MOBILE RADIO

MAINTENANCE MANUAL

TEST CALIBRATOR MODEL 4EX20A10
COMBINATION NUMBER TC51

4EX20A10

SPECIFICATIONS *

Used With	MASTR® Personal and PMII CHARGERS
Operating Current Range	25 to 1000 milliamps (adjustable)
Equivalent Zener Impedance	Less than 50 milliohms
Temperature Stability	Less than 2.5 millivolts/°C
Voltages Provided:	
Position 1	7-8.25
2	8-9.5
3	9.5-11
4	11-12.5
5	12.4-13.9
Current Metering Accuracy	±8% fs
Voltage Calibration:	
8.7 & 9.0 Volt (Ranges)	±.1 VDC

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS!

DESCRIPTION

Calibration 4EX20A10 provides a quick functional test for a General Electric 3-hour desk or rack battery charger. The calibrator also provides a charge current check for General Electric 16-hour chargers and most other chargers. With the standard test adaptor 19C321913G1 connected to the calibrator and plugged into the charging insert of the 3-hour charger, battery pack voltage and temperature conditions for the standard 700 mAh battery pack can be simulated, and operation of the charger circuitry checked.

A logic test lead with a level indicator (LED) is provided to assist the service technician in troubleshooting the charger logic circuits. Logic tables to be used with the test lead are provided in the charger maintenance manuals.

Two optional battery pack adaptors are available: 500 mAh battery pack adaptor 19C321919G1 and 700 mAh Intrimsically Safe battery pack adaptor 19C321919G2. These optional adaptors provide a method of measuring the C/10 trickle charge current and charge voltage for 500 mAh battery pack (50 mA) and 700 mAh Intrinsically Safe battery pack (70 mA) chargers. A simple circuit in Figure 2 enables the calibrator to check charge current and voltage of most other chargers.

OPERATION

3-Hour Chargers

To use calibrator 4EX20A10 with the 3-hour charger, set the VOLTAGE RANGE switch S3103 to position 2 and S3104 to the HOT position. See Figure 1. Set RANGE ADJUST control R3101 to the left of the vertical mark. Plug the battery pack adaptor, for the standard 700 mAh battery pack, into the charging insert of the 3-hour charger. The amber LED indicator labeled CHARGING, on the charger, should light and the charger should charge at the trickle charge rate (50 mA). The trickle charge current can be read on ammeter M3101 by pressing HI-SENS switch S3102. The green LED indicator labeled READY should remain off. Place switch S3104 in the NORM position. After approximately 0.5 seconds the charger should begin the high charge rate. The high rate charge current is read directly on ammeter M1301. The high charge current is approximately 350 mA for desk chargers and approximately 400 mA for rack chargers. Place switch S3104 in the HOT position. The charger should return to trickle charge and both the amber and green indicator should be on. Place switch S3104 back to the NORM position. The charger should stay in the trickle charge mode and both indicators remain on. Press RESET switch S3103 for one second. The green indicator should go off and the charger should go back to the high charge rate as soon as the RESET switch is released.

16-Hour Chargers

To check trickle charge current of a General Electric, one charge level, 16-hour charger, plug the appropriate battery pack adaptor into the charging insert. Set VOLTAGE RANGE switch S3103 to position 2 and RANGE ADJUST control R3101 to the left of the vertical mark. Read the charge current on ammeter M3101 by pressing HI SENS switch S3102. The charge voltage can be read on an external voltmeter connected across EXT METER jacks J3101 (+) and J3102 (-).

To check the operation of General Electric, two charge level, 16-hour chargers, connect 500 mAh battery pack adaptor 19C321919G1 to the calibrator. Turn VOLTAGE ADJUST control R3101 fully counterclockwise. Set VOLTAGE RANGE switch S3101 to position 2. Connect an external voltmeter across EXT METER jacks J3101(+) and J3102(-). Plug the adaptor into the charging insert. The red CHARGE indicator, on the charger, should light. Rotate VOLTAGE ADJUST control R3101 clockwise while observing the CHARGE indicator. When the indicator just goes out the fast charge dropout voltage can be read on the external voltmeter. The high charge current should be read on ammeter M3101 just before the charger switches to the trickle charge rate.

Fast Charger

Calibrator 4EX20A10 can not be used to check General Electric Fast Charger 4EP73A10. The measured cut-off voltage would not be correct because the charging current is to high. The calibrator can be used to set R12 on the fast charger if the high charge current has been disabled. See adjustment instructions in LBI-4255.

To use the calibrator to set R12 connect the positive lead of a digital voltmeter to J3101 on the calibrator and the negative lead to J3102. Set the calibrator VOLTAGE RANGE switch S3101 to position 2 and the RANGE ADJUST R3101 to the left of the vertical mark. Plug battery pack adaptor 19C321919G1 into the charging insert and adjust RANGE ADJUST R3101 to 8.78 Volts on the digital voltmeter. Continue the adjustment procedure outlined in LBI-4255 omitting step 4.

Other Chargers

The operation of most other chargers can be checked by using the simple adaptor circuit shown in Figure 2. Simply connect the adaptor circuit to the calibrator and the test leads across the charging contacts of the charger. Follow the same instructions for the General Electric 16-hour chargers.

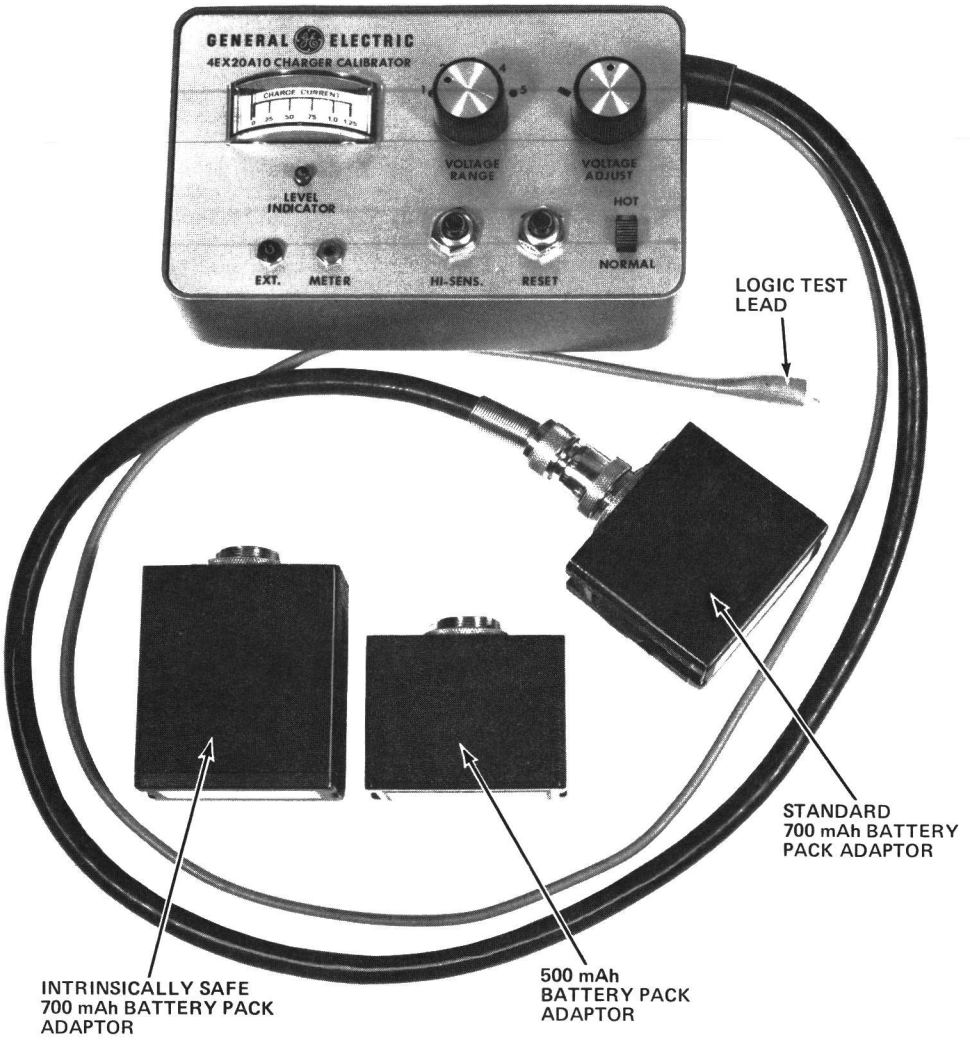


Figure 1 - Calibrator

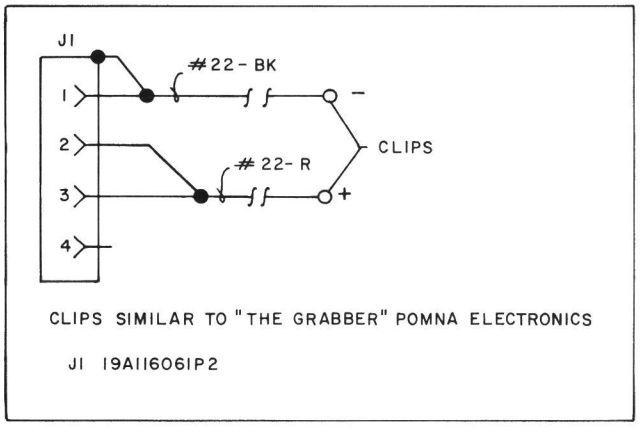


Figure 2 - Adaptor Circuit

CIRCUIT ANALYSIS

The temperature sensing element inside of 700 mAh battery pack 19D413522G4 connects in a resistive bridge circuit when the battery pack is in the charging insert of a 3-hour charger (see Figure 3). If the battery pack is cold (below 10°C of ambient) the bridge circuit will be unbalanced and the charger will charge the battery pack at the trickle charge rate (70 mA). The trickle charge causes the battery pack to heat. When the battery pack heats to within 10°C of ambient and the bridge circuit is almost balanced, the charger will charge at the high rate. When the battery pack heats to 10°C above ambient the charger will switch back to trickle charge.

Resistance circuit R7, R8 and R9 in calibrator 4EX20A10 simulates the temperature of a standard 700 mAh battery pack. Resistors R7 and R8 actually replace temperature sensing element RT Batt.

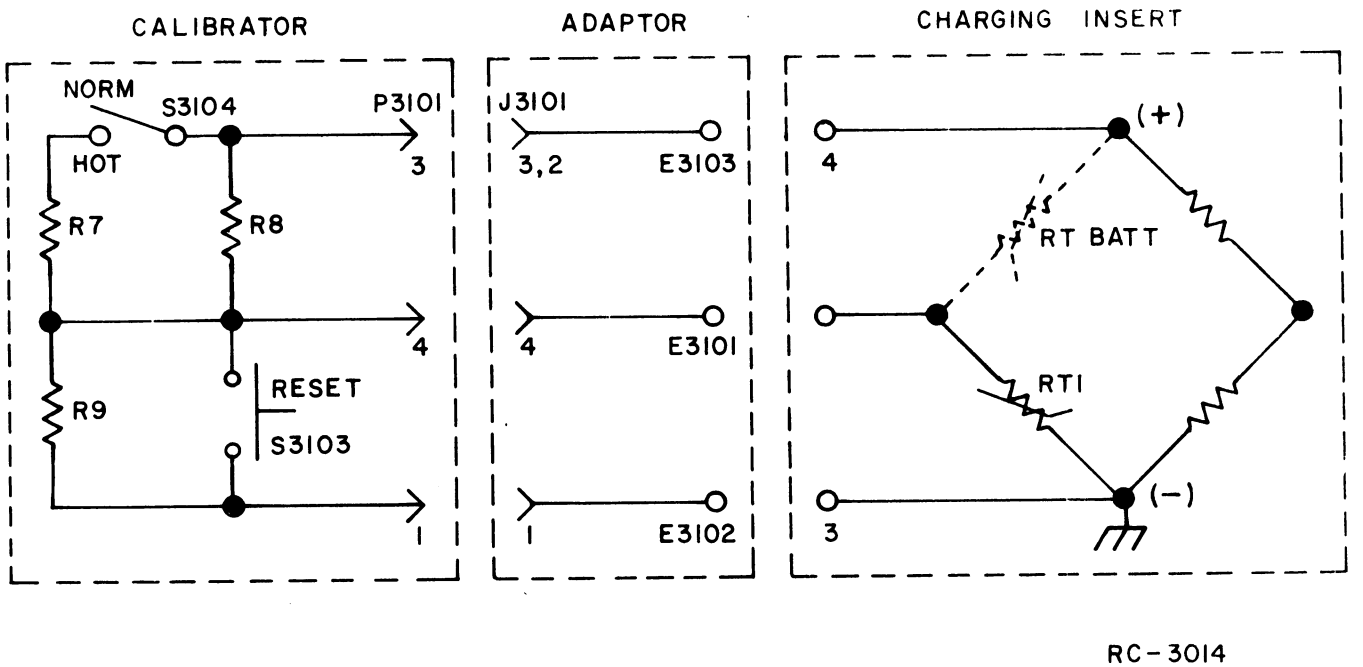


Figure 3 - Simplified Battery Pack Simulation Circuit

Resistor R9 parallels RT1 in the charging insert to maintain bridge circuit balance. With Switch S3104 in the NORM position, the charger sees a relatively high resistance, indicating a battery pack temperature in the high charge range. With Switch S3104 in the HOT position a lower resistance is seen by the charger, indicating the battery pack to be fully charged.

Pressing RESET switch S3103 unbalances the bridge circuit. To the charger it appears that the battery pack has been removed from the charging insert. Removing the battery pack from the charging insert resets the logic circuit in the charger.

Battery pack voltage simulation is accomplished by controlling the conduction of Darlington connected circuit Q1 and Q3101 to regulate the voltage across the charging contacts of the charger.

VOLTAGE RANGE switch S3101 and VOLTAGE ADJUST R3101 selects the desired voltage to be programmed across the charging contacts. The selected voltage can be read on an external voltmeter connected across EXT METER jacks J3101 and J3102. A current due to the selected voltage is connected to the positive input of comparator circuit AR1-A. A reference current from constant current source AR1-B is connected to the negative input of AR1-A. If the battery voltage starts to drop, the current on the positive input of AR1-A starts to drop. If the current on the positive input is less than the current on the negative input the voltage output at Pin 5 of AR1-A will be low. The low voltage output of AR1-A will cause Darlington circuit Q1 and Q3101 to conduct less and the voltage across the charging contacts will increase.

If the voltage across the charging contacts starts to decrease, the current on the positive input of AR1-A will start to increase. When the current on the positive input of AR1-A is larger than the current on the negative input the output voltage on Pin 5 of AR1-A will be high. Q1 and Q3101 will conduct more and the voltage across the charging contact will decrease.

The charging current is metered by ammeter M3101. M3101 is connected in the collector circuit of transistors Q1 and Q3101.

The logic test circuit consists of comparator circuit AR1-C and indicator driver circuit AR1-D. A reference current is applied to the negative input of AR1-C and the test lead is connected to the positive input. When the logic level on the logic test lead is causing the current on the positive input of AR1-C to be larger than the current on the negative input the output on Pin 9 goes high. The high output of AR1-C on the positive input of AR1-D causes AR1-D to light LED indicator CR3101.

MAINTENANCE

Disassembly

To gain access to the calibrator circuitry, remove the Phillips-head screw on

each side of the back cover. Carefully separate the front panel from the back cover.

Adjustment

To adjust the 4EX20A10 calibrator the following equipment is required:

1. Digital Voltmeter JK Fluke 8120A or equivalent.
2. DC Supply 15 VDC @ 1.0 amp with adjustable current limit.

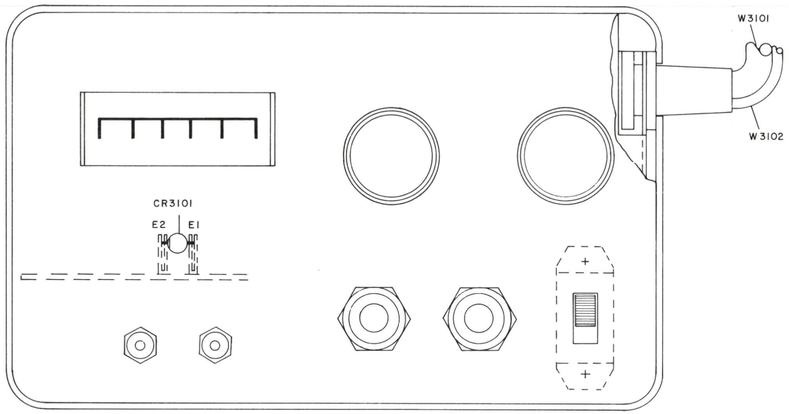
Setup

1. Connect the positive output of the DC Supply to P3101-3, 2 and the negative output to P3101-1 (shell of P3101). The adaptor circuit shown in Figure 2 can be used.
2. Connect the digital Voltmeter across jacks J3101(+) and J3102(-).

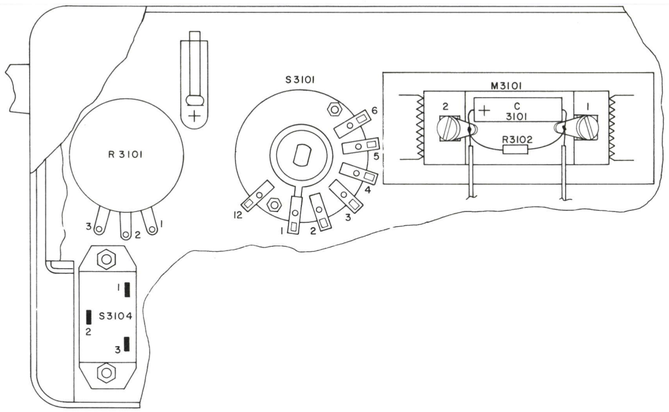
Procedure

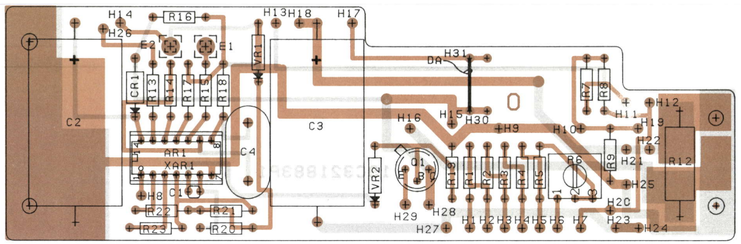
1. Set VOLTAGE RANGE switch to position 2.
2. Set VOLTAGE ADJUST to the vertical calibration mark.
3. Set switch S3103 to the NORM position.
4. Program the DC supply for 50 milliamps ±1 milliamps and 15 VDC ±0.5 open circuit voltage.
5. Adjust R6 for a reading of 9.0 ±.01 volts on the Digital Voltmeter.

TOP VIEW



REAR VIEW





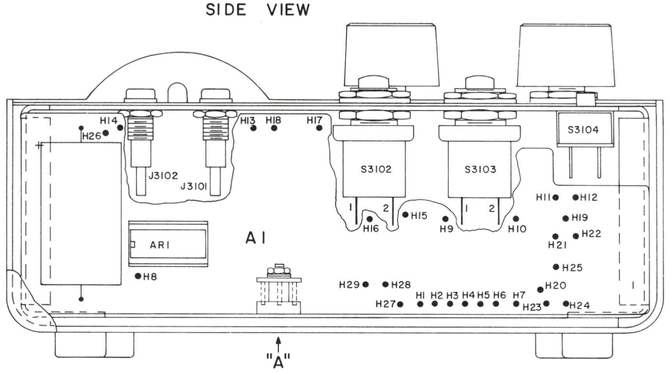
(19C327228, Rev. 0)
(19B227143, Sh. 2, Rev. 0)
(19B227143, Sh. 3, Rev. 0)

LEAD IDENTIFICATION
FOR Q1

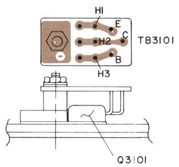
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

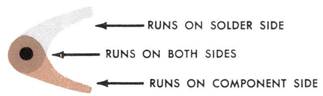
SIDE VIEW



(19D424018, Rev. 0)
(19A127512, Sh. 1, Rev. 0)
(19A127512, Sh. 2, Rev. 0)

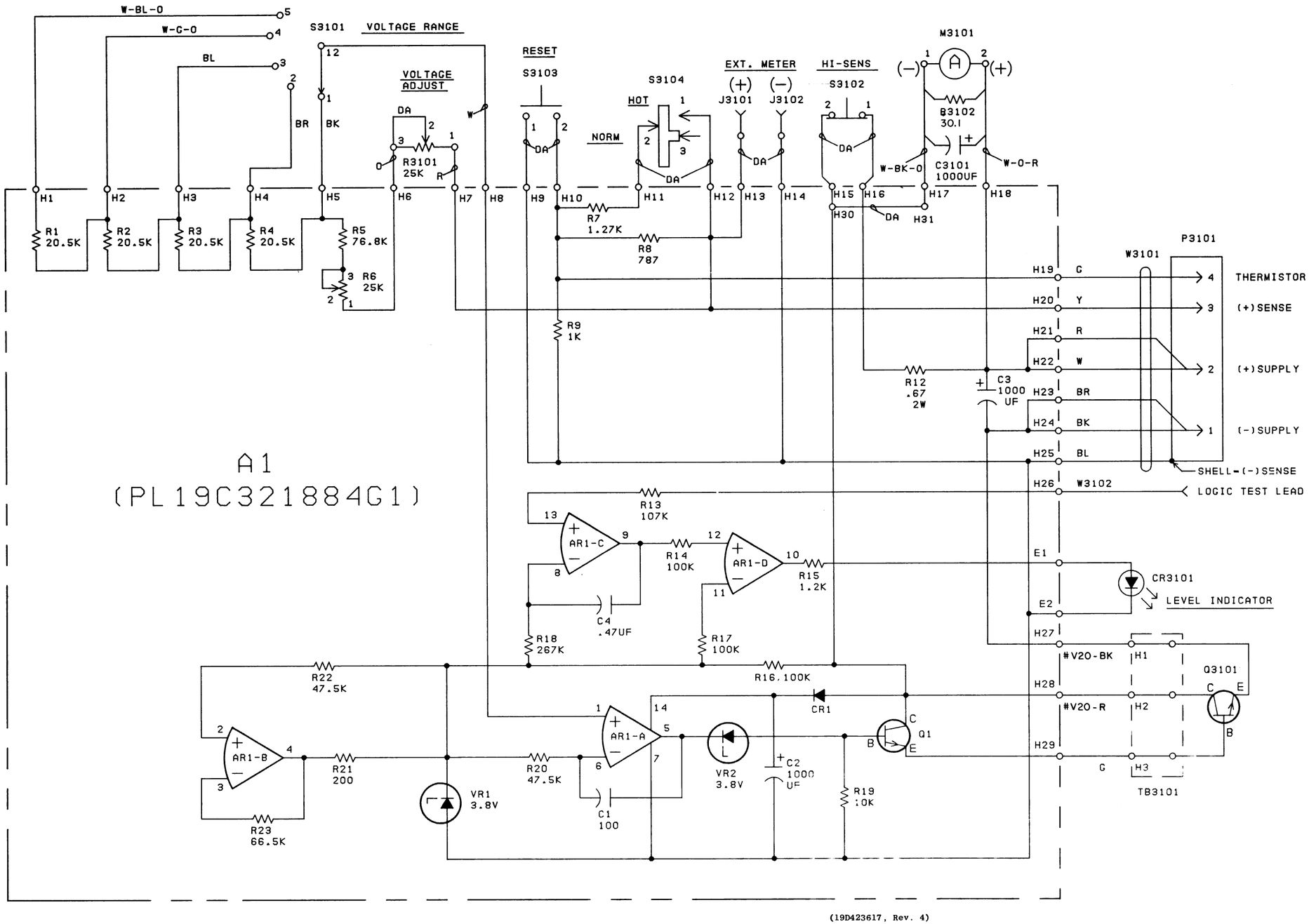


VIEW AT "A"
(ROTATED 90°)



OUTLINE DIAGRAM

TEST CALIBRATOR 4EX20A10



(19D423617, Rev. 4)

NOTES:

1. UNLESS OTHERWISE NOTED ALL WIRES ARE SF22.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO

MODEL NO	REV LETTER
4EX20A10	A

SCHEMATIC DIAGRAM

TEST CALIBRATOR 4EX20A10

PARTS LIST

LBI30077A

TEST CALIBRATOR
4EX20A10

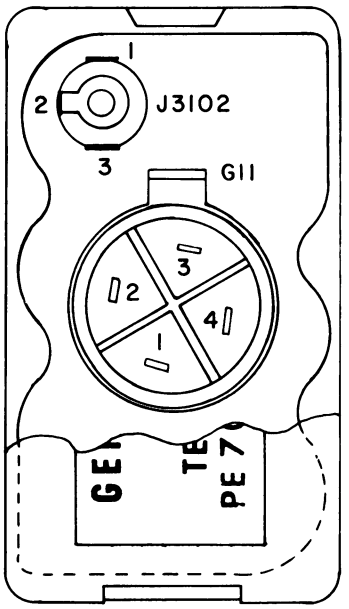
SYMBOL	GE PART NO.	DESCRIPTION
A1		COMPONENT BOARD 19C321884G1
AR1	19A134122P1	Integrated circuit, linear: Quad Operational Amplifier; sim to RCA CA 3401.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P11064	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -4200 PPM.
C2 and C3	5493132P18	Electrolytic: 1000 µf +150% -10%, 20 VDCW.
C4	19A116080P111	Polyester: 0.47 µf ±10%, 50 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	4037822P1	Silicon, 1000 mA, 400 PIV.
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E1 and E2	4031537P1	Terminal: sim to Alden Products 654T.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115300P4	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 thru R4	19C314256P22052	Metal film: 20.5K ohms ±1%, 1/4 w.
R5	19C314256P27682	Metal film: 76.8K ohms ±1%, 1/4 w.
R6	19A116559P107	Variable, cermet: 25K ohms ±20%, .5 w; sim to CTS Series 360.
R7	19C314256P21271	Metal film: 1270 ohms ±1%, 1/4 w.
R8	19C314256P27870	Metal film: 787 ohms ±1%, 1/4 w.
R9	19C314256P21001	Metal film: 1K ohms ±1%, 1/4 w.
R12	19A115416P8	Wirewound: 0.67 ohms ±1%, 2 w; sim to Dale Type RS-2B.
R13	19C314256P21073	Metal film: 107K ohms ±1%, 1/4 w.
R14	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R15	3R152P122J	Composition: 1.2K ohms ±5%, 1/4 w.
R16	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R17	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R18	19C314256P22673	Metal film: 267K ohms ±1%, 1/4 w.
R19	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R20	19C314256P24752	Metal film: 47.5K ohms ±1%, 1/4 w.
R21	19C314256P22000	Metal film: 200 ohms ±1%, 1/4 w.
R22	19C314256P24752	Metal film: 47.5K ohms ±1%, 1/4 w.
R23	19C314256P26652	Metal film: 66.5K ohms ±1%, 1/4 w.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1 and VR2	4036887P3	Zener: 500 mW, 3.8 v. nominal.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XAR1	19A116384P1	Integrated circuit, socket: sim to Methode M-1141.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C3101	5493132P19	Electrolytic: 1000 µf +100% -10%, 6 VDCW.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR3101	19A134146P4	Diode, optoelectronic: red; sim to Opcoa LSM-6L.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J3101	5490384P2	Jack, tip: red nylon; sim to EF Johnson 105-252-1.
J3102	5490384P3	Jack, tip: black nylon; sim to EF Johnson 105-253-1.
		- - - - - - - - - - - METERS - - - - - - - - - - -
M3101	19A134306P1	Meter, panel, special scale: sim to Electro-Mechanical Instrument Div., VLN Corp. Model No. 132D3(Drawing 0-328).
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P3101		(Part of W3101).
		- - - - - - - - - - TRANSISTOR - - - - - - - - - -
Q3101	19A116118P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R3101	5490032P6	Variable, molded composition: 25K ohms ±20%, 2.25 w; sim to Allen-Bradley Type J.
R3102*	19C314256P23019	Metal film: 30.1 ohms ±1%, 1/4 w.
		Earlier than REV A:
	19C314256P22100	Metal film: 210 ohms ±1%, 1/4 w.
		- - - - - - - - - - WSWITCHES - - - - - - - - - -
S3101	19C307127P1	Rotary: 2 sections, 2 poles, 11 positions, non-shorting contacts, 2 amps at 28 VDC or 1 amp at 110 VAC; sim to Oak Type "F".
S3102	7481654P2	Pushbutton: black, single pole, normally open, 1/2 amp at 115 VAC; sim to Grayhill 10YY2047.
S3103	7481654P1	Pushbutton: red, single pole, normally open, 1/2 amp at 115 VAC; sim to Grayhill 10YY2042.
S3104	7145098P3	Slide: SPDT, 0.75 amp at 125 VAC or 0.5 amp at 125 VDC; sim to Stackpole SS-32.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W3101		CABLE ASSEMBLY
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P3101	7478726P6	Connector, cable: 4 male contacts; sim to Amphenol Type 91-MC4M.
	7160478P6	Cable: approx 4 feet long.
W3102	19A130878G1	Cable: approx 4 feet long.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4036555P1	Insulator, washer: nylon. (Used with Q1 on A1).
	19A115185P2	Retainer strap. (Part of retainer securing W3101, W3102).
	19A115185P4	Strap base: sim to Panduit Corp. TA-1. (Part of retainer securing W3101, W3102).
	7165075P3	Hex nut, brass: thd. size No. 15/32. (Used with S3102, S3103).
	7115130P11	Lockwasher: No. 15/32; sim to Shakeproof 1222-1. (Used with S3102, S3103).
	7165075P1	Hex nut, brass: thd. size No. 3/8-32. (Used with R3101, S3101).
	7115130P9	Lockwasher: No. 3/8; sim to Shakeproof 1220-2. (Used with R3101, S3101).
	19A116170P1	Knob, push on. (Used with R3101, S3101).
	19B201074P204	Tap screw, Phillips POZIDRIV®: No. 4-40 x 1/4. (Secures A1).
	19B226586P1	Seal. (Used with W3101, W3102).
	19B227154G1	Can.
	NP280088	Faceplate.
	19B201074P205	Tap screw, Phillips POZIDRIV®: No. 4-40 x 5/16. (Secures rubber bumpers).
	19A115081P2	Rubber bumper.
	19A134016P1	Insulator, bushing. (Used with Q3101).
	19A116023P3	Insulator, plate. (Used with Q3101).
	N402P5C6	Plain washer. (Used with Q3101).
	N404P11C6	Lockwasher: No. 4. (Used with Q3101).
	4036994P1	Solderless terminal: sim to Zierick Mfg Corp 505. (Located at C3101, R3102).
	19B227150G1	Support. (Secures A1).
	19B227151P1	Base plate.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

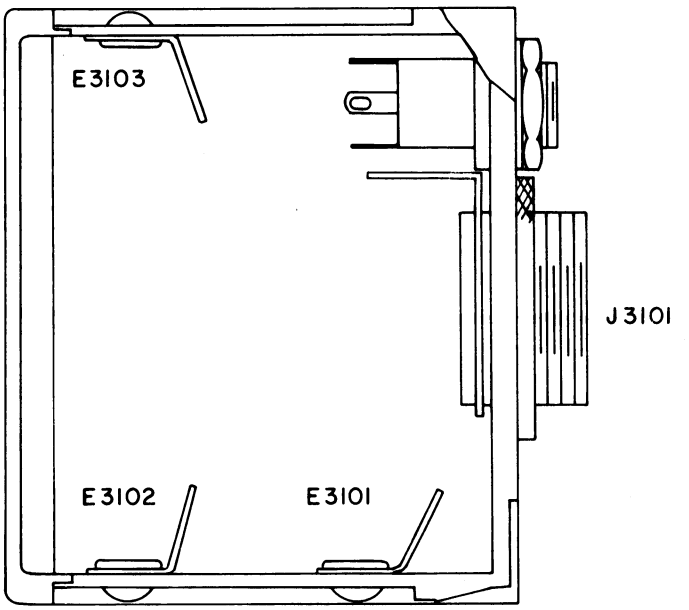
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

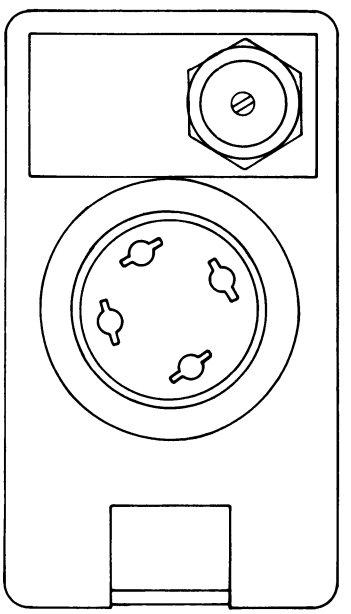
REV. A - To improve meter accuracy.
Changed R3102.



BOTTOM VIEW



SIDE VIEW



TOP VIEW

(19C327245, Rev. 1)

OUTLINE DAIGRAM

ADAPTOR 19C321919G1
FOR STANDARD 700 mAh BATTERY PACK

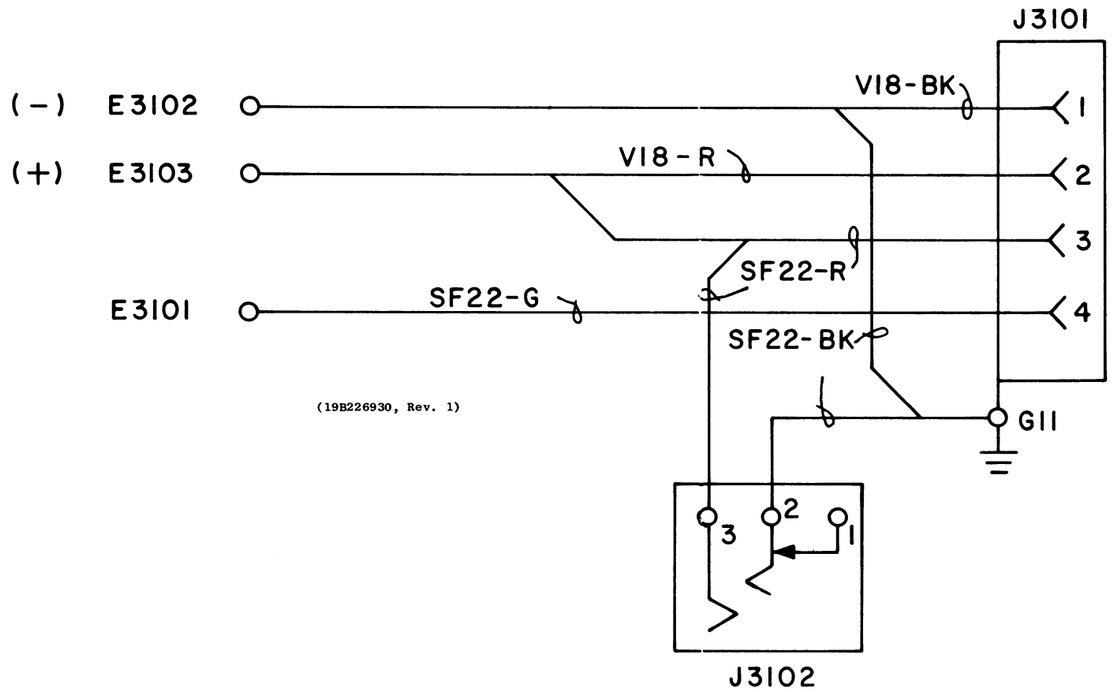
PARTS LIST

LBI-30132

ADAPTOR
19C321913G1

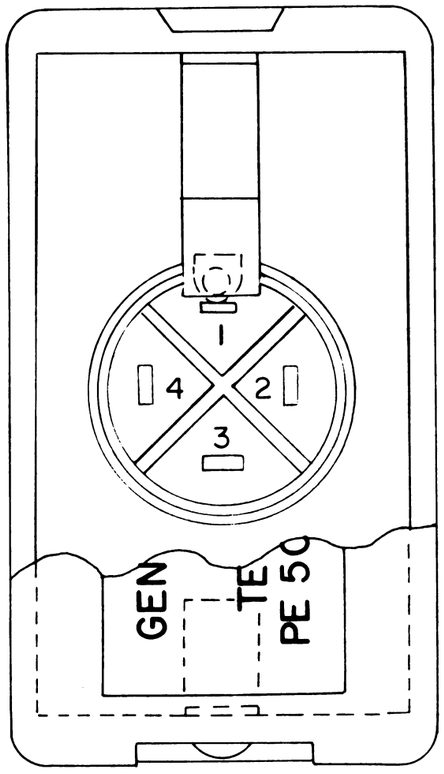
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E3101	4035338P5	Terminal, solder: sim to Zierick 597.
E3102 and E3103	4033714P19	Terminal, solder: sim to Zierick 9.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J3101	19A116061P2	Connector: 4 female contacts; sim to Amphenol Type 91-PN4F-1000.
J3102	19A134219P2	Connector, plug.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A130883G1	Case.
	19D417297P1	Cover.
	19A116061P5	Knurled nut. (Used with J3101).
	N327P9008E	Rivet, tubular. (Secures E3101-E3103).
	19A116061P4	Lockwasher. (Used with J3101).
	19A116049P1	Solderless terminal. (Used with J3101).

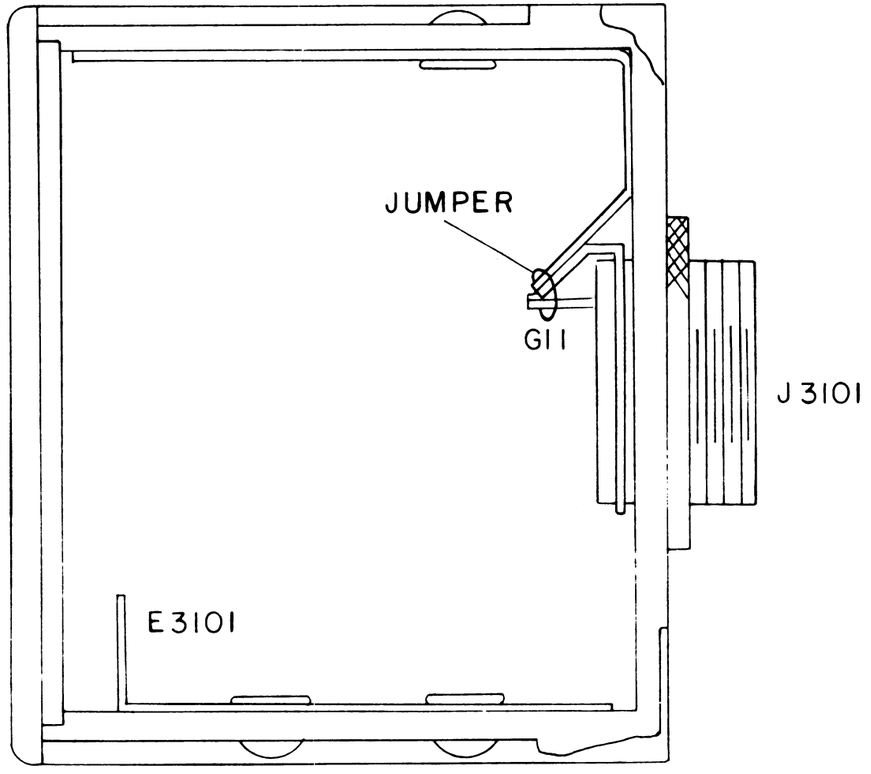
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



SCHEMATIC DIAGRAM

ADAPTOR 19C321913G1
FOR STANDARD 700 mAh BATTERY PACK





(19C327381, Rev. 0)

OUTLINE DIAGRAM

ADAPTOR 19C321919G1
FOR 500 mAh BATTERY PACK

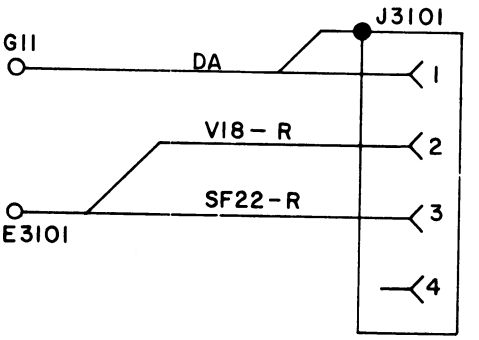
PARTS LIST

LBI-30133

ADAPTOR
19C321919G1
FOR 500 mAh BATTERY PACK

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E3101	19A127743P1	Strap.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J3101	19A116061P2	Connector: 4 female contacts; sim to Amphenol Type 91-PN4F-1000.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A130886G1	Case.
	19C317375P1	Cover.
	19B216812P1	Cap. (Connects to G11).
	19A116049P1	Solderless terminal: brass. (Used with J3101).
	N327P3008E	Rivet, tubular. (Secures 19B216812P1 cap to case).
	19A116061P4	Lockwasher, internal tooth: steel. (Used with J3101).
	19A116061P5	Knurled nut: brass. (Used with J3101).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

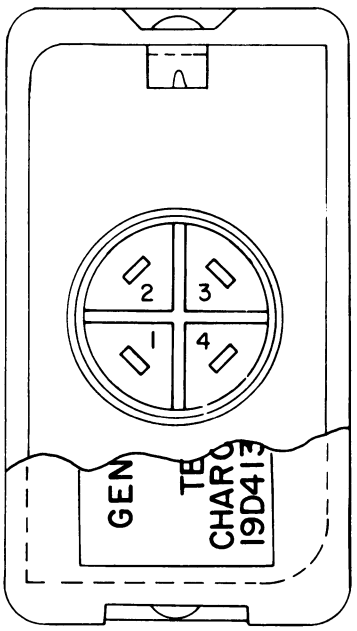


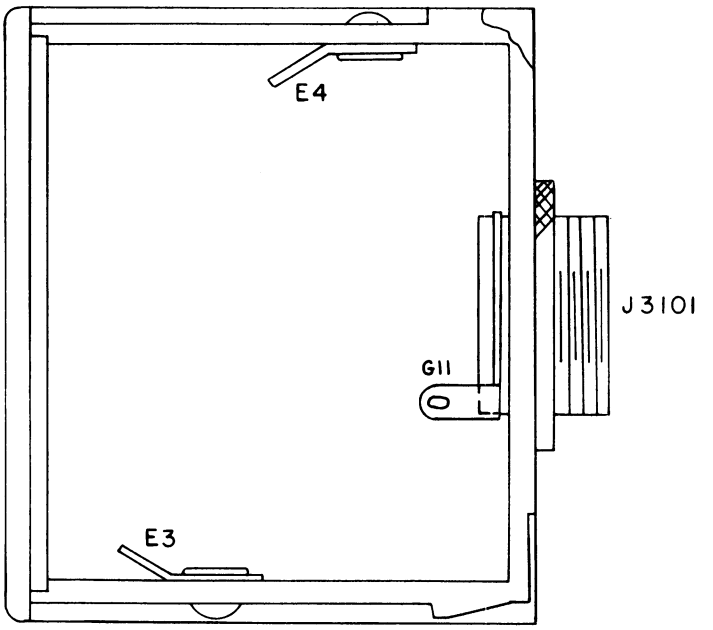
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C312919G1	

(19A130893, Rev. 3)

SCHEMATIC DIAGRAM

ADAPTOR 19C321919G1
FOR 500 mAh BATTERY PACK

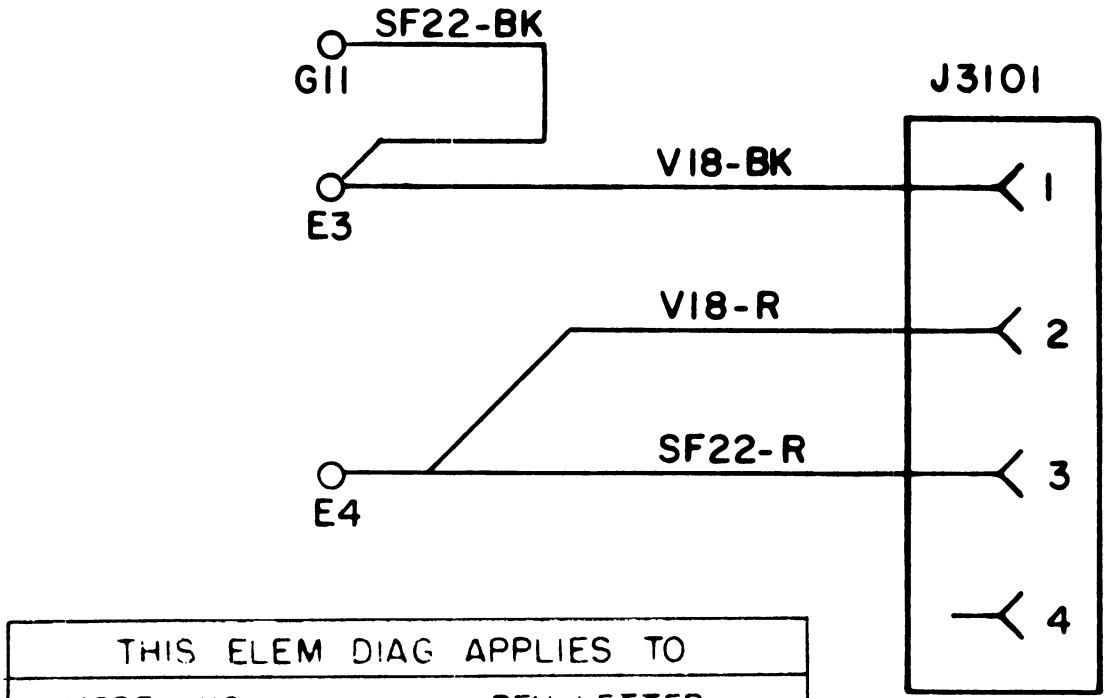




(19C327382, Rev. 1)

OUTLINE DIAGRAM

ADAPTOR 19C321919G2
FOR mAh 700 INTRINSICALLY SAFE
BATTERY PACK



THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C312919G2	

(19A136636, Rev. 1)

SCHEMATIC DIAGRAM

ADAPTOR 19C321919G2
FOR 700 mAh INTRINSICALLY SAFE
BATTERY PACK

PARTS LIST

LBI-30227

ADAPTOR
FOR
INTRINSICALLY SAFE BATTERY PACK
19C321919G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TERMINALS - - - - - - - - - -
E3 and .1	4033714P19	Terminal, solderless: sim to Zierick 9.
G11	19A116049P1	Terminal, solderless: brass.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J3101	19A116061P2	Receptacle: 4 female contacts; sim to Amphenol Type 91-PN4F-1000.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A130886G2	Case.
	19D417297P1	Cover.
	19A116061P5	Nut, knurled. (Secures J3101).
	19A116061P4	Lockwasher. (Secures J3101).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES