

D E P A R T M E N T O F T H E A R M Y T E C H N I C A L M A N U A L

OPERATOR'S MANUAL
TEST SET GENERATOR AND VOLTAGE REGULATOR, AUTOMOTIVE 12- AND 24-VOLT SYSTEMS
(SUN ELECTRIC MODEL LVR-3A) (4910-092-9136)

Headquarters, Department of the Army, Washington, D. C.
22 May 1969

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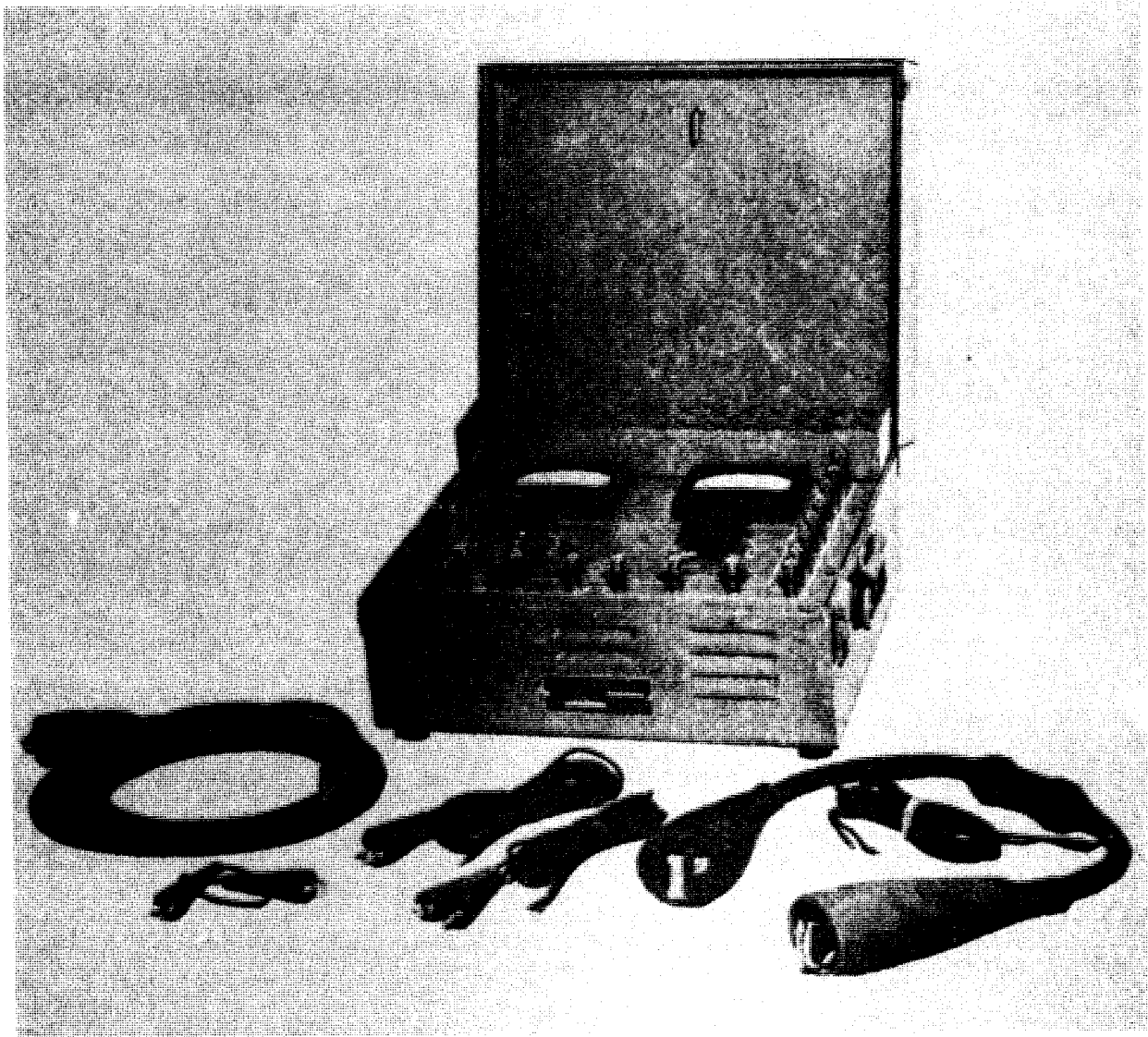


Figure 1. Automotive Low Voltage Circuit Test Set, Model LVR-3A

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION. This handbook provides Operating and Maintenance Instructions and a Parts List for the Automotive Low Voltage Circuit Tester, Federal Stock Number 4910-092-9136, manufactured by the Sun Electric Corporation, Chicago, Illinois 60631 and designated as Sun Model LVR-3A.

1-2. USE. The Automotive Low Voltage Circuit Tester, referred to in this handbook as the tester is used for testing dc generators, starters, voltage regulators, and other components associated with the electrical systems of Automotive type gasoline engines. Test leads are provided for connecting the tester to engine electrical systems. Instruments and controls of the tester are internally connected to separate binding posts on the panel.

1-3. DESCRIPTION. The tester is a portable unit, consisting of a steel carrying case with removable cover, and containing instruments, controls, and test leads. Test leads are stored inside the cover; circuit diagram and parts list are printed on the bottom (inside) of the case. All the electrical instruments, controls, and binding posts are mounted on the instrument panel which is easily removable for cleaning or servicing. Case has louvers on front, back, and bottom and an expanded metal vent in back of panel to provide ventilation for cooling internal resistance elements. Louvers and vent must be unobstructed when tester is in use. (See figure 1.)

Four voltmeter ranges permit readings from 0.02 volt to 50 volts direct current, and four current ranges permit readings from 0.1 ampere to 500 amperes dc. A variable resistance load circuit is used to check generator output and to provide an electrical load of from 5 to 100 amperes on 6-, 12-, or 24-volt systems. The three lower reading current scales of the ammeter have shunts inside the tester. The high reading (500-ampere) scale requires the use of the external shunt. Generator output is manually controlled with a field rheostat when testing at fixed engine speeds. A fixed resistor of 0.25 ohm resistance is provided for voltage regulator testing. Test leads have color coded (red and black) tip plugs and test clips. The parts list for the tester appears in Section VI; Electrical schematic diagram appears on last page.

1-4. METER RANGES. Each meter has four ranges. Select proper binding posts for desired meter ranges.

TABLE I.

D.C. AMMETER & D.C. VOLTMETER RANGES

D. C. Ammeter	D.C. Voltmeter
- 3 to 0 to 10	0 to 1
- 15 to 0 to 50	0 to 10
- 30 to 0 to 100	0 to 20
-150 to 0 to 500	0 to 50

SECTION II

INSPECTION AND PREPARATION FOR USE

2-1. INSPECTION. Inspect tester for broken binding posts or meters, or any other damage that may have occurred during shipment. See that instruction books and cables are in cover of tester.

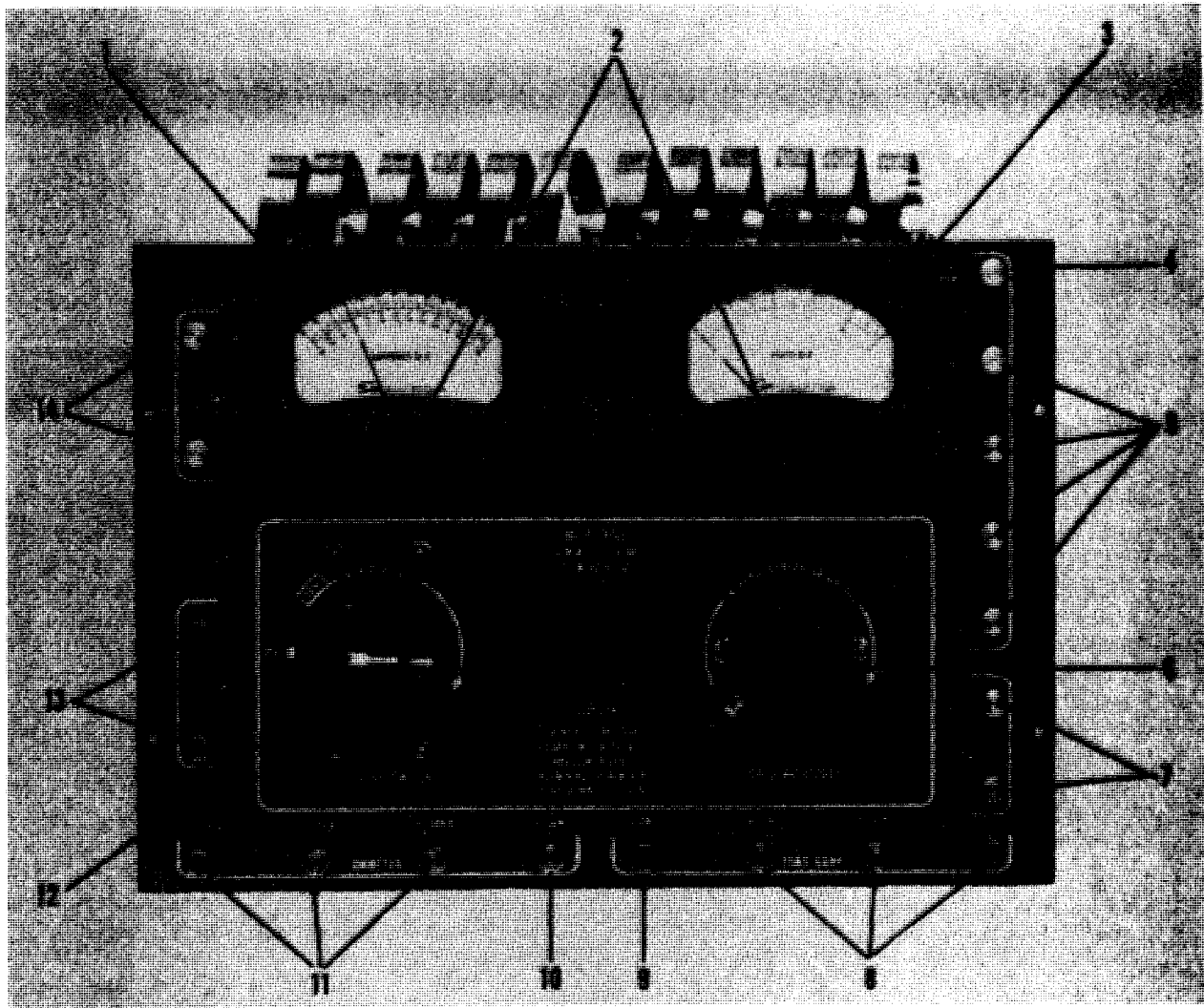
2-2. PREPARATION FOR USE. Tester is shipped ready for use. Adjust meter pointers to read zero before making connections. Locate tester where louvers will not be obstructed so that internal components will have adequate cooling air.

SECTION III

OPERATING INSTRUCTIONS

3-1. PRECAUTIONS.

- Connect test lead tip plugs to panel binding posts before connecting test lead clips to circuit. Always disconnect test lead clips before changing panel connections, to prevent arcing at the binding posts.
- Always turn LOAD BANK SWITCH knob to OFF position before attaching or removing LOAD BANK test lead clips.
- The AMMETER "+ COM" binding post and the LOAD BANK "COM" binding post are connected together internally.



- | | |
|---|---|
| 1. D. C. Ammeter | 8. Load Bank + (positive) binding posts |
| 2. Meter Zero Corrector | 9. Load Bank COMMON (negative) binding post |
| 3. D. C. Voltmeter | 10. Ammeter + COMMON binding post |
| 4. Voltmeter + COMMON binding post | 11. Ammeter - (negative) binding posts |
| 5. Voltmeter - (negative) binding posts | 12. Load Bank Switch knob |
| 6. Field Rheostat knob | 13. Fixed Resistance 0.25 ohm binding posts |
| 7. Field Rheostat binding posts | 14. External Shunt Binding posts |

Figure 2. Instruments and Controls

- d. Do not use test leads with small pin plugs in binding posts with large holes (AMMETER, LOAD BANK FIXED RESISTANCE .25 OHM).
- e. In choosing a location for the tester, at the vehicle or on the service bench, be sure tester has adequate ventilation.

CAUTION

Do not exceed the duty cycle of 3 minutes on and 27 minutes off when using LOAD BANK binding posts.

3-2. **AMPERES D. C.** The ammeter is a four scale instrument with zero-adjusting button on the front. Meter indicates both positive and negative current readings (forward and reverse currents). Correct polarity must be observed when making connections. Scale zeros are located approximately 1/3 scale from left end. Ammeter is used for measuring generator and starter currents, testing voltage regulator, and making other dc tests. Reverse current readings are noted when making voltage regulator cutout relay tests. (See figure 2.)

Connections to ammeter are made to AMMETER binding posts (for the three lower reading scales) using test leads with the larger tip plugs. Connect red tip plug of test lead to + COM (positive) binding post, and black tip plug to desired -10A, -50A, or -100A (negative) binding post.

The high reading scale, 500 amperes dc, requires the use of the EXTERNAL SHUNT (see paragraph 3-7). When the positive post of the vehicle's battery is grounded (instead of the negative post) the ammeter polarity must be reversed from what it is with negative ground.

3-3. **VOLTS D. C.** The voltmeter is a four scale instrument with zero adjusting button on the front. It is used for measuring voltages, and voltage drops (or loss) across cables and cable connections.

Connections to voltmeter are made to the + COM, and to one of the negative VOLTMETER binding posts. Each negative binding post is marked with the voltmeter range it represents. Observe polarities when connecting test leads to binding posts (red test lead to positive; black

test lead to negative). Voltage of battery determines which voltmeter scale to use, except where different scales are specified in some of the test procedures.

3-4. **LOAD BANK SWITCH.** Load bank switch circuit consists of a compression type carbon pile rheostat with an integral series switch in a circuit with series resistances. Switch opens when arrow on knob is turned to OFF. Clockwise rotation of knob closes switch to complete the circuit, and compresses carbon pile to gradually increase the load.

Connections to load bank switch circuit are normally made to whichever LOAD BANK binding posts correspond to voltage of battery. The + COM binding post of the ammeter circuit is directly connected internally to the COM binding post of the load bank switch circuit for convenience when measuring load current. The COM binding post is the negative (-) binding post of the LOAD BANK circuit, but is not marked (-) on the panel because being close to the + COM binding post, the two posts might be accidentally connected across a circuit, or a battery. Load current during "duty cycle" may be as much as 100 amperes through load resistors.

3-5. **FIELD RHEOSTAT.** Field rheostat is a wire-wound power type, variable resistance which opens the circuit when turned to OPEN position. Clockwise rotation decreases its resistance. Field rheostat is connected in series with field circuit of dc generator for manual control of generator output. The field rheostat will carry up to 15 amperes direct current.

Connections to field rheostat are made to FIELD RHEOSTAT binding posts. See paragraphs 4-12, -13, -14 for use of field rheostat.

3-6. **FIXED RESISTANCE 0.25 OHM.** A separate fixed 0.25 ohm resistance is inside tester with two binding posts on panel. It will carry up to 10 amperes of direct current.

Connections to fixed resistor are usually made when checking or adjusting voltage regulators. Fixed resistor is connected in series with battery. See applicable Instruction Manuals for connections and procedures.

3-7. **EXTERNAL SHUNT 500 AMP.** External shunt element is increased in a two-piece rubber cover, and has attached to it two short

heavy leads with heavy clips. Two long light leads with pin plugs, also attached to the shunt, must be connected to the EXT. SHUNT binding posts on the panel.

Connect heavy clips in series in the circuit where current is to be measured, observing polarity (red to positive (+), and black to negative (-) side of the circuit). Connect tip plugs to EXT SHUNT 500 AMP binding posts observing polarity.

SECTION IV

STARTER AND CHARGING CIRCUIT TESTS

4-1. The test lead connections given in the following tests are for circuits where negative post of battery is grounded (negative ground). When positive post of battery is grounded, reverse test lead clips of ammeter and voltmeter for correct indication.

4-2. BATTERY CELL VOLTAGE. Fasten red tip plug in VOLTMETER + COM binding post, and black tip plug in VOLTMETER -10V binding post. Connect red test lead clip to + (positive) post of battery and make connection with black test lead clip to strap between cells to read voltage of a single cell. Read cell voltage; crank engine with ignition off and read cell voltage again while starter is cranking engine. Cell voltage with starter running should be 1.7 volts. Repeat the test with test leads connected across the other cells. A difference of more than 0.2 volt between cells will indicate that the lowest reading cell is bad, however, reserve judgment of battery condition until after starter motor cranking current has been checked (paragraph 4-5).

4-3. STARTER CIRCUIT VOLTAGE LOSS (INSULATED CIRCUIT). For negative ground circuits, connect red voltmeter test lead clip to insulated (not grounded) battery post and connect black voltmeter test lead clip to cable post on starter. For positive ground circuits interchange voltmeter test lead clips. Voltage of battery determines which voltmeter range to use. Pointer will show battery voltage, and then drop while engine is being cranked to show desired insulated circuit reading, which is the voltage loss, across battery cables and solenoid switch contacts. High voltage loss means high resistance in the circuit. While starter is

cranking engine the reading should not be more than 0.3 volt for starting circuits having two cables and one switch. If reading is too high clean and tighten connections or replace defective cables. The cables may be tested separately by connecting the voltmeter test lead clips across one cable at a time and then cranking the engine. Change to a lower voltmeter scale for a better indication. A 0.1 to 0.2 volt loss is allowed for the cables in 6-volt systems. In 12-volt and higher voltage systems the loss may be twice as much. A short length of cable (or a strap) should show no voltage loss. See manufacturer's specifications for voltage loss (voltage drop) allowable.

4-4. STARTER CIRCUIT VOLTAGE LOSS (GROUND CIRCUIT). For negative ground circuits, connect red voltmeter test lead clip to body of starter, and black voltmeter test lead clip to grounded post of battery. For positive ground circuits interchange voltmeter test lead clips. Crank engine and read voltmeter using IV scale. Reading should not be more than 0.1 volt.

4-5. STARTER MOTOR AMPERAGE DRAW. Connect tip plugs of external shunt to EXT SHUNT 500 AMP binding posts observing polarity. Disconnect battery cable from starter terminal (or from starter solenoid switch terminal if more convenient) and clip red heavy test clip of external shunt to battery cable. Clip black heavy test clip to starter terminal (or starter solenoid terminal). With ignition off, crank engine and read amperage draw of starter on 0 to 500 scale. If amperage is low the circuit may have excessive voltage loss (high resistance) or battery may be defective.

4-6. IGNITION PRIMARY CIRCUIT VOLTAGE LOSS. Slowly crank engine with ignition switch off until ignition breaker points are closed. For negative ground circuits, connect red voltmeter test lead clip to insulated positive post of battery and black voltmeter test lead clip to "battery" terminal of ignition coil. Voltmeter should read only a few tenths of a volt. Change to IV voltmeter range for more accurate reading. For positive ground circuits interchange voltmeter test lead clips. Normally the voltmeter should not read more than 0.2 volt. Return voltmeter to higher range and turn ignition switch off and on several times. Voltmeter should read the same each time switch is turned on. If voltmeter reading exceeds 0.2 volt, isolate the trouble by clipping

the test leads across each wire and each connection in turn. The reading across a connection should be zero. If trouble is not found move red voltmeter test lead clip to "distributor" terminal of ignition coil and black voltmeter test lead clip to terminal of distributor to check wire to distributor. Then move clips to distributor terminal and ground to check internal circuit of distributor.

4-7. D. C. CHARGING SYSTEM TYPES. There are two types of dc charging systems which are referred to as Type A and Type B. The generators and voltage regulators of the two systems have different electrical circuits and are therefore not interchangeable.

In a Type A system the generator has one wire of its field winding connected internally to the armature terminal. To complete the circuit the other wire which is connected to the field terminal is connected externally through the voltage regulator contacts to ground.

In a Type B system the generator has one wire of its field winding connected internally to the frame (ground). To complete the circuit the other wire which is connected to the field terminal is connected externally through the voltage regulator contacts to the armature.

4-8. GENERATOR POLARITY. The dc generator will build up voltage in either direction depending on the polarity of the residual magnetism in the pole shoes. After a generator has been repaired it should be polarized before starting the engine.

Type A generators are polarized by momentarily touching a jumper lead between the battery terminal ("B" or "BAT") and the armature terminal ("A" or "GEN") of the voltage regulator.

Type B generators are polarized by disconnecting the field lead from the field terminal ("F" or FIELD") of the voltage regulator and momentarily touching it to the battery terminal ("B" or "BAT") of the voltage regulator.

4-9. FINDING "BY" TERMINAL OF VOLTAGE REGULATOR. With engine not running battery voltage should appear at only one terminal of the voltage regulator--the "B" (or "BAT") terminal.

4-10. FINDING TYPE OF CHARGING SYSTEM. Disconnect battery wire from "B" terminal of voltage regulator. Clip red ammeter test lead (+ COM) to "B" terminal of

voltage regulator and black ammeter test lead (-50A) to disconnected battery wire (with negative ground system).

Disconnect field wire of generator from "F" (or "FIELD") terminal of voltage regulator. Using test leads connected to FIELD RHEOSTAT binding posts, clip one test lead to lug of removed field wire and the other test lead to a good ground ("F" terminal of voltage regulator is unconnected.).

Start engine and run at about 1500 rpm. Turn FIELD RHEOSTAT knob full clockwise. If D. C. AMMETER shows a reading the charging system has a Type A electrical circuit. If D. C. AMMETER does not show a reading, remove the test lead from the ground connection and clip it to the "A" (or "GEN") terminal of the voltage regulator (the other test lead remains clipped to the field wire). If D. C. AMMETER now shows a reading, the charging system has a Type B electrical circuit.

4-11. GENERATOR INSPECTION. The generator should be visually inspected before making electrical tests. Inspect generator for loose bearings, worn brushes, burned commutator, loose connections, and loose fan belt.

4-12. GENERATOR OUTPUT CURRENT. Disconnect battery wire from "B" terminal of voltage regulator. Using ammeter test leads connect "B" terminal to + COM binding post of ammeter (if negative post of battery is grounded), and connect battery wire to -100A binding post of ammeter. For a positive ground circuit interchange heavy ammeter clips.

Connect one FIELD RHEOSTAT test lead clip to field terminal ("F") of generator, and the other test lead clip to ground if charging system is a Type A (field winding externally grounded), or to Armature terminal ("A") of generator if charging system is Type B (field winding internally grounded). Start the engine and increase speed to approximately 1700 rpm. Turn FIELD RHEOSTAT clockwise to increase generator output until ammeter reads 1-1/2 times the rated output of the generator. Turn FIELD RHEOSTAT to OPEN position immediately.

CAUTION

Do not run generator overloaded for more than 5 seconds.

4-13. CHARGING CIRCUIT VOLTAGE LOSS (INSULATED CIRCUIT). With ammeter and field rheostat connected as in paragraph 4-12 adjust engine speed and FIELD RHEOSTAT until ammeter indicates 20 amperes. If circuit has negative ground clip red voltmeter test lead to "A" terminal of generator, and black voltmeter test lead to positive post of the battery. If positive post of battery is grounded interchange voltmeter test lead clips. The voltmeter should not read more than 0.8 volt. Change negative test lead tip plug to a lower voltage binding post to read voltage more accurately.

4-14. CHARGING CIRCUIT VOLTAGE LOSS (GROUND CIRCUIT). With engine running and ammeter indication 20 amperes as in paragraph 4-13 clip red voltmeter test lead to grounded post of battery (with negative ground) and black voltmeter test lead to the generator frame. The voltmeter should not indicate more than 0.1 volt. If positive post of battery is grounded interchange voltmeter test lead clips.

4-15. VOLTAGE REGULATOR AND OTHER TESTS. For procedures to use when testing voltage regulators, and other electrical components of the engine, refer to the applicable voltage regulator or engine Instruction Manuals.

SECTION V

MAINTENANCE

5-1. CLEANING. Meters have plastic windows. Clean windows with soft cloth; do not scratch plastic. Clean panel and control knobs. Keep cables clean, and brush corrosion from battery clips. Inside the tester, keep insulating strips, resistance elements, and carbon pile plates free of dirt.

5-2. INSPECTION. Check control knob pointer indexing periodically and tighten control knobs if necessary. Check that pointers of meters are not damaged and can be zeroed. See that all component mounting screws, binding posts, and electrical connections are tight.

5-3. SERVICING. For access to all the internal components remove the nine slotted hexagon washer head, machine screws, (four on top of panel, three in front and two under case) securing panel assembly to case, and remove panel assembly from case. When servicing is required refer to electrical schematic diagram and illustrations to identify components.

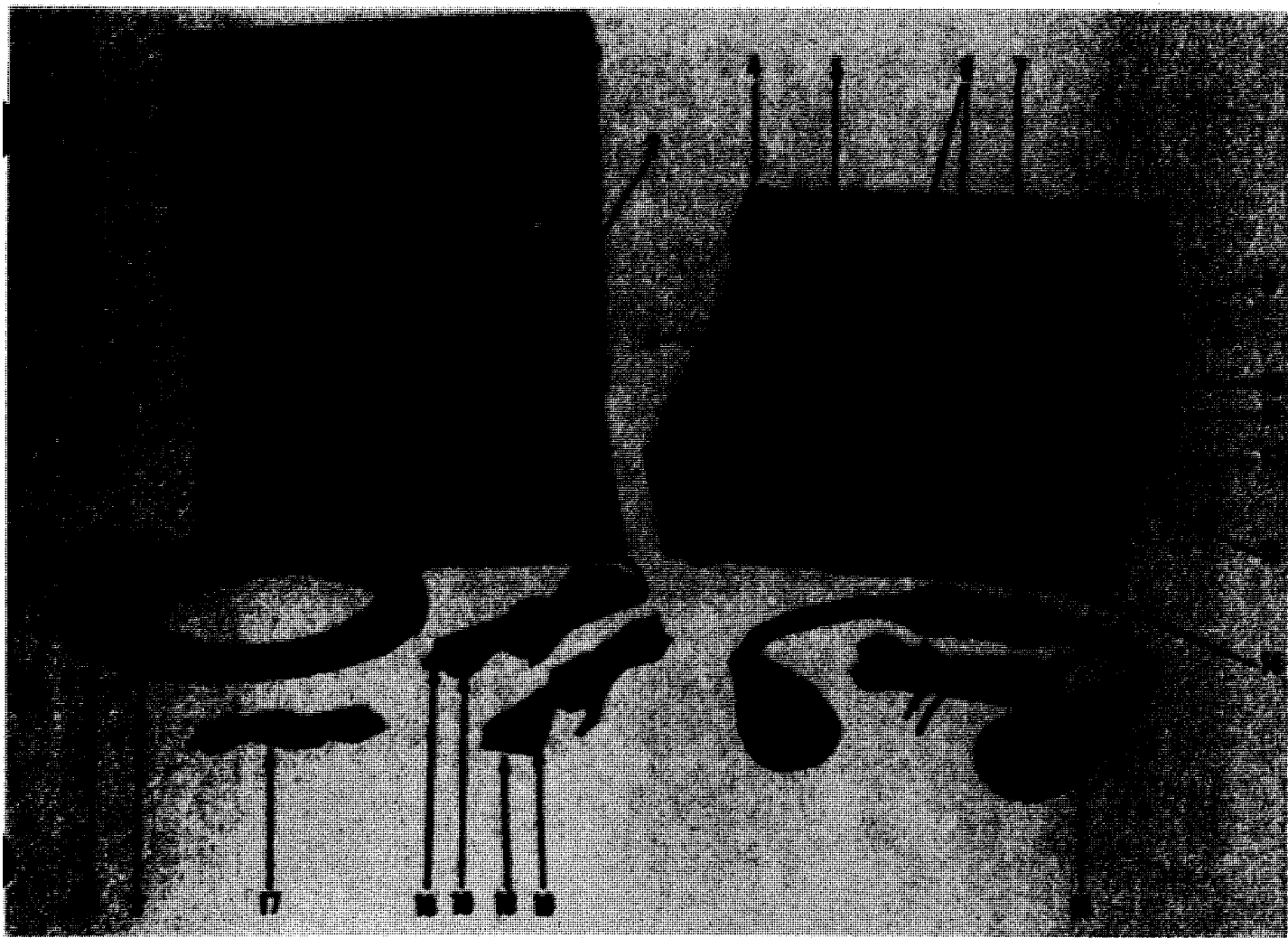


Figure 3. Cover Removed, Showing Storage Compartment and Cables

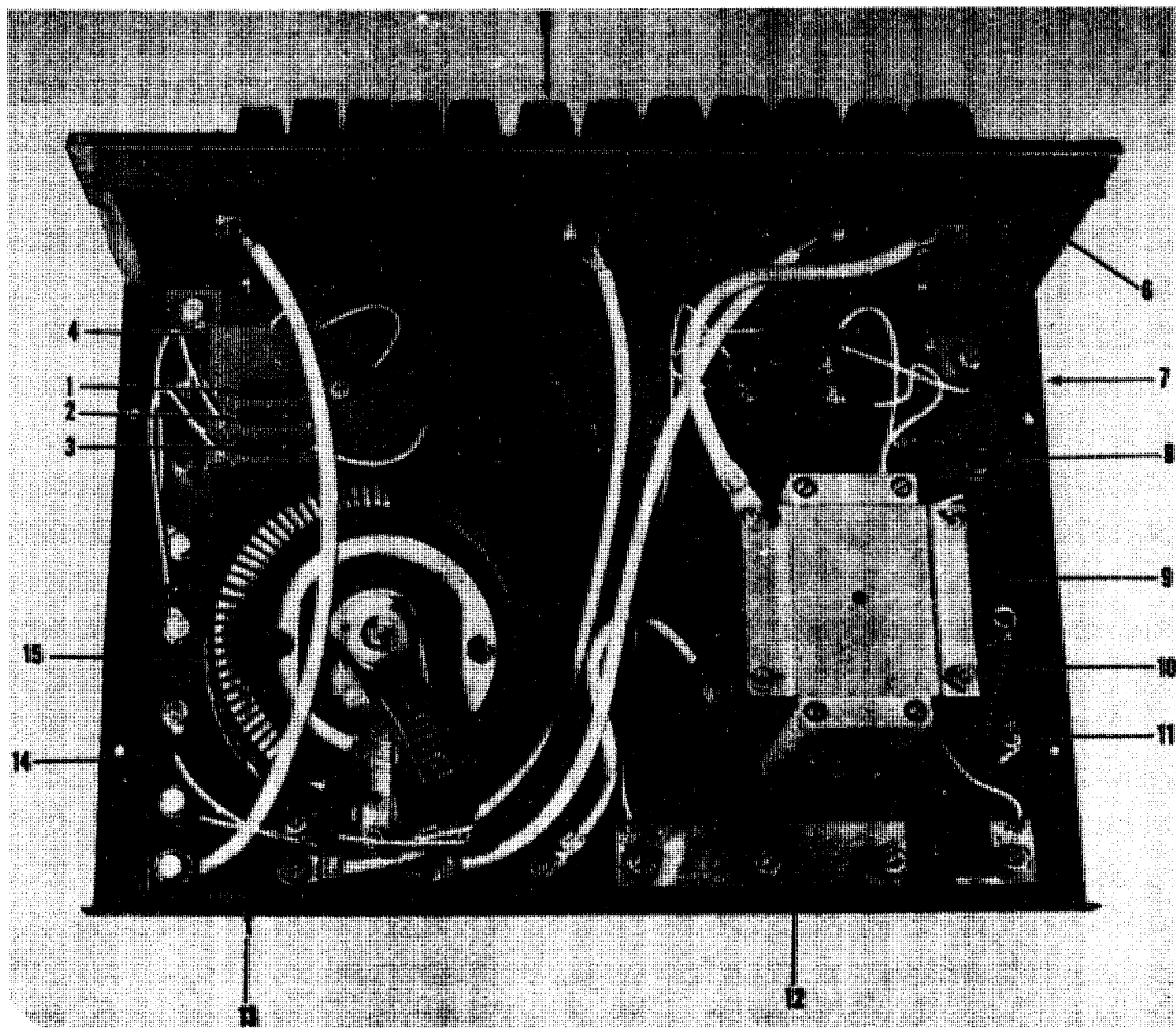


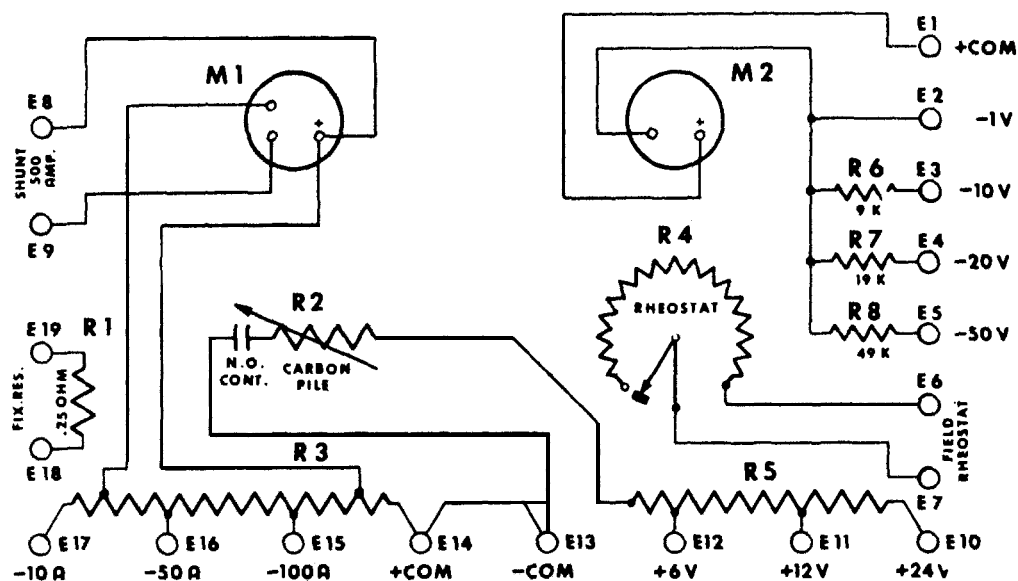
Figure 4. Control Panel, Rear View

SECTION VI

PARTS LIST

FIG. & INDEX NO.	SUN PART NO.	DESCRIPTION	REF. SYMBOL	QUANTITY PER TESTER
3-	Model LVR-3A	LOW VOLTAGE CIRCUIT TESTER		1
3-1	7020-370	. COVER, Case		1
3-2	1409-506	. LATCH ASSY.		1
3-3	6002-089	. LEAD, TEST, Ammeter, Black		1
3-4	7020-381	. CASE, Steel		1
3-5	678-311	. AMMETER, D.C.	(M1)	1
3-6	7033-009	. GASKET, RUBBER		2
3-7	676-310	. VOLTMETER, D. C	(M2)	1
3-8	777-514	. KNOB, Carbon Pile		1
3-9	758-119	. KNOB, Rheostat		1
3-10	828-504	. POST, BINDING, 10 Amp.	(E1-E9)	9
3-11	828-503	. POST, BINDING, 100 Amp.	(E10-E19)	10
3-12	400-106	. WASHER, FIBER, 25/64" O. D. , 1/32" thick .		38
3-13	400-227	. WASHER, FIBER, 9/16" (O. D. , 1/16" thick .		19
3-14	1489-4	. RUBBER FOOT		4
3-15	6002-093	. SHUNT, EXTERNAL, 500 Amp		1
3-16	6002-090	. LEAD, TEST, Ammeter, Red		1
3-17	6002-088	. LEAD, TEST, Jumper		1
3-18	6002-091	. LEAD, TEST, Voltmeter, Black		2
3-19	6002-092	. LEAD, TEST, Voltmeter, Red		2

FIG. & INDEX NO.	SUN PART NO.	DESCRIPTION	REF. SYMBOL	QUANTITY PER TESTER
4-1	670-209	. RESISTOR FIXED, 49K, 1/2W, 1/2%.	(R8)	1
4-2	670-210	. RESISTOR FIXED, 19K, 1/2W, 1/2%.	(R7)	1
4-3	670-211	. RESISTOR FIXED, 9K, 1/2W, 1/2%.	(R6)	1
4-4	7008-084	. TERMINAL BOARD		1
4-5	684-404	. RESISTOR, FIXED, Ribbon	(R5)	1
4-6	7031-050	. ASBESTOS PANEL		1
4-7	7020-496	. PANEL, Case		1
4-8	7031-047	. INSULATOR STRIP, 4-hole		1
4-9	7036-018	. CARBON PILE ASSY	(R2)	1
4-10	684-378	. RESISTOR, FIXED, W. W. , 0.25 Ohm	(R1)	1
4-11	2179-2	. TERMINAL STUD		6
4-12	7035-010	. SHUNT, Ammeter	(R3)	1
4-13	7031-048	. INSULATOR STRIP, 8-hole		1
4-14	7031-049	. INSULATOR STRIP, 7-hole		1
4-15	389-057	. RESISTOR, VARIABLE, W. W. , 70-Ohm	(R4)	1



Ref. Symbol	Description	Ref. Symbol	Description
E1-E9	Binding Post, 10-Ampere	R3	Ammeter Shunt, tapped, 100A max.
E10 -E19	Binding Post, 100-Ampere	R4	Rheostat, WW, 0-70 ohms, 15A max.
M1	DC Ammeter, 0-500A	R5	Resistance Ribbon, tapped, 100A max.
M2	DC Voltmeter, 0-50V	R6	Resistor, Fixed, MF, 9000 ohms, 1/2w
R1	Resistance Wire, 0.25 ohm, 10A max.	R7	Resistor, Fixed, MF, 19000 ohms, 1/2w
R2	Carbon Pile Rheostat, 100A max.	R8	Resistor, Fixed, MF, 49000 ohms, 1/2w

F i g u r e 5 . Electrical Schematic Diagram

INSTRUCTIONS FOR REQUISITIONING PARTS NOT IDENTIFIED BY FSN

When Requisitioning parts not identified by Federal Stock Number, it is mandatory that the following information be furnished the supply officer:

1. Manufacturer's Federal Supply code number:
2. Manufacturer's part number exactly as listed herein.
3. Nomenclature exactly as listed herein, including dimensions if necessary.
4. Manufacturer's model number:
5. Manufacturer's serial number (end item).
6. Any other information such as type, frame number, and electrical characteristics, if applicable.
7. If DD Form 1348 is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-50.

Complete form as follows:

- a. In blocks 4, 5, and 6, list manufacturer's Federal Supply code number: _____ followed by a colon and manufacturer's part number for the repair part.

- b. Complete Remarks field as follows:

Noun: (nomenclature of repair part).

For: FSN _____

Mfr: _____

Model: _____

Serial: (of end item).

Any other pertinent information such as frame number, type, dimensions, etc.

RECOMMENDATIONS FOR PUBLICATION IMPROVEMENTS

Reports of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028

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Seventh USA (5)	29-500 (DA-DD)
Eighth USA (5)	55-500 (GF)
Corps (2)	

NG: None

USAR: None

For explanation of abbreviations used, see AR 320-50.

Change }
No. 1 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D. C., *11 April 1973*

Operator's Manual
TEST SET GENERATOR AND VOLTAGE REGULATOR,
AUTOMOTIVE: 12-AND 24-VOLT SYSTEMS
(SUN ELECTRIC, MODEL LVR-3A)
(4910-092-9136)

(Current as of 27 February 1973)

TM 9-4910-489-10, 22 May 1969, is changed as follows:
Page 1. Paragraph 1-5 and 1-6 are added as follows:

1-5. Reporting of Errors

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forward direct to Commander, US Army Weapons Command, ATTN: AMSWE-MAS, Rock Island, IL 61201.

1-6. Parts included with End Item

Parts included with end item and considered a component or part of item configuration are

listed in the following table. All items are manufactured by the SUN ELECTRIC COPR (Manufacturer's Code 82386).

<i>PART</i>	<i>PARTNUMBER</i>
LEAD, TEST Ammeter, black	6002-089
LEAD, TEST: Ammeter, red	6002-090
LEAD, TEST Jumper	6002-088
LEAD, TEST: Voltmeter, black	6002-091
LEAD, TEST Voltmeter, red	6002-092
SHUNT, EXTERNAL: 500 amp	6002-093

Page 12. Delete the last paragraph "RECOMMENDATIONS FOR PUBLICATION IMPROVEMENTS."

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LOGCOMD (3)
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Seventh (5)
Eighth (5)

Div (2)
Bde (1)
Regt/Gp(1)
Bn(1)
Co/Btry(1)
USAECFB (2)
TEAD (16)
LEAD (2)
LBAD (1)
4th USASA Fld Sta (1)
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10-500 (EE)
29-500 (DA-DD)
55-500 (GF)

ARNG & USAR: None.

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

* U.S. GOVERNMENT PRINTING OFFICE :1987 O-181-421 (60318)

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