DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S, ORGANIZANTIONAL, DS, GS, AND DEPOT

MAINTENANCE MANUAL INCLUDING

REPAIR PARTS AND SPECIAL TOOLS LIST

VOLTMETER TS-2843/ U AND JOHN FLUKE MFG CO.

MODEL 883A

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY
FEBUARY 1971

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications, the format has not been structured to consider level of maintenance nor to include a formal section on depot overhaul standards.

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 6 August 1980

Operator's, Organizational, DS and GS Maintenance Manual
VOLTMETER TS-2843/U (JOHN FLUKE CO. MODEL 883A)
(NSN 6625-00-935-7002)

TM 11-6625-2400-15, 4 February 1971, is changed as follows:
1. Title of the manual is changed as shown above.
2. New or changed material is indicated by a vertical bar in the margin.
3. Remove and insert pages as indicated below:
4.

Remove pages	Insert pages
i and ii	i and ii
v	
1-1 through 1-3	1-1 through 1-4
5-1 through 5-4	5-1 through 5-3(5-4 blank)
A-1	A-1
C-1 through C-5	C- through C-5
D-1 through D-38	None

4. File this change sheet in front of the publication for reference purposes.
5. The purpose of this change is to update maintenance information and delete the RPSTL (appendix D) which has been superseded by TM 11-6625-2400-24P.

By Order of the Secretary of the Army:

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TECOM (1)
USACC (2)
USACC-EUR (2)
USACC-PAC (2)
USACC-SO (1)
USACC-A (2)
HISA (Ft Monmouth) (21)
MDW (1)
WRAMC (1)
Armies (1)
ATS (1)
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USASIGS (10)
USAADS (2)
USAICS (2)
USAFAS (2)
USAARMS (2)
USAIS (2)
USAES (2)
USAOC&S (2)
USAMCC (2)
WSMR (1)
Ft Carson (2)
Army Dep (1) except
LBAD (14)
SAAD (30)
TOAD (14)
ANAD (2)
SHAD (3)
USA Dep (1)
Sig Sec USA Dep (1)
Units org under fol TOE:
9550 (1)
11-302 (1)
29134 (1)
29227 (1)

ARNG: State AG (3); Units: None
USAR: None
For explanation of abbreviation used see AR 310-50.

TECHNICAL MANUAL
No. 11-6625-2400-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 4 February 1971

OPERATOR'S, ORGANIZATIONAL, DS AND GS MAINTENANCE MANUAL
VOLTMETER TS-2843/U (JOHN FLUKE CO. MODEL 883A)
(NSN 6625-00-935-7002)

Section I Title Page

Section		Title	Page
I	1-1.	Scope	1-1
	1-1.1	Items comprising an operable equipment	1-1
	1-2.	Indexes of Publications	1-1
	1-4.	Purpose and Use	1-1
	1-5.	Input Power	1-2
	1-6.	Damage in Shipment	1-2
	1-7.	Specifications	1-3
II		OPERATING INSTRUCTIONS	2-1
	2-1.	Function of External Controls, Terminals and Indicators	2-1
	2-3.	Preliminary Operation for, Model 883A	2-1
	2-5.	Preliminary Operation for Model 883AB	2-3
	2-7.	Zeroing Instructions	2-3
	2-9.	Battery Charging	2 - 3
	2-10.	Operation as a DC Differential Voltmeter	2-4
	2-11.	Operation as an AC Differential Voltmeter	2-4
	2-12.	Operation as a Conventional Voltmeter	2-4
	2-14.	Measurement of Voltage Excursions about a Nominal Value	2-4
	2-15.	Recording Voltage Excursions	2-5
	2-17.	Use of 883A with an A88 Isolation Amplifier and a Recorder	2-5
	2-19.	Use of 883A with a Recorder	2-5
	2-21.	Measurement of High Resistance	2-5
	2-24.	Notes on Measuring AC or DC Voltages	2-6
	2-25.	Ground Loop Precautions	2 - 6
	2-27.	Use of Shorting Link	2 - 6
	2-29.	Battery Checking	2 - 6
	2-31.	Effect of Common Mode Voltages	2-6
	2-33.	Notes on Measuring DC Voltages	2-6
	2-34.	Effect of AC Components on DC Measurements	2-6
	2-36.	Measurement of Negative Voltages	2-7
		Notes on Measuring AC Voltages	2-7
	2-39.	Errors Due to Distortion	2 - 7
	2-41.	Errors Due to Grounding	2 - 7
	2-43.	Internal Converter Noise	2-7
	2-45.	Most Sensitive Null Range on AC	2-8
III		THEORY OF OPERATION	3-1
	3-1.	Introduction	3-1
	3-5.	DC Input Attenuator	3 - 2
	3-7.	DC Transistorized Voltmeter	3-2
	3-8.	General	3-2
	3-12.	TVM Attenuator	3-2
	3-15.	Input Resistance	3-3
	3-18.	Chopper Drive Circuit	3-3
	3-20.	Null Detector Power Supply	3-3
	3-22.	Effect of AC Components on DC Measurements	3-3
	3-26.	Recorder Output	3 - 4
	3-28.	0 to 11 Volt Reference	3 - 4
	3-29.	General	3-4
	3-31.	-18 Volt Power Supply	3-4
	3-33.	Range Divider	3-4
	3-35.	Kelvin-Varley Divider	3-4

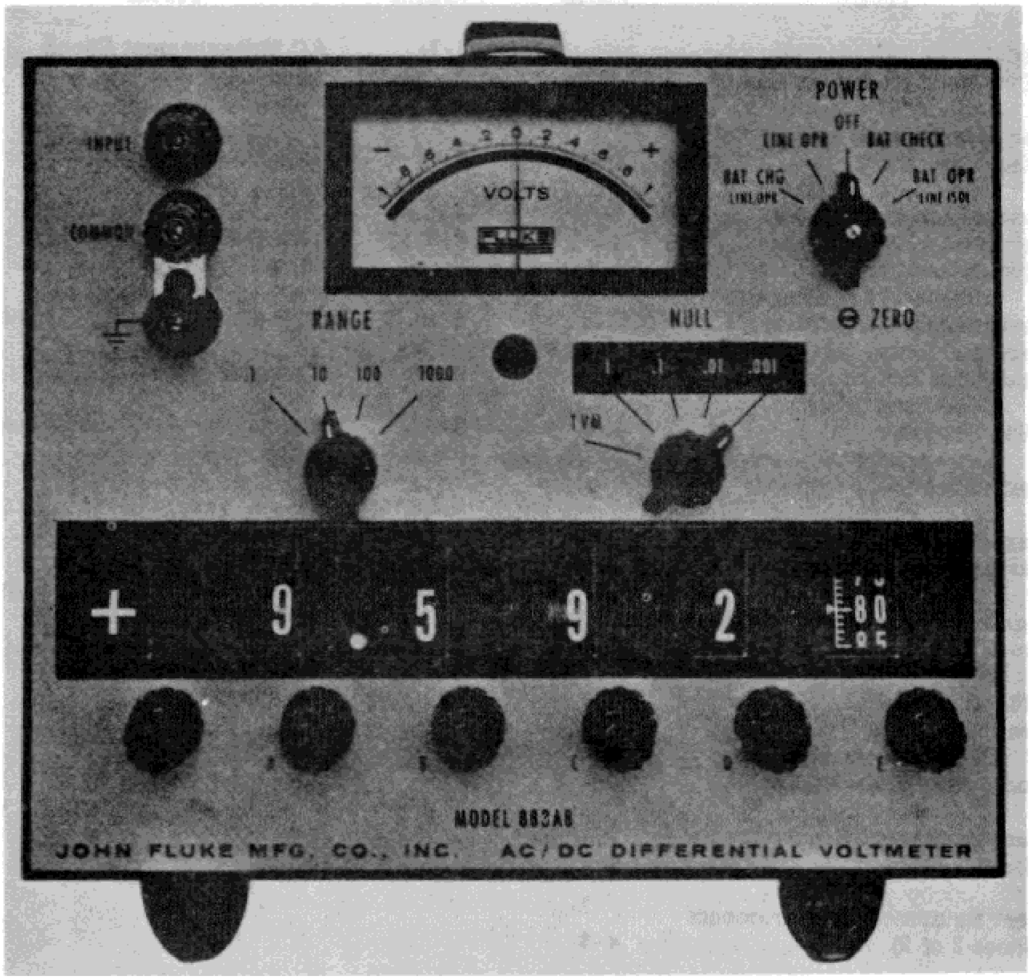
Section		Title	Page
	3-37.	Adjustments	3-4
	3-29.	AC to DC Converter	3-5
	3-40.	General	3-5
	3-42.	Converter Power Supply	3-5
	3-44.	Operation	3-5
	3-46.	Adjustments	3-5
	3-48.	AC-DC Polarity Switch	4-1
IV	'MAINTENANCE		4-1
	4-1.	Introduction	4-1
	4-3.	Test Equipment	4-1
	4-5.	Periodic Maintenance	4-1
	4-8.	Performance Checking	4-1
	4-9.	General .	4-1
	4-11.	Null Detector Check	4-4
	4-13.	DC Differential Measurement Check	4-4
	4-15.	AC Measurement Check	4-6
	4-17.	Calibration	4-6
	4-18.	General	4-6
	4-20.	DC Differential Voltmeter Calibration	4-7
	4-27.	AC to DC Converter Calibration	4-9
	4-38.	Corrective Maintenance	4-10
	4-39.	General	4-10
	4-41.	Troubleshooting	4-10
	4-52.	Electronic Adjustments	4-15
	4-61.	Mechanical Drum Adjustments	4-17
V	PREVENTIVE MAINTENANCE INSTRUCTIONS		5-1
	5-1.	Scope of Maintenance	5-1
	5-2.	Materials Required for maintenance	5-1
	5-3.	Preventive Maintenance	5-1
	5-4.	Preventive Maintenance Checks and Services Periods	5-1
	5-5.	Daily Preventive Maintenance Checks and Services Chart	5-2
	5-6.	Weekly Preventive Maintenance Checks and Services Chart	5-2
	5-7.	Monthly Maintenance	5-2
	5-8.	Monthly Preventive Maintenance Checks and Services Chart	5-2
	5-9.	Quarterly Maintenance	5-2
	5-10.	Quarterly Preventive Maintenance Checks and Services Chart	5-3
	5-11.	Cleaning	
	5-11.	Cleaning.	
	5-12.	Touchup Painting Instructions	5-3

APPENDIX

	A.	REFERENCES	A-1
	B.	BASIC ISSUE ITEMS LIST (BIIL) AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL). (Not Applicable)	
		MAINTENCANCE ALLOCATION CHART	
Section I.		Introduction	C-1
	II.	Maintenance Allocation Chart for Voltmeter TS-28431UG	C-3
	III.	Tools and Test Equipment Required for Voltmeter S-2843/U	C-4
	IV.	Remarks	C-5
	D.	Deleted	

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
Frontis-piece	Model 883A Differential AC/DC Voltmeter	v
2-1	Location of Controls, Terminals, and Indicators	2-1
	Description of Controls, Terminals, and Indicators (Sheet 1 of 2)	2-2
2-2.	Description of Controls, Terminals, and Indicators (Sheet 1 of 2)	
2-3.	TVM Ranges	2-4
2-4.	Resistance Measurements	2-6
2-5.	Percent Error Due to Harmonic Distortion	2-7
2-6.	Signal Voltage With Converter Noise	2-8
3-1.	883A Differential Voltmeter Block Diagram	3-1
3-2.	Function of Polarity Switch.	3-6
4-1.	Test Equipment Requirements (Sheet 1 of 2)	4-2
4-1.	Test Equipment Requirements (Sheet 2 of 2)	4-3
4-2.	Settings for Null Detector Check	4-4
4-3.	Differential Measurement Check and Calibration Setup	4-4
4-4.	Reference Supply and External Kelvin-Varley Divider Check Setup	4-5
4-5.	Voltage Readout Dial Limits .	4-6
4-6.	AC to DC Converter Calibration Setup	4-6
4-7.	AC Measurement Check	4-7
4-8.	Adjustment Locations	4-7
4-9	Troubleshooting Chart (Sheets 1 of 2)	4-10
4-9	Troubleshooting Chart (Sheet 2 of 2)	4-11
4-10.	Transistor Terminal Locations	4-12
4-11.	Transistor Voltage Chart	4-13
4-12.	Kelvin-Varley Divider Check Setup	4-15
4-13.	Kelvin-Varley Divider Error Limits	4-16
4-14.	Kelvin-Varley Divider Adjustment Setup	4-17
4-15.	Kelvin-Varley "A" Deck Adjustment.	4-18



MODEL 883A DIFFERENTIAL AC/DC VOLTMETER

SECTION I
INTRODUCTION AND SPECIFICATIONS

1-1. Scope

a. This manual includes operation instructions and maintenance information applicable to direct supportce allocation chart is in appendix
port (DS), general support (GS, and depot

Mfg. Co. Model 883AB. It also covers their Model appendix D.
nance. It describes Voltmeter TS-2843/U as the commercial equipment identified as John M. Fluke 1970.

1-1.1. Items Comprising an Operable Equipment

FSN	QTY	Nomenclature, part, No., and mfr code	Fig. No.

NOTE

The part number is followed by the applicable 5idigit Federal supply code for manufacturers (FSCM) identified in SB 708-42 and used to identify manufacturer, distributor, or Government agency, etc.

NOTE

Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantities necessary for the particular organization in accordance with SB 11-6.

66259658304		Voltmeter TS2843/U which includes:	1-1
6140-93204801		Battery, Dry: 9-6V500BH; 06860	D-2
6140-93U20481	1	Battery, Dry: 1-2SC; 06860	D-2
66~2971-16981		Cable Assembly, Power, Electrical CX-12001/U	D-1

SECTION I
INTRODUCTION AND SPECIFICATIONS

1-1. Scope

a. This manual provides operating instructions and maintenance data for organizational, direct support (DS), general support (GS), and depot maintenance. It covers Voltmeter TS-2843/U and its commercial equivalent, the John Fluke Manufacturing Company Model 883A.

b. Appendix C provides a maintenance allocation chart (MAC) which is current as of February 15, 1980. Repair parts and special tools lists for all levels of maintenance are provided in TM 11-6625-2400-24P.

1-1.1. Items Comprising an Operable Equipment

FSN	QTY	Nomenclature, part No., and mfr code

NOTE

The part number is followed by the applicable 5-digit Federal supply code for manufacturers (FSCM) identified in SB 70842 and used to identify manufacturer, distributor, or Government agency, etc.

NOTE

Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantities necessary for the particular organization in accordance with SB 11-6.

66259658304		Voltmeter TS-2843/U which includes:
6140-932-0480	1	Battery, Dry: 9-6V500BH; 06860
6140-932-0481	1	Battery, Dry: 1-2SC; 06860
6625971-1698	1	Cable Assembly, Power, Electrical CX-12001/U

1-2. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine if there are any new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-3. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficien-
cies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 735-11-2/NAVSUPINST 4440.127E/AFR 400-54/MCO 4430.3E and DSAR 4140.55.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 5538/NAVSUPINST 4610.33B/AFR 75-18/ MCO P4610.19C and DLAR 4500.15.

d. Reporting of Equipment Manual Improvements. You can help to improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be sent directly to you.

1-3.1. Reporting Equipment Improvement Recommendations (EIR)

If your Voltmeter TS-2843/U needs improvements, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know what you don't like about the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, US Army Com- munications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Mon- mouth, NJ 07703. We'll send you a reply.

1-4. Purpose and Use

a. This instruction manual is for use with the 883A series Differential AC/DC voltmeters. These are available as either a line-powered instrument (Model 883A) or as a combination line-powered or battery-powered instrument (Model 883AB).

Both instruments are half rack size and are equipped with resilient feet and tilt-up bail for field or bench use. A single instrument may be mounted in a standard 19 inch rack by means of metal handle rack adapter kit 881A-102. Two instruments may be mounted side-by-side by means of metal handle rack adapter kit 881A-103.

b. The 883A series instruments are capable of being used as conventional voltmeters for rapid determination of voltages from 0 to 1100 volts dc and from 0.001 to 1100 volts ac to within -+3% of range setting, as differential voltmeters for precise measurement of dc voltages from 0 to 1100 volts to within + (0.01% of input voltage + 5 uv), as an accurate ac voltmeter for measurement of ac voltages from 0.001 to 1100 volts to within + (0.1% of input voltages + 25 uv) from 20 Hz to 5 kHz and with reduced accuracy from 5 Kz to 100 kHz, and as megohmmeters for measurements of resistance from 10 megohms to 11, 000 megohms with a typical accuracy of 5%. They can also be used to measure the excursions of a voltage about some nominal value. One feature that should be emphasized is that no current is drawn from the unknown source at null up to 11 volts dc. Thus the determination of the unknown potential is independent of its source resistance. Above 11 volts dc, the input resistance is an excellent 10 megohms. To minimize errors due to common mode voltages, the 883A series is provided with extremely high leakage resistance to ground - typicaly several hundred thousand megohms. Also, where ground loops errors are a problem, the battery operated mode of the 883AB eliminates these errors due to complete isolation from the power line. As additional features, the 883A series contains a polarity switch for equal convenience in measuring positive or negative dc voltages and an adjustable recorder output which makes the instrument particularly useful for monitoring the stability of almost any ac or dc voltage. Furthermore, thorough shock, vibration, humidity, and temperature testing assure years of hard use under severe environmental conditions.

c. When used as a dc differential voltmeter, the 883A operates on the potentiometric principal. An unknown voltage is measured by comparing it to a known adjustable voltage with the aid of a null detector. An accurate standard for measurement is obtaned from an 11 volt dc reference supply derived from a pair of temperature-compensated zener diodes. The known adjustable reference voltage is provided by a Kelvin-Varley voltage divider with four decades of FLUKE precision wire-wound resistors and a high-resolution inter- polating vernier that are set accurately by five voltage readout dials to give a six digit readout. In this way, the 11 volts can be precisely divided into increments smaller than 10 microvolts. The unknown voltage is then simply read from the voltage dials. For voltages between 11 and 1100 volts dc, an input attenuator divides the unknown voltage by 100 before it is measured potentiometrically. When used as an accurate ac voltmeter, the 883A operates essentially the same as for dc differential measurements.The ac input voltage is converted to a dc voltage and this dc voltage is measured by comparing it to a known adjustable reference voltage.

1-5. Input Power

The 883A is normally supplied with dual primary windings connected in parallel for 115 volt line operation. Upon request, the instrument is supplied for 230 volt line operation with the primary windings connected in series. If it becomes desirable to convert from one mode of operation to the other, refer to the instruction decal on the power transformer.

1-6. Damage in Shipmemt

Immediately upon receipt, thoroughly inspect the instrument for any damage that may have occurred in transit. If any damage is noted, follow the instructions in paragraph 1-3.

AS A DIFFERENTIAL VOLTMETER

DC ACCURACY: ± (0.01% of input voltage + 5 uv) over the complete operating conditions listed under general specifications.

DC ACCURACY UNDER CONTROLLED ENVIRONMENT: ± (0.005% of input voltage + 0.0002% of range setting + 5 uv) at 73° F (23° C). Derated at 0.0002%/° F (0.0004%/° C) from 73° F (23° C) between 55° F and 95° F (13° C and 35° C).

AC ACCURACY:

Input Voltage	Basic AC Accuracy		Low Frequency AC Accuracy		High Frequency AC Accuracy	
	20 Hz to 5 kHz	5 kHz to 10 kHz	10 Hz to 20 Hz	5 Hz to 10 Hz	10 kHz to 20 kHz	20 kHz to 100 kHz
0.001 to 1100V	±(0.1% + 25uv)	±(0.15% + 25uv)	±(0.3% + 25uv)	±(1% + 25uv)	-	-
0.1 to 1100	-	-	-	-	±0.3%	-
0.1 to 110	-	-	-	-	-	±1%

AC ACCURACY UNDER CONTROLLED ENVIRONMENT: ± (0.06% of input voltage + 0.002% of range + 25 uv) from 0.001 to 500 volts and ± 0.08% of input voltage from 500 to 1100 volts between 30 Hz and 5 kHz at 73° F (23° C). Derated at 0.0015%/° F from 73° F between 55° F and 95° F (13° C and 35° C).

RANGE:

Voltage Range	Null Range	DC Input Resistance at Null	AC Input Impedance
1	0.1-0-0.1	Infinite	1 Meg, 40 pf
	0.01-0-0.01	Infinite	"
	0.001-0-0.001	Infinite	"
	0.0001-0-0.0001	Infinite	"
10	1-0-1	Infinite	"
	0.1-0-0.1	Infinite	"
	0.01-0-0.01	Infinite	"
	0.001-0-0.001	Infinite	"
100	10-0-10	10 Meg	"
	1-0-1	10 Meg	"
	0.1-0-0.1	10 Meg	"
	0.01-0-0.01	10 Meg	"
1000	100-0-100	10 Meg	"
	10-0-10	10 Meg	"
	1-0-1	10 Meg	"
	0.1-0-0.1	10 Meg	"

NOTE: Each voltage range and each null range has the capability of measuring 10% over voltage.

RESOLUTION:

Voltage Readout Dial Resolution

Voltage Range	Null Range	Resolution	
		ppm of Voltage Range	Volts
1	any	1 ppm	1 uv
10	"	1 ppm	10 uv
100	"	1 ppm	100 uv
1000	"	1 ppm	1 mv

Meter Resolution (1/2 of a small meter scale division)

Voltage Range	Null Range	Resolution
any	0.0001	1 uv
"	0.001	10 uv
"	0.01	100 uv
"	0.1	1 mv
"	1	10 mv
"	10	100 mv
"	100	1 v

AS A CONVENTIONAL VOLTMETER

ACCURACY: ± 3% of range from 0 to 1100 vdc and 0.001 to 1100 vac.

RANGE:

Voltage Range	DC Input Resistance	AC Input Impedance
1000-0-1000	10 Meg	1 Meg, 40 pf
100-0-100	"	"
10-0-10	"	"
1-0-1	"	"
*0.1-0-0.1	"	"
*0.01-0-0.01	"	"
*0.001-0-0.001	1 Meg	"
*0.0001-0-0.0001	"	"

*These ranges are obtained by using null ranges with all five voltage dials set to zero.

NOTE: Each range has the capability of measuring 10% overvoltage.

GENERAL

ELECTRICAL DESIGN: Completely solid-state.

INPUT RESISTANCE OF NULL DETECTOR: 10 megohms on two highest null ranges for all input ranges; 1 megohm on two lowest null ranges for all input ranges.

REFERENCE ELEMENT: Temperature-compensated zener diode, stability within ±15 ppm per year, and temperature coefficient less than 2 ppm/°C.

REGULATION OF REFERENCE SUPPLY: 0.0005% for a 10% line voltage change.

STABILITY OF REFERENCE SUPPLY: ±0.001% per hour after 5 minute warmup.

ACCURACY OF OFF-NULL DEFLECTION: ±5% of null range (±3% with voltage dials to zero).

KELVIN-VARLEY ACCURACY: ±0.002% of setting from 1/11 of full scale to full scale. Ratio stability of decade resistors, 10 ppm/year.

RECORDER OUTPUT: Adjustable from 0 to at least +20 mv for full scale right deflection and from 0 to at least -20 mv for full scale left deflection.

POLARITY: Front panel switch selects +DC, -DC, and AC.

WARMUP TIME: DC-15 seconds; AC-1 minute.

COMMON MODE REJECTION: 130 db at dc; 85 db at 60 cps; 70 db at 400 cps. Up to 1000 vdc may be applied between common and ground posts without damage. NOTE: Battery operation of Model 883AB provides complete isolation from power system ground, for elimination of errors due to ground loops.

OPERATING TEMPERATURE RANGE: Within DC specifications from 55°F to 95°F (13°C to 35°C), derated at 0.0004%/°F (0.0007%/°C) outside these limits to 32°F and 122°F (0°C and 50°C).

Within AC specifications from 55°F to 95°F (13°C to 35°C), derated outside these limits to 32°F and 122°F (0°C and 50°C) as follows:
±0.002%/°F (±0.004%/°C) up to 10KC
±0.004%/°F (±0.008%/°C) above 10KC

STORAGE TEMPERATURE RANGE: Model 883A, -40°F to +158°F (-40°C to +70°C); Model 883AB, -40°F to +140°F (-40°C to +60°C).

SHOCK: Meets requirements of MIL-T-945A and MIL-S-901B.

VIBRATION: Meets requirements of MIL-T-945A.

INPUT POWER: Model 883A - 115/230 vac ±10%, 50 - 440 cps; Model 883AB - 115/230 vac ±10%, 50 - 440 cps and rechargeable battery operation (minimum 30 hours operation on full charge).

SIZE: 7" high x 8-1/2" wide 14-3/4" deep.

WEIGHT: Model 883A - approximately 13 lbs.
Model 883AB - approximately 14 lbs.

SECTION II

OPERATING INSTRUCTIONS

2-1. FUNCTION OF EXTERNAL CONTROLS, TERMINALS AND INDICATORS

2-2. The location, circuit symbol, and a functional description of the external controls, terminals, and indicators on the 883A and 883AB Precision Differential DC Voltmeter may be found in figure 2-1 and 2-2.

2-3. PRELIMINARY OPERATION FOR 883A

2-4. The following procedure prepares the Model 883A for operation.

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING

The round pin on polarized three-prong plug connects instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

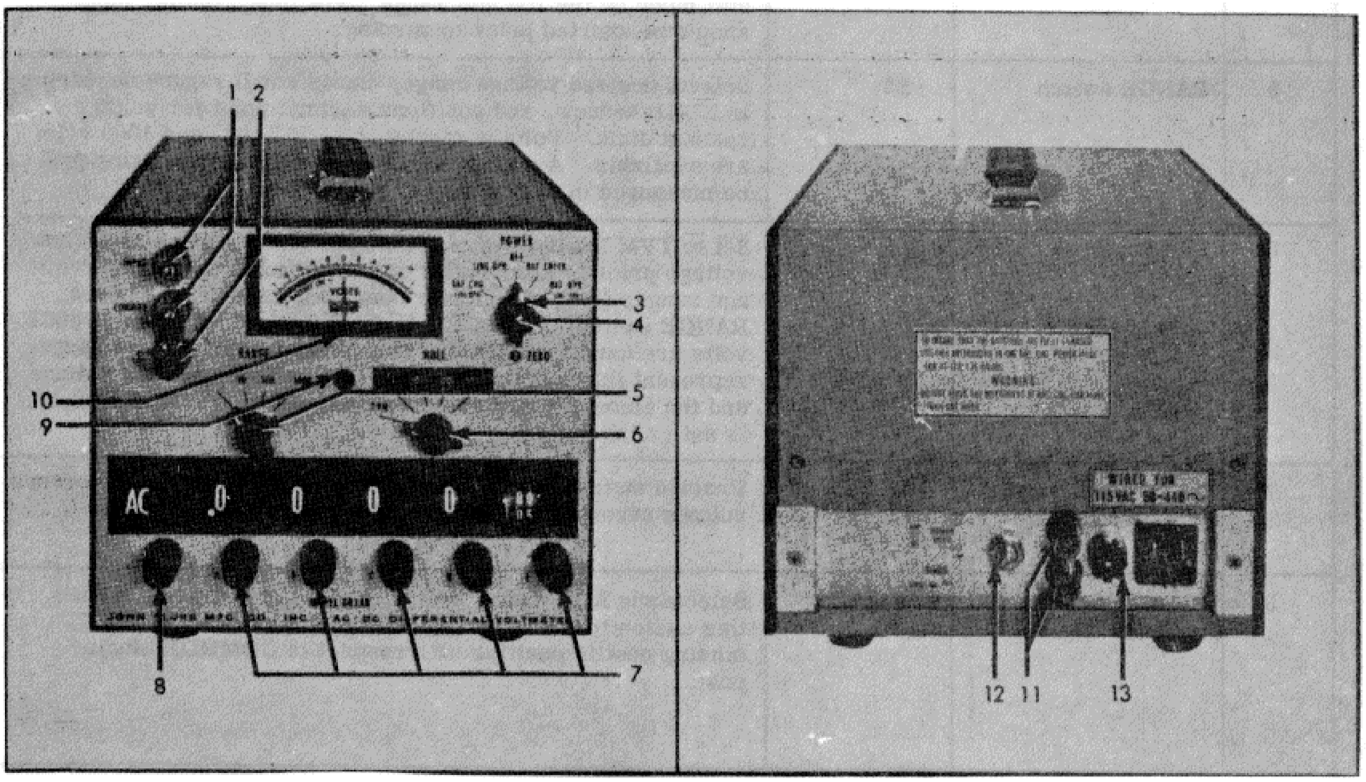


Figure 2-1. LOCATION OF CONTROLS, TERMINALS, AND INDICATORS2-1

INDEX NO. AND	CONTROLS TERMINALS AND INDICATORS	CIRCUIT SYMBOL	FUNCTIONAL DESCRIPTION
1	INPUT and COMMON terminals	J1, J2	Provided for connecting ac or dc voltage to be measured.
2	Chassis ground terminal	J3	Provided for grounding purposes. A 0.01 uf capacitor is connected from the COMMON binding post to the chassis ground post. The INPUT post should never be connected to the chassis ground post. Since the instrument is equipped with a three-wire line cord with the third wire fastened to the chassis, the circuit should be checked for conflicts in grounding before connecting COMMON binding post to the chassis post.
3	POWER switch	S1	In the Model 883A, the POWER switch applies ac line voltage to primary circuit of transformer when turned from OFF to ON. In the Model 883AB, positions for OFF, BAT CHECK, and three modes of operation (LINE OPR, BAT CHG - LINE OPR, and BAT OPR - LINE ISOL) are available. When set to LINE OPR, ac line voltage is applied to primary circuit of transformer. When set to BAT CHG - LINE OPR, ac line voltage is applied to primary of transformer and batteries are charged at the same time. When set to BAT OPR -LINE ISOL, battery power is applied to the instrument and both sides of primary circuit are open. When set to BAT CHECK, battery power is applied to the instrument, both sides of primary circuit are open, and meter is connected in series with a resistor to measure voltage between reference supply batteries and reference supply output which indicates the condition of the batteries.
4	Electronic ZERO control	R239	A screwdriver adjustment used to zero null detector in the control .0001 volt null mode on the 1 volt range and in the .01 volt null mode on the 100 volt range. For best results, input should be shorted prior to zeroing.
5	RANGE switch	S2	Selects desired voltage range, changes null ranges appearing in NULL window, and positions decimal point for voltage readout dials. Voltage ranges of 1, 10, 100, and 1000 volts are available. A voltage 10% higher than range setting may be measured in each range.
5	NULL switch	S3	Set to TVM for determining the approximate value of unknown voltage prior to differential measurements. Seven null voltage ranges (four of which are used for each setting of the RANGE switch) of 100, 10, 1, 0. 1, 0. 01, 0. 001, and 0.0001 volts are used for differential measurements. These ranges represent full scale differences between the unknown voltage and the amount of precision internal reference voltage that is set on the voltage readout dials.
7	A, B, C, D, and E voltage readout dials	S5, S6, S7, S8 R13	Provide an in-'line readout of the amount of internal reference voltage necessary to null the unknown voltage.
8	AC-DC polarity switch	S4	Selects the AC, + (dc), or - (dc) mode of operation. With this switch in the positive position, the polarity of INPUT binding post is positive with respect to COMMON binding post.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

INDEX NO.	CONTROLS TERMINALS AND INDICATORS	CIRCUIT SYMBOL	FUNCTIONAL DESCRIPTION
9	Mechanical zero	None	Sets meter to zero mechanically. This adjustment should be control used only after instrument has been turned off for at least three minutes or when the internal meter terminals have been shorted.
10	Meter	M1	Indicates approximate voltage when 883A is in TVM mode and difference between unknown and internal reference voltage when 883A is in differential mode.
11	RECORDER OUT-PUT terminals	J4, J5	Provided for attaching a recorder to monitor voltage excursions.
12	AMP ADJ control	R8	Varies the output level of the output binding post from 0 to at least 20 millivolts at full scale deflection.
13	Fuse	Fl	Fuse holder protrudes from instrument to provide easy access to the fuse. The fuse is a 1/16 ampere slow blowing type for 115 volt operation and a 1/32 ampere slow blowing type for 230 volt operation.

Figure 2-2. DESCRIPTION OF CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

b. Set switches on 883A voltmeter as follows:

RANGE	1000
NULL	TVM
ac-dc polarity	+ (positive)
all voltage readout dials	0 (zero)
POWER	ON

2-5. PRELIMINARY OPERATION FOR883AB

2-6. The following procedure prepares the Model 883AB for operation.

a. For line operation, connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

WARNING

The round pin on polarized three-prong plug connects instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

b. For line operation, set POWER switch to LINE OPR.

c. For battery operation, set POWER switch to BAT CHECK. Meter needle should deflect to BATTERY OK
region. If meter needle does not stay within BATTERY OK region for 10 seconds, charge batteries as out- lined in paragraph 2-9. If batteries are charged, set POWER switch to BAT OPR-LINE ISOL.

d. Set switches on 883AB voltmeter as follows:

RANGE 1000
NULL TVMac-dc polarity + (positive)
all voltage readout dials 0 (zero)

2-7. ZEROING INSTRUCTIONS

2-8. From time to time, it may be necessary to adjust the electronic meter zero control. This will normally be done at somewhat more frequent intervals than complete instrument calibration. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Mechanically zero the meter with the adjustment screw on the front of the meter case. If the instrument is in the case, it must be shut off for at least three minutes prior to this adjustment. If out of case, another method would be to short out the internal panel meter terminals prior to zeroing.

c. Turn instrument on and allow a 5 minute warmup period.

d. Set RANGE switch to 1, voltage readout dials to zero, and NULL switch to 0. 0001.

e. Short INPUT post to COMMON post and adjust electronic ZERO control with a screwdriver for zero meter deflection.

f. Remove short from between INPUT and COMMON post.

2-9. BATTERY CHARGING

a. Connect power plug to a 115 volt ac power outlet. If instrument has been wired for 230 volt operation, connect to 230 volts ac.

b. Set POWER switch to BAT CHG-LINE OPR. After 16 hours, batteries will be fully charged and capable of operating the instrument for at least 30 hours. While the batteries are being charged, the instrument may be operated the same as for line operation.

CAUTION

Since overcharging decreases battery life, it is recommended that the batteries be charged for less than 48 hours and never more than 1 week. When used properly, the batteries will give more than 200 charge-discharge cycles of operation.

2-10. OPERATION AS A DC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Connect unknown voltage between INPUT and COMMON post.

c. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.

d. If meter reads to left, turn ac-dc polarity switch to negative position. The meter needle will deflect to right. This is because polarity of unknown voltage is negative.

e. Noting position of decimal point, set five voltage readout dials to approximate voltage determined in step

c. For example, if voltage is approximately 35 volts, decimal point will be between B and C voltage readout dials. Therefore, set A dial to 3 and B dial to 5.

f. Set NULL switch from TVM to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage under measurement is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on readout dials.

g. Read unknown voltage directly from five voltage readout dials.

2-11. OPERATION AS AN AC DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Set ac-dc polarity switch to AC.

c. Connect unknown ac voltage between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

d. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.

e. Noting the position of the decimal point, set five voltage readout dials to approximate voltage determined in step d. For example, if the voltage is approximately 35 volts, the decimal point will be between the B and C voltage readout dials. Therefore, set A dial to 3 and B dial to 5.

f. Set NULL switch to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to the right, magnitude of voltage under measurement is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on readout dials.

g. Read unknown voltage directly from the five voltage readout dials.

2-12. OPERATION AS A CONVENTIONAL VOLTMETER

2-13. If it is desired to use the instrument as a conventional 3% voltmeter only, additional ranges can be made available by converting the NULL ranges to conventional voltmeter ranges. This is made possible by setting the voltage readout dials to zero. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Consult figure 2-3, and select full scale voltage deflection desired. If approximate value of voltage to be measured is unknown, select the 1000 volt range

c. Set ac-dc POLARITY switch, RANGE switch, initially. NULL switch, and voltage dials as indicated for the range selected.

d. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

e. Read voltage from meter scale. Deflection to right indicates an unknown dc voltage is of positive polarity. An unknown ac voltage will always deflect to the right.

FULL-SCALE DEFLECTION	AC-DC POLARITY SWITCH	RANGE SWITCH	NULL SWITCH	VOLTAGE DIALS
DC:				
1000-0-1000	+	1000	TVM	No effect
100-0-100	+	100	TVM	No effect
10-0-10	+	10	TVM	No effect
1-0-1	+	1	TVM	No effect
0.1-0-0.1	+	1	0.1	All zero
0.01-0-0.01	+	1	0.01	All zero
0.001-0-0.001	+	1	0 001	All zero
0.0001-0-0.0001	+	1	0.0001	All zero
AC:				
0-1000	AC	1000	TVM	No effect
0-100	AC	100	TVM	No effect
0-10	AC	10	TVM	No effect
0-1	AC	1	TVM	No effect
0-0 1	AC	1	0.1	All zero
0-0.01	AC	1	0.01	All zero
0-0 001	AC	1	0 001	All zero

Figure 2-3. TVM RANGES

2-14. MEASUREMENT OF VOLTAGE EX-CURSIONS ABOUT ANOMINALVALUE

a. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

b. Set ac-dc polarity switch to desired position.

c. Connect voltage to be observed between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post. Deflection to the left indicates the voltage being measured is negative dc; set polarity switch to the negative position in this case. This will cause meter pointer to deflect to the right.

d. Set RANGE switch to lowest range which will give an on-scale meter indication and note nominal value of voltage indicated.

e. Set five voltage readout dials to nominal voltage.

f. Turn NULL switch to lowest position that will allow voltage excursions to remain on scale.

g. Read voltage excursions from meter. Note that full scale right and left meter deflections are equal to the NULL range setting (disregarding 10% over-range at end of scale). Meter deflection to the right indicates that magnitude of voltage under observation has increased above the nominal value while deflection to the left indicates it has decreased.

2-15. RECORDING VOLTAGE EXCURSIONS

2-16. Recorder output binding posts and an output level control are provided on the 883A and 883AB for monitoring the excursions of an unknown voltage from the voltage indicated by the voltage readout dial settings. If the leakage resistance between the recorder and ground is less than 10, 000 megohms, the accuracy of the voltmeter will be impaired. Therefore, the FLUKE Model A88 Isolation Amplifier is recommended for this application. The A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder.

2-17. USE OF 883A WITH AN A88 ISOLATION AMPLIFIER AND A RECORDER

2-18. To use the A88 Isolation Amplifier and a recorder with the 883A or 883AB, proceed as follows:

a. Set A88 POWER switch to ON.

b. When batteries are being used as a power source for A88, measure voltage at BATT TEST jacks. If voltage is between 11.7 and 14 volts DC, the batteries are satisfactory for use. However, if battery voltage is below 12.8 volts, batteries are approaching end of their useful life and should be replaced.

c. Connect RECORDER OUTPUT terminals of differential voltmeter to INPUT terminals of isolation amplifier with teflon leads.

d. Connect OUTPUT terminals of isolation amplifier to recorder input terminals.

e. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

f. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00000

The meter will indicate full scale (-1. 0). This provides up to a maximum of at least 20 millivolts at RECORDER OUTPUT terminals depending on setting of AMP ADJ control.

g. Turn on recorder and set recorder gain so that a recorder input of either *2 volts or near maximum if maximum is below *2 volts, will cause recorder deflection desired for full scale deflection of differential voltmeter.

h. Adjust AMP ADJ control on rear of differential voltmeter until recorder deflection obtained is that desired to correspond to full scale deflection of the differential voltmeter.

i. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed as instructed under paragraph 2-14.

2-19. USE OF 883A WITH A RECORDER

2-20. To use a recorder with the 883A or 883AB proceed as follows:

a. Connect RECORDER OUTPUT terminals of differential voltmeter to input terminals of recorder with teflon leads.

NOTE

Do not ground either of the voltmeter RECORDER OUTPUT terminals or either of the recorder input terminals. If any of these terminals are grounded, current will be drawn from the Kelvin-Varley divider and the voltmeter will no longer be accurate.

b. Perform preliminary operation as stated in paragraph 2-3 or 2-5.

c. Check for excessive electrical leakage as follows:

(1) Connect a voltage to the input of the 883A and differentially measure its potential in the most sensitive null range.

(2) Alternately connect and disconnect the recorder leads from the output terminals of the 883A while noting the meter needle deflection. More than one major scale division deflection (10% of null range) indicates that excessive leakage has been introduced by the recorder. This will impair the accuracy of the 883A voltmeter.

(3) Disconnect the voltage.

d. Short INPUT post to COMMON post and set switches on voltmeter as follows:

RANGE	10
NULL	1
voltage readout dials	1.00000

The meter will indicate full scale (-1.0). This provides up to a maximum of at least 20 millivolts at RECORDER OUTPUT terminals depending on setting of AMP ADJ control.

e. Adjust AMP ADJ control until recorder deflection obtained is that desired to correspond to full scale deflection of the voltmeter.

f. Remove short from INPUT to COMMON post. The voltmeter and recorder are now ready for recording the measurement of voltage excursions about a nominal value. Proceed as instructed under paragraph 2-14.

2-21.MEASUREMENT OF HIGH RESISTANCE

2-22. One of the features of the 883A voltmeter is its ability to be used as a megohmmeter for rapid mieasurements of high resistance from 10 megohms to 11, 000 megohms with a typical accuracy of 5%. The following equation may be used to compute the resistance in megohms of an unknown connected to the input binding posts when the RANGE switch is set to 10:

$R_x = R_i$ (= E/E_m-1) megohms

where:

R_x is the unknown resistance in megohms.

E is the voltage indicated by the voltage readout dials.

E_m is the voltage indicated on the meter.

R_i is the input resistance of the TVM circuit in megohms. 10 for the 1 and 0.1 null range and 1 for the 0.01 and 0.001 null range on the 10 volt range.

2-23. For rapid measurement of resistance between 10 megohms and 11, 000 megohms, proceed as follows:

a. Perform preliminary operation, paragraph 2-3 or 2-5.

b. Set RANGE switch to 10 and NULL switch to 1.

c. Connect unknown resistance between INPUT post and COMMON post. Use short isolated leads to prevent measurement of leakage resistance between leads.

d. Adjust voltage readout dials for full scale meter deflection (-1.0). If full scale deflection cannot be obtained with NULL switch set to 1, set NULL switch to 0. 1 or 0. 001.

e. Determine value of unknown resistance from figure 2-4.

2-24. NOTES ON MEASURING AC OR DC VOLTAGES

2-25. GROUND LOOP PRECAUTIONS

2-26. Ground loop currents should be avoided to assure accuracy when making measurements. Potential differences are often found at different points on power system grounds. When this is the case, current may flow from the power system ground through the 883A and the equipment under measurement and back to the power system ground. To avoid this when system being measured is grounded, do not connect 883A COMMON binding post to
chassis ground post.

2-27. USE OF SHORTING LINK

2-28. A 0.01 uf capacitor (C1) is connected from the COMMON binding post to the chassis ground post to reduce the effect of circulating ac currents from the transformer. In some cases, it is possible for C1 to acquire a charge. For example, C1 will become charged when making common mode voltage measurements. This condition may cause an error on low level measurements (under 5 volts) due to C1 discharging through the Kelvin-Varley divider and leakage resistance to ground. Connecting the shorting link from the COMMON post to the ground post for a few seconds will discharge C1 and thus prevent an inaccurate indication.

2-29. BATTERY CHECKING

2-30. If the voltmeter is left in the battery operating mode for an extended period of time, the batteries will

Range of Unknown Resistance	Null Switch Position	To Obtain Value Of Unknown In Megohms When Meter Indicates Full Scale
10 MΩ to 100 MΩ	1	Multiply amount set on voltage readout dials by 10 and subtract 10.
90 MΩ to 1090 MΩ	0.1	Multiply amount set on voltage readout dials by 100 and subtract 10.
1, 000 MΩ to 11, 000 MΩ	0. 001	Multiply amount set on voltage readout dials by 1000.

Figure 2-4. RESISTANCE MEASUREMENTS

become discharged. When the batteries are left in a completely discharged state with the voltmeter turned off, their voltage will recover with time. It is possible that the batteries may have recovered enough for the meter to indicate they are charged when the power switch is first set to battery check. However, after a few seconds, the battery voltage will fall and the meter will indicate that the batteries need to be charged. It should also be noted that the voltage characteristic of the nickel-cadmium batteries is very flat except near full charge and c6mplete discharge. Therefore, when the batteries are checked, the meter needle deflection will not be proportional to the remaining ampere-hour capacity of the batteries. Just after the batteries are charged, the meter needle will indicate near full scale. However, most of the time the batteries are charged, the meter needle will indicate near half scale. A few hours before the batteries need a recharge, the meter needle will indicate just within the battery ok region.

2-31. EFFECT OF COMMON MODE VOLTAGES

2-32. Common mode errors are caused by leakage currents passing through ground loops. Since great care has been taken in the design and construction to insulate the circuitry from chassis ground, accurate dc common mode measurements up to 1000 volts dc above ground can be made with the 883A and 883AB. The dc common mode rejection is at least 134 db (5, 000, 000 to 1) or 0.2 uv error per common-mode-volt all the way up to 70% relative humidity. However, since the leakage resistance is dependent on dampness, the dc common abode error is typically much less at lower relative humidities. Thus, common mode measurements should be made with a relative humidity below 70%. Also, if the common mode voltage is greater than 50 volts, the measurement should be made several
minutes after hookup for best accuracy. This is due to the time it takes to charge stray capacities to ground through the extremely high leakage resistances.

2-33. NOTES ON MEASURING DC VOLTAGES

2-34. EFFECT OF AC COMPONENTS ON DC MEASUREMENTS

2-35. An ac component of several times the unknown dc may be present on the unknown and the 883A will always indicate well within the specifications for frequencies over a few hundred cycles. An ac component may have an adverse effect if it is of a low frequency or if it has a frequency that is a multiple or submultiple of the chopper frequency. A triple section low pass filter (R201, C201, R202, C202, R203, and C203) is used at the input of the null detector to reduce any ac present on the dc being measured. At lower frequencies, this low pass filter is less effective and the magnitude of the ac component is more significant. If this frequency is below 100 Hertz, the accuracy may no longer be with specifications. For example, a 60 Hertz ac voltage that is 1% of the input will cause an error of approximately 0. 001% which is well within the specifications. This 1000:1 rejection of ac also applies until the ac voltage is 1000 times the null range. For example, on the .01 volt null range, the ac rejection of 1000:1 applies up to 10 vac. When the frequency is very close to a multiple or submultiple of the chopper frequency (approximately 84 Hertz), the meter needle will oscillate at the difference frequency. If ac components that affect the accuracy are ever encountered, additional filtering will be required. For an ac of a single frequency, a twin-T filter is effective and has the advantage of low total series resistance. For an ac variable frequency, an ordinary low pass filter may be used. In either case, high quality capacitors of high leakage resistance should be used.

2-36. MEASUREMENT OF NEGATIVE VOLTAGES

2-37. Because of a polarity switch, voltage which are negative with respect to ground as well as the more commonly encountered positive voltages may be measured with equal facility. If the INPUT post is connected to the metal case, either at the 883A or at the source under measurement, the accuracy of the voltmeter may be reduced. However, with the polarity switch, the INPUT post never has to be connected to ground. If the unknown voltage is grounded, always connect the grounded side to the COMMON post and use the polarity switch to obtain the proper result.

2-38. NOTES ON MEASURINGAC VOLTAGES

2-39. ERRORS DUE TO DISTORTION

2-40. The ac to dc converter in the 883A is an average measuring device calibrated in rms. The converter will put out a dc voltage that is proportional to 1. 11 times the average value of the ac input voltage. Thus, if the input signal is not a true sinusoid, the 883A reading is probably in error because the ratio of rms to average is usually not the same in a complex wave as in a sine wave. The magnitude of the error is dependent on magnitude of the distortion and on its phase and harmonic relationship with respect to the fundamental. Figure 2-5 indicates how the accuracy will be affected by various harmonics for different percentages of distortion. If the distortion present in the signal is composed of even harmonics and is less than 2%, the error between the 883A reading and true rms is minor. A larger error can occur if the distortion is composed of odd harmonics, especially the third harmonic. Note that for 2% of third harmonic distortion the error in the reading could range from 0 to 0. 687%.

RMS* Harmonic Positive	Distortion Negative	% Error From True	
		Maximum	Maximum
Any even harmonic	0.1	0.000	0.000
	0.5	0.000	0.0001
	1.0	0.000	0.005
	2.0	0.000	0.020
Third harmonic	0.1	0.033	0.033
	0.5	0.167	0.168
	1.0	0.328	0.338
	2.0	0.667	0.687
Fifth harmonic	0.1	0.020	0.020
	0.5	0.099	0.101
	1.0	0.195	0.205
	2.0	0.380	0.420

*Error depends upon phase relationship between harmonic and fundamental, i. e. error can be any value between maximum positive and maximum negative, including zero.

Figure 2-5. PERCENT ERROR DUE TO HARMONIC DISTORTION

2-41. ERRORS DUE TO GROUNDING

2-42. In the 883A there is a 0.01 uf capacitor connected from the COMMON terminal (middle post) to chassis ground. If it is desired to make measurements where the voltage to be connected to the lower input terminal is not at ground potential, a line cord adapter must be used to isolate the 883A chassis from line ground. Otherwise, the 0.01 uf capacitor would place an ac load on the circuit being measured.

2-43. INTERNAL CONVERTER NOISE

2-44. When the instrument is shorted in the ac mode, the converter may produce a residual noise output of approximately 100 uv. This noise voltage will cause an insignificant error as long as ac input signals of 1 mv or larger are applied to the-instrument. Figure 2-6 shows a typical half wave of the signal voltage at the output of the converter amplifier. It is easily seen that the noise contributes very little to the average value of the signal and is well within the 2.6% accuracy of the instrument at 1 mv. Also for input signals over 1 mv, the instrument is noise free to within 2 parts per million of the input range. For example, on the 1 volt input range the instrument will contribute less than 2 uv of noise to any measurement.

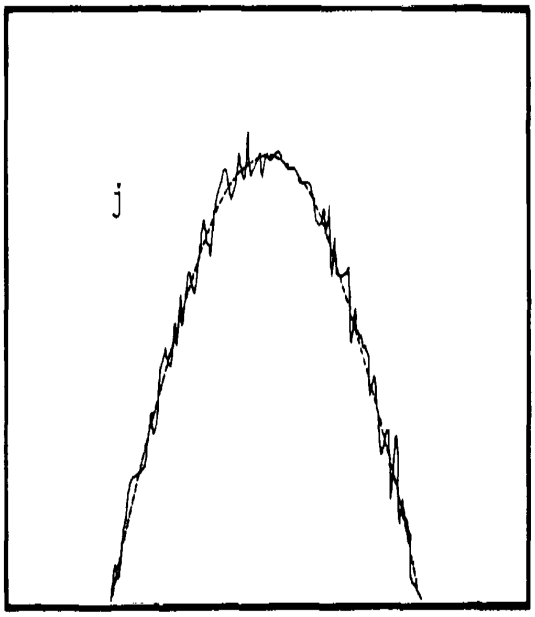


Figure 2-6. SIGNAL VOLTAGE WITH CONVERTER NOISE

2-45. MOST SENSITIVE NULL RANGE ON AC

2-46. The most sensitive null range for each input range should be used with caution when measuring ac voltages. Most ac sources are not stable enough to be used on this range. For example, if 1.0 volt is measured with the range switch set to 1 and the null switch set to 0. 0001, the null detector sensitivity is 100 microvolts full scale. Since 100 uv is 0. 01% of 1. 0 volt, an ac source with a stability worse than 0O. 01% will cause the 883A meter pointer to swing from one end of the meter scale to the other. Also, if the input is shorted with the range switch set to 1 and the null switch set to 0. 0001, the meter needle may deflect more than full scale due to converter noise. However, as pointed out in paragraph 2-43, converter noise will not impair the accuracy for input signals greater than 1 mv. Thus, any excessive erratic meter needle movement is due to ac source stability.

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. Figure 3-1 shows the block diagram for the 883A Differential Voltmeter. As seen in this figure, the circuit is mainly composed of an ac to dc converter, a dc input attenuator, a dc transistorized voltmeter (tvm), and an extremely accurate 0 to 11 volt reference. The dc input attenuator reduces the input voltage by a factor of 100 on the 1000 and 100 volt dc range. The tvm uses a null detector, an attenuator, and a meter to obtain high sensitivity. The 0 to 11 volt reference uses a range divider and a Kelvin-Varley attenuator to make the output of two well regulated zener diodes adjustable. Refer to the functional schematic following Section VI for more detail, This schematic is designed to aid in the understanding of circuit theory an troubleshooting. The signal flow is from left to right and the components are laid out in a functionally logical manner.

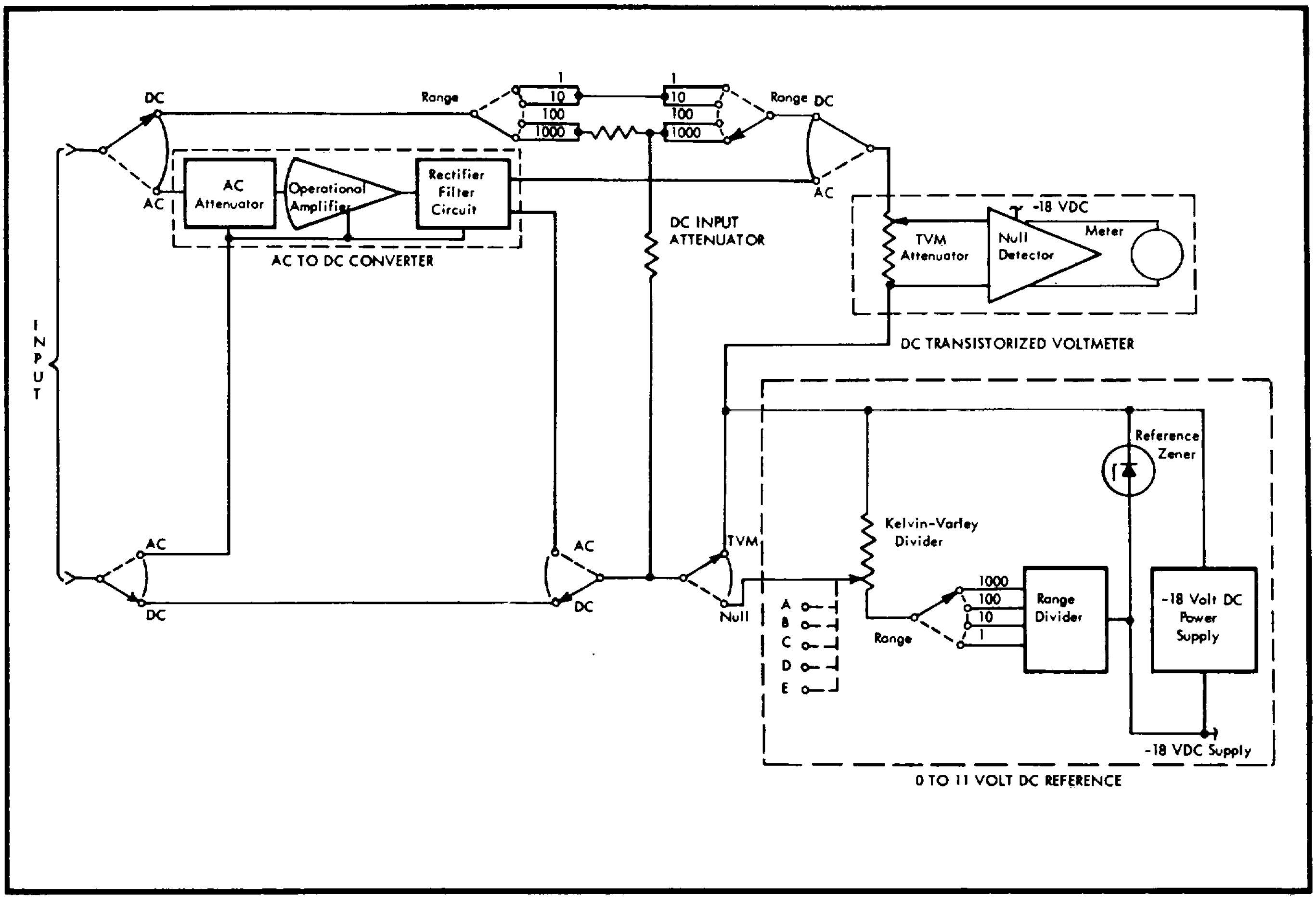


Figure 3-1. 883A DIFFERENTIAL VOLTMETER BLOCK DIAGRAM

3-3. The overall operation of the voltmeter may be summarized as follows. To measure the approximate value of a dc voltage between 0 and 11 volts, the unknown voltage is connected directly across the tvm attenuator. This attenuator is set in such a way that the maximum voltage for each range is reduced to a signal of 1 millivolt (100 microvolts for the 1 volt range in the highest null mode). The signal is then applied to the null detector and causes 100 microamperes to flow through the meter for full scale deflection. To accurately measure this dc voltage, the unknown voltage is connected across the series combination of the tvm and the 0 to 11 volt reference. The reference voltage is then adjusted with the five voltage readout dials until it matches the unknown voltage as indicated by the tvm. For voltages between 11 and 1100 volts, the dc input attenuator divides the unknown voltage by 100. The 883A then operates essentially the same as for measurements from 0 to 11 volts. All ac measurements are made by first converting the ac input voltage to a dc voltage by means of the ac to dc converter. The 883A then operates essentially the same as for approximate and accurate dc measurements.

3-4. In order to provide for a more complete understanding of the 883A voltmeter, the following paragraphs describe each section of the circuit in detail.

3-5. DC INPUT ATTENUATOR

3-6. Since the instrument contains a 0 to 11 volt reference, the unknown voltage is measured by comparing it to a known voltage with the aid of a null detector only on the 1 and 10 volt range. On the 100 and 1000 volt range, the dc input attenuator (R100 through R104) divides the unknown voltage by 100 and this attenuated voltage is then measured by the potentiometric principal. Thus, after attenuation by 100, the 100 and 1000 volt ranges are reduced to the equivalent of 1 and 10 volt ranges. The dc input attenuator is extremely accurate and has excellant long term stability. The 10K variable resistor (R103) is used during factory calibration to setup the proper division ratio. This adjustment can then be performed as required at regular calibration intervals.

3-7. DC TRANSISORIZED VOLTMETER

3-8. GENERAL

3-9. The dc tvm is composed of an attenuator, a null detector, and meter. The heart of the dc tvm is the null detector in which the dc signal is modulated by an
electromechanical chopper, amplified by a five stage resistance-capacitance coupled amplifier, rectified by a transistor switch, and finally filtered to produce a dc output. The null detector has a high amount of negative current feedback. This makes the proportion of the output current feedback approximately equal to the signal voltage divided by the resistance of the feedback resistor, regardless of the amplifier characteristics. The high negative feedback also makes the amplifier relatively insensitive to the gain changes in individual transistors due to aging, and replacement. The output current from the null detector is indicated on a meter that has tautband suspension. This suspension does away with all friction associated with meter pivot stickiness. Thus, any tendency for the meter pointer to stick at one point of the scale and then jump to another point is eliminated. The tvm attenuator is used to reduce the voltage span of each range to a common range usable by the null detector to produce proper meter deflection.

3-10. NULL DETECTOR

3-11. The null detector is a current feedback amplifier that drives a meter. Any feedback amplifier is essentially a null seeking device. That is, it tends to make the voltage fed back to the input equal to the input voltage. In a current feedback amplifier, the feedback voltage is equal to the voltage drop across a fixed resistor caused by the output current or a portion of the output current. At the input to the 883A null detector R201, C201, R202, C202, R203, and C203 form a triple section low pass filter that reduces any ac component present on the d, voltage being measured. The difference between the voltage appearing at the output of the filter and the voltage developed across feedback resistor R236 is converted to an alternating voltage by G201, an 84 hertz chopper. The voltage across R236 is proportional to the current flowing in the meter. The alternating voltage created by G201 is amplified by a five-stage solid-state amplifier. The first stage-is a p-channel field effect transistor (Q201). The field effect transistor provides both high impedance and low noise input characteristics. The next four stages consist of two transistor doubletons (Q202 to Q205). During one portion of the chopper cycle, the output of the amplifier is clamped to approximately null detector common potential by Q206, a transistor switch. The transistor switch is gated in synchronization with the chopper since the gating pulse comes from the voltage that is used to drive the chopper. During the other portion of the
chopper cycle, the output of the amplifier is filtered by R-C filter R225-C219 to provide a dc current for the meter. A portion of the current that flows through the meter is shunted back to the 200Q1 feedback resistor R236 thus completing the feedback loop. The null de-tector has a basic sensitivity of 1 millivolt except In the most sensitive null mode for the 1 and 100 volt range where the sensitivity is 100 microvolts. For the two most sensitive null modes in the 100 and 1000 volt range, the sensitivity is boosted 10% to compensate for the
loading effect of the tvm attenuator on the dc input attenuator. The output resistance of the dc input attenuator is 100K and the input resistance of the tvm dc attenuator is 1 meg. Thus, when monitoring voltage excursions, much more accurate off null readings are obtained due to the 10% boost in null sensitivity.

3-12. TVM ATTENUATOR

3-13. In the dc tvm mode, two positions on the tvm attenuator selected by range switch section S2H provide the necessary reduction of the 1 and 10 volt ranges for proper null detector input. The same two positions on the tvm attenuator are used for the 100 and 1000 volt ranges because the input attenuator divides the input signal by 100 and thus reduces the 100 and 1000 volt ranges to the equivalent of 1 and 10 volt ranges. In the differential mode, the voltage difference (unknown voltage, or unknown voltage divided by 100, minus reference voltage) is reduced as necessary by positions on the tvm attenuator selected by null switch sections S3H, S3G, and S3E to provide the basic null detector inputs of 1 millivolt or 100 microvolts.

3-14. Id the ac tvm mode, null switch section S3H and ac-dc polarity switch section S4E provide connection to only one position on the tvm attenuator regardless of where the range switch is set. Also, in the ac differential mode, the voltage difference (converter output voltage minus reference voltage) is reduced by the same positions on the tvm attenuator as for 1 volt dc differential measurements. This is because the output of the ac-dc converter is 1 volt dc for full input on each range.

3-15. INPUT RESISTANCE

3-16. For the tvm, low sensitivity, and medium low sensitivity modes, the, 'input resistance of the tvm attenuator is 10 megohms (R4through R7). For the medium high and high sensitivity modes, the input resistance of the tvm attenuator is 1 megohm (R4 through R7). However, this is not the input resistance of the 883A for the dc tvm and dc differential mode. For the 1 and 10 volt range, the input resistance is determined by dividing the unknown voltage by the, current drawn from the unknown. The current drawn from the unknown is equal to the difference between the unknown terminal voltage and the internally known voltage divided by the resistance of the tvm attenuator. The equation for input resistance an therefore be written as:

$$R_{in} = \frac{E_u}{I_u} \quad \frac{E_u R_a}{(E_u - E)} = E_s \frac{(R_a + R_s)}{(E_s - E)} - R_S$$

where:
R_{in} = input resistance of voltmeter

E_u = E_s - I_U R_S = terminal voltage of unknown

I_u = current drawn from unknown
E_s = source voltage of unknown

R_s = source resistance of unknown

R_a = input resistance of tvm attenuator

E = voltage indicated by voltage readout dials

I I = absolute value (magnitude only)

Thus, the input resistance is essentially infinite (leakage resistance across input is in the order of 1012 ohms) at null when E is equal to E_u and E_s. For the 100 and 1000 volt range, the dc input attenuator is always connected across the input terminals. Thus, the input resistance is equal to the resistance of the dc input attenuator which is 10 megohms.

3-17. The input impedance for the ac tvm and ac differential mode depends on the input impedance of the ac to dc converter and its attenuator. The ac input impedance is thus 1 megohm and 40 picofarads.

3-18. CHOPPER DRIVE CIRCUIT

3-19. The chopper drive circuit determines the chopper timing frequency of 84 Hz. The circuit is symmetrical with the transistors biased so that they can conduct simultaneously. However, cross-coupling capacitors C105 and C106 force Q106, Q109 and Q107, Q108 to conduct alternately. This results in a square wave varying from about 0 to 6 volts that drives chopper coil G201. The symmetry and frequency of the waveform are adjusted with R125 and R123 respectively.

3-20. NULL DETECTOR POWER SUPPLY

3-21. The voltage for null detector amplifier stages Q201 through Q205 is supplied by the same -18 volt power supply that is used to power the 0 to 11 volt reference. The voltage for chopper drive circuit transistors Q106 through Q109 is obtained from a half-wave rectifier consisting of diode CR101 and an R-C vilter network (R105 and C101) that supplies 6 volts dc. Current determining resistors R238 and R240, diodes CR201 and CR202, and divider resistor R239 provide a compensating voltage for the purpose of adjusting the null detector to zero with R239 when there is no signal input. Diode CR201 keeps one side of R239 at approximately +0.6 volt dc with respect to the null detector common while diode CR202 keeps the other side at approximately -0. 6 volt dc.

3-22. EFFECT OF AC COMPONENTS ON DC MEASUREMENTS

3-23. The only ac voltage component that will reduce the accuracy of the 683A is one that either saturates the null detector or one that beats with the chopper frequency. Since the voltage required for saturation is greater than that required for beating, the null detector is most sensitive to an ac component with a frequency that is a submultiple or a low multiple of the chopper frequency. However, this is easy to detect because the meter will beat at the difference frequency. The low pass filter at the input of the chopper-amplifier will attenuate any ac component. The magnitude of the ac voltage appearing at the output of the filter depends on both its)amplitude and frequency before filtering. For all practical purposes, one should never encounter any trouble above a hundred cycles. Below this, the filter may not attenuate the ac component enough. However, this is not as bad as it appears. A 60 cycle ac voltage that is 1% of the input voltage will cause an error of approximately 0. 001% which is well within specifications. If ac components that affect accuracy are ever encountered, additional filtering as set forth in the operating instructions will eliminate the problem.

3-24. TVM GAIN AND ZERO ADJUSTMENTS

3-25. Variable resistor R239 in the feedback network provides a means of adjusting the output current of the null detector to zero when there is no input signal. The gain of the null detector is adjusted by means of R230 in the feedback network for the 1 millivolt sensitivity and by means of R231 for the 100 microvolt sensitivity.

3-26. RECORDER OUTPUT

3-27. The recorder output is picked off divider string R226, R8, and R227. Recorder output AMP ADJ control R8 provides a means of adjusting the output voltage up to a maximum of at least 20 millivolts at full scale deflection (disregarding 10% over-range at end of scale). The voltage at the RECORDER OUTPUT terminals is proportional to the meter reading.

3-28. 0 TO 11 VOLT REFERENCE

3-29. GENERAL

3-30. When the 883A is used to make differential dc voltage measurements between 0 and 11 volts, an internal voltage is nulled or matched against the unknown voltage. An extremely accurate reference is therefore required. This is obtained from the 0 to 11 volt reference. The 0 to 11 volt reference is composed of a well regulated - 18 volt power supply, a range divider, and a five decade Kelvin-Varley divider. The range divider reduces the voltage from a pair of stable Zener diodes in the -18 volt reference supply to 11 volts for the 10 and 1000 volt dc ranges and to 1.1 volts for the 1 and 100 volt dc ranges before it is applied to the Kelvin-Varley divider. The Kelvin-Varley divider divides its input voltage (11 or 1.1 volts) into over 1, 100, 000 equal increments any number of which may be selected by setting the five decades with the five voltage readout dials. The output of the Kelvin-Varley divider, therefore, provides an extremely accurate reference voltage.

3-31. -18 VOLT POWER SUPPLY

3-32. The -18 volt power supply uses a diode (CR102) and a filter network (R106 and C102) to supply unregulated dc voltage to series passing transistor Q101. In the Model 883AB, unregulated dc is supplied directly from a set of two batteries (BT3) in the BAT CHECK and BAT OPR modes. The voltage is regulated by com-paring a sample of the output voltage tapped off a divider string (R108, R109, and R110) with the voltage from Zener reference diodes CR103 and CR104 in differential amplifier Q102 - Q103. The output of Q102 - Q103 is fed to differential amplifier Q104 - Q105 which drives the base of series pass transistor Q101. The control action of the differential amplifiers continuously adjusts the voltage drop across the series pass transistor so as to keep the sample voltage equal to the voltage of the Zener reference diodes. Any difference in voltage, the error,
is amplified by Q102 - Q103 and Q104 - Q105 and thus changes the voltage drop across Q101 to maintain the output at -18 volts. The -18 volt output is used to provide operating voltages for the null detector and, with the aid of current determining resistors R115 and R116, to supply an extremely constant current to its own Zener reference diodes CR103 and CR104. The voltage across the two Zener diodes may be anywhere between approxi-mately 11. 4 and 13 volts. However, this voltage has a stability of better than +15 ppm per year and an overall temperature coefficient of less than 2 ppm per °C.

3-33. RANGE DIVIDER

3-34. In the 1000 and 10 volt dc range, the Zener reference diode voltage is connected directly to the Kelvin-Varley divider through resistors R118 and R119 by means of range switch sections S2J and S2I. The voltage drop across R118 and R119 reduces the Zener ref- erence voltage to 11 volts at the input of the Kelvin-Varley divider. In the 100 and 1 volt dc range, range resistors (R120, R121, and R122) selected by range switch sections S2J and S2I reduce the voltage to 1.1 volts at the input to the Kelvin-Varley divider. With the ac-dc switch set to AC, ac-dc switch section S4H provides connection to the range resistors that dividethe reference voltage to 1.1 volts. This 1.1 volts is then passed to the Kelvin-Varley divider by ac-dc switch section S4G. The voltage applied to the Kelvin-Varley divider is always 1.1 volts for ac because the maximum output of the ac to dc converter is always 1.1 volts.

3-35. KELVIN-VARLEY DIVIDER

3-36. The five Kelvin-Varley decades composed of resistors R13 and R302 to R364, and associated voltage dials A through E provide a means of making the two precision voltages (11 and 1. 1 volts) adjustable. The first decade has twelve 5K resistors (a 4, 999.2 ohm resistor and a 2 ohm trimmer). Two of these resistors are shunted by the 10K total resistance of the second decade. Between the two wipers of S5 (voltage dial A) then, there is a total resistance of 5K (10K paralleled by 10K). Thus, the first decade divides the voltage across it into eleven equal parts with one of the equal parts appearing across the two shunted resistors. Similarly, the second, third, and fourth decades divide the voltage across them into ten equal parts. Note that the second, third, and fourth decades each have eleven 1K resistors. The resistors may have the same value because padding resistors R328 - R329 and R315 - R316 are used across the third and fourth decades respectively to keep the proper resistance matching. The last decade, with its associated shunt resistors to keep the proper matching, is a variable resistor which can be set to pick off increments equal to less than 1/100 times the voltage across its input. The Kelvin-Varley resistors are matched for both temperature coefficient and tolerance thus providing an overall accuracy of 0. 002% absolute from 1/11 of full scale to full scale. With the null switch in any null range, the output of the Kelvin-Varley divider is connected in series with the tvm attenuator thus providing the accurate 0 to 11 volt or 0 to 1.1 volt reference voltage required.

3-37. ADJUSTMENTS

3-38. Variable resistor R110 is used during final factory calibration to set the reference supply to -18 volts. This adjustment is not exceedingly critical and should have to be done only when a component of the reference supply has been replaced. The voltage from the Zener refer- ence diodes is reduced to 11 volts at the input to the Kelvin-Varley divider by adjusting variable resistor R119 during calibration. R, 4nge-divider variable resistor R121 may then be adjusted for 1. 1 volts at the input to the Kelvin-Varley divider. The 2 oh trimmer resistors (even resistors from R342 to R364) and vari-able padding resistors R329, R316, and R30 should require adjustment only after a component of the Kelvin-Varley divider has been replaced.

3-39. AC TO DC CONVERTER

3-40. GENEFAL

3-41. The ac to dc converter is composed of an attenuator, an operational amplifier, and a rectifier-filter circuit. A pair of diodes in the rectifier-filter circuit are used to convert the unknown ac into pulsating dc. This pulsating dc is then filtered to obtain a dc voltage that is proportional to the average value of the ac input voltage. The output, however, is calibrated to indicate the rms value of a pure sine wave. An operational amplifier with high negative feedback is used to make the rectification characteristics of the diodes linear and stable. The first stage is an n-channel field effect transistor (Q501). The field-effect transistor provides both high impedance and low noise input characteristics. The next four stages consist of two transistor doubletons (Q502, Q503, Q504, and Q506). Transistor Q505 acts as a dynamic load and thus increases the output impedance of the amplifier. The amplifier achieves a midband loop gain of approximately 70 db with a virtually flat frequency response from 20 Hz to 20 kHz. At the output of the amplifier, full wave rectification is used to return negative feedback to the gate of the field-effect transistor. The high negative feedback makes the amplifier practically noise free and relatively insensitive to gain changes in individual stages due to aging and transistor replacement. An attenuator is used to reduce the ac input voltage on the higher ranges to within the operating level of the converter amplifier.

3-42. CONVERTER POWER SUPPLY

3-43. The auxiliary power supply for the converter is composed of Q507, Q508, Q509, and the associated components. Diode CR505 and filter network R534-C519 supply unregulated dc voltage to series pass transistor Q507. In the 883AB, unregulated dc voltage is supplied from a set of batteries, BT2, in the BAT CHECK and BAT OPR modes. The emitter voltage of Q509 is set by Zener diode CR506. The base input to Q509 is taken from a divider string, R538, R539, and R540, which samples the output voltage of the +18 volt supply. Any variation in the +18 volts varies the base drive of Q509, which varies the output from the collector load of Q509. Since the output of Q509 drives Q508, the collector current of Q508 continuously adjusts the conductance of Q507 to maintain the auxiliary voltage constant at the value determined by the setting of R539.

3-44. OPERATION

3-45. All ac measurements are made by first converting the ac input voltage into a dc voltage. The converter provides a dc output of 1 volt when full range voltage is applied to the 883A in each ac range. In the 1 volt ac range, the ac-dc polarity switch and the range switch connect the input binding posts directly to the converter input. The converter gain is of such a value that the dc output voltage is equal to .he rms value of the converter input voltage for a sine wave. For the 1000, 100, and 10 volt ac ranges, a separate input attenuator for each range reduces the unknown ac voltage by a factor of 1000, 100, and 10 respectively. The operation of the converter is then the same as for the 1 volt range. Thus, an output of 1 volt dc is provided for full range input of a pure sine wave on any ac range.

3-46. ADJUSTMENTS

3-47. The converter gain is adjusted with R503 in the feedback loop of the operational amplifier. Capacitor C502 In the feedback loop is used to adjust the high frequency response of the converter. The attenuation of the 1000, 100, and 10 volt attenuators are adjusted with R410, R406, and R403 respectively. Capacitors C405, C403, and C401 are used to adjust the high fre- quency response attenuators. The bias of field-effect transistor Q501 should require adjustment with R508 only when Q501 or a component in its drain-source circuit is replaced. The amplifier output level at the collector of Q506 should require adjustment with R522 only if Q505, Q506, or a component in one of these stages is replaced.

3-48. AC-DC POLARITV SWITCH

3-49. The ac-dc polarity switch is provided for selecting either the ac or dc mode of operation. When the ac-dc polarity switch is set to AC, the ac to dc converter is switched into the circuit by sections S4A, S4B, S4C, and S4D. Also, sections S4H and S4G are used to switch 1.1 volts dc to the Kelvin-Varley divider. Section S4E is used to provide proper attenuation in the tvm attenuator. 3-50. For the dc mode of operation, the ac-dc polarity switch may be set to the positive or the negative dc position. As seen in figure 3-2, the polarity switch reverses the transistorized voltmeter - reference voltage combination with respect to the input. Note that a 0.01 uf capacitor (C1) is connected from the COMMON post to the chassis ground post to reduce the effect of ac circulating currents. If the instrument did not contain a polarity switch, the grounded side of any unknown voltage that is negative with respect to ground would

have to be connected to the INPUT post. This would ground the INPUT post and effectively place C1 across the input. With this capacitance connected across the circuit being measured several problems would arise. The polarity switch provides equal convenience in measuring positive and negative voltages without the occurance of these problems.

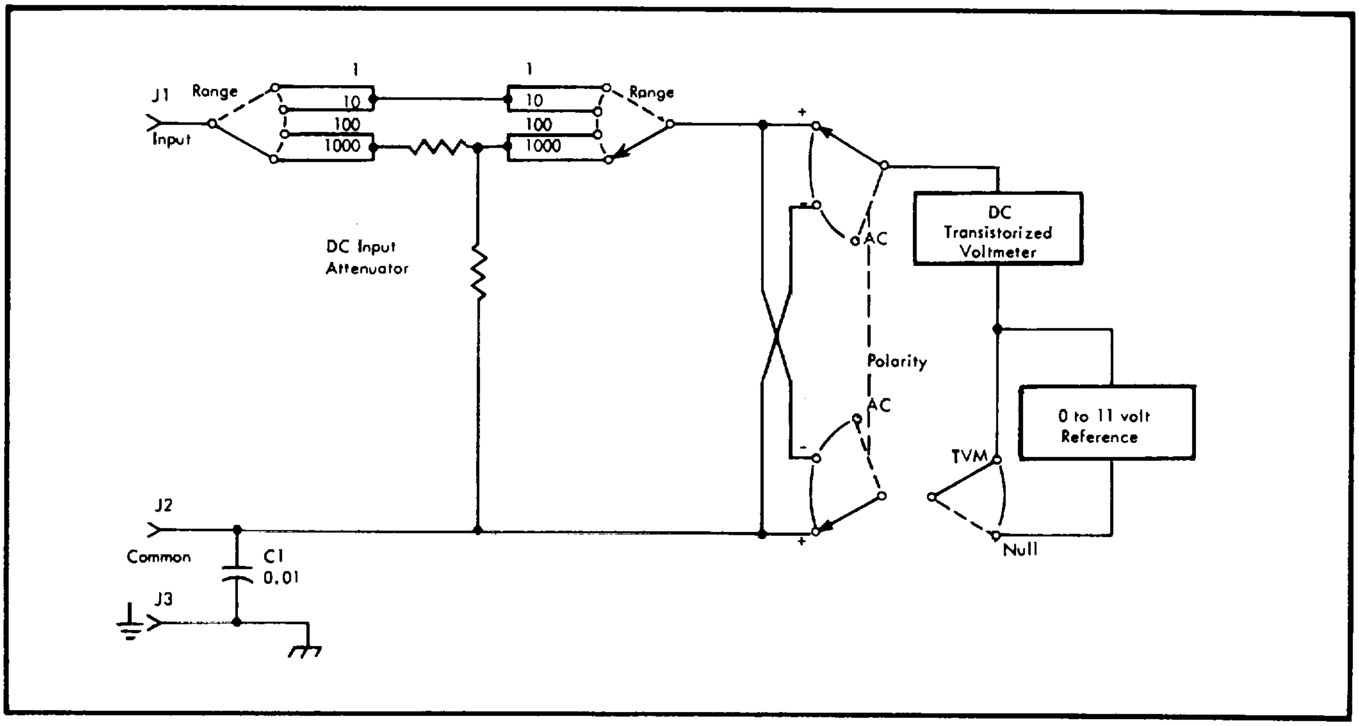


Figure 3-2. FUNCTION OF POLARITY SWITCH

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. The 883A AC/DC Differential Voltmeter seldom requires any maintenance. Without extreme abuse, all that should be required is periodic cleaning and calibration, as specified in this section. However, to determine if the instrument is within specifications, it is recommended that its performance be checked by using the performance checks given in this section. If a problem arises, the information on corrective maintenance in this section will be extremely useful.

4-3. TEST EQUIPMENT

4-4. Figure 4-1 lists the recommended equipment and specifications required for performance checking, calibration, and corrective maintenance. If the recommended equipment is not available, other equipment which meets the required specifications may be used.

4-5. PERIODIC MAINTENANCE

4-6. Periodic maintenance consists primarily of occasional cleaning to remove dust, grease, and other types of contamination. However, since the 883A is a completely enclosed unit, the need for occasional cleaning is greatly reduced. Special care has been taken to prevent leakage across critical switch wafers, areas of some printed circuit boards, and from the printed circuit boards to chassis ground. The power, range, null, polarity, and all voltage readout dial switches are .vacuum impregnated with Dow Corning silicone oil. These switches are also isolated from the front panel with Lexan spacers. The printed circuit boards are coated with Epocast 8267. Also, the printed circuit boards are isolated from chassis ground by means of polyethelene grommets.

4-7. To prevent excessive electrical leakage, proceed as follows:

CAUTION

> Avoid touching polyethelene grommets. The grease on the hands of some people can cause excessive electrical leakage.

a. Blow instrument out with low-pressure, clean, dry air to remove most accumulations of dust and foreign matter. Pay particular attention to the input binding posts, binding post wiring, switches, and polyethelene grommets which insulate printed circuit boards from chassis.

b. Clean polyethelene grommets, binding posts, and front panel with anhydrous denatured ethyl alcohol,

CAUTION

> Do not use Metriclene, acetone, lacquer thinner, or any other methyl ethyl ketones, since they will react with the Lexan rotor on the CTS plastic switches. Also, be careful not to saturate the switch contacts which have been lubricated for life.

c. When necessary, clean all exposed dielectric surfaces of switches with denatured alcohol using a small, stiff-bristled brush which has been wrapped with a clean cloth to prevent saturating the switch contacts.

d. After cleaning, recoat exposed switch insulating material in accordance with the procedures in TB SIG 355-3 (Depot Inspection Standard for Moisture and Fungus Resistant

4-8. PERFORMANCE CHECKING

4-9. GENERAL

4-10. The following performance checks are designed to check the instruments performance against the specifications. As such, they may be used as a routine maintenance procedure and as an incoming inspection procedure. They should be accomplished under typical laboratory conditions in a draft free area with an ambient temperature of 72. 5 (±2.5) °F. It is recommended that these performance checks be done just before calibration of the instrument. When used in this way, the performance checks yield a valuable case histroy on the characteristics of each individual instrument. Just prior to calibration, the instrument should be within specifications. If the instrument is out of specifications, the error should not be calibrated out of the instrument. The correct procedure is to find the reason why and then eliminate it. Localizing the problem to a particular area of the instrument may be done by an analysis of the performance check results.

NOMEN- CLATURE	SPECIFICATIONS REQUIRED	RECOMMENDED INSTRUMENT	USED FOR	PARA
VTVM	Range: 0 to 40 vdc 0 to 300 vac Accuracy: +3% dc, +5%/ ac Input Impedance: 10MΩ 5 pi dc 1MΩ, 100 pf ac	RCA Voltohmyst	CORRECTIVE MAINTENANCE -Voltage Level Checking -Reference Voltage Regulation Check -Null Detector Input Stage Bias Adjustment -Converter Input Stage Bias Adjustment -Cdnverter Output Adjustment	 4-44 4-48 4-56 4-58 4-59
Autotransformer	103 to 127 volts (207 to 253 volts for volts nominal line instru- ments)	General Radio Model 230W5MT3 Variac (W5HMT for 230 volts nominal line instruments)	CORRECTIVE MAINTENANCE -Reference Voltage Regulation Check	 4-48
DC Differential Voltmeter	Range: 10 to 20 vdc Accuracy: 0. 05% Null Range: At least 10 mv.	Almost any FLUKE Differential Voltmeter	CORRECTIVE MAINTENANCE -Voltage Level Checking -Reference Voltage Regulation Check -Negative 18 Volt Supply Adjustment -Converter Supply Adjustment	 4-44 4-48 4-54 4-57
Standard Cell Bank	Accuracy: +0.0005%	Guildline Instruments Model 9152/P4	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Common Mode Measurement Check	 4-13 4-22 4-49
Power Supply	Voltage: 1 to 1100 vdc Current: 0 to 2 ma Stability: ±O. 005% per hour Resolution: 5 mv	FLUKE Model 412B	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Common Mode Measurement Check -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-13 4-22 4-48 4-51 4-60
Null Detector	Range: 1 uv to 1 mv end scale	FLUKE Model 845A	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION -DC Preliminary Calibration CORRECTIVE MAINTENANCE -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	 4-13 4-22 4-51 4-60

Figure 4-1. TEST EQUIPMENT REQUIREMENTS (Sheet 1 of 2)

NOMEN- CLATURE	SPECIFICATIONS REQUIRED	RECOMMENDED INSTRUMENT	USED FOR	PARA
Kelvin-Varley Divider	Number of Decades Input Resistance: 100K Ratio Accuracy: 1 ppm from 1/10 of full scale to full scale	FLUKE Model 720A Seven	PERFORMANCE CHECKING -Differential Measurement Check CORRECTIVE MAINTENANCE -Kelvin-Varley Divider Check -Kelvin-Varley Divider Adjustment	4-13 4-51 4-60
Lead Compen- sator	Resolution: 10 mΩ Divider Resistance Ratios: From 1:1 to 10:1	FLUKE Model 721A -Kelvin-Varley Divider	CORRECTIVE MAINTENANCE Check -Kelvin-Varley Divider Adjustment	4-51 4-60
Voltage Reference Divider	Input Voltage: 10, 100, 1000 vdc Output Voltage: 1, 10, 100, 1000 vdc Accuracy: ±0.001%+2 uv Divider Current Adjust- ment Range: To a mini- mum of 1 ppm and a maximum of 5 ppm on all ranges	FLUKE Model 750A -	PERFORMANCE CHECKING -DC Differential Measurement Check CALIBRATION DC Preliminary Calibration	4-13 4-22
Oscilloscope	Sweep Range: 1 msec/cm to 10 msec/cm Sensitivity: 2 v/cm	Hewlett Packard Model 120B	CORRECTIVE MAINTENANCE -Chopper Drive Circuit Adjustment	4-55
Voltage Standard	Voltage: 1 to 1000 vdc Current: 0 to 6 ma Stability: 0.0005% per hour Resolution: 0.0005% Accuracy: 0.004%	FLUKE Model 332A -	PERFORMANCE CHECKING -AC Measurement Check AC Preliminary Calibration	4-15 4-29
Transfer Standard	Voltage: 1 to 1000 volts Frequency: 400 Hz, 10 kHz, and 20 kHz Accuracy: 0.01%	FLUKE Model 540,	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	4-15 4-29
AC Source	Voltage: 1 to 1000 volts Frequency: 400 Hz, 10 kHz, and 20 kHz Stability: 0.01% per hour Distortion: Less than 0. 05% for each odd harmonic and 1% for each even harmonic	Optimation Model AC-101	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	4-15 4-29
Wave Analyzer	Frequency: 1 kHz to 1 MHz	Hewlett Packard Model 310A	PERFORMANCE CHECKING -AC Measurement Check -AC Preliminary Calibration	4-15 4-29

Figure 4-1. TEST EQUIPMENT REQUIREMENTS (Sheet 2 of 2)

4-11. NULL DETECTOR CHECK

4-12. The null detector is checked in this procedure by using the instruments internal reference supply and Kelvin-Varley divider. This is possible because the reference supply and Kelvin-Varley divider are a few hundred times more accurate than the null detector. If the instrument fails to pass this check, there is a remote chance that the cause is due to a faulty reference supply or Kelvin-Varley divider. In this case, the measurement of an appropriate voltage in the TVM mode will indicate if the null detector is operating properly. Proceed as follows:

a. Set 883A meter to zero with mechanical zero control
b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a warmup period of 5 minutes.
c. Short INPUT post to COMMON post.
d. Set ac-dc switch to + (positive).
e. Set switches on voltmeter as shown in figure 4-2. Meter should indicate within 1-1/2 small scale divisions (+3% of null range) of value shown in figure 4-2.

VOLTMETER SWITCH SETTINGS			METER INDICATION
RANGE	NULL	VOLTAGE READOUT DAILS A B CD E	
10	1.0	1. 0 0 0 00	-1.0
10	.1	0. 1 0 0 00	-1.0
10	.01	0. 0 1 0 00	-1.0
10	.001	0. 0 0 1 00	-1.0
1	.1	.1 0 0 0 00	-1.0
1	.01	.0 1 0 0 00	-1.0
1	.001	.0 0 1 0 00	-1.0
Before proceeding, set RANGE switch to 1, NULL switch to .0001, all voltage readout to zero, and null meter by adjusting electronic ZERO control.			
1	.0001	0 0 0 1 00	-1.0
100	10	1 0. 0 0 00	-1.0
100	1	0 1.0 0 00	-1.0
100	.1	0 0.1 0 00	-1.0
100	.01	0 0. 0 1 00	-1.0
1000	100	1 0 0. 0 00	-1.0
1000	10	0 1 0.0 00	-1.0
1000	1	0 0 1.0 00	-1.0
1000	.1	0 0 0. 1 00	-1.0
10	1	0. 1 0 0 00	-0.1
10	1	0. 2 0 0 00	-0.2
10	1	0. 3 0 0 00	-0.3
10	1	0. 4 0 0 00	-0.4
10	1	0. 5 0 0 00	-0.5
10	1	0. 6 0 0 00	-0.6
10	1	0. 7 0 0 00	-0.7
10	1	0. 8 0 0 00	-0.8
10	1	0. 9 0 0 00	-0.9
10	1	1. 0 0 0 00	-1.0
10	1	1. 1 0 0 00	-1.1

Figure 4-2. SETTINGS FOR NULL DETECTOR CHECK

f. Remove short from between INPUT and COMMON posts and set POWER switch to OFF.

4-13. DC DIFFERENTIAL MEASUREMENT CHECK

4-14. The following procedure checks the accuracy of the instrument with full input on each dc range and also with each voltage readout dial set to 1, then to 2, 3, 4, 5, 6, 7, 8, and 9 on the 10 volt range. This method allows the accuracy to be checked with a minimum number of measurements. Proceed as follows:

a. Set meter to zero with mechanical zero control.
b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).
c. Set up the necessary equipment to provide dc voltages of 1, 10, 100, and 1000 volts with an accuracy of+(0.0015% + 2 uv). Proceed as follows:
(1) Connect equipment as shown in figure 4-3.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

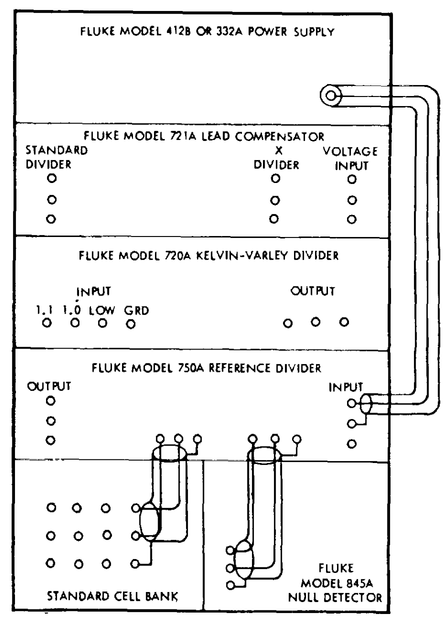


Figure 4-3. DIFFERENTIAL MEASUREMENT CHECK

(2) Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/z hour).
(3) Set STANDARD CELL VOLTAGE switches on 750A Reference Divider to voltage of standard cell.

(4) Set INPUT switch on 750A Reierence Divider to 1000 volts.

(5) Set voltage dials on 412B Power Supply to 1000 volts.

(6) Set HIGH VOLTAGE switch on 412B Power Supply to ON.

(7) Set 845A Null Detector to 100 MICROVOLTS.

(8) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider fur a null in each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(9) Voltages of 1, 10, 100, and 1000 volts dc are available at the OUTPUT terminals when the OUTPUT switch is set to the 1, 10, 100, and 1000 volt positions respectively. Note that COARSE and FINE dials on 750A Reference Divider and possibly voltage dials on 412B Power Supply may have to be adjusted to maintain a null on 845A Null Detector due to drifting or loading of the reference divider.

d. Connect 883A ground post to line ground.

e. Short INPUT post to COMMON post.

f. Set 883A ac-dc POLARITY switch to +, RANGE switch to 1, NULL switch to .0001, and all voltage readout dials to 0 (zero).

g. Null meter by adjusting electronic zero control (R239).

h. Remove short from between INPUT and COMMON posts.

i. Set 883A NULL switch to 0.1 and voltage readout dials to 1.000000.

j. Apply 1 volt dc +(0. 0015% + 2 uv) between INPUT and COMMON posts.

k. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between .999950 and 1.000050.

l. Set 883A RANGE switch to 10, NULL switch to 1, and voltage readout dials to 10.00000.

m. Apply 10 volts dc 0. 0(015% between INPUT and COMMON posts.

n. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 9.99950 and 1.00050.

o. Set 883A RANGE switch to 100, NULL switch to 10, and voltage readout dials to 100.0000.

p. Apply 100 volts dc :0. 00159% between INPUT and COMMON posts. Note that voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider must be readjusted for a null on 845A Null Detector due to loading of voltmeter on 750A Reference Divider.

q. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 99. 9950 and 100.0050.

r. Set 883A RANGE switch to 1000, NULL switch to 100, and voltage readout dials to 1000. 000.

s. Apply 1000 volts dc +0. 00150/between INPUT and COMMON posts. Note that votlage dials on 412B in each successively more sensitive null range. Final voltage readout dial setting should be between 999.950 and 1000. 050.

u. Set up the necessary equipment to provide voltage of 1.111111, 2. 222222, . . . ,9.999999 volts dc with an accuracy of ±(0. 0015%(+ 2 uv). Proceed as follows:

(1) Set HIGH VOLTAGE switch to off on 412B Power Supply.

(2) Reconnect OUTPUT of 750A Reference Divider to INPUT of 720A Kelvin-Varley Divider as shown in figure 4-4. COMMON posts. Note that voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider must be readjusted for a null on 845A Null Detector because the voltmeter no longer loads 750A Reference Divider.

t. Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between 999.950 and 1000.050.

u. Set up the necessary equipment to provide voltage of 1.111111, 2.222222, . . ., 9.999999 volts dc with an accuracy of ± (0.0015% + 2 uv). Proceed as follows:

(1) Set HIGH VOLTAGE switch to off on 412B Power Supply.

(2) Reconnect OUTPUT of 750A Reference Divider to INPUT of 720A Kelvin-Varley Divider as shown in figure 4-4.

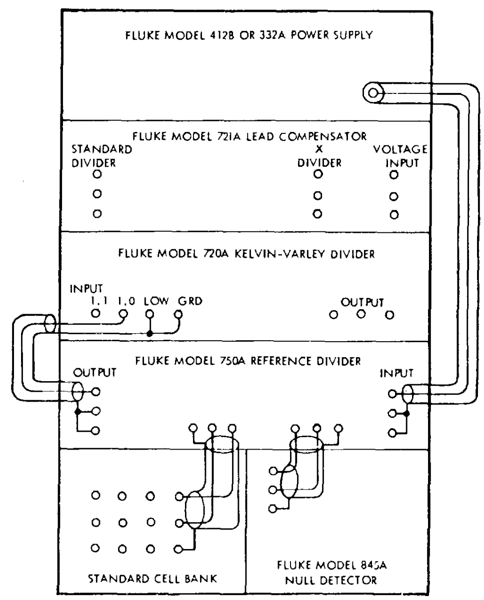


Figure 4-4. REFERENCE SUPPLY AND EXTERNAL KELVIN-VARLEY DIVIDER CHECK SETUP

(3) Set voltage dials to 10 volts on 412B Power Supply.

(4) Set INPUT switch and OUTPUT switch on 750A Reference Divider to 10 volts.

(5) Set HIGH VOLTAGE switch to ON on 412B Power Supply.

(6) Set 845A Null Detector to 100 MICROVOLTS.

(7) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials or. 750A Reference Divider for a null In each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(8) Voltages of 1.111111, 2.222222, ... 9.999999 volts dc are available at the OUTPUT terminals of 720A Kelvin-Varley Divider when all voltage dials are set to 1, 2, 9 respectively.

v. Set RANGE switch to 10 and NULL switch to .001 on 883A.

w. Apply voltages listed in figure 4-5 between INPUT and COMMON posts of 883A, set voltage readout dials on 883A as indicated for applied voltage, and adjust voltage readout dials for a null on 883A meter. Final voltage readout dial settings should be within the values listed in figure 4-5.

VOLTAGES APPLIED TO 883A	INITIAL VOLTAGE READOUT DIAL SETTING	FINAL VOLTAGE READOUT DIAL SETTING
1. 111111	1. 11111	1. 11103 to 1. 11119
2. 2222222.	22222	2. 22209 to 2. 22236
3. 333333	3. 33333	3. 33314 to 3. 33353
4. 444444	4. 44444	4. 44420 to 4. 44469
5. 555555	5. 55555	5. 55525 to 5. 55586
6. 666666	6. 66666	6. 66631 to 6. 66702
7. 777777	7. 77777	7. 77736 to 7. 77819
8. 888888	8. 88888	8. 88842 to 8. 88936
9. 999999	9. 99999	9. 99947 to 10. 00052

Figure 4-5. VOLTAGE READOUT DIAL LIMITS

4-15. AC MEASUREMENT CHECK

4-16. The following procedure checks the accuracy of the instrument with full input on each ac range at 400 Hz and 20 kHz. Proceed as follows:

a. Zero instrument as stated in paragraph 2-7.
b. Set switches on voltmeter as follows:

RANGE	10
NULL	TVM
ac-dc polarity	AC
voltage readout dials	10.00000

c. Set up the necessary equipment to provide 1000, 100, 10, and 1 volts ac nrrs such that the average value has an accuracy of 0.03% at 400 Hz and 0. 1% at 20 kHz including harmonic distortion.

NOTE

Odd harmonic distortion will cause a maxi- mum error equal to the percent distortion divided by the order of the harmonic. For example, third harmonic distortion of 0.03% will cause an error between -0. 01% and +0.01% depending on the phase relationship.

Proceed as follows:
(1) Connect all test equipment as shown in figure 4-6.
(2) Turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).
(3) Set dc voltage standard to rms value of ac voltage required.
(4) Apply output of dc voltage standard to transfer standard and null galvanometer by adjusting internal reference supply of transfer standard.
(5) Apply output of ac source to transfer standard and null galvanometer by adjusting ac source voltage. The output of the ac source now equals the required voltage.
(6) Check output of ac source with a wave analyzer to make sure that harmonic distortion is not excessive.

d. Complete procedure indicated for each horizontal line of figure 4-7.

4-17. CALIBRATION

4-18. General

4-19. The term calibration as used in this text is to be understood as an adjustment to refine meter readings. It is not intended in any way as a substitute for the official calibration required by TB 750-236. The AC to DC Converter Calibration should be done

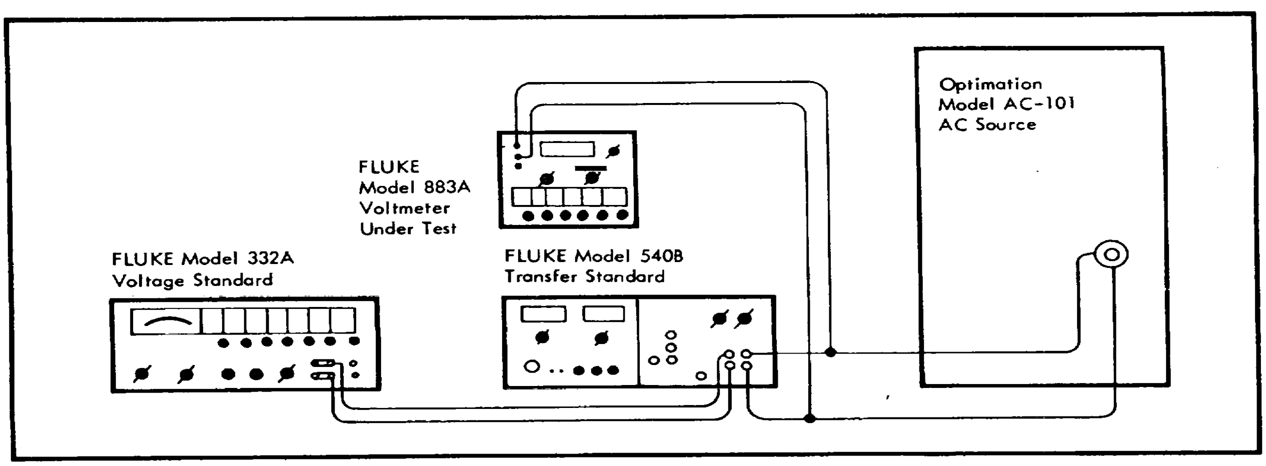


Figure 4-6. AC TO DC CONVERTER CALIBRATION SETUP

Set RANGE switch to	Set NULL switch to	Apply the following voltage between INPUT and COMMON posts	Adjust voltage readout dials for zero meter deflection in each successively more sensitive null range. Final voltage readout dial setting should be between
1	TVM	1 vac, 400 Hz, ±0.03%	.999400 to 1.000600
1	TVM	1 vac, 20 kHz, ±0.10%	.998000 to 1.002000
10	TVM	10 vac, 400 Hz, ±0.03%	9.99400 to 10.00600
10	TVM	10 vac, 20 kHz, ±0.10%	9.98000 to 10.02000
100	TVM	100 vac, 400 Hz, ±0.03%	99.9400 to 100.0600
100	TVM	100 vac, 20 kHz, ±0.10%	99.8000 to 100.2000
1000	TVM	1000 vac, 400 Hz, i0.03%	999.200to 1000.800
1000	TVM	1000 vac, 20 kHz, ±0.10%	998.000to 1002.000

Figure 4-7. AC MEASUREMENT CHECK

every 2 months. For special applications where extreme accuracy is required, it may be desired to calibrate the instrument more frequently. Calibration should be accomplished under typical laboratory conditions in a draft free area with an ambient temperature of 72.5 (+2.5) F for maximum accuracy. The recommended equipment and the specification required for calibration are shown in figure 4-1. All controls may be located with the aid of figure 4-8.

4-20. DC DIFFERENTIAL VOLTMETER CALIBRATION

4-21. For convenience, DC Differential Voltmeter Calibration is divided into five parts: Preliminary Calibration, Null Detector Calibration, 10 Volt Range Calibration, 1 Volt Range Calibration, and 100 & 1000 Volt Range Calibration. Calibration is normally done by performing all five parts in the sequency given here. However, the calibration procedure is written so that

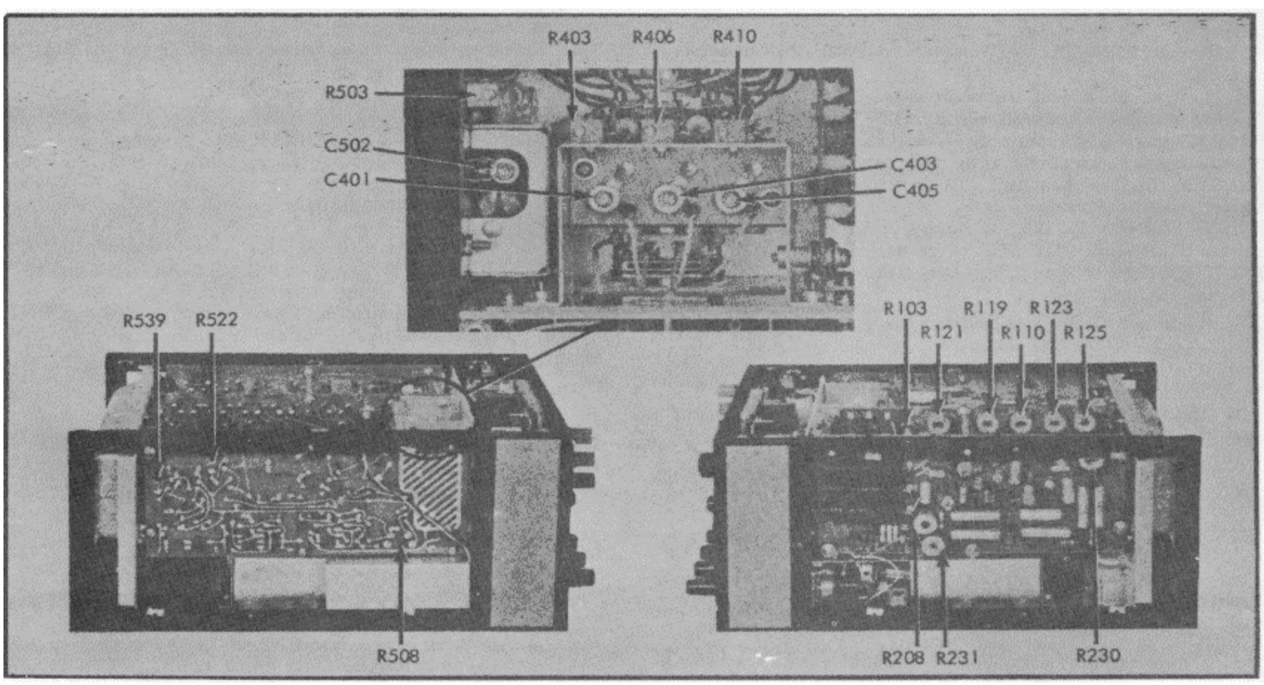


Figure 4-8. ADJUSTMENT LOCATIONS

any section may be calibrated by performing the calibration procedure for that section after performing DC Preliminary Calibration.

4-22. DC PRELIMINARY CALIBRATION

a. Set meter to zero with mechanical zero control.
b. Set switches on 883A as follows:

RANGE 10
NULL 0.001
ac-dc polarity +
all voltage readout dials 0 (zero)

c. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow voltmeter to warmup to equilibrium temperature (about 5 minutes).

d. Set up the necessary equipment to provide dc voltages of 100, 10, and 1 volts with an accuracy of i(0. 0015 % + 2 uv). Proceed as follows: (- Connect equipment as shown in figure 4-3.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

(2) Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

(3) Set STANDARD CELL VOLTAGE switches on 750A Reference Divider to voltage of standard cell.

(4) Set INPUT VOLTAGE switch on 750A Reference Divider to 100 volts.

(5) Set voltage dials on 412B Power Supply to 100 volts.

(6) Set HIGH VOLTAGE switch on 412B Power Supply to ON.

(7) Set 845A Null Detector to 100 MICROVOLTS.

(8) Adjust voltage dials on 412B Power Supply and COARSE and FINE dials on 750A Reference Divider for a null in each successively more sensitive null range on 845A Null Detector. The null detector should be zeroed as necessary.

(9) Voltages of 100, 10, and 1 volts dc are available at the OUTPUT VOLTAGE terminals when the OUTPUT VOLTAGE switch is set to the 100, 10 and 1 volt positions respectively.

e. Connect 883A ground post to line ground.

4-23. NULL DETECTOR CALIBRATION

a. Short INPUT post to COMMON post and null meter by adjusting electronic ZERO control (R239).
b. Set switches on 883A as follows:

RANGE 1
NULL 0.1
voltage readout dial 1

c. Adjust 1 mv gain control R230 for full scale deflection to the left (-1).
d. Set switches on 883A as follows:

RANGE 1
NULL 0.0001
all voltage readout dials 0 (zero)

e. Null meter by adjusting electronic ZERO control (R239). Right side panel must be on instrument when making this adjustment.

f. Set voltage readout dial D to 1 and adjust 100 iv gain control R231 so that meter indicates full scale (-1) when right side panel is replaced.

g. Remove short from between INPUT and COMMON posts.

4-24. 10 VOLT RANGE CALIBRATION

a. Set switches on 883A as follows:
b. Set switches on 883A as follows:

RANGE 10
NULL 1.0
voltage readout dials 10.00000

b. Apply 10 volts dc (0O. 0015%) between INPUT and COMMON posts.

c. Adjust 10 volt range control R119 for a zero meter deflection in each successively more sensitive null range.

4-25. 1 VOLT RANGE CALIBRATION

a. Short INPUT post to COMMON post.
b. Set switches on 883A as follows:

RANGE 1
NULL 0.0001
all voltage readout dials 0 (zero)

c. Null meter by adjusting electronic ZERO control (R239). Right side panel must be on instrument when making this adjustment.

d. Remove short from between INPUT and COMMON posts.

e. Set switches on 883A as follows:

RANGE 1
NULL 0.1
voltage readout dials 1.000000

f. Apply 1 volt dc +(0. 0015% + 2 uv) between INPUT and COMMON posts.

g. Adjust 1 volt range control R121 for zero meter deflection in each successively more sensitive null range. Right side panel must be on instrument when making this adjustment.

4-26. 100 AND 1000 VOLT RANGE CALIBRATION

a. Set switches on 883A as follows:

RANGE 100
NULL 10
voltage readout dials 100.0000

b. Apply 100 volts dc (+0.0015%) between INPUT and COMMON posts.

c. Adjust input attenuator control R103 for zero meter deflection in each successively more sensitive null range. Note that this adjustment calibrates both the 100 and 1000 volt range.

4-27. AC TO DC CONVERTER CALIBRATION

4-28. The dc differential voltmeter section of the voltmeter must be within specifications before the ac to dc converter can be accurately calibrated. The ac to dc converter must be calibrated in the following order.

4-29. AC PRELIMINARY CALIBRATION

a. Zero instrument as stated in paragraph 2-7.

b. Set switches on voltmeter as follows:

RANGE 1
NULL TVM
ac-dc polarity AC
voltage readout dials 1.000000

c. Set up the necessary equipment to provide: 100, 10, and 1 volts ac rms such that the average value has an accuracy of 0. 03% at 400 Hz and 0. 1% at 20 kHz including harmonic distortion; 500 or 1000 volts ac rms such that the average value has an accuracy of 0.03% at 400 Hz and 0.05% at 10 kHz including harmonic distortion.

NOTE

Odd harmonic distortion will cause a maxi- mum error equal to the percent distortion divided by the order of the harmonic. For example, third harmonic distortion of 0.03% will cause an error between -0. 01% and +0. 01% depending on the phase relationship. Proceed as follows:

(1) Connect all test equipment as shown in figure 4-6.

(2) Turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

(3) Set dc voltage standard to rms value of ac voltage required.

(4) Apply output of dc voltage standard to transfer standard and null galvanometer by adjusting internal reference supply of transfer standard.

(5) Apply output of ac source to transfer standard and null galvanometer by adjusting ac source voltage. The output of the ac source now equals the required voltage.

(6) Check output of ac source with a wave analyzer to make sure that harmonic distortion is not excessive.

4-30. 1 VAC CONVERTER GAIN ADJUSTMENT

a. Apply 1 volt ac (0. 03%) at 400 Hz between INPUT and COMMON posts.

b. Set NULL switch to .001.

c. Adjust 1 vac gain adjust control R503 until meter needle is within 100 microvolts (1 major division) of null.

4-31. 1 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 1 volt ac (±0. 1%) at 20 kHz between INPUT and COMMON posts.

NOTE

The capacitors used for converter frequency adjustments in current instruments have improved humidity protection over the older type. For these instruments a small cap must be unscrewed and removed before making any adjustments and then it must be replaced. These improved capacitors for C401, C403, and C405 are used in serial numbers 570 and on, and for C502 in serial numbers 590 and on.

b. Adjust 1 vac high frequency trim control C502 until meter needle is within 100 microvolts (1 major division) of null.

4-32. 10 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 10 and NULL switch to TVM.

b. Apply 10 volts ac (0O. 03%) at 400 Hz between INPUT and COMMON posts.

c. Set NULL switch to .01.

d. Adjust 10 vac attenuator control R403 until meter needle is within 0 to +1 millivolt (0 to +1 major division) of null. Note that 10, 100, and 1000 volt attenuator controls and 10, 100, and 1000 volt high frequency controls are located from left to right respectively on bracket next to converter board.

4-33. 10 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 10 volts ac (+0. 1%) at 20 kHz between INPUT and COMMON posts.

b. Adjust 10 vac high frequency trim control C401 until meter needle is within 1 millivolt (1 major division) of null.

4-34. 100 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 100 and NULL switch to TVM.

b. Apply 100 volts ac (i0. 03%) at 400 Hz between INPUT and COMMON posts.

c. Set NULL switch to . 1.

d. Adjust 100 vac attenuator control R406 until meter needle is within 0 to +10 millivolts (0 to +1 major division) of null.

4-35. 100 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 100 vac (_0. 1%) at 20 kHz between INPUT and COMMON posts.

b. Adjust 100 vac high frequency trim control C403 until meter needle is within 10 millivolts (1 major division) of null.

4-36. 1000 VAC ATTENUATOR ADJUSTMENT

a. Set RANGE switch to 1000, NULL switch to 1, and voltage readout dials to 500.000.

b. Apply 500 volts ac (±0. 03%) at 400 Hz between INPUT and COMMON posts.

c. Adjust 1000 vac attenuator control R410 until meter needle is within 50 millivolts (1/2 major division) of null.

NOTE

The preferable calibration voltage for this adjustment is 500 volts ac. If 500 volts ac is not available, 1000 volts ac may be used by adjusting R410 until meter needle is within 100 millivolts (1 major division) of null.

4-37. 1000 VAC HIGH FREQUENCY ADJUSTMENT

a. Apply 500 volts ac (+0. 05%) at 10 kHz between INPUT and COMMON posts.

b. Adjust 1000 vac high frequency trim control C405 until meter needle is within 50 millivolts (1/2 major division) of null.

NOTE

The preferable calibration voltage for this adjustment is 500 volts ac. If 500 volts ac is not available, 1000 volts ac may be used by adjusting C405 until meter needle is within 100 millivolts (1 major division) of null.

4-38. CORRECTIVE MAINTENANCE

4-39. GENERAL

4-40. Since the 883A AC/DC Differential Voltmeter is a completely transistorized instrument of conservative design, the possibility of a component failure is greatly reduced. Under normal circumstances, the only thing that will interfere with the operation of the instrument is the need for calibration. However, if the instrument does not perform correctly after calibration, the technician may use the information given here as a complete guide for locating and correcting the source of trouble. All equipment required for maintaining the instrument is listed in figure 4-1.

4-41. TROUBLESHOOTING

4-42. TROUBLESHOOTING TIPS. The purpose of troubleshooting is to quickly and accurately correct the cause of any abnormal condition. Thus, servicing should begin with an attempt to localize the general area of trouble. By performing a complete performance check as outlined in paragraph 4-8, the trouble may be isolated to the null detector, reference supply, Kelvin-Varley divider, dc input attenuator, or ac to dc converter. To assist in localizing some of the more common troubles that might occur, the causes and remedies for a number of symptoms are listed in the trouble-shooting chart (figure 4-9). However, an understanding of the theory of operation and frequent reference to the schematic diagram is the best way to locate the cause of any abnormal condition.

4-43. VISUAL INSPECTION. Trouble can sometimes be found by a thorough visual inspection. Look for:

a. Accumulations of dirt, dust, moisture, or grease. Remove contamination as outlined in periodic maintenance (paragraph 4-5).

b. Scorched or burned parts. Damage of this type is often due to some other defective component. Determine cause of damage before replacing overheated part.

CAUTION

Avoid touching polyethelene gromments. The grease on the hands of some people can cause excessive electrical leakage.

c. Cracks, cuts, and other damage to polyethelene grommets. Replace grommets using a plastic bag over the hand to prevent contamination.

d. Input divider resistors (R100, RI01, and R102) touching printed circuit board. When these resistors touch the board, leakage paths are created which can result in meter offset.

e. Loose or intermittent connections.

f. Any other condition which suggests a source of trouble.

4-44. VOLTAGE LEVEL CHECKING. When the trouble has been localized to a stage, the defective part may be isolated by voltage level measurements at the transistor terminals. Figure 4-10 may be used to locate the transistor terminals. When making measurements on printed circuit boards, use a sharp probe and press firmly while rotating probe to break through the insulating

SYMPTOM	PROBABLE CAUSE	REMEDY
Drift of reference supply evidenced by null detector meter needle drift when measuring an extremely stable voltage.	A wire wound resistor (R108, R109, R115, R116, R118, R120, or R122) changing value with temperature.	Locate faulty resistor by heating slightly with a soldering iron held near resistor, while looking for a meter needle change of a standard cell measurement.
	Battery Voltage Low.	Charge Batteries
	Faulty Zener diode.	Monitor voltage across Zener diode pair. Look for drift of Zener voltage. Replace if defective.
	Q101, Q102, Q103, Q104, or Q105 defective.	Check by replacement.

Figure 4-9. TROUBLESHOOTING CHART (Sheet 1 of 2)

SYMPTOM	PROBABLE CAUSE	REMEDY
Meter rattle or drift. 46. If rattle replacement.	Field effect transistor Q201 defective.	Check as outlined in paragraph 4- is excessive, check Q201 by
	Chopper G201 defective.	Check as outlined in paragraph 4-46. If rattle is excessive, check G201 by replacement.
	Moisture, dirt, or other contamination on printed circuit boards or switches.	Clean instrument as outlined in paragraph 4-5.
Measurements are out of tolerance on every range when Kelvin-Varley divider is dialed to any setting other than 10999100.	Out of adjustment or one of the Kelvin-Varley divider resistors is out of tolerance Using procedure of paragraph 4-	Check accuracy of Kelvin-Varley divider using paragraph 4-51. If these checks indicate an out of tolerance condition, first try adjusting Kelvin-Varley divider 60. If Kelvin-Varley divider cannot be adjusted, use out of tolerance data obtained from procedure of paragraph 4-51 to isolated defective resistor.
Meter cannot be brought to zero with ZERO control	Chopper drive not symmetri-cal.	Readjust chopper drive circuit using procedure of paragraph 4-55.
	CR201 or CR202 defective.	Check and replace if defective.
Meter beating with voltage under measurement	Chopper drive circuit out of adjustment.	Adjust chopper drive circuit using Procedure of paragraph 4-55
NOTE: Assuming all dc measurements are normal, the following symptoms are common to ac measurements only.		
Measurements are out of tolerance on the 1000, 100, or 10 volt ac range only.	Out of calibration.	Recalibrate per paragraph 4-27.
	One or more resistors in the 1000, 100, or 10 volt ac attenuator has shifted in value.	Recalibrate per paragraph 4-27.
Measurements are out of tolerance on all ac ranges.	Out of calibration.	Recalibrate per paragraph 4-27.
	Transistor Q501, Q502, Q503, Q504, Q505, or Q506 faulty.	Check by measuring dc bias voltages or by replacement.
	R501, R504, R530, or R531 has shifted in value.	Recalibrate per paragraph 4-27.
Measurements are out of tolerance at some fre-quencies.	Out of calibration.	Recalibrate per paragraph 4-27.
	Faulty frequency compensation capacitor.	Locate faulty capacitor and replace. If trouble occurs on all ranges, check C501 and C503. If trouble occurs on 1000 volt range only, check C406 and C407. If trouble occurs on 100 volt range only check C404. If trouble occurs on 10 volt range only, check C402.

Figure 4-9. TROUBLESHOOTING CHART (Sheet 2 of 2)

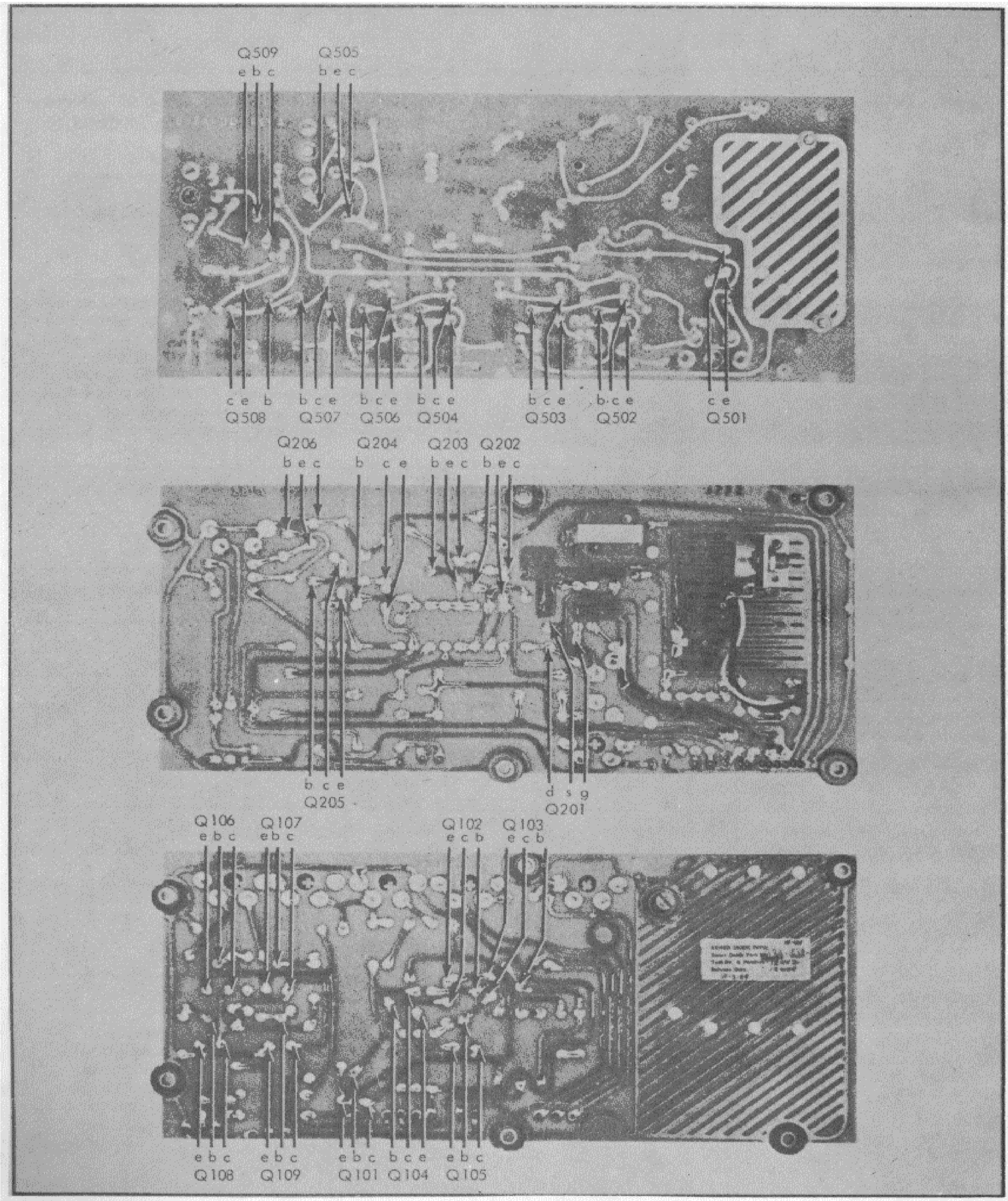


Figure 4-10. TRANSISTOR TERMINAL LOCATIONS

coating. Measurements that differ widely from those listed in the transistor voltage chart (figure 4-11) can be used along with the schematic to localize the trouble to a specific part, in most cases.

CAUTION

When measuring voltage, it is recommended that care be used to avoid momentary short circuits which could damage components.

4-45. TROUBLESHOOTING CHECKS. The following troubleshooting checks list several normal conditions that should exist in the instrument. The most probable cause or causes of an abnormal condition in these checks is also given.

4-46. Meter Rattle Check. If the meter needle appears to rattle excessively, perform the following check:

a. Set switches on 883A as follows:

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q101	-30❶	-29.4	-18.0❷
Q102	-13	-12.4	- 7.1
Q103	-13	-12.4	- 6.7
Q104	- 6.5	- 7.1	-29.4
Q105	- 6.5	- 6.7	-18.0❷
Q106	6.9❺	5.9	3.0
Q107	6.9❺	5.9	3.0
Q108	0	.16	3.0
Q109	0	.16	3.0
Q201	-3.3 (SOURCE)	0 (GATE)	-10 (DRAIN)
Q202	-16.6	-16	-12.4
Q203	-13	-12.4	-10
Q204	-18.0❷	-17.4	-15. 4
Q205	-16	-15, 4	- 9.5
Q206	0	+ 2.5	0
Q501	7.1 (SOURCE)	5.5 (GATE)	11 (DRAIN)
Q502	0	0.6	3.5
Q503	2.7	3.5	8.2
Q504	0	0.7	3.7
Q505	11.3	11.9	18.0❹
Q506	3.0	3.7	9.5
Q507	34.0❸	33	18.0❹
Q508	1.7	2.2	33
Q509	6.8	6.62	2.2

The above operating voltage levels are measured under the following conditions: (a) Line voltage at 115/230vac, 50 to 440 Hz. (b) All voltages measured with a 3%, 10 megohm, 5 pf voltmeter unless otherwise indicated. (c) All voltages for Q501 to Q509 are measured from specified terminal to ac to dc converter common. The COMMON post is ac to dc converter common when ac-dc polarity switch is set to AC. (d) All other voltages are measured from specified terminal to reference supply - null detector common. The COMMON post is reference supply - null detector common when in TVM mode or when in a NULL mode with all voltage dials set to 0 and polarity switch set to +. (e) Some voltages may vary as much as 15 to 20%; (f) Bias voltages (difference between emitter and base voltages) should remain approximately the same; (g) All volt-

NOTES: Emitter of Q101 as measured with a differential voltmeter should be between -26 and -34 vdc ages are dc unless otherwise indicated. for ON (88A) and LINE OPR (883AB) at 115/230 vac line, -19.5 and -21.0 vdc for BAT OPR (883AB only), and not less than -23.5 vdc for BAT CHG (883AB only) at 115/230 vac line. (2) Collector of Q101 and Q105 apd emitter of Q204 as measured with a differential voltmeter should be between -17. 9 and -18. 1 vdc. (3) Emitter of Q507 as measured with a differential voltmeter should be between +26 and +35 vdc for ON (823A) and LINE OPR (883AB) at 115/230 vac line, +19.5 and +21.0 vu for BAT OPR (883AB only), and not less than +23.5 vdc for BAT CHG (883AB only) at 115/230 vac line. (4) Collector of Q507 and Q505 as measured with a differential voltmeter should be between +17.9 and +18.1 vdc with less than 200 uv ripple. (Emitter of Q106 and Q107 as measured with a differential voltmeter should be between +6.3 and +7.0 vdc for ON (883A) and LINE OPR (883AB) at 115/230 vac line and +4.9 and +5.3 vdc for BAT OPR (883AB only).

Figure 4-11. TRANSISTOR VOLTAGE CHART

RANGE	1
NULL .	.0001
ac-dc polarity	+
all voltage readout dials	0 (zero)

b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.

c. Short INPUT post to COMMON post. Random excursions of meter needle should be less than 1 small division peak-to-peak. If rattle is excessive, check field-effect transistor Q201 by replacement. If meter rattle is still excessive, chopper is probably faulty.

4-47. Leakage Resistance Check. Leakage from the -18 volt supply to chassis ground causes an error in differential measurements. This error is much greater in the negative polarity because the leakage current flows through the tvm attenuator in the negative polarity. This provides a convenient way to check for excessive leakage. Proceed as follows:

a. Zero instrument as stated in paragraph 2-7.
b. Short COMMON post to chassis ground post.
c. Set switches on instrument as follows:

RANGE	1
NULL	.0001
ac-dc polarity	- (negative)
all voltage readout dials	0 (zero)

d. Meter needle should indicate less than 1/2 major division (5 uv). If leakage is excessive, clean instrument as instructed in paragraph 4-5 and check polyethelene grommets as instructed in paragraph 4-43.

4-48. Reference Voltage Regulation Check. If the reference voltage is suspected of being faulty, perform the following check:

a. Connect adjustable autotransformer to line power.

b. Connect 883A line cord to output of autotransformer.

c. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.

d. Set autotransformer to 103 volts (207 volts when 883A is wired for 230 volts nominal) as measured with a VTVM.

e. Set NULL switch to TVM and ac-dc polarity switch to +.

f. Differentially measure -18 volt supply between COMMON post and collector of Q101 with a differential voltmeter.

g. Set autotransformer to 127 volts (253 volts when 883A is wired for 230 volts nominal) as measured with a VTVM. Output of -18 volt supply should change by less than 3.5 millivolts from step f. If regulation is excessive, check transistors Q101 through Q105.

4-49. Common Model Measurement Check. If the instrument is suspected of making incorrect common mode measurements, perform the following check:

a. Measure the voltage of a standard cell in the 1 volt range and in the positive polarity.

b. Connect 500 volts dc from chassis ground post to COMMON post and wait about 3 minutes.

c. Measure voltage of standard cell. If the measurements are not withiun 50 microvolts of each other, there is excessive electrical leakage to ground. Clean instrument as instructed in paragraph 4-5.

4-50. Converter Offset Check. If low level voltage measurements are not accurate, perform the following check:

a. Set switches on 883A as follows:

RANGE	1
NULL	.001
ac-dc polarity	AC
all voltage readout dials	0 (zero)

b. Set POWER switch to LINE OPR with 883AB or to ON with 883A and allow a 5 minute warmup period.

c. Short INPUT post to COMMON post. Meter needle should indicate less than 160 uv after all transients have stopped. If noise is excessive, check Q501, CR502, and for converter power supply ripple less than 200 uv.

4-51. Kelvin-Varley Divider Check. The Kelvin-Varley check requires that connections to the Kelvin-Varley divider be made inside the instrument. Also, the Kelvin-Varley check takes a considerable amount of time to perform. Therefore, this check should be performed only if the differential measurement check (paragraph 4-13) indicates there is a problem or if the Kelvin-Varley divider has been adjusted (paragraph 4-60). Proceed as follows:

a. Disconnect 883A from line power.

b. Set POWER switch to OFF and set NULL switch to TVM.

c. Remove bottom panel and top-back panel.

d. Locate high input (wire from Kelvin-Varley board to range switch S2, usually purple or point 13 on Kelvin-Varley board), high output (wire from R12 to null switch S3, usually yellow), and input-output common (wire from Kelvin-Varley board to voltage dial A, S5, usually black or point 1 on Kelvin-Varley board) of Kelvin-Varley divider.

CAUTION

Make sure HIGH VOLTAGE switch on 412B Power Supply is set to off.

e. Connect equipment as shown in figure 4-12.

f. Turn all equipment on and allow it to warrmup to equilibrium temperature (about 1/2 hour).

g. Set voltage dials on 412B Power Supply for an out- put of 11.0 volts dc.

h. Set 883A voltage readout dials to 000000 and 720A Kelvin-Varley Divider dials to 0000000.

i. Set 845A Null Detector to 30 MICROVOLTS.

j. Set function switch to VOLTAGE OFF on 721A Lead Compensator.

k. Zero 845A Null Detector

l. Set function switch to Rs > Rx on 721A Lead Com-pensator.

m. Adjust LOW BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on LOW BALANCE controls.

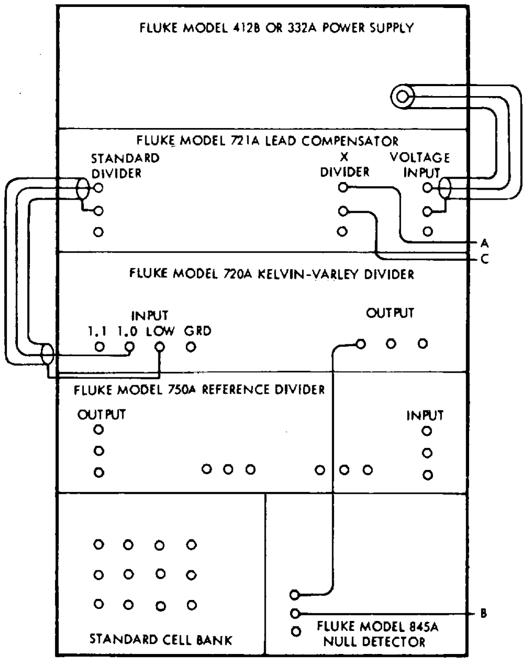


Figure 4-12. KELVIN-VARLEY DIVIDER CHECH SETUP

n. Set 883A voltage dials to 10999100 and 720A Kelvin-Varley dials to 109999910.

o. Set function switch to VOLTAGE OFF on 721A Lead Compensator.

p. Zero 845A Null Detector.

q. Set function switch to Rs > Rx on 721A Lead Compensator.

r. Adjust HIGH BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on HIGH BALANCE controls.

s. Set 845A Null Detector to 300 MICROVOLTS and change to 100 MICROVOLTS and 30 MICROVOLTS as required.

t. Set 883A voltage readout dials and 720A Kelvin-Varley Divider dials to first positions shown in figure 4-13.

u. Set function switch to VOLTAGE OFF on 721A Lead Compensator.

v. Zero 845A Null Detector.

w. Set function switch to Rs > Rx on 721A Lead Compensator. The 845A Null Detector indication should be equal to or less than the listed deviation.

x. Repeat steps u through w for remaining switch positions shown in figure 4-13. If Kelvin-Varley divider is out of tolerance between settings of 1000000 and 0999100, readjust as set forth in paragraph 4-60. If a resistor-trimmer combination of the first deck can not be adjusted for a null during adjustment, the 4999.2 ohm resistor is defective and must be replaced. If Kelvin-Varley divider is out of tolerance for remaining settings, make sure padding trimmers are adjusted correctly (paragraph 4-60) before attempting to replace a resistor.

4-52. ELECTRONIC ADJUSTMENTS

4-53. The following electronic adjustments are not performed during calibration because they may never require adjusting during the life of the instrument under normal circumstances. All controls may be located with the aid of figure 4-8.

4-54. NEGATIVE 18 VOLT SUPPLY ADJUSTMENT. Sampling string resistor RI10 should be adjusted whenever a part in the -18 volt power supply is replaced. If R110 is adjusted, it will be necessary to perform the 10 volt and 1 volt range calibration (paragraph 4-24 and 4-25). Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Set NULL switch to TVM.

c. Connect a differential voltmeter between COMMON post and junction of C104 and R112.

d. Set up differential voltmeter to differentially measure -18. 0 volts dc.

e. Adjust RI10 for -18. 0 (+0. 1) volts.

f. Perform 10 volt and 1 volt range calibration.

4-55. CHOPPER DRIVE CIRCUIT ADJUSTMENT. The chopper drive circuit should be adjusted for symmetry and frequency if a part in the chopper drive circuit is replaced, if there is difficulty in zeroing the meter, or if line operation causes the meter to beat due to the relationship of the chopper frequency with the line power frequency. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Set NULL switch to TVM and ac-dc polarity switch to +.

c. Connect oscilloscope between COMMON post and one side of the chopper drive coil G201 to observe the output waveform.

d. Adjust R125 until output is within i10% of symmetry.

e. Adjust R123 for a frequency of 84 (+1) Hz.

4-56. NULL DETECTOR INPUT STAGE BIAS ADJUSTMENT. The bias of field-effect transistor Q201 should be adjusted if it or any component in its drain-sink circuit is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 881AB or to ON with 883A.

b. Set NULL switch to TV'M and ac-dc polarity switch to +.

c. Adjust R208 until voltage from COMMON post to drain of Q201 (junction of C207 and R207) is -10 (+0. 5) volts as measured with a VTVM.

4-57. CONVERTER SUPPLY ADJUSTMENT. Sampling string resistor R539 should be adjusted whenever a part in the converter power supply is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Connect a differential voltmeter across C523.

c. Set up differential voltmeter to differentially measure +18.0 vdc.

883A Voltage Dial Settings	Standard Divider Settings	Maximum Deviation for an Input of 11.0 vdc (± microvolts)
1000000	10000000	200
9999100	10000000	200
900000	9000000	180
8999100	9000000	180
800000	8000000	160
7999100	8000000	160
700000	7000000	140
6999100	7000000	140
600000	6000000	120
5999100	6000000	120
500000	5000000	100
4999100	5000000	100
400000	4000000	80
3999100	4000000	80
300000	3000000	60
2999100	3000000	60
200000	2000000	40
1999100	2000000	40
100000	1000000	20
0999100	1000000	20
090000	0900000	20
0899100	0900000	20
080000	0800000	20
0799100	0800000	20
070000	0700000	20
0699100	0700000	20
060000	0600000	20
0699100	0600000	20
050000	0500000	20
0499100	0500000	20
040000	0400000	20
0399100	0400000	20
030000	0300000	20
0299100	0300000	20
020000	0200000	20
0199100	0200000	20
010000	0100000	20
0199100	0100000	20
0099100	0090000	20
0089100	0090000	20
008000	0080000	20
0079100	0080000	20

883A Voltage Dial Settings	Standard Divider Settings	Maximum Deviation for an Input of 11.0 vdc (± microvolts)
007000	0070000	20
0069100	0070000	20
006000	0060000	20
0059100	0060000	20
005000	0050000	20
0049100	0050000	20
004000	0040000	20
0039100	0040000	20
003000	0030000	20
0029100	0030000	20
002000	0020000	20
0019100	0020000	20
001000	0010000	20
0009100	0010000	20
000900	0009000	20
0008100	0009000	20
000800	0008000	20
0007100	0008000	20
000700	0007000	20
0006100	0007000	20
000600	0006000	20
0005100	0006000	20
000500	0005000	20
0004100	0005000	20
000400	0004000	20
0003100	0004000	20
000300	0003000	20
0002100	0003000	20
000200	0002000	20
0001100	0002000	20
000100	0001000	20
0000100	0001000	20
000090	0000900	20
000080	0000800	20
000070	0000700	20
000060	0000600	20
000050	0000500	20
000040	0000400	20
000030	0000300	20
000020	0000200	20
000010	0000100	20
000000	0000000	0

Figure 4-13. KELVIIN-VARLEY DIVIDER ERROR LIMITS

d. Adjust R539 for +18.0 (+0. 1) vdc.

4-58. CONVERTER INPUT STAGE BIAS ADJUSTMENT. The bias of field-effect transistor Q501 should be adjusted if it or any component in its drain-sink circuit is replaced. Proceed as follows:

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Adjust R508 until voltage from converter common to drain of Q501 (lead from Q501 to R507) is +11.0 (+0. 5) vdc as measured with a VTVM.

4-59. CONVERTER OUTPUT ADJUSTMENT. The converter output should be adjusted with R522 when Q505, Q506, or any component in these two stages is replaced. Proceed as follows;

a. Set POWER switch to LINE OPR with 883AB or to ON with 883A.

b. Adjust R522 until voltage from converter common to collector of Q506 is 9. 5 (+0. 5/-1.5) vdc as measured with a VTVM. If voltage will not reach 9.5 vdc, it should be at least 8.0 vdc.

4-60. KELVIN-VARLEY DIVIDER ADJUSTMENT. The Kelvin-Varley divider should be adjusted only after a resistor has been replaced or after the Kelvin-Varley divider check (paragraph 4-51) indicates that the Kelvin- Varley divider is out of tolerance. Proceed as follows:

a. Disconnect 883A from power line.

b. Set POWER switch to OFF and NULL switch to TVM.

c. Remove bottom cover.

d. Open jumpers marked with a U, V, W, X, Y, and Z by unsoldering one end and pulling it loose. Also unsolder high input of Kelvin-Varley divider (wire from Kelvin-Varley board to range switch S2, usually purple).

e. Connect equipment as shown in figure 4-14.

f. Turn on all equipment and allow it to warmup to equilibrium temperature (about 1/2 hour).

CAUTION

Do not allow power supply voltage to exceed 10 volts as damage to the Kelvin-Varley resistors may result.

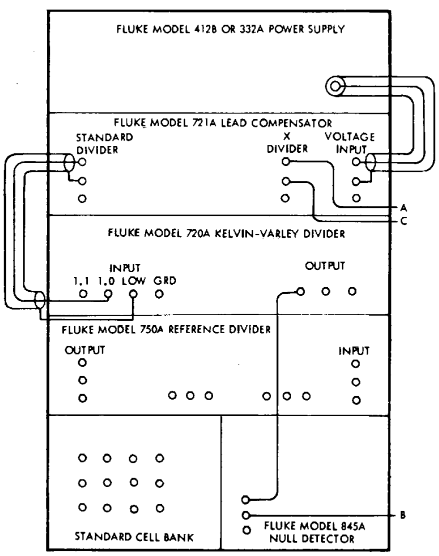


Figure 4-14. KELVIN-VARLEY DIVIDER ADJUSTMENT SETUP

g. Set 412B Power Supply for an output of 4 volts dc.

h. Connect points A and C of figure 4-12 to test points 14 and 16 of Kelvin-Varley board respectively.

i. Eliminate errors due to resistance of leads and connections as follows:

(1) Set 845A Null Detector to 30 MICROVOLTS.

(2) Set 720A Kelvin-Varley Divider dials to 0000000.

(3) Connect point B of figure 4-14 to test point that point C is connected to.

(4) Set function switch to VOLTAGE OFF on 721A Lead Compensator.

(5) Adjust ZERO control to null meter on 845A Null Detector.

(6) Set function switch to Rs > Rx on 721A Lead Compensator.

(7) Adjust LOW BALANCE controls on 721A Lead Compensator for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to find null point on LOW BALANCE controls.

(8) Set 721A Kelvin-Varley Divider dials to 10000000.

(9) Connect point B 6f figure 4-14 to test point that point A is connected to.

(10) Repeat steps (4), (5), and (6).

(11) Adjust HIGH BALANCE controls on 721A for a null on 845A. It may be necessary to temporarily reduce sensitivity of 845A to.find null point on HIGH BALANCE controls.

j. Set voltage dial E to 50.

k. Connect point B of figure 4-14 to test point 15.

l. Set 720A Kelvin-Varley Divider to 5000000.

m. Eliminate error due to thermal voltages as follows:

(1) Set function switch to VOLTAGE OFF on 721A Lead Compensator.

(2) Set 845A Null Detector to 30 MICROVOLTS and adjust ZERO control to null meter.

(3) Set function switch to Rs> Rx on 721A Lead Compensator.

n. Set 845A Null Detector co 1 MILLIVOLT.

o. Adjust R303 (at point P) to within i200 microvolts of null.

p. Reconnect points A and C to test points 17 and 18 respectively.

q. Solder down jumpers Z and Y.

r. Repeat step i.

s. Connect point B to test point 19.

t. Repeat steps m and n.

u. Adjust R316 (at point N) to within i50 microvolts of null.

v. Reconnect points A and C to test points 20 and 21 respectively.

w. Solder down jumpers X and W.

x. Repeat step i.

y. Connect point B to test point 22.

z. Repeat steps m and n.

aa. Adjust R329 (at point M) to within i20 microvolts of null.

ab. Set 412B Power Supply for an output of 18 volts dc.

ac. Reconnect points A and C to test points 23 and 24 respectively.

ad. Solder down jumper V.

ae. Repeat step i.

af. Connect point B to test point 25.

ag. Set 720A Kelvi'n-Varley Divider dials to 6666667.

ah. Make adjustments as given in each horizontal line of figure 4-15.

ai. Solder down jumper U and high input wire of Kelvin-Varley divider.

aj. Check accuracy of Kelvin-Varley divider using procedure of paragraph 4-51.

4-61. MECHANICAL DRUM ADJUSTMENTS

4-62. Occasionally the need may arise to align the po-

Set Voltage Dial A To	Short Test Points	Eliminate Thermal Voltage Errors as in step m	Set 845A Null Detector to 100 microvolts	Adjust Control to Within +15 microvolts of Null at Point		Remove Short from Between
0	2 to 3	"	"	R364	A	2 and 3
0	1 to 2	"	"	R362	B	1 and to 5
2	4 to 5	"	"	R360	C	4 and 5 2
2	3 to 4	"	"	R358	D	3 and 4
4	6 to 7	"	"	R356	E	6 and 7
4	5 to 6	"	"	R354	F	5 and 6
6	8 to 9	"	"	R352	G	8 and 9
6	7 to 8	"	"	R350	H	7 and 8
8	10 to 11	"	"	R348	I	10 and 11
8	9 to 10	"	"	R346	J	9 and 10
10	12 to 13	"	"	R344	K	12 and 13
10	11 to 12	"	"	R342	L	11 and 12

Figure 4-15. KELVIN-VARLEY "A" DECK ADJUSTMENT

larity switch drum or one of the voltage dial drums in the readout windows. Also, if the drive gear on a switch or dial shaft is no longer in line with the drum shaft, the gears may bind as the dials are turned. Proceed as follows:

a. Remove both side front-covers aid the bottom cover from 883A.

b. Stand instrument on rear.

c. Make sure that drive gear on polarity switch shaft and drive gear on shaft of voltage dial E are in line with drum shaft. If not, loosen set screw of drive gear with

a 1/16" hex key and align drive gear with drum shaft.

d. Loosen adjusting bracket at left side of instrument and position drum shaft up or down until there is just discernible backlash. That is, until polarity drum just moves when rotated with a finger without moving drive gear on polarity switch shaft.

e. Loosen adjusting bracket at right side of instrument and position drum shaft until there is just discernible backlash for drum of voltage dial E.

f. Turn polarity switch and all voltage dials fully counterclockwise.

g. Loosen set screw of drive gear for drum being aligned and slide drive gear toward back of instrument.

NOTE

See step 1. for adjustment of voltage dial E.

h. Insert finger through window and hold drum being aligned in desired position.

i. Insert hex key into set screw of drive gear and lift drive gear into place allowing it to turn counterclockwise as the teeth mesh.

j. When drive gear is in line with drum shaft tighten set screw.

k. Check character alignment in window. If necessary, loosen set screw and rotate drive gear slightly for final adjustment.

l. To align drum for voltage dial E, loosen set screw of drive gear and slide toward rear of instrument.

m. Insert hex key into set screw of drive gear and lift drive gear into alignment with drive shaft while noting how much drum turns.

n. Slide drive gear toward rear of instrument.

o. Position drum so that 00 position will line up with pointer when gear is raised into position.

p. Raise drive gear into alignment with drum shaft and position 00 in line with pointer by rotating drive gear slightly before tightening set screw.

SECTION V
PREVENTIVE MAINTENANCE INSTRUCTIONS

5-1. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of this equipment are listed below together with a reference to the paragraphs covering the specific maintenance functions. The preventive maintenance procedures require no special tools or test equipment.

a. Daily preventive maintenance checks and services chart (para 5-5).

b. Weekly preventive maintenance checks and services chart (para 5-6).

c. Monthly preventive maintenance checks and services chart (para 5-8).

d. Quarterly preventive maintenance checks and services chart (para 5-10).

e. Cleaning (para 5-11).

f. Touchup painting instructions (para 5-12).

5-2. Materials Required for Maintenance

a. Cleaning Compound, Freon PCA, type TF (NS 6850-00-105-3084).

b. Cleaning cloth.

c. Fine sandpaper.

d. Touchup paint.

5-3. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedure given in paragraphs 5-4 through 5-12 cover routine sys tematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services.

The preventive maintenance checks and services charts outline functions to be performed at specific intervals. These checks and services are to maintain equipment in a combat-serviceable condition; that is, in a good general (physical) condition and in good operationing condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal conditions. The References column lists the illustration or paragraphs that contain additional information. If the defect cannot be found by performing the corrective action indicated, higher category maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

5-4. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of this equipment are required daily, weekly, monthly, and quarterly. Paragraph 5-6 specifies checks and services that must be performed weekly. If the equipment is maintained in a standby condition, the daily and weekly checks and services should be accomplished at the same time. The maintenance checks and services that are accomplished monthly are specified in paragraph 5-8 Quarterly maintenance checks and services are specified in paragraph 5-10.

5-5. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be Inspected	Procedure	References
1	Completeness---------------------------- --	Check -o see that equipment is complete.	App. B.
2	Cleanliness----------------------------------	Exterior of equipment must be clean and dry; free of fungus, dirt, dust or grease.	Para 5-11.
3	Operational check---------------------- --	Check operational efficiency.	
4	Controls------------------------------------ --	Check to see that controls operate smoothly and are fastened in place securely.	

5-6. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspectd	Procedure	References
1	Cables-----------------------------------	Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, stripped, or worn.	
2	Handles--------------------------------	Inspect handles for looseness or sharp edges. Replace or tighten as necessary.	
3	Metal surfaces--------------------------	Inspect exposed metal surface for rust and corrosion. Clean and touch up with paint as required.	Para 5-1 1 AND 5-12.

5-7. Monthly Maintenance

Perform the maintenance functions indicated in the monthly preventive maintenance checks and services chart (para 5-8) once each month. Periodic daily (para 5-5) and weekly (para 5-6) services constitute a part of the monthly checks. A month is defined as approximately 30-calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly preventive maintenance checks and services should be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition must have monthly preventive maintenance checks and services. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

5-8. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspectd	Procedure
1	Terminations --------------------------	Inspect for loose connections and cracked or broken insulation.
2	Control panel --------------------------	Clean panel thoroughly and check all surfaces for chips, cracks, or abnormal wear.
8	Hardware -------------------------------	Inspect all hardware for possible damage.

5-9. Quarterly Maintenance

Quarterly preventive maintenance checks an services are required for this equipment. Periodic daily, weekly, and monthly services constitute a part of the quarterly preventive maintenance checks and services and must be performed con currently. All deficiencies or shortcomings will b recorded in accordance with the requirements of

TM 38-750. Perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (para 5-10) in the sequence listed. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition must have quarterly preventive maintenance checks and services. Equipment in limited storage (requires service before operation) does not require quarterly preventive maintenance. An inventory of spare parts is an essential part of the quarterly checks and services program.

5-10. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspectd	Procedure	References
1	Publications	Check to see that all publications are complete, serviceable, and current.	DA Pam 310-4.
2	Modifications	Check DA Pam 310-7 to determine whether new applicable MWO's have been published. ALL URGENT MWO's must be applied immediately. ALL NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-7.
3	Spare parts	Check all spare parts (operator and organizational) for general condition and method of storage. No overstock should be evident, and all shortages must be on valid requisitions.	App. B.

5-11. Cleaning

a. Inspect exterior surfaces. Surfaces must be free of dust, dirt, grease, fungus and other foreign material.

b. Remove dust and dirt with a clean, soft cloth. If dust and dirt are difficult to remove, use mild soap and water. Remove dust and dirt from jacks and plugs with a soft brush.

WARNING

Adequate ventilation must be provided while using TRICHLOROTRIF-LUOROETHANE (Cleaning Compound, Freon PCA, Type TF). Prolonged breath- ing of the vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE will dissolve natural oils, prolonged contact with the skin should be avoided. When necessary, use gloves that the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

c. Remove grease, fungus and ground-in dirt with a cloth dampened, not wet, with Cleaning Compound (Freon PCA, Type TF).

5-12. Touchup Painting Instructions

Remove dust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB 746-10.

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7,8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	US Army Equipment Index of Modification Work Orders.
TB 9-6625-1894-50	Calibration Procedure for Differential Voltmeter TS-2843/U (John Fluke Model 883AB).
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TM 11-6625-537-15	Operator, Organizational, Field, and Depot Maintenance Manual: Voltmeter, Electronic ME-202/U.
TM 11-6625-539-15	Operator, Organizational, Field and Depot Maintenance Manual: Transistor Test Set TS-1836/U.
TM 11-6625-654-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual Repair Parts and Special Tools List for Multimeter AN/USM-223.
TM 11-6625-683-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual: Signal Generator AN/URM-127 (NSN 6625-00-783-5965).
TM 11-6625-938-15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual: Transportable Maintenance Calibration Facility AN/TSM-55A.
TM 11-6625-2400-24P	Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Voltmeter TS-2843/U (NSN 6625-00-488-4039).
TM 11-6625-2658-14	Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Oscilloscope AN/USM-281C (NSN6625-00-106-9622).
TM 38-750	The Army Maintenance Management System.
TM 750-244-2	Procedures for Dstruction of Electronics Materiel to Prevent Eneny Use (Electronics Command).

APPENDIX C
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

C-1. General

This appendix provides a summary of the maintenance operations for the TS-2843/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

C-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

t: Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (servicel/saction) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

C-3. Column Entries

a. Column 1, Group .Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 1 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the maintenance categories, appropriate "work time" figures will be shown for each category. The number of task-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, trouble-shooting time, and quality assurance /quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4

C - Operator/Crew
O -Organizational
F - Direct Support
H - General Support
D - Depot

e. Colh1itom 5, Tools and Equipment t. Column 5
specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f: Column Remarks column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

C-4. Tool and Test Equipment Requirements (Sect. III).

a. Tool or, Test Equipment Code. The - numbers in this column coincide with the numbers used in the tools and equipment columnn of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allo- cated the tool ol test equipment.

c. No,(,,clteh rter-e. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. Jr. This column lists the National/NATO stock number of the specific tool of test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

C-5. Remarks (Sect. IV)

a. Retries c(e Code. This code refers to the appropriate item in section II, column 6.

b. Remark. This column provides the required explanatory information necessary to clarify items appealing in section II.

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIPMENT	(6) REMARKS
00	VOLTMETER TS-2843/U	Impact		0.1				7	
		Test				0.5		1 thru 6	
		Service		0.2				7	A
		Adjust				0.2		1 thru 6	
		Align				0.4		1 thru 6	
		Repair		0.1				7	B
		Repair				2.0			
		Rebuild					6.0	1 thru 6	

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR VOLTMETER TS-2843/U

Tool or Test Equipment REF Code	Maintenance category	Nomenclature	National/NATO Stock Number	Tool Number
1	H,D	GENERATOR, SIGNAL AN/URM-127	6625-00-783-5965	
2	H,D	MULTIMETER AN/USM-223	6625-00-999-7465	
4	H,D	VOLTMETER, AC, DC ME-202/U	6625-00-050-8686	
5	H,D	TEST SET, TRANSISTOR TS-1836/U	6625-00-893-2628	
6	H,D	TOOL KIT TK-105/G	5180-00-610-8177	
7	0	TOOLS AND TEST EQUIPMENT AVAILABLE TO THE ORGANIZATIONAL REPAIR TECHNICIAN BECAUSE OF ASSIGNED MISSION.		

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	SIMPLE TESTS AND ADJUSTMENTS.
B	BY REPLACEMENT OF KNOBS, FUSES, BATTERIES, AND CABLE ASSEMBLY.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

USASA (2)
CNGB (1)
ACSC-E (2)
Dir of Trans (1)
CofEngrs (1)
TSG (1)
CofSptS (1)
USAARENBD (2)
USAMB (10)
USACDCCEA (1)
USACDCCEA
Ft Huachica (1)
USACDC (1)
USACDCOA (1)
USAMC (1)
CONARC (5)
ARADCOM (2)
ARADCOM Rgn (1)
OS Mai Comd (4)
LOGCOMD (2) except
1st Log Comd (5)
2d Log Comd (5)
USAMICOM (5)
USATECOM (2)
USASTRATCOM (5)
USASTRATCOM-EUR (5)
USASTRATCOM-PAC (5)
USASTRATCOM-SO (5)
USASTRATCOM-A (2)
USARV (5)
USAESC (40)
MDW (1)
Armies (2)
Corps (2)
1st Cav Div (2)
Svc Colleges (2)
USASCS (10)
USASESS (10)
USAADS (2)
USAINTS (3)
USAFAS (2)
USAARMS (2)
USAIS (2)
USAES (2)
USAOC&S (2)
USAMCC (3)
Fort Huachuca (5)
WSMR (3)
Fort Carson (7)
Army Dep (2) except
LBAD (14)
SAAD (30)
TOAD (14)
LEAD (7)
ATAD (10)
USACDCEC (10)
GENDEP (2)
Sig Sec GENDEP (5)
Sig Dep (5)
USACRREL (2)
WRAMC (1)
SigFLDMS (1)
ATS (1)
USAERDAA (2)
USAERDAW (5)
Units org under fol TOE:
(2 cys each)
9-550 (EK)
11-158
29-134
29-227
29-670

NG: None.

ETSAR: None.

For explanation of abbreviations used, see AR 310-50.

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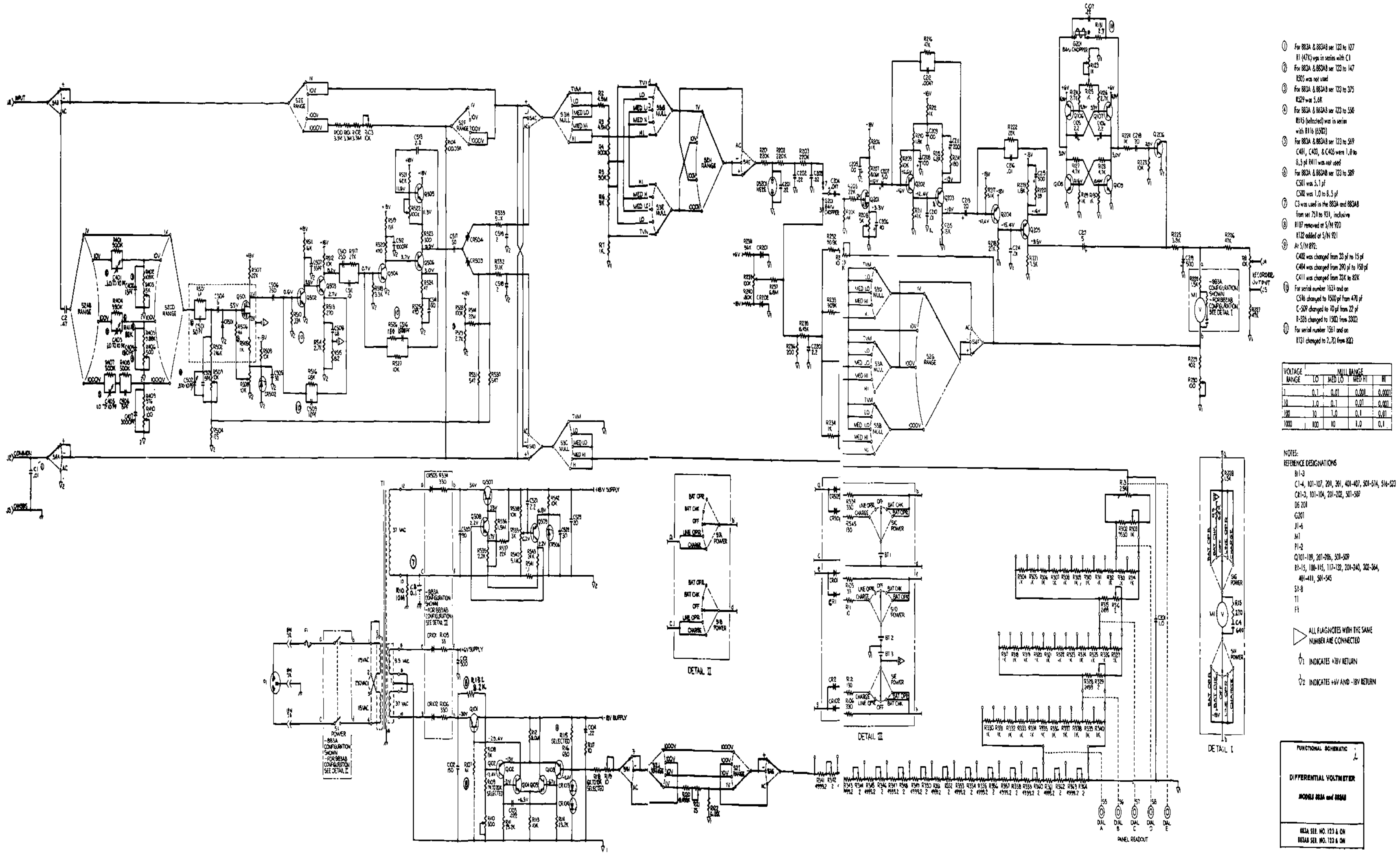
INDICATES +6V AND -18V RETURN
FUNCTIONAL SCHEMATIC
DIFFERENTIAL VOLTMETER
883A SER. NO. 123 & ON
883AB SER. NO. 123 & ON
DETAIL I
DETAIL II
DETAIL III
PANEL READOUT

TEAR ALONG PERFORATED LINE

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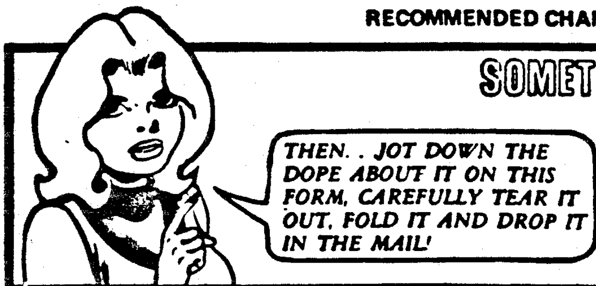

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