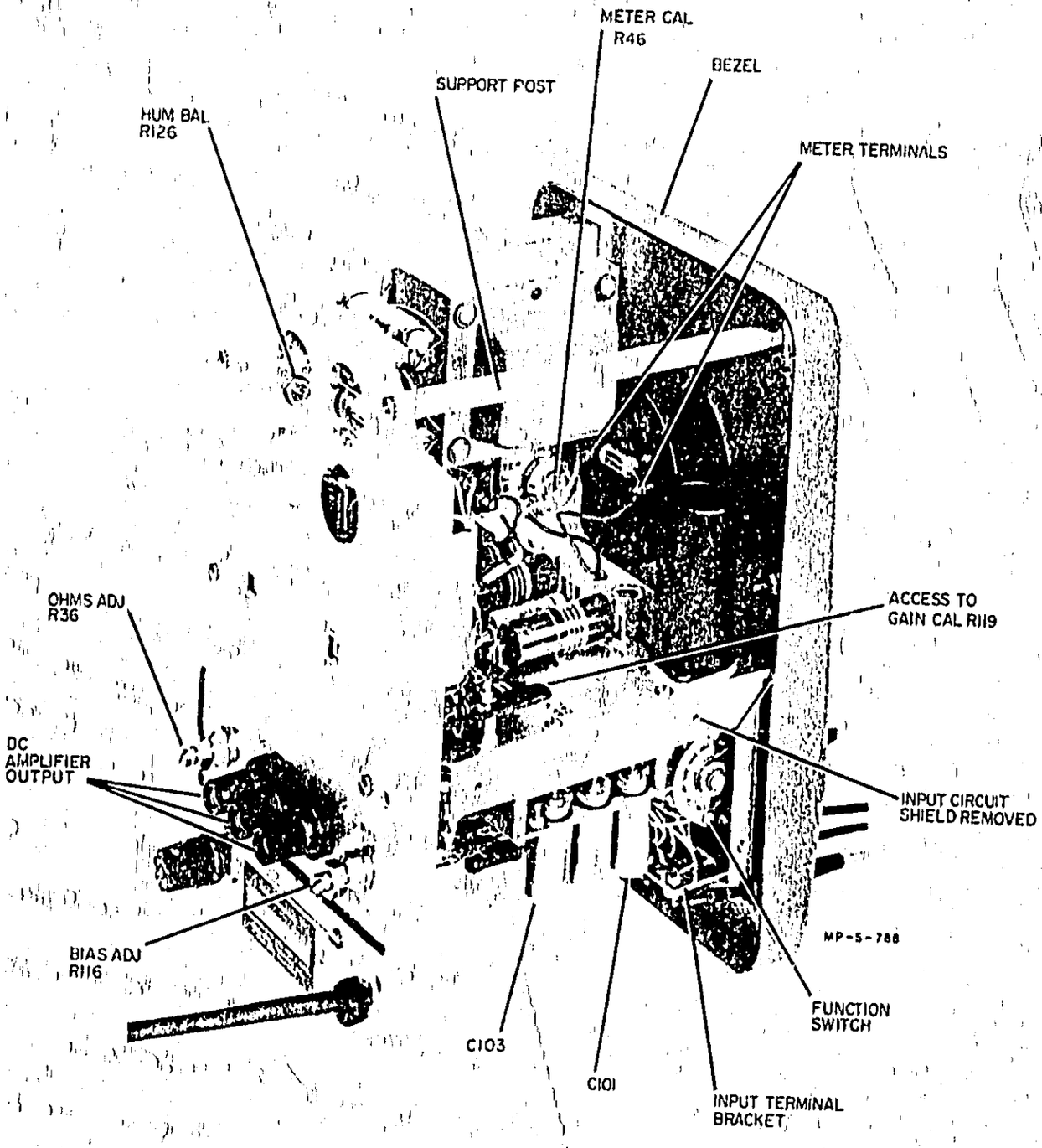

Figure 1. Model 412A Left Side View

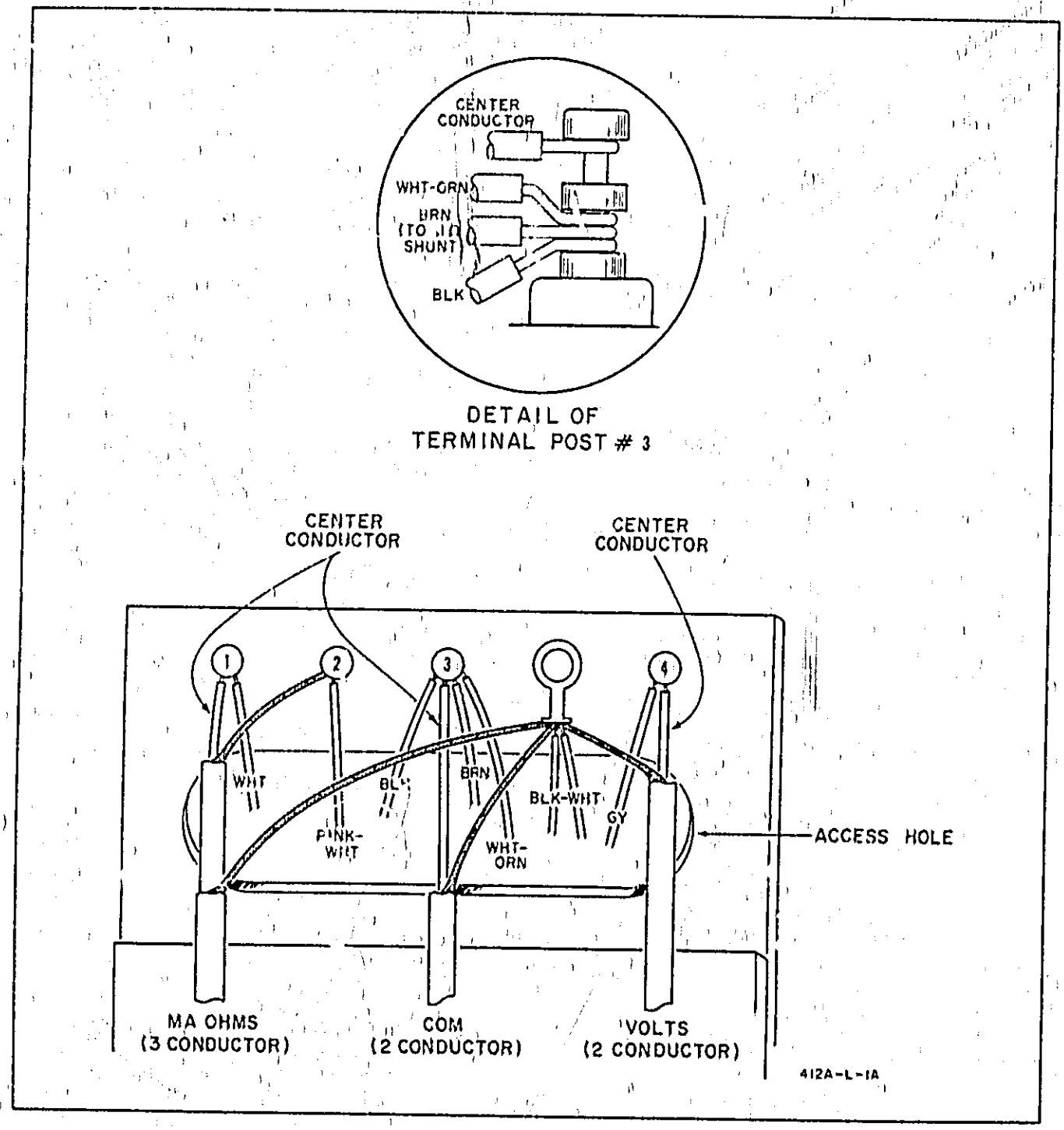

Figure 2. Connection Diagram for MA/OHMS, COM, and VOLTS CABLES (Cabinet Mounted Instrument Only)

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 from chassis (no wires need be unsoldered yet).

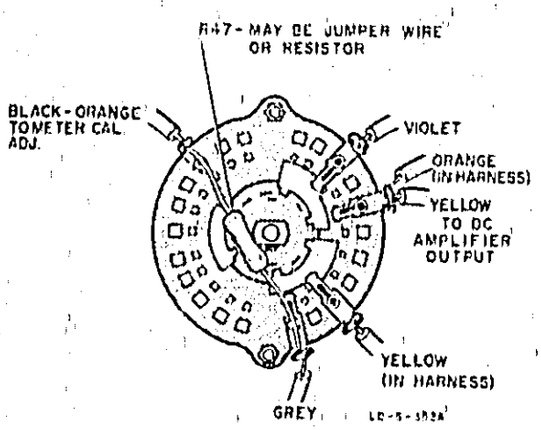

Figure 3. Polarity Switch Wiring

13) Detach POLARITY switch from chassis (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 connecting RANGE switch to input terminals.

16) Refer to figure 4-10 in Operating and Service Manual. Remove black wire from R10 (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). 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 (.1μf) and resistor R101 (470K) which is the "A" input to the modulator.

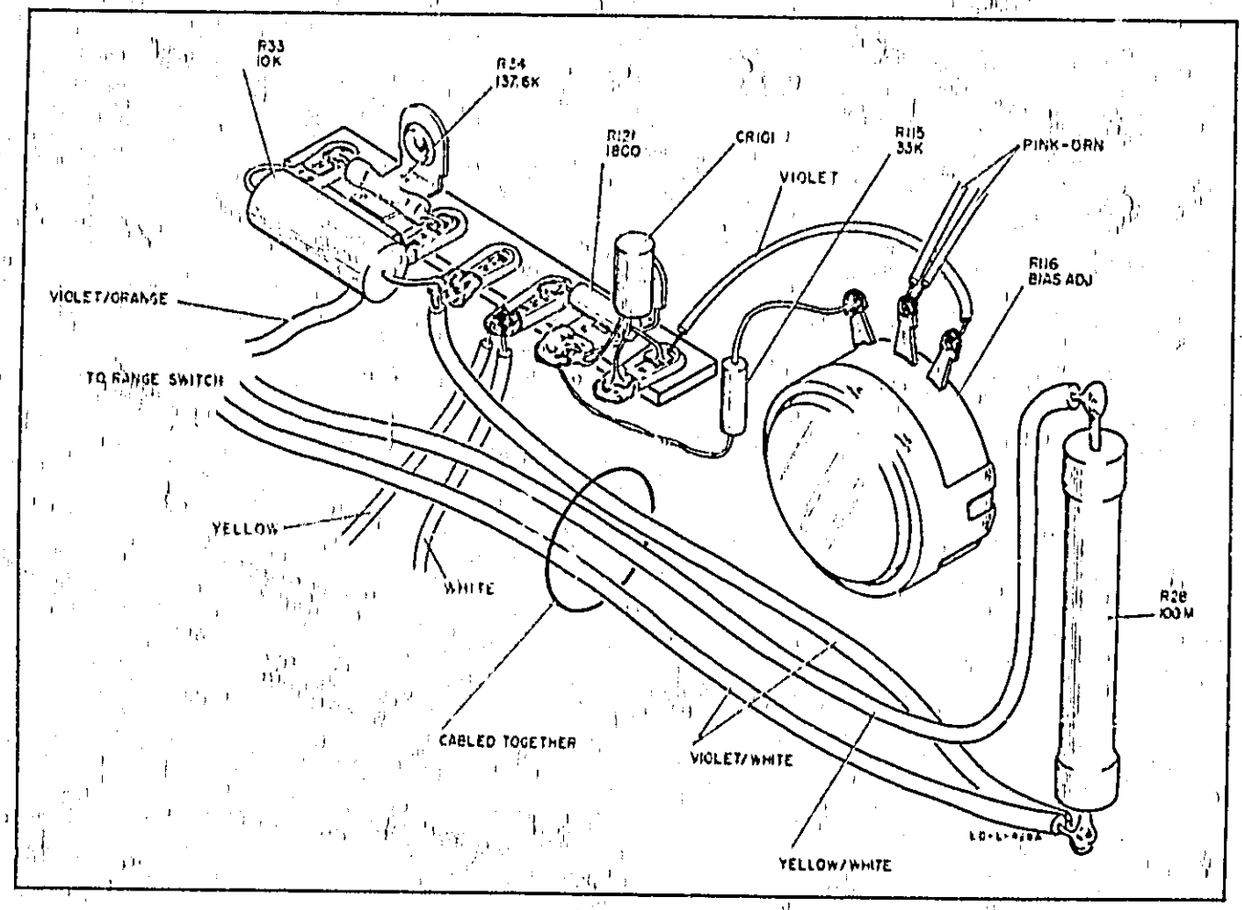

Figure 4. 7-Lug Terminal Strip Detail

00398-3

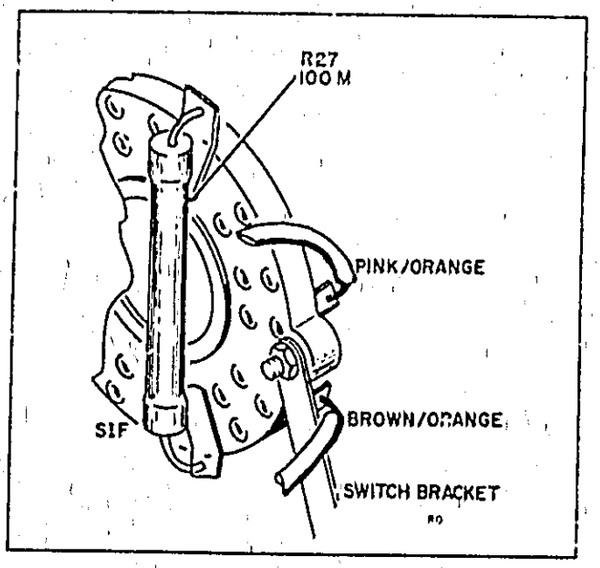

Figure 5. Range Switch Bracket Detail

21) Disconnect switch mounting bracket at rear of RANGE switch (see figure 5).

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 type TF Freon*, $\frac{1}{2}$ stock number 8500-0232, 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 wires on other side of switch and toward input terminal bracket.

29) Mount FUNCTION switch. Center lever in slot. Tighten #6 x 5/16 in. binding head screws.

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 #6 x 5/16 in. binding head screws.

34) Solder green wire from terminal lug on FUNCTION switch to junction of capacitor C101 (.1 μf) 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 μf) 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-1R

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.

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

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".

412A-3D

SEP 1965

-hp- Model 412A/AR DC Vacuum Tube Voltmeter

INSTALLATION OF DEMODULATOR ASSEMBLY
-hp- Part No. 412A-23B

The Demodulator Assembly, -hp- Part No. 412A-23B, is a direct replacement part in *any -hp- Model 412A/AR DC Vacuum Tube Voltmeter. It should be installed whenever the original assembly requires replacement.

INSTALLATION PROCEDURE.

1. Remove the demodulator assembly to be replaced.

2. Install replacement assembly. Connect wires to agree with Figure 1.

*Note: Units with serial 339-00330 and below were equipped with a 3-terminal assembly (-hp- Part No. 425A-23B). The 5-terminal assembly is an improved, direct replacement part for these instruments. To install, remove 3-terminal assembly to be replaced. Mount replacement assembly. Connect wires to agree with Figure 1.

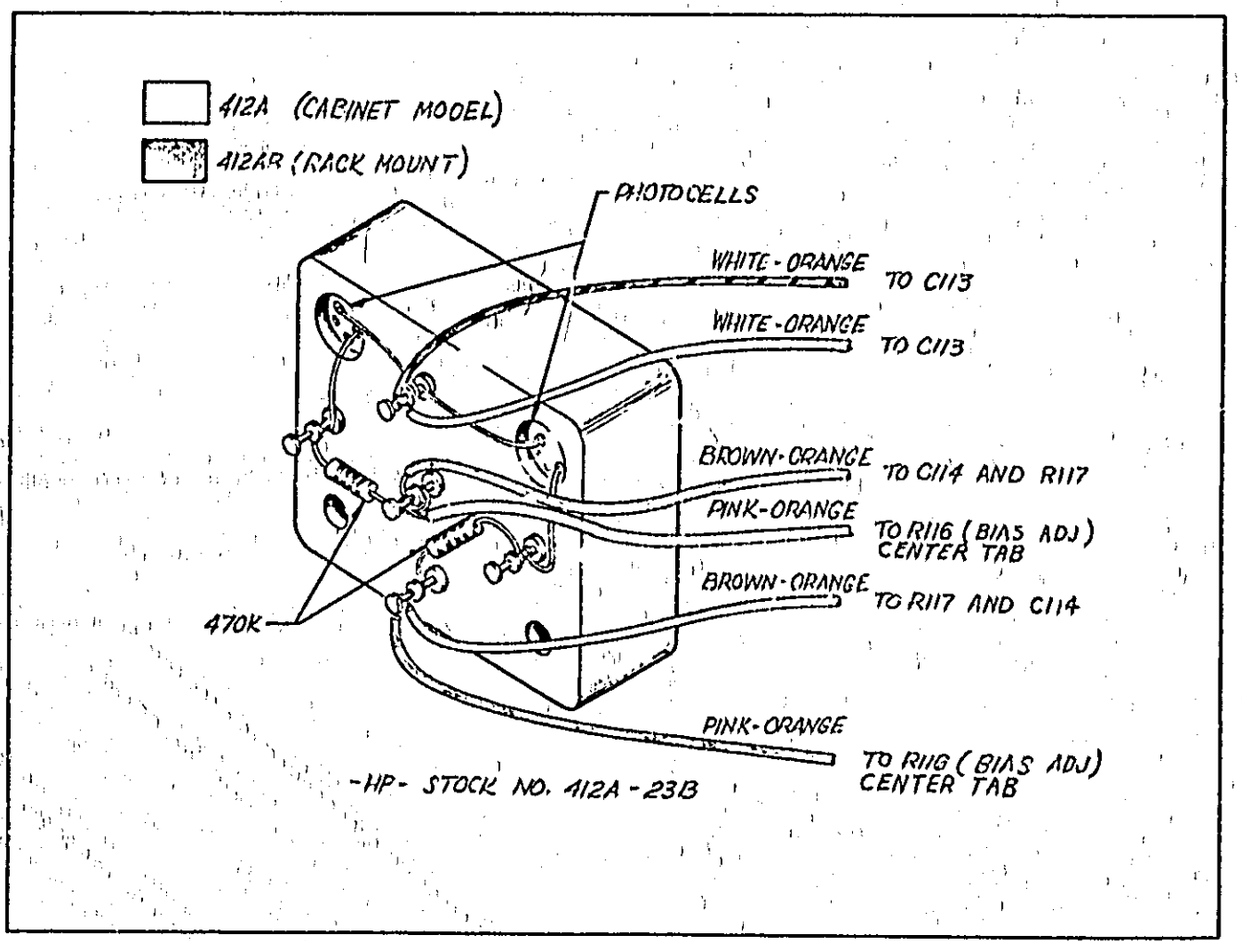

Figure 1. Demodulator Assembly

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412A/AR-3

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SERVICE NOTE

412A/AR-3

-hp- Model 412A/AR DC Vacuum Tube Voltmeter
Serial Number 424-14482 and below

RECOMMENDED REPLACEMENT FOR CR101

The recommended replacement for CR101 (-hp- Part No. 1902-0206) is -hp- Part No. 1902-0048. CR101 should be replaced only if -hp- Part No. 1902-0206 fails. The high power capability of the -hp- Part No. 1902-0206 is not required.

Correct the Replaceable Parts List in your Operating and Service Manual.

Hewlett-Packard Model 412A/AR's with serial number 424-14483 and above have the -hp- Part No. 1902-0048 installed during manufacture.

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412A/AR-4

WA
SEP 1974

P.C. None

SUPERSEDES
NONE

hp MODEL 412A/AR DC VACUUM TUBE VOLTMETER

OFFSETS ON CURRENT RANGES

Some instruments exhibit an offset on the current ranges only. This offset may be affected by either temperature or humidity but is generally a constant amount independent of the current input. The offset may even be seen with zero input and the input leads open.

If alignment fails to correct the zero offset, check R45 on the range switch. R45 is composed of a half watt resistor with a special wire wrapped around it (see Figure 1). The bottom resistor shown in Figure 1 was made using an improper type of wire and will cause zero offsets. This resistor has about 7 turns of wire around it. A good resistor such as one shown at the top of the figure has only about 5 turns of wire.

If a faulty resistor is found, it must be replaced. Changing the wire length will not solve the problem because the type of wire used is important.

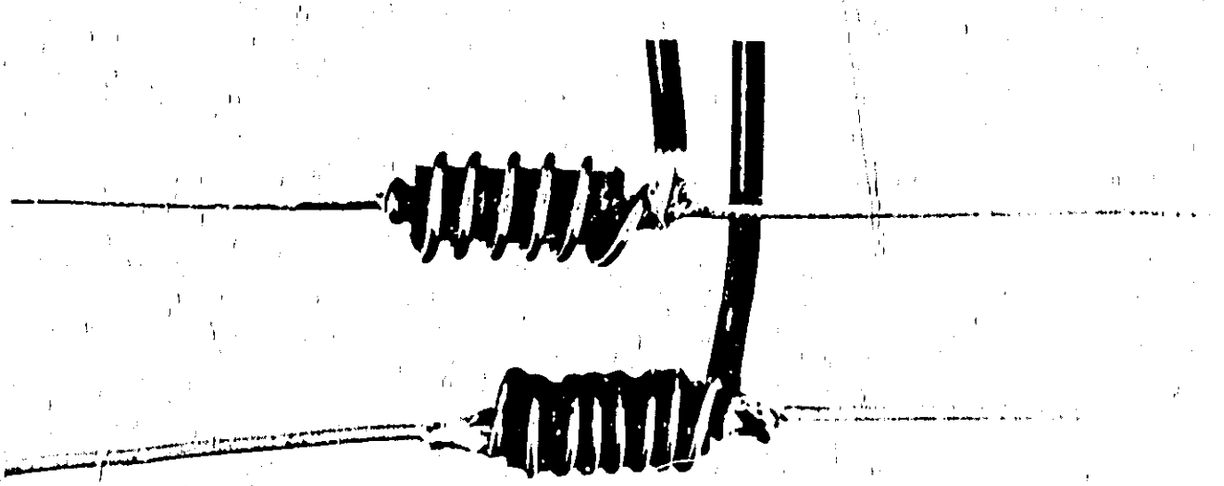

Figure 1.

CWC/bjb/WA

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412A/AR-5

SAFETY

WN
MAY 1975

P.C. None

SUPERSEDES
NONE

-hp- MODEL 412A DC VACUUM TUBE VOLTMETER

Serial Numbers: (412A) 978-19484 and below
(412AR) 0978-20458 and below

REVISIONS TO MINIMIZE SHOCK POTENTIALS

WARNING

When some Model 412A/AR's are floated above ground, the shafts on the RANGE, FUNCTION and POLARITY switches, BIAS ADJ. pot, OHMS ADJ. pot and exposed rear inner chassis are at the same potential as the COM (common) INPUT lead.

A kit is available, -hp- Part No. 00412-69503, for updating your instrument to conform to new safety specifications. Installation time is approximately two hours for the 412A and one hour for the 412AR. The kit is available at factory cost.

CHECKING FOR ISOLATION.

1. Turn instrument on, place FUNCTION to OHMS, RANGE to 1 K, and POLARITY to + (minus).
2. Connect a needle probe (or paperclip) to the OHMS lead and touch it to the set screws of the POLARITY switch, FUNCTION switch, and RANGE switch and note readings. Also check BIAS ADJ pot, OHMS ADJ pot, and exposed rear inner chassis and note readings.
3. The instrument should indicate infinity. If it shows continuity instead, it is recommended that the modification be installed.

Parts Included in Kit Part Number 00412-69503

Quantity	Description	-hp- Part No.
4	Washer, Locking	2190-0007
10*	Washer, Insulating	3050-0159
4	Screw, Insulating	0570-0111
1	Knob, Range	0370-2791
1	Cap, Range Knob	5040-7767
1	Shield, Clear Plastic	00412-0410]
1	Punch	8710-0681
1	Warning Sticker	7120-4082
1	Service Note	412A/AR-4
2	Washer, Insulating	425A-41C
2	Washer, Flat	3050-0067
2	Washer, Star	2190-0016

* 8 needed for 412A, 10 for 412AR

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MODIFICATION FOR 412A AND 412AR (RACK MOUNT).

1. Remove all power to 412A/AR to be modified.

2. Remove the three front panel knobs and outer cabinet.

CAUTION

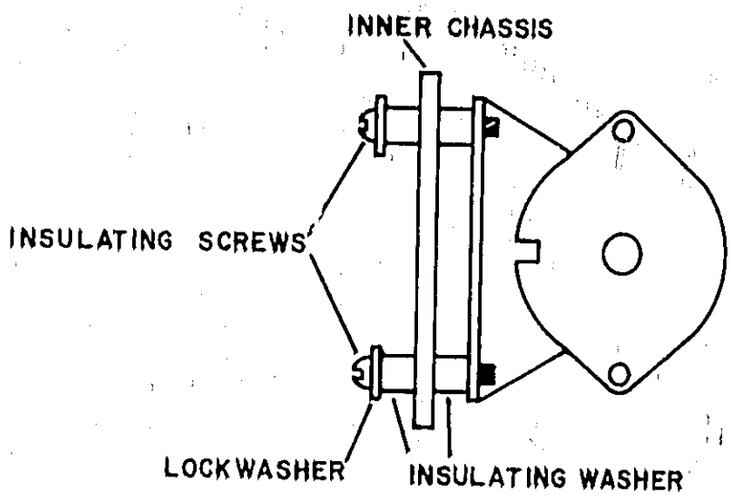
Do not touch the range switch components, switch wafers, or any glass resistors with the fingers. Wear a pair of light cotton gloves when working around switch or glass resistors, since skin oils and acids can contaminate and degrade instrument performance.

3. Remove the two detachable shields around the input circuit board. (Skip this step for 412AR.)

4. Unbolt front panel from inner chassis and remove the screw holding the chassis support rod (MP3, Figure 6-1 in Part Number 00412-90003 Manual) to the rear panel. (NOTE: On 412AR, also remove OUTPUT jacks and insulator from front panel and skip the part about the chassis support rod.)

5. Slide front panel away from inner chassis, while carefully pulling the test cables thru the cable boots, until the screws holding the POLARITY and FUNCTION switches can be reached.

6. Remove the two screws holding the POLARITY switch to the inner chassis and remount the switch as shown below.



NOTE

On 412AR's, place TWO insulating washers between the POLARITY switch and inner chassis.

7. Make sure the switch does not touch the inner chassis at any point and that the switch shaft is centered both vertically and horizontally, on the inner chassis, to prevent binding and possible shorting.

8. Repeat Steps 6 and 7 for the FUNCTION switch.

NOTE

For easy remounting of the FUNCTION switch on the 412A, unscrew the input circuit bracket.

9. Reinstall the input circuit bracket, if removed, and the front panel.

10. Check that the POLARITY and FUNCTION switch shafts do not touch the front panel in any normal position. Reposition the switch slightly if necessary.

11. Reinstall the POLARITY and FUNCTION switch knobs. (On 412AR's, also remove the OUTPUT insulator and jacks).

12. Use the new knob provided in the kit for the RANGE switch. This new knob does not have set screws but uses a collet. The collet nut must be tightened firmly using a 9 mm socket.

NOTE

If the shaft is extremely polished, it may be necessary to slightly burr the shaft to prevent slippage. This may be easily done with a pair of common pliers by grabbing the shaft with the jaws and rocking the pliers back and forth slightly.

13. Snap the cap on the new RANGE knob WITH THE WHITE LINE ON THE CAP LINED UP WITH THE WHITE LINE ON THE KNOB. (For 412AR modification, skip Steps 14 through 20).

14. Remove the screws holding on the rear panel.

15. Remove the DC AMPLIFIER OUTPUT jacks and insulator.

16. Unbolt the BIAS ADJ. pot and OHMS ADJ. pot and slide them back out of their mounting holes.

17. Using punch (included in the kit), punch the BIAS ADJ. and OHMS ADJ. mounting holes to 1/2 inch.

18. Pull rear panel back far enough to install clear plastic shield (provided in the kit) between rear panel and inner chassis.

19. Reinstall the DC AMPLIFIER OUTPUT insulator and jacks.

20. Remount the BIAS ADJ. pot and OHMS ADJ. pot using parts in the following order: Pot Body and Insulating Washer inside the chassis' Flat Washer, Star Washer and locking device on the outside (washers provided in the kit).

21. Reassemble the instrument.

22. Repeat the isolation check given on Page 1 to insure proper isolation.

23. Place warning sticker on the modified instrument in a prominent location.

24. Reset the BIAS ADJ. and OHMS ADJ. as in Section V of the Operating and Service Manual. (On 412AR's, the BIAS ADJ. and OHMS ADJ. need no resetting.) Check the operation of the instrument. Add the parts list to your Operating and Service Manual's Table of Replaceable Parts, and add the following Note at the beginning of Section V.

NOTE

When installing the collet knob on the RANGE switch, make sure that THE WHITE LINE ON THE CAP IS LINED UP WITH THE WHITE LINE ON THE KNOB.

THIS COMPLETES THE MODIFICATION.

412A-6C

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APR 1968

SERVICE NOTE

SUPERSEDES
NONE

-hp- MODEL 412A DC VOLTMETER-OHMMETER-AMMETER

RANGE SWITCH MAINTENANCE

CAUTION

KEEP SWITCH CLEAN. WEAR A PAIR OF CLEAN RUBBER GLOVES WHEN HANDLING.

The following precaution should be exercised when cleaning the 412A VTVM range switches. The Pyrofilm resistors have a silicon coating – be careful to not wash the silicon off these resistors when cleaning the range switch. If you should accidentally remove the silicon coating, it may be reapplied by using Dupont Silicon Insulcone.

SERIAL NO. 424-14281 AND BELOW.

I. 412A-19W and 412A-19W-1 (White Wafers).

This switch should be cleaned with a detergent and warm water. Other cleaning agents may contain chemicals which could attack the wafer material or cause it to become brittle.

The washing should be followed by a very complete rinsing. Use distilled water as a last rinse. The switch should then be dried overnight at approximately 120°F.

Lubricate the switch following the cleaning process as described at the end of this service note.

II. 412A-19A and 412A-19B (Green Wafers).

Freon TF is recommended as an effective cleaning agent for these switches. Any cleaning agent containing weak acids, weak alkalies, or organic solvents such as tolulene, carbon tetrochlorjde, or chlorinated compounds may cause the wafer material to swell and should not be used.

Lubricate the switch following the cleaning process as described at the end of this service note.

SERIAL NO. 424-14282 AND ABOVE.

III. 412-19A and 412A-19B (Green or White Wafers).

These switches are physically identical except for color which may be green or white.

Follow the same maintenance procedure as in case II above for green wafer switches.

Lubrication

The detent assembly should have a small amount of lubricant applied to it following the cleaning process.

A small amount of lubricant should be applied to the rotor blades on the switch wafers after cleaning. This must be carefully applied as too much lubricant may cause leakage paths to adjacent contacts.

-hp- part numbers for recommended material are:

Freon TF, 16 oz. spray can	8500-0232
Lubriplate, 1/2 oz. tube	6040-0018
Gloves, rubber	8650-0015

JBA/my/WO

4/68-9

For more information, call your local HP Sales Office or East (201) 265-5000 • Midwest (312) 677-0400 • South (404) 436-6181 West (213) 877-1282. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California 94304. In Europe, 1217 Meyrin-Geneva

HEWLETT hp PACKARD

412A-7B

WO
JUL 1974

412A-7B
SERVICE NOTE

SUPERSEDES
412A-7A

-hp- MODEL 412A/AR VACUUM TUBE VOLTMETER

All Serial Numbers

REPLACEABLE PARTS FOR VOLTAGE PROBE ASSEMBLY

The Hewlett-Packard Model 412A/AR Vacuum Tube Voltmeter voltage probe assembly has been redesigned because some of the probe parts have become obsolete and are no longer available.

The new voltage probe assembly can be used as a replacement on all -hp- Model 412A's; installation instructions are given in Section I. Replaceable parts for voltage probe assemblies, -hp- Part No.'s 412A-21A, 412A-21D, 412A-21G, 00412-62101, and 00412-62104 are identified in the following figures.

INSTALLATION PROCEDURE

A. Serials 134-07482 and below: Voltage Probe Assembly, -hp- Part No. 00412-62101, is an overall replacement for the 412A-21A Voltage Probe. The cable should be cemented to the cable boot to relieve the stress on the input solder connections. A pair of plastic grip rings can also be installed to reduce the effects of excess stress on the input connection. This modification is available in kit form, -hp- Part No. 00412-69501, and can be purchased from your local -hp- Sales and Service Office.

B. Serials 301-07483 through 316-10282: Voltage Probe Assembly, -hp- Part No. 00412-62104, is a direct overall replacement for the 412A-21D Voltage Probe.

C. Beginning with Serials 424-10283, -hp- Part No. 412A-21G (now 00412-62104), is used as the original Voltage Probe Assembly.

REPLACEABLE PARTS FOR PROBE ASSEMBLIES

NOTE

The item numbers in Tables 1 and 2 refer to Figures 1 and 2. Former -hp- Part No.'s are listed in parenthesis after part description.

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Table 1. Replaceable Parts for Voltage Probe Assembly -hp- Part No.'s 412A-21A and 412A-21D (see Figure 1).

Item	Description	-hp- Part No.
1-8	Complete Probe Assembly (412A-21A)	replaced by 00412-62101
1-7	Probe Cable Assembly less Cable Boot (412A-21D)	replaced by 00412-62104
2-8	Probe Assembly less Jaw Assembly	replaced by 00412-62103
1	Jaw and Sleeve Assembly	5060-0416
4	Locknut	6040-0407
5	No. 4 Allen setscrew (two required)	3030-0051
6	Handle	6040-0405
8	Cable Boot	412A-83A

The following are no longer individually replaceable.

2	Inner Sleeve Assembly including R4B (412A-21A-95A)	order 00412-62103
3	Inner Shield Assembly (412A-21A-96B)	order 00412-62103
7	Probe Cable (412A-21A-1 or 412A-21D-1	order 00412-62103

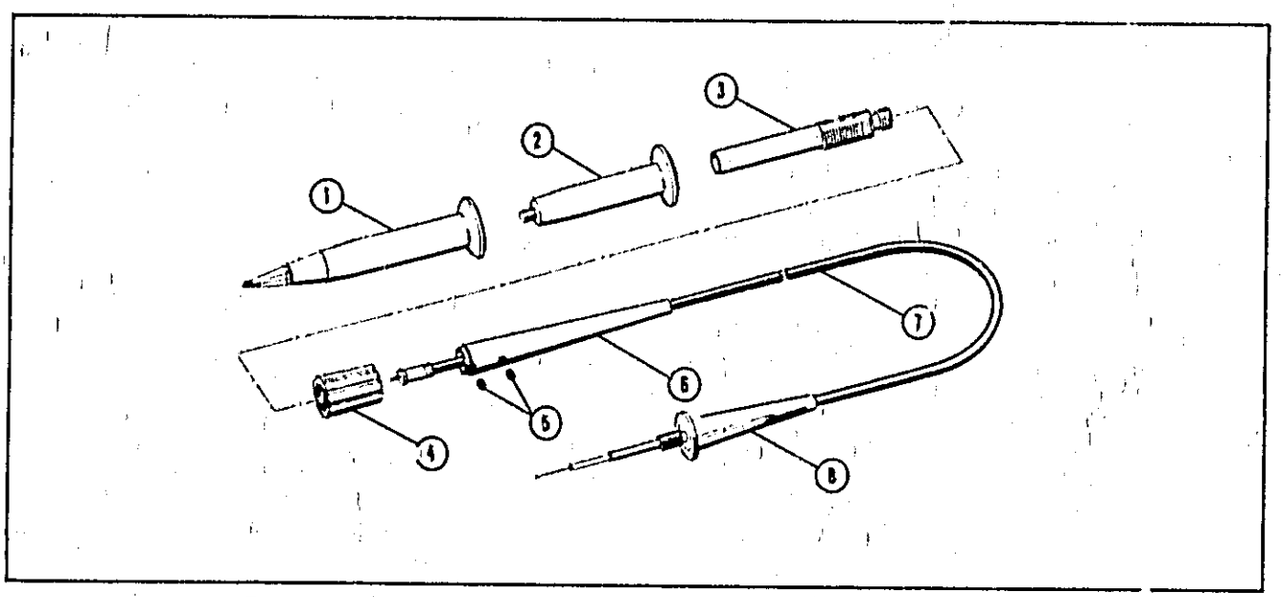

Figure 1. Voltage Probe Assembly, -hp- Part No.'s 412A-21A and 412A-21D, (412A-21D does not include Item 8)

Table 2. Replaceable Parts for Voltage Probe Assembly
·hp· Part No. 00412-62101, 00412-62104, and 412A-21G (see Figure 2).

Item	Description	·hp· Part No.
9-15	Complete Probe Assembly	00412-62101
9-14	Probe Assembly less Cable Boot (412A-21G)	replaced by 00412-62104
10-15	Probe Assembly less Jaw Assembly	00412-62103
9	Jaw and Sleeve Assembly	5060-0416
10	Probe Sleeve Assembly (includes cable and R48)	00412-62102
11	Ground Body	5020-0648
12	Locknut (old light gray)	5040-0407
	Locknut (new darker gray)	5040-5166
13	No. 4 Allen setscrew (two required)	3030-0051
14	Handle (red)	5040-0405
	Handle (gray)	5040-5160
15	Cable Boot	412A-83A

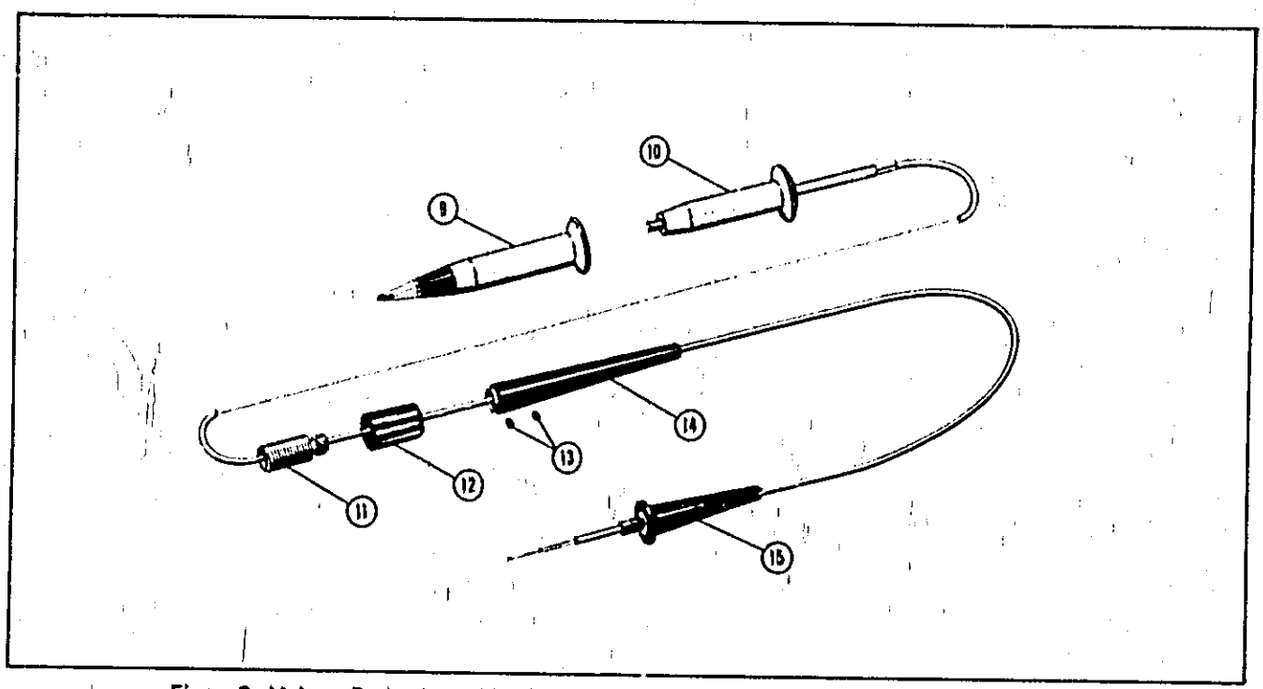

Figure 2. Voltage Probe Assembly, ·hp· Part No.'s 00412-62101, 00412-62104, and 412A-21G
(412A-21G and 00412-62104 do not include item 15)

412A-8A

MAY 1967

HEWLETT hp PACKARD

SERVICE NOTE

412A-8A

-hp- Model 412A/AR Voltmeter-Ohmmeter-Ammeter
Serials 134-07482 and below

INPUT CABLE MODIFICATION KIT, -hp- PART NO. 00412-69501

Installation of this modification kit will prevent damage to the input cables by reducing the effects of excess strain. The plastic cable clamps provided in this kit transfer the strain previously experienced at either the cable boots or the tie points to the modified cable support bracket. As a result, you will experience longer and more reliable performance from the Model 412A/AR.

This Service Note is presented in two sections. Section I contains installation procedures to be used with cabinet model instruments. Section II contains installation procedures to be used in conjunction with rack mounted models.

No special tools are required to effect this modification. Either type of modification can be completed in approximately 2 hours.

PARTS SUPPLIED IN MODIFICATION KIT

-hp- Part No. 00412-69501

Quantity	Description	-hp- Part No.
1	Bracket, tie point	412A-12E
1	Bracket, cable support (cabinet model).	412A-12C
1	Bracket, cable support (rack mount model). . .	412A-12D
3	Clamp, cable	0400-0019
2	Machine screw, 6-32 x 3/8 BH with lockwasher.	2390-0009

SECTION I. INSTALLATION INSTRUCTIONS FOR CABINET MODEL.

1. Remove cabinet and turn instrument on its top.
2. Remove shield on the function switch side of the instrument.
3. Unsolder all wires from the tie point bracket located on main chassis where the input cables enter the instrument (see Figure 1).
4. Remove the hexagonal nuts and screws indicated by arrows in Figure 2.
5. Remove FUNCTION, POLARITY, and RANGE knobs from the front panel using an Allen wrench. For ease of removal and replacement, set RANGE switch to .001 volt position before removing knobs. Remove the front panel.
6. Remove old tie point bracket from chassis and discard (see Figure 3).
7. Bolt new tie point bracket to chassis as illustrated in Figure 3.
8. Feed input cables through the front panel. Pull 2-1/2 inches of cable through. Snap the plastic cable clamps onto the input cables as shown in Figure 3. Insure that at least two inches of cable are available to the rear of the plastic clamps. There are two brackets included with this kit; one to be used with cabinet models, the other with rack models. Slip the cable support bracket over the input cables and snap the plastic clamps into the cable support bracket. Refer to Figures 3 and 4.
9. When plastic clamps are firmly seated, bolt cable support bracket to tie point bracket as shown in Figures 3 and 4. Insure that forward face of plastic cable clamp fits firmly against rear end of cable boot mounting studs as shown in Figures 3 and 4.
10. Solder the input cable wires as shown in Figure 4.

CAUTION

When unsoldering and soldering input cables to tie points, insure that cable shielding strands do not penetrate cable insulation, thus grounding the element.

11. Replace front panel by reversing steps #4 and 5 above.
12. Replace shield cover by reversing step #2 above.
13. Replace instrument cabinet.

SECTION II. INSTALLATION INSTRUCTIONS FOR RACK MOUNTED MODELS.

1. Remove the dust cover from the instrument.
2. Unsolder the input cable wires at the tie points just behind the input cable boots (see Figure 5).

May 1967-9

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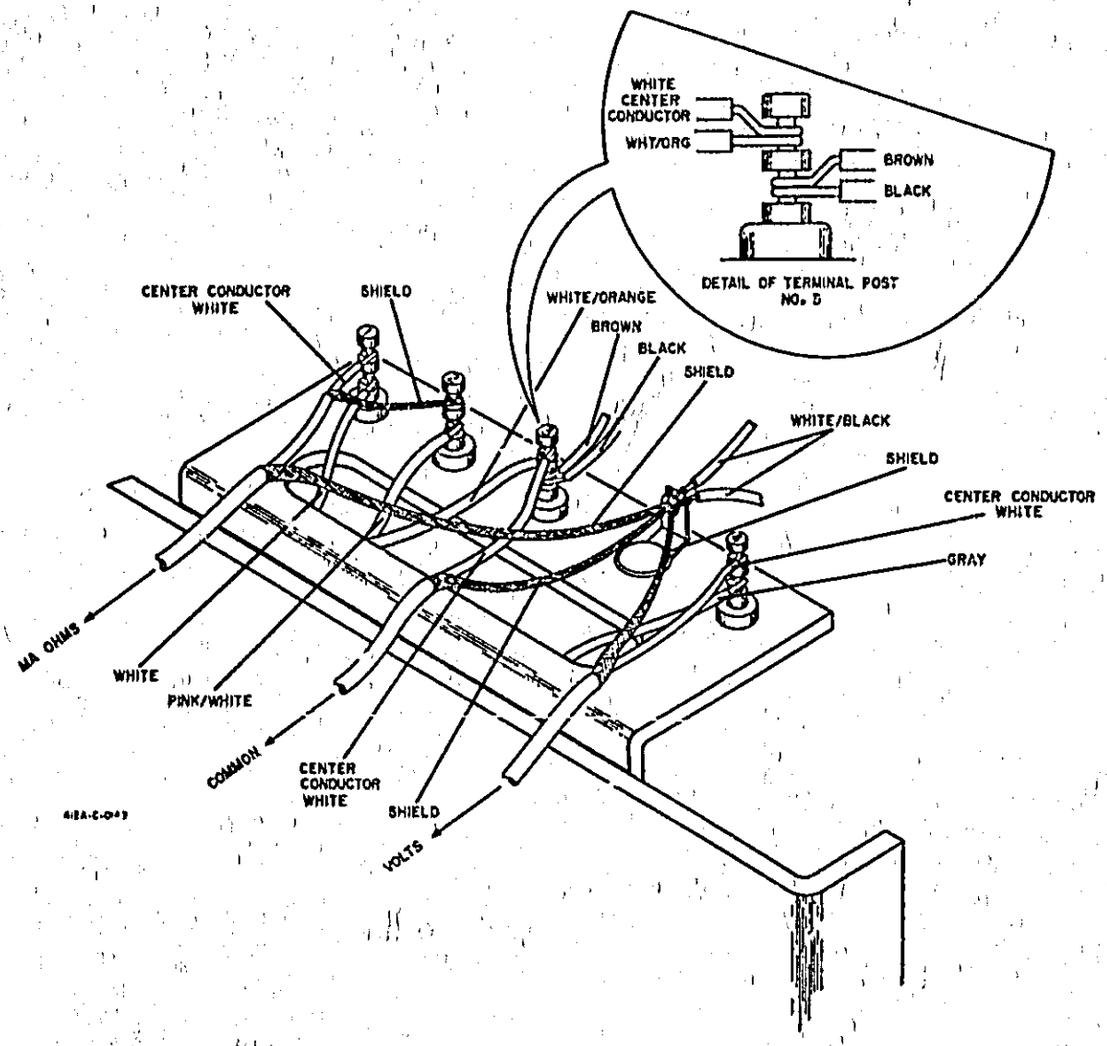

Figure 1

3. Feed the cables through the holes in the cable support bracket provided and seat the plastic cable clamps as indicated in Figure 6. Refer to steps 8 and 9, Section I.
4. Position the cable support bracket so that the front face of the plastic cable clamp sits firmly against the rear end of the cable boot mounting stud. Mark and drill #28 holes in the chassis as indicated in Figure 6, using the bracket as a guide.
5. Fasten cable support bracket to the chassis using the two 6-32 x 3/8 screws.
6. Solder the input cables as illustrated in Figure 6.

CAUTION

When unsoldering and soldering input cables to tie points, insure that cable shielding strands do not penetrate cable insulation, thus grounding the element.

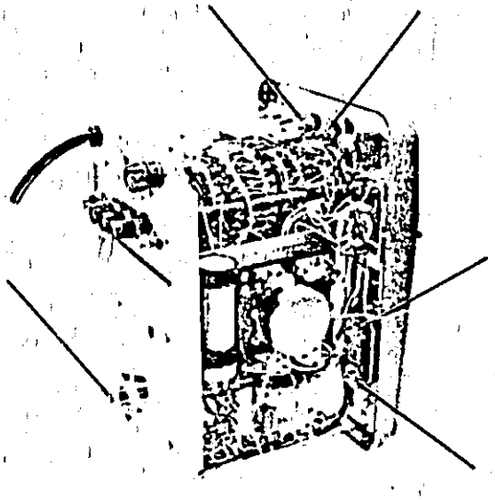

Figure 2

7. Replace dust cover.

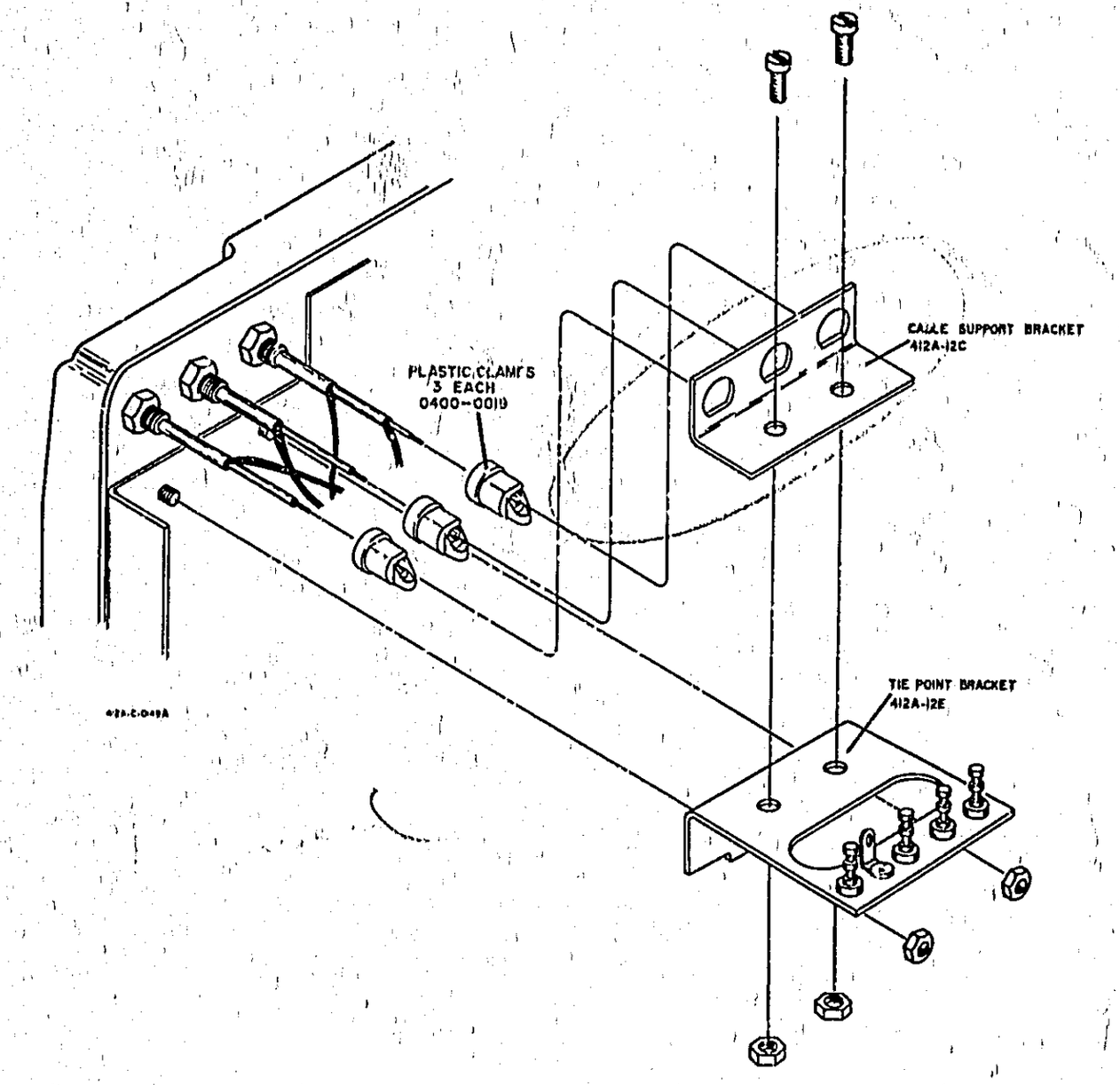

Figure 3

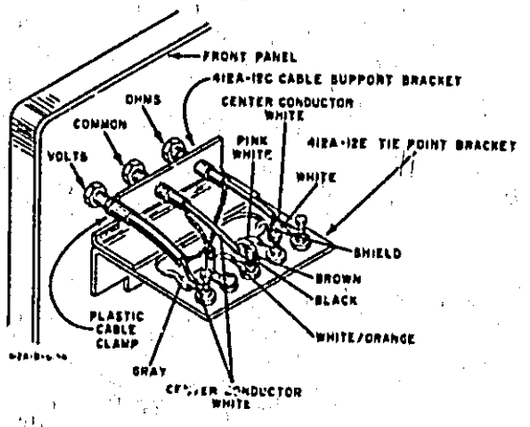

Figure 4

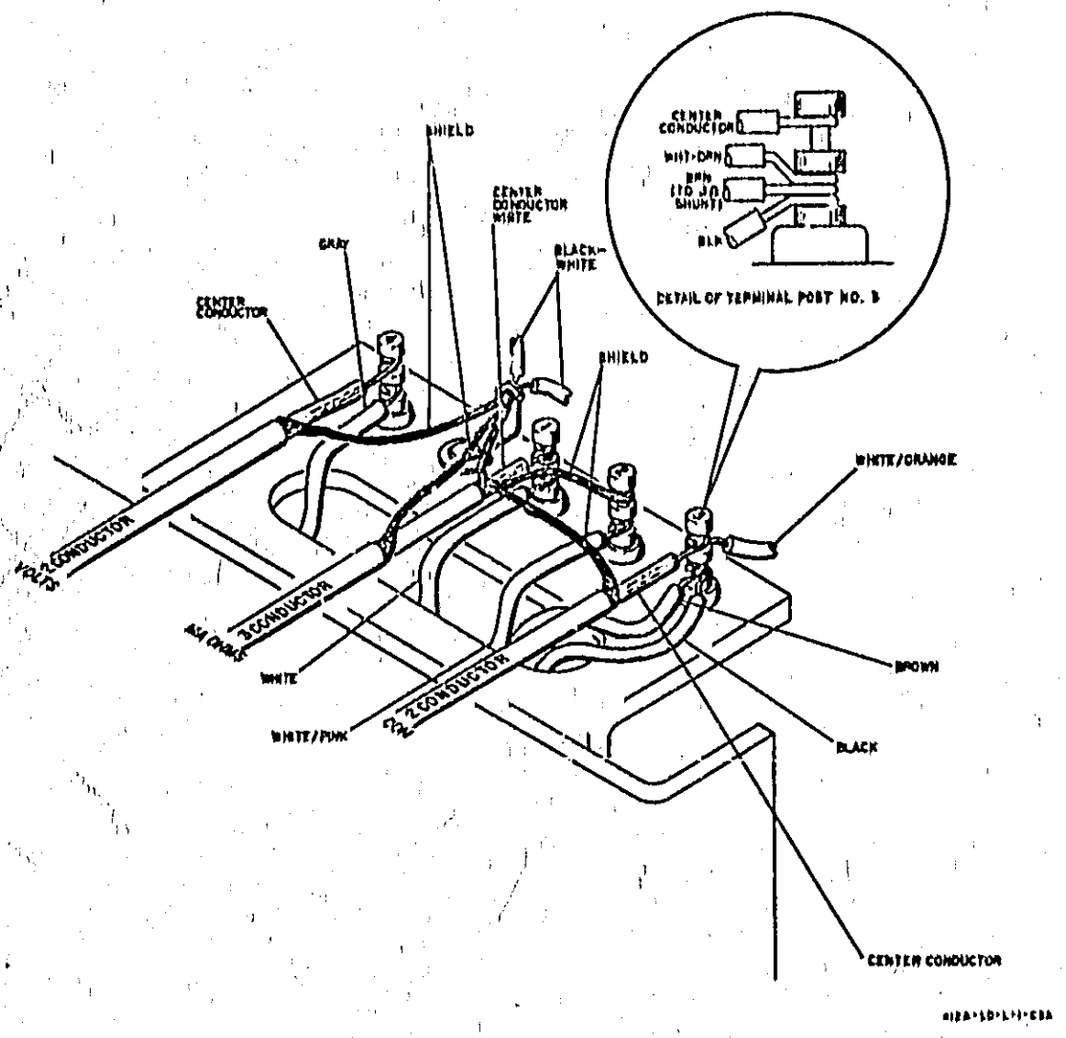

Figure 5

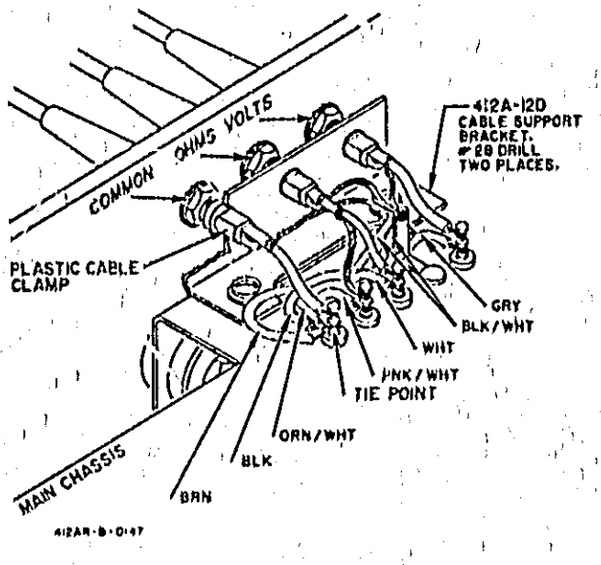

Figure 6

412A-9C-S

SAFETY

WA
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PRODUCT SAFETY SERVICE NOTE

P.C. None

SUPERSEDES
P.C. 412A-8B-S

-hp- MODEL 412A VACUUM TUBE VOLTMETER

All Serials

ELIMINATION OF A POTENTIAL SAFETY HAZARD

The Model 412A Vacuum Tube Voltmeter "volts" probe (-hp- Part No. 00412-62101) has a small Allen screw set in the red rubber boot to the rear of the probe. This Allen screw has been recessed and covered with a rubber insulating compound to prevent possible flash-over between the screw (common ground) and the operator, when making floating measurements.

Frequent checks should be made to insure that this insulation is properly seated. If replacement becomes necessary, a compound such as G.E. RTV-108 Silicone Rubber (-hp- Part No. 0470-0304) is recommended. As an additional safety precaution, a vinyl black electrical tape (-hp- Part No. 0460-0992) and 0.5 inch diameter shrink tubing are also added to insure safety.

Procedure

1. Disassemble the probe.
2. Add the silicone rubber to the recess.
3. Wrap three turns of the black vinyl tape about the recess.
4. Add the shrink tubing to the handle but do not heat.
5. Re-assemble the probe.
6. Place the shrink tubing over the recess and heat.

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412A-11A

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JAN 1967

SUPERSEDES
NONE

-hp- MODEL 412A DC VACUUM TUBE VOLTMETER

Serial Number 424-14482 and below

INSTALLATION OF ZERO ADJUST CONTROL

A constant zero offset, independent of range setting (-hp- Model 412A in the voltmeter function), can be eliminated by the installation of a Zero Adjust variable resistor (R129). If your Model 412A has a zero offset which decreases as the range is increased, see Service Note 412A/AR-1.

NOTE

Minor zero offsets can be eliminated by the following procedure:

A bare resistance wire connects B6, B4, C3, C1, C18, and C16 on the range switch. B6 indicates wafer B, pin 6, with the switch wafers lettered from the front of the instrument. See Figure 1.

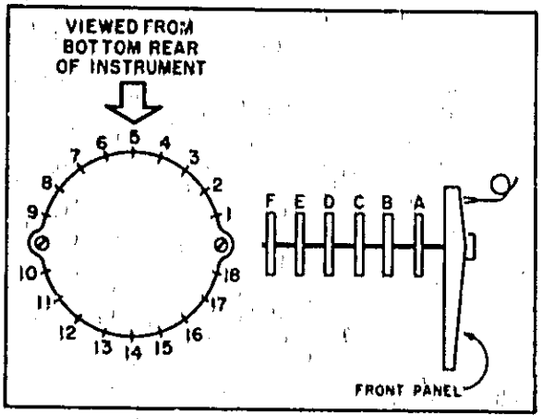

Figure 1. Rear View of Range Switch Wafer.

A red/orange wire connects from one of these pins to the function switch. Reconnecting the red/orange wire closer to B6 will eliminate a small downscale offset and reconnecting closer to C16 will eliminate a small upscale offset. Zero offset may increase in the upscale direction when the instrument is operated in an increased temperature environment. Allow 20 minutes warm-up for the instrument to reach ambient operating conditions before removing the cabinet. Reposition the red/orange wire to correct the zero offset and allow 20 minutes operation before determining the results of repositioning the red/orange wire. If the above procedure does not eliminate the zero offset, install the zero adjust control as outlined in the following procedure.

INSTALLATION PROCEDURE FOR ZERO ADJUST CONTROL.

1. Remove cabinet.
2. Refer to Figure 2 for Steps 2, 3, and 4. Mount 5 pin terminal strip (TB5) on the transformer mounting bolt.
3. Unfasten plastic straps securing C105B and swing the capacitor away from its mounted position. Drill holes for installing rubber grommet and R129. Install R129 and the rubber grommet.

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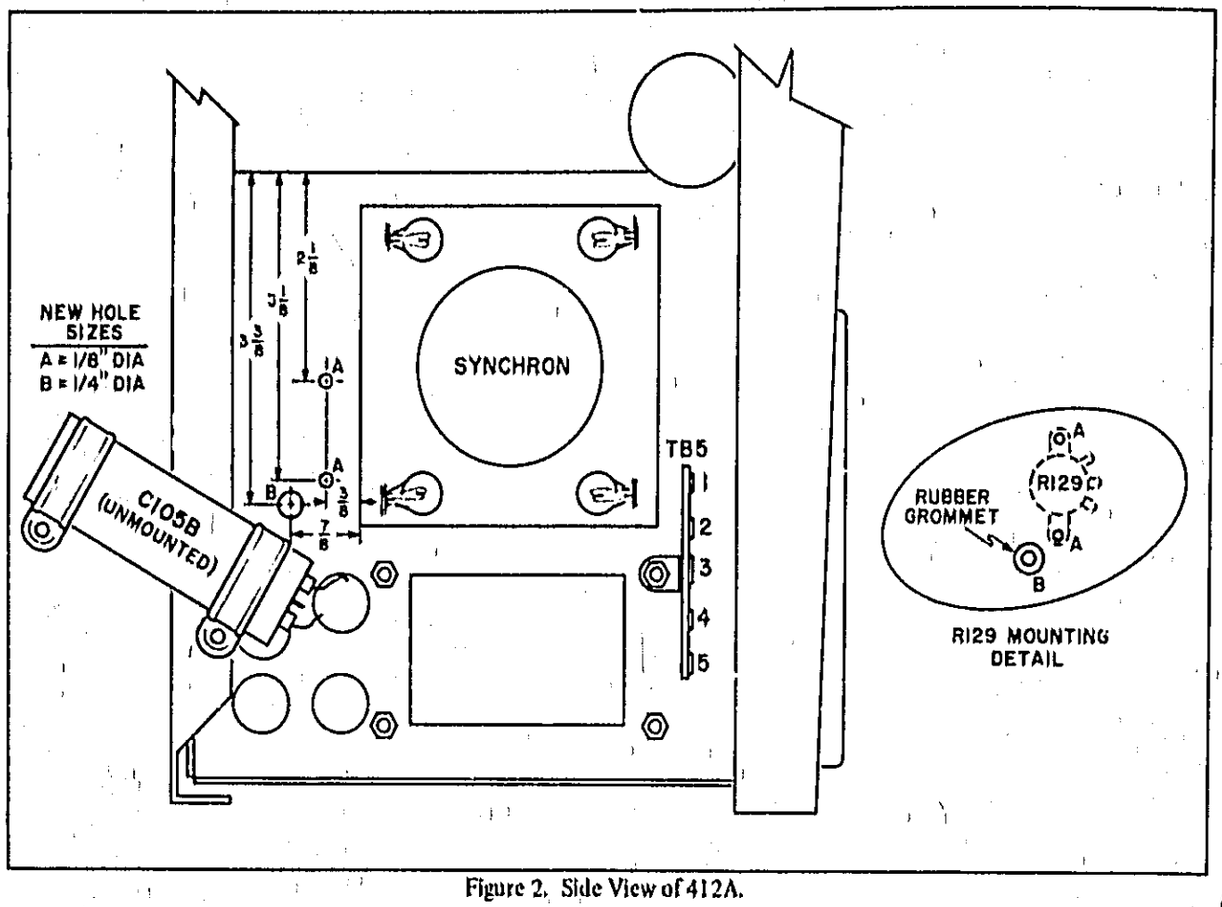

Figure 2. Side View of 412A.

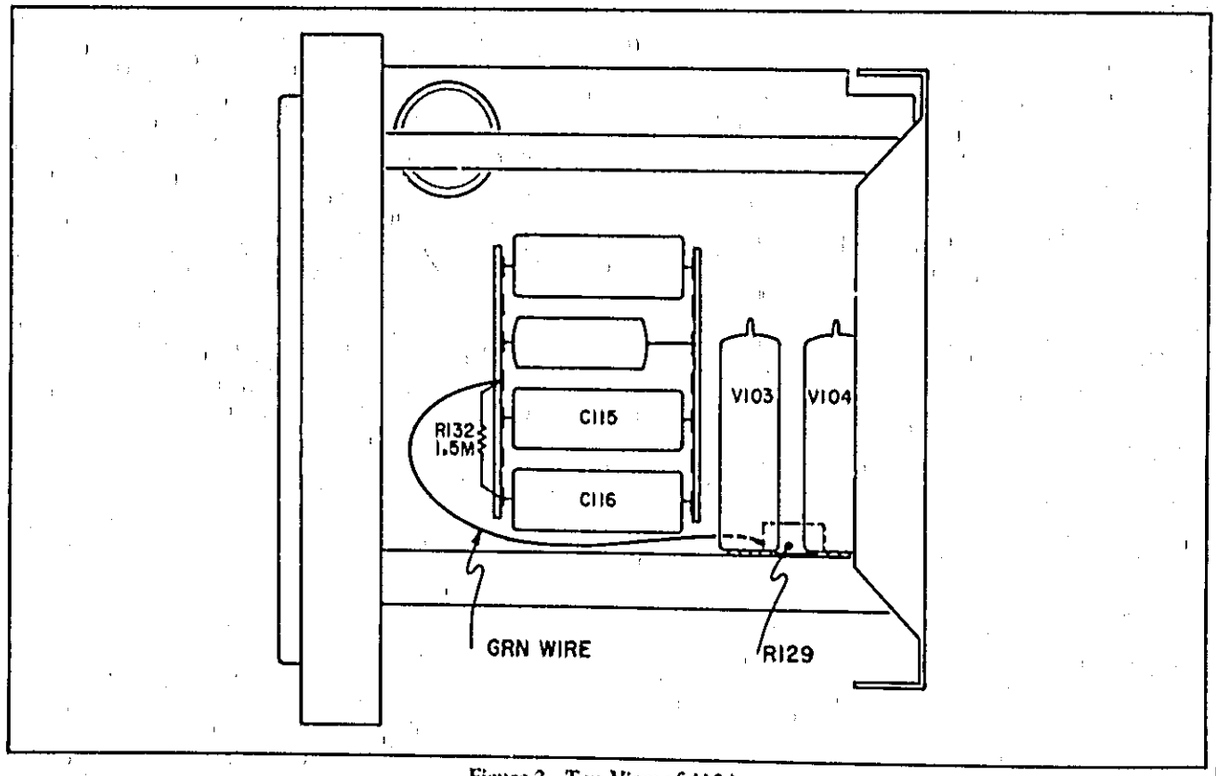

Figure 3. Top View of 412A.

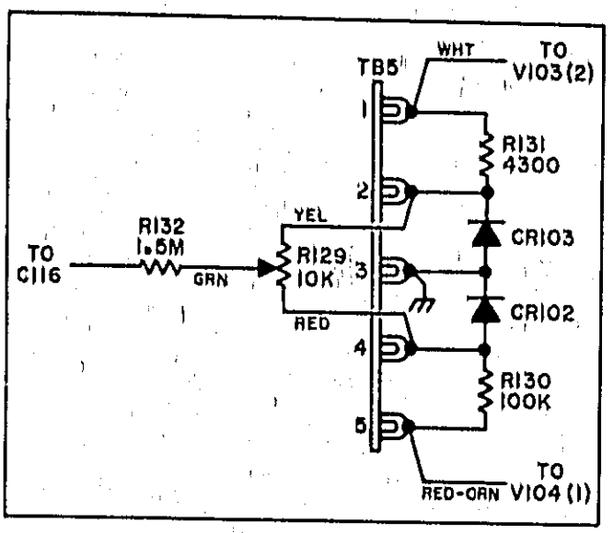

Figure 4. Wiring Diagram of Zero Adjust Control.

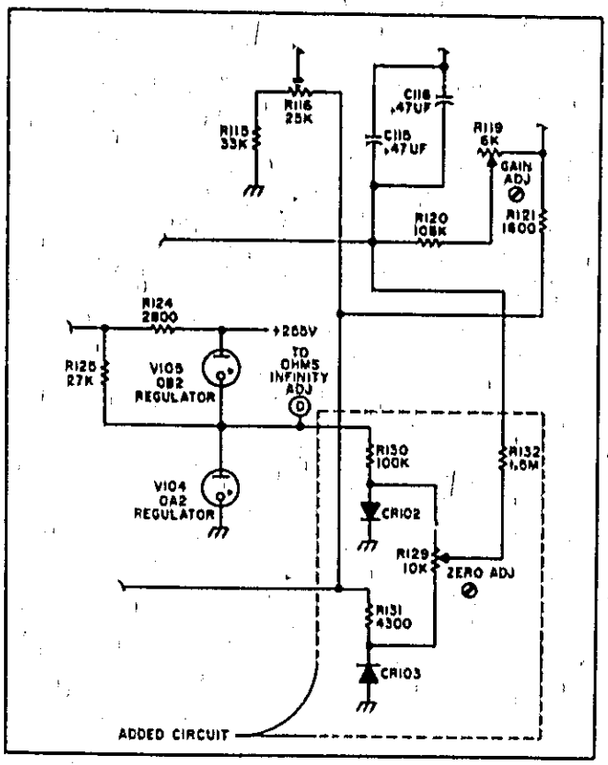

Figure 5. Schematic Diagram of Zero Adjust Control.

4. Connect a yellow wire from pin 2 and a red wire from pin 4 of TB5 (see Figure 4) through the rubber grommet installed in Step 3 and connect a wire to each of the outer arms of the Zero Adjust (R129).

5. Connect a green wire from the center arm of R129 to the unused center terminal of the forward terminal strip supporting C115. Connect the 1.5 MΩ resistor from the center terminal of the forward terminal strip to the terminal connecting C116 (see Figure 3). Reinstall C105B.

6. Refer to Figure 4. Install R130, R131, CR102, and CR103. Connect a white wire from pin 1 of TB5 to pin 2 of V103 and connect a red/orange wire from pin 5 of TB5 to pin 1 of V104.

7. Reinstall the cabinet and warm up the instrument for 20 minutes. Use the following procedure to set the Zero Adjust and add this paragraph to your Operating and Service Manual between the CATHODE FOLLOWER BIAS ADJUSTMENT and the AMPLIFIER GAIN CALIBRATION AND METER CALIBRATION paragraphs.

DC ZERO ADJUST.

a. Set the mechanical zero according to Maintenance Section of manual.

b. Set the 412A function switch to + DCV and the range switch to 1 V.

c. Short the DCV cable to COM cable.

d. Adjust the Zero Adjust variable resistor for zero deflection on the meter. Check the zero by switching from + DCV to - DCV. When the meter is properly zeroed, this switching should produce less than a minor division of deflection.

Add the components in Table 1 to the Replaceable Parts List in your Operating and Service Manual. Correct the schematic as shown in Figure 5.

Table 1

Circuit Designator	Description	-hp- Part No.
R129	Resistor, var ww 10 kilohms	2100-1567
R130	Resistor, fxd 100 kilohms	0683-1045
R131	Resistor, fxd 4300 ohms	0683-4325
R132	Resistor, fxd 1.5 megohms	0757-0156
CR102, 103	Diode	1910-0016
TB5	5 Pin Terminal Strip	0360-0018
	Rubber grommet 1/4 mtg. hole	0400-0074
Wire for Modification*		
	Yellow	8 inches
	Red	8 inches
	White	7 inches
	Green	5-1/2 inches
	Red/Orange	8-1/2 inches

*All wire is 22 gauge

-hp- Model 412A with serial number 424-14483 and above reflect this change.

412A-12

JUL 1967

-hp- Model 412A DC Vacuum Tube Voltmeter
All Serial Numbers

MODIFICATIONS TO REDUCE NOISE AND ZERO OFFSET

A modulator shield -hp- Part No. 5000-5870 that will reduce noise and zero offset should be installed in -hp- Model 412A's. Refer to Table 1 for serial number breaks.

Table 1

Serial Number	Complete Input Circuit Assembly	Recommendations For Installation of 5000-5870 Modulator Shield
424-14482 and below	-hp- Part No. 412A-58A	Install 5000-5870 when replacing 412A-58A with recommended replacement 412A-30A
424-14883 to 649-15882	-hp- Part No. 412A-30A	Install 5000-5870 in all instruments
649-15883	-hp- Part No. 412A-30A	5000-5870 installed during manufacture

INSTALLATION INSTRUCTIONS

1. Unplug 412A.
2. Remove 412A from the cabinet.
3. Turn the 412A upside down.
4. Carefully slip the modulator shield between the input circuit assembly and the rear panel as shown in Figure 1.
5. Using a screw holder type screwdriver, fasten the modulator shield to the nut already existing in the bottom deck. Use a No. 6-32 machine screw, 0.250 in. long with external toothed lockwasher. (-hp- Part No. 2360-0171.)
6. Reinstall the 412A chassis in the cabinet.

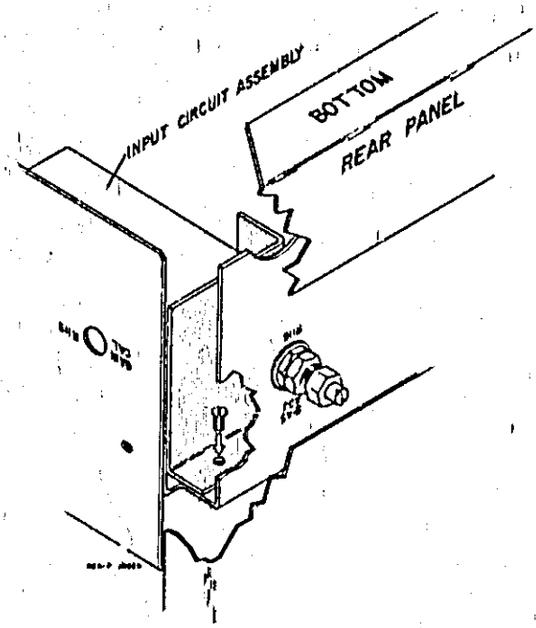

FIGURE 1

CONTINUED OVER

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The lead dress of certain leads in the -hp- Model 412A may also contribute to noise and zero offset.

LEAD DRESS INSTRUCTIONS

1. Unplug 412A.
2. Remove the 412A chassis from the cabinet.
3. Turn the 412A upside down
4. Be sure the input coaxial cable is routed over the top of the input circuit assembly and away from the rear of the instrument. (Steps 4 thru 10 refer to Figure 2.
5. Dress the AC power cable up against the rear deck and away from input coaxial cable.
6. The green lead from input circuit assembly to range switch should be on the p c. board and between C101 and C102.
7. The two white/violet leads from the teflon stand-off at the bottom of R28 on the rear chassis should be close to the rear chassis and down on the deck.
8. Rotate the 412A to work on the side shown in Figure 2.
9. The brown twisted wires that run from the pilot light to the power transformer should be dressed close to the inner chassis and at the front edge of the chassis.
10. The black and grey wires that run to the power switch should be dressed as shown.
11. Recalibrate the 412A
12. Reinstall the 412A chassis in the cabinet.

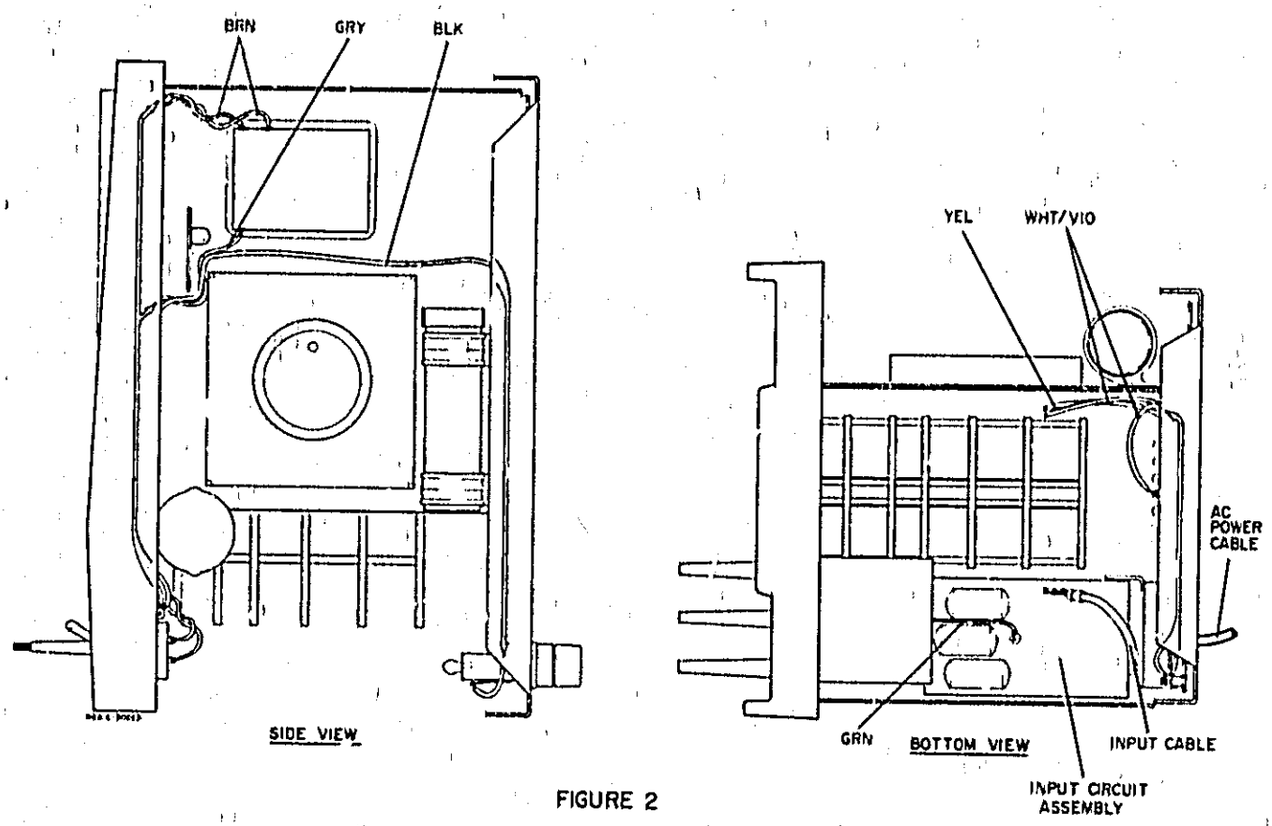

FIGURE 2

412A-13/
413A-13

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MAR 1968

412A-13
413A-3

SERVICE NOTE

SUPERSEDES
NONE

-hp- MODEL 412A DC VACUUM TUBE VOLTMETER
All Serial Numbers

-hp- MODEL 413A DC NULL VOLTMETER
All Serial Numbers

MODULATOR CABLE ASSEMBLY

The modulator cable assembly for Model 412A and 413A, -hp- Part No. 412A-16A, has been made available as a separately replaceable part. This cable is no longer included as a part of the modulator assembly (412A-30A).

Add this part to the Replaceable Parts List of your 412A and 413A Operating and Service Manual as a replaceable part for cabinet mount instruments only.

DES/my/WN

March 1968-9

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412A-14A

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OCT 1971

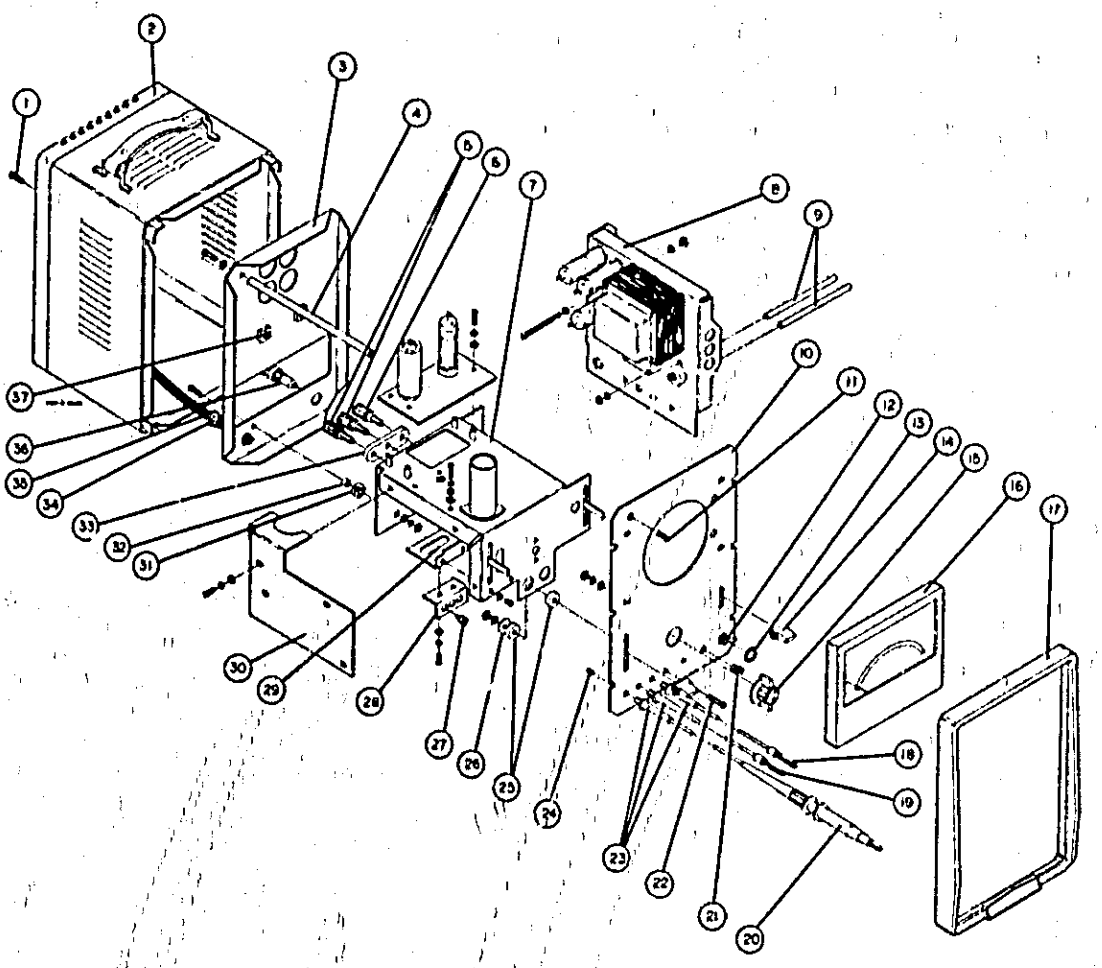
SERVICE NOTE

SUPERSEDES
412A-14

MECHANICAL PARTS IDENTIFICATION

DC VACUUM TUBE VOLTMETER
-hp- Model 412A

This mechanical parts breakdown is provided as a convenient means of mechanical parts identification for Model 412A.



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PARTS LIST

INDEX NUMBER	DESCRIPTION	-hp- PART NO.
1	Screw, 3/32 x 5/8"	2510-0001
2	Cabinet assembly (blue)	5060-0698
	Cabinet assembly (olive gray)	5060-5967
3	Chassis, rear deck	412A-1C
4	Support, chassis	412A-47A
5	Binding post, black	5060-0632
6	Binding post, red	5060-0633
7	Chassis, main deck	412A-1A
8	Chassis, side deck	412A-1B
9	Light rod modular	412A-37A
10	Panel (blue)	412A-2
	Panel (olive gray)	00412-00201
11	Machine screw, 8/32 x 1/2"	2530-0003
12	Switch, toggle	3101-0001
13	Nut, knurled, 0.6" OD x 1/16"	0590-0012
14	Knob, lever	0370-0081
15	Knob, bar with arrow	0370-0035
16	Meter	1120-0305
17	Bezel No. 1 (blue)	5020-0653
	Bezel No. 1 (olive gray)	5020-6849
18	Cable assembly, ohm - mA	412A-21C
19	Cable assembly, common	412A-21B
20	Probe and cable assembly, voltage	00412-62101
21	Jewel (below Serial No. 978-19208)	1450-0020
	Jewel (Serial No. 978-19208 and above)	1450-0413
22	Screw, 8-32 x 1"	2520-0009
23	Boot, cable	412A-83A
24	Screw, 6/32 x 1/4"	2460-0010
25	Insulator, binding post, 1 hole	0340-0089
26	Washer, 3/4" OD	3050-0055
27	Grommet cable	0400-0019
28	Bracket, cable	412A-12C
29	Bracket, cable	412A-12A
30	Shield, input circuit	412A-6A
31	Grommet, rubber, 3/8"	0400-0010
32	Spacer, No. 6 - 8 x 1/4"	0380-0018
33	Insulator, binding post, 3 hole	0340-0091
34	Grommet, black nylon	0400-0013
35	Power cord (below Serial No. 19208)	8120-0050
	Power cord (Serial No. 978-19208 and above)	8120-1348
36	Fuse holder	1400-0084
37	Retaining nut 8/32	0510-0189

412A-15

WO

SERVICE NOTE

SUPERSEDES
NONE

-hp- MODEL 412A DC VACUUM TUBE VOLTMETER

Serial Number 649-17582 and below

MODIFICATION TO REDUCE CURRENT THROUGH REGULATOR TUBE V105

This modification should prevent the V105 regulator tube from breaking down (flashing) under transient or steady state high line conditions by reducing the current through it. The modification should be performed only in the case of a flashing V105 regulator tube.

MODIFICATION PROCEDURE

1. Disconnect the power cord from the wall receptacle.
2. Remove the cabinet assembly from the instrument by removing the two rear securing screws from the instrument.
3. Locate R124 and R125 on the 412A chassis. This may be accomplished using the typical right side view given in the 412A Operating and Service Manual.
4. Remove R124, a 2.8 k ohm resistor, and replace with -hp- Part No. 0811-1512, a 4 k ohm, 5%, 5 W resistor leaving sufficient room for resistor heat dissipation.
5. Remove R125, a 27 k ohm resistor, and replace with -hp- Part No. 0811-1867, a 15 k ohm, 5%, 5W resistor leaving sufficient room for resistor heat dissipation.
6. Replace V105 with a new -hp- Part No. 1940-0007.
7. Replace and secure the cabinet assembly.

No adjustment should be required as a result of this modification.

This modification is factory incorporated in 412A's serial number 649-17583 and above.

Correct the Replaceable Parts List and Schematic of your 412A Operating and Service Manual to reflect this change.

JK/pw/WO 7/71-9

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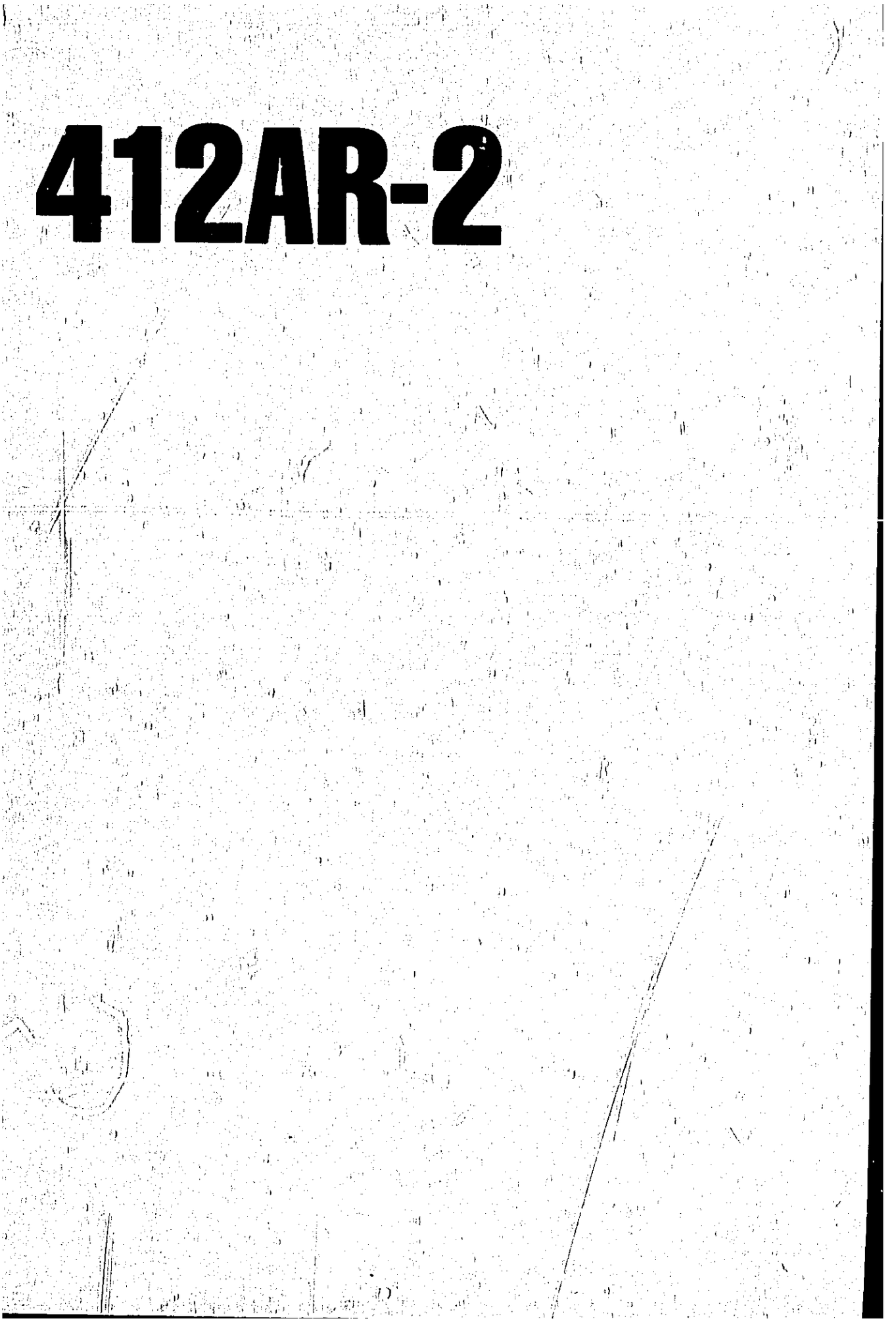
412AR-2



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SERVICE NOTE

412AR-2

hp MODEL 412AR DC VACUUM TUBE VOLTMETER
SERIAL 134-05282 AND BELOW
(Rack mounted Instrument)

IMPROVED GROUND CONNECTION

To facilitate using the hp Model 412AR* DC Vacuum Tube Voltmeter, Serial 134-05282 and below, with a "floating" ground, the easy-to-make circuit change described in this Service Note is necessary.

Installation of this modification will provide a better ground connection for the shielded cable leading from the Modulator Assembly to Amplifier Tube V101A. This new ground will eliminate bias circuit disturbances when use of your Voltmeter requires an input isolated from ground.

* Rack mounted instrument only.

MODIFICATION PROCEDURE

1) Disconnect power and remove cabinet.

2) The black lead extending from the modulator end of the shielded cable (routed from the Modulator Assembly to Amplifier Tube V101A) should be disconnected from the center terminal of the five-pin terminal strip. This terminal strip is located near the rear panel OUTPUT terminals.

3) Connect this black wire to the main ground terminal on the Modulator Assembly. (At junction of two other black leads.)

4) Replace cabinet.

5) No adjustments are required - an operating check completes the modification.

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412AR-3

JAN 1967

-hp- Model 412AR DC Vacuum Tube Voltmeter
Serial Number 424-15082 and below

INSTALLATION OF ZERO ADJUST CONTROL

A constant zero offset, independent of range setting (-hp- Model 412AR in the voltmeter function), can be eliminated by the installation of a Zero Adjust variable resistor (R129). If your Model 412AR has a zero offset which decreases as the range is increased, see Service Note 412A/AR-1.

NOTE

Minor zero offsets can be eliminated by the following procedure:

A bare resistance wire connects B6, B4, C3, C1, C16 and C16 on the range switch. B6 indicates wafer B, pin 6, with the switch wafers lettered from the front of the instrument.

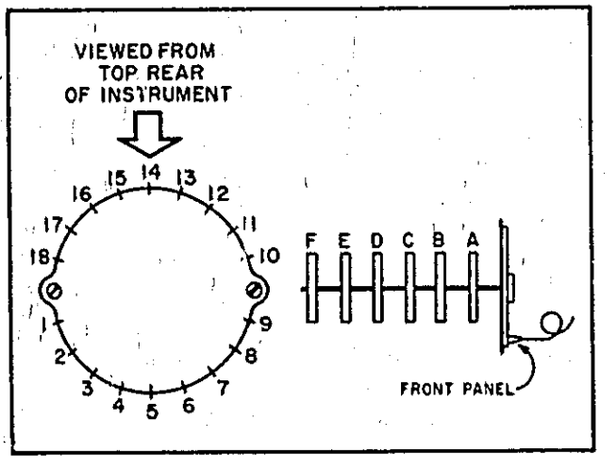

Figure 1. Rear View of Range Switch Wafer

A red/orange wire connects from one of these pins to the function switch. Reconnecting the red/orange wire closer to B6 will eliminate a small downscale offset and reconnecting closer to C16 will eliminate a small upscale offset. Zero offset may increase in the upscale direction when the instrument is operated in an increased temperature environment. Allow 20 minutes warm-up for the instrument to reach ambient operating conditions before removing the cabinet. Reposition the red/orange wire to correct the zero offset and allow 20 minutes operation before determining the results of repositioning the red/orange wire. If the above procedure does not eliminate the zero offset, install the zero adjust control as outlined in the following procedure.

INSTALLATION PROCEDURE FOR ZERO ADJUST CONTROL.

1. Remove dust cover.
2. To facilitate the installation of zero adjust circuit, the power transformer must be moved, so temporarily remove 120 Ω (R122) and 560 Ω (R123) bias resistors from terminal #10 of power transformer. Then remove the mounting nuts and move the transformer out of the way.
3. Drill holes as diagrammed in Figure 2. Mount 7 pin terminal strip and potentiometer. Replace power transformer and reconnect the two bias resistors.
4. Install components as diagrammed in Figure 3.
5. Refer to Figure 2 & 3. Connect a violet lead from TB7 (1) to negative side of C118. Connect two black leads from TB7 (3) and TB7 (5) to corresponding sides of zero adjust control (R129). Connect a white-orange lead from TB7 (4) to C115, and an orange lead from TB7 (7) through the metal grommet to V104 (5).

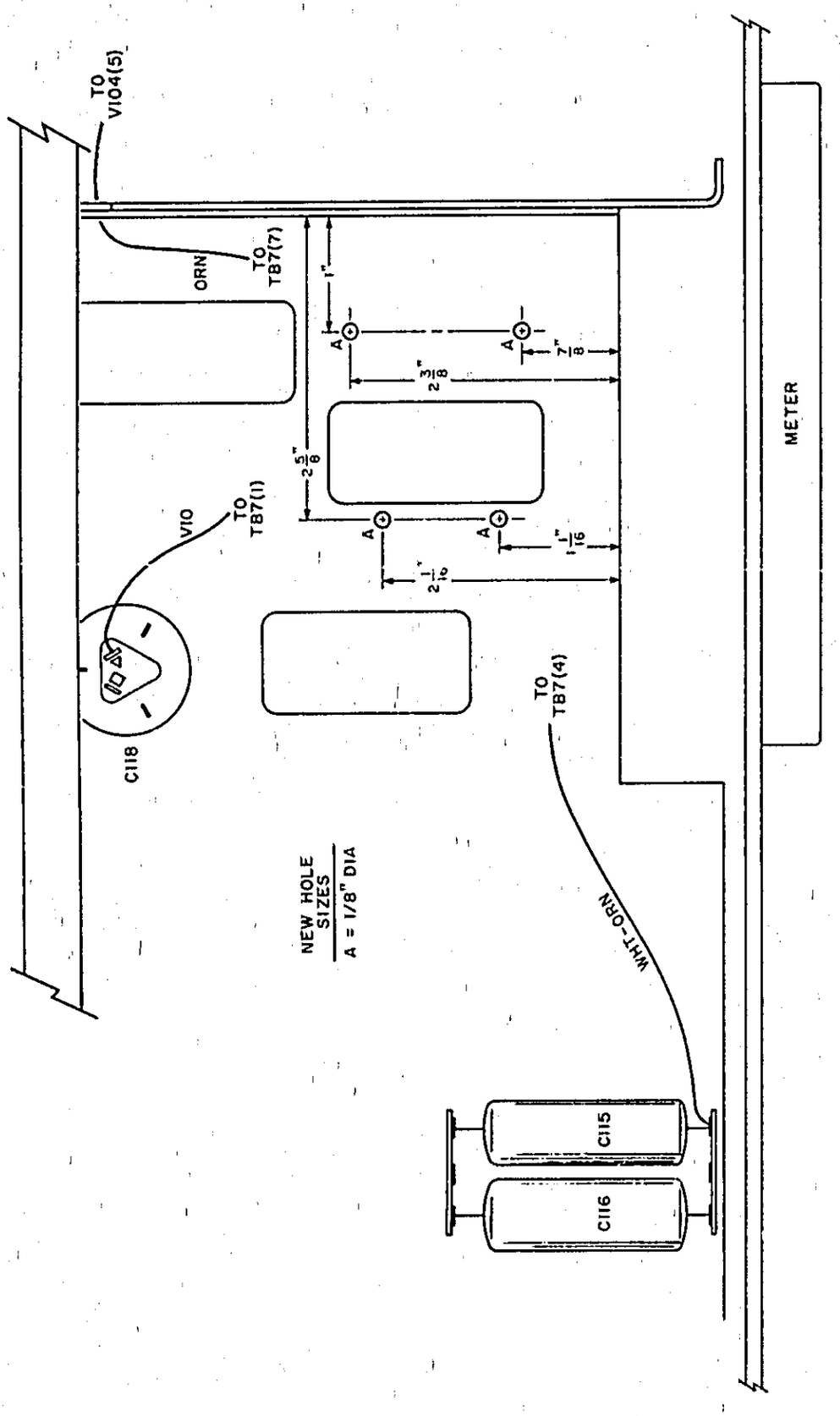

Figure 2. Bottom View of 412AR

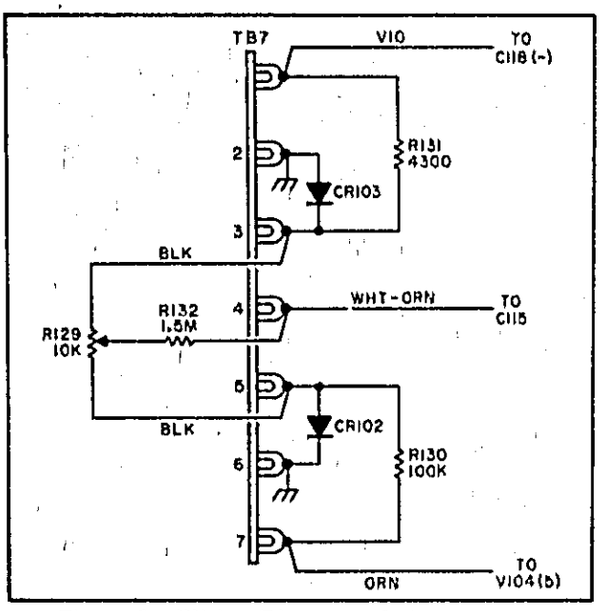

Figure 3. Wiring Diagram of Zero Offset Adjust Control

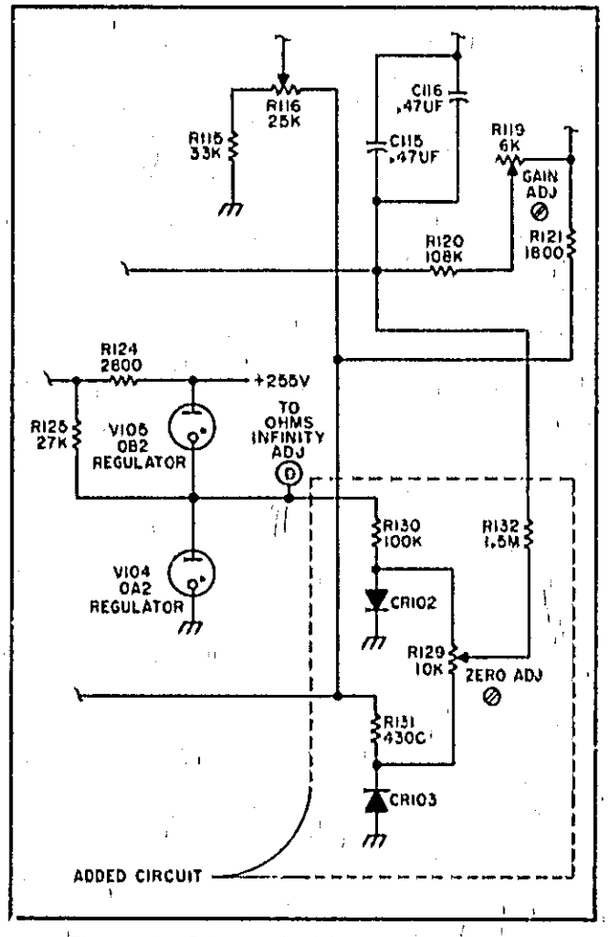

Figure 4. Schematic Diagram of Zero Offset Adjust Control

6. Reinstall the dust cover and warm-up the instrument for 20 minutes. Use the following procedure to set the Zero Adjust and add the paragraph to your Operating and Service Manual between the CATHODE FOLLOWER BIAS ADJUSTMENT and the AMPLIFIER GAIN CALIBRATION and METER CALIBRATION paragraphs.

DC ZERO ADJUST.

a. Set the mechanical zero according to the Maintenance Section of the manual.

b. Set the 412A function switch to +DCV and the range switch to 1 V.

c. Short the DCV cable to COM cable.

d. Adjust the Zero Adjust variable resistor for zero deflection on the meter. Check the zero by switching from +DCV to -DCV. When the meter is properly zeroed, this switching should produce less than a minor division of deflection.

Add the components in Table 1 to the Replaceable Parts List in your Operating and Service Manual. Correct the schematic as shown in Figure 4.

Table 1

Circuit Designator	Description	-hp- Part No.
R120	Resistor, var ww 10 kΩ	2100-1567
R130	Resistor, fxd 100kΩ	0683-1045
R131	Resistor, fxd 4300Ω	0683-4325
R132	Resistor, fxd 1.5 MΩ	0757-0156
CR102, 103	Diode	1910-0016
TB7	7 Pin Terminal Strip	0360-0023

Wire for Modification *	
1 Violet	3-1/2 inches
1 White/Orange	12 inches
1 Orange	9-1/2 inches
2 Black	1-1/4 inches

*All wire is 22 guage

-hp- Model 412AR with serial number 649-15082 and above reflect this change.

412AR-4/
413AR-2

MAR 1968

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SERVICE NOTE

412AR-4
413AR-2

-hp- Model 412AR DC Vacuum Tube Voltmeter
(All Serial Numbers)

-hp- Model 413AR DC Null Voltmeter
(All Serial Numbers)

MODULATOR CABLE ASSEMBLY

The modulator cable assembly for Model 412AR and 413AR, -hp- Part No. 412A-16F, has been made available as a separately replaceable part. This cable is no longer available as part of the modulator assembly (412A-30A).

Add this part to the Replaceable Parts List of your 412A and 413A Operating and Service Manual as a replaceable part for rack mount instruments only.

March 1968-9

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412AR-5

APR 1968

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SERVICE NOTE

412AR-5

MECHANICAL PARTS IDENTIFICATION

DC VACUUM TUBE VOLTMETER
-hp- Model 412AR

This mechanical parts breakdown is provided as a convenient means of mechanical parts identification for Model 412AR.

April 1968-0

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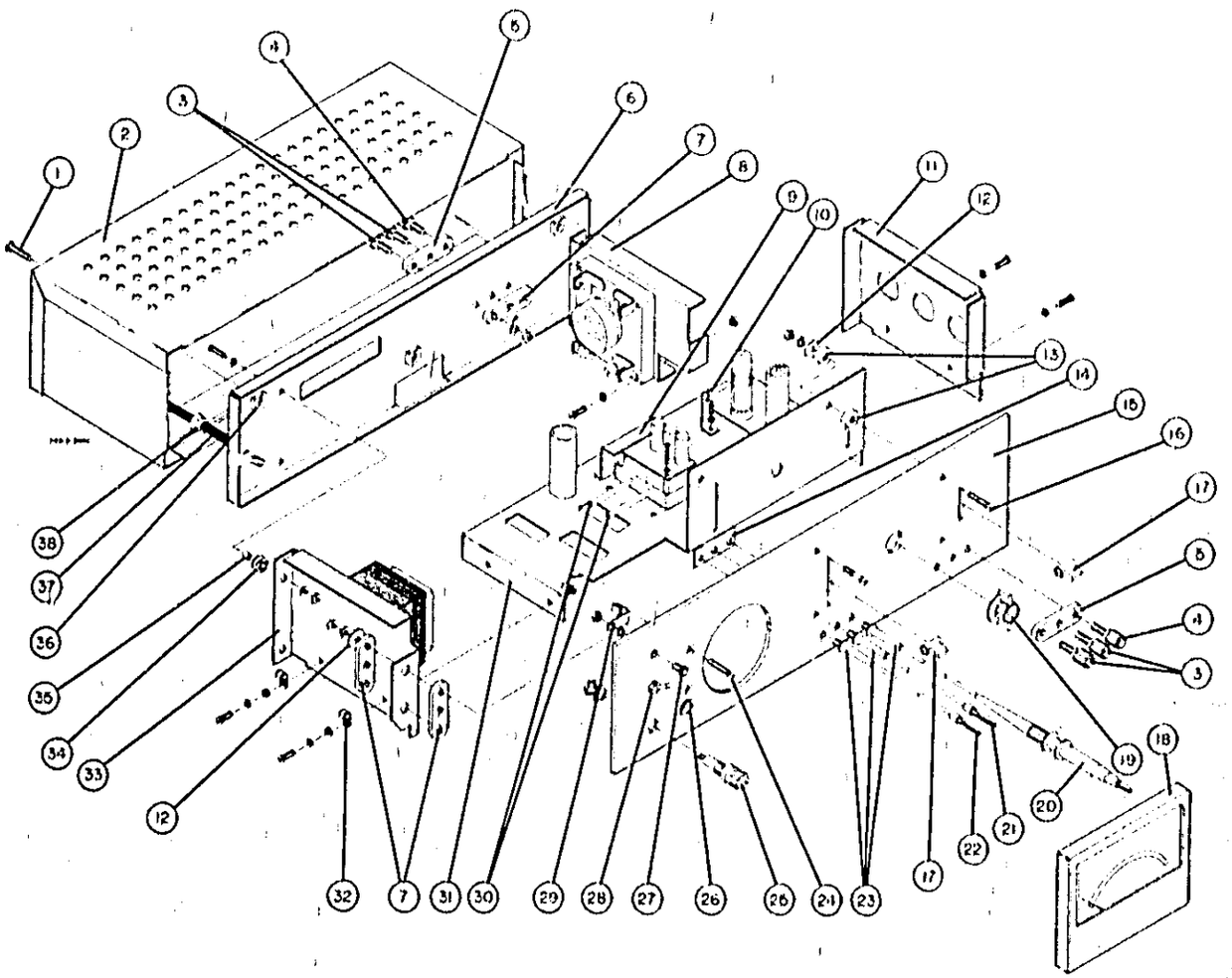
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PARTS LIST

INDEX NUMBER	DESCRIPTION	-hp- PART NO.
1	Screw, 8/32 x 5/8"	2510-0001
2	Dust cover assembly	412-44R
3	Binding post assembly, black	5060-0632
4	Binding post assembly, red	5060-0633
5	Insulator, binding post, 3 hole	0340-0091
6	Chassis, rear deck	412A-1E
7	Insulator, binding post, 3 hole	0340-0087
8	Chassis, motor mount	412A-1G
9	Shield, modulator	412A-6D
10	Bracket, switch	412A-12B
11	Gusset	412A-1H
12	Washer, 3/4 OD	3050-0055
13	Insulator, binding post, 1 hole	0340-0089
14	Bracket, cable clamp	412A-12D
15	Panel	412A-2R
16	Machine screw 8/32 - 1"	2570-0009
17	Knob - lever	0370-0081
18	Meter	1120-0305
19	Knob - bar with arrow	0370-0035
20	Probe and cable assembly, voltage	412A-21G
21	Cable assembly, ohm - mA	412A-21C
22	Cable assembly, common	412A-21B
23	Boot, cable	412A-83A
24	Machine screw 8/32 x 1"	2530-0006
25	Fuse holder	1400-0084
26	Nut, knurled, 0.6" OD x 1/16"	0590-0012
27	Jewel	1150-0020
28	Switch - toggle	3101-0001
29	Lamp holder	1450-0022
30	Light rod, modulator	412A-37B
31	Chassis, main deck	412A-1D
32	Clamp, cable, 1/2" wide	1400-0031
33	Chassis, power supply	412A-1F
34	Grommet, rubber, 3/8"	0400-0010
35	Spacer, #6 - 8 x 1/4	0380-0018
36	Retaining nut, 8/32	0510-0189
37	Power cord	8120-0050
38	Grommet, black nylon	0400-0013

412AR-6

WO

SERVICE NOTE

SUPERSEDES
NONE

-hp- Model 412AR DC Vacuum Tube Voltmeter
(Serial Number 649-17582 and below)

MODIFICATION TO REDUCE CURRENT THROUGH REGULATOR TUBE V105

This modification should prevent the V105 regulator tube from breaking down (flashing) under transient or steady state high line conditions by reducing the current through it. The modification should be performed only in the case of a flashing V105 regulator tube.

MODIFICATION PROCEDURE

1. Disconnect the power cord from the wall receptacle.
2. Remove the cabinet assembly from the instrument by removing the two rear securing screws from the instrument.
3. Locate R124 and R125 on the 412AR chassis.
4. Remove R124, a 2.8 k ohm resistor, and replace with -hp- Part No. 0811-1512, a 4 k ohm, 5%, 5 W resistor leaving sufficient room for resistor heat dissipation.
5. Remove R125, a 27 k ohm resistor, and replace with -hp- Part No. 0811-1867, a 15 k ohm, 5%, 5W resistor leaving sufficient room for resistor heat dissipation.
6. Replace V105 with a new -hp- Part No. 1940-0007.
7. Replace and secure the cabinet assembly.

No adjustment should be required as a result of this modification.

This modification is factory incorporated in 412AR's serial number 649-17583 and above.

Correct the Replaceable Parts List and Schematic of your 412A Operating and Service Manual to reflect this change.

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GM/ms/wo

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