TM 11-6125-239-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, GS,

AND DEPOT MAINTENANCE MANUAL

MOTOR-GENERATOR

PU-544/A

This copy is a reprint which includes current pages from Changes 1 through 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

AUGUST 1964

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Serious injury or death may result from contact with the output circuit of Motor-Generator PU-544/A. Be extremely cautious when working with the equipment.

DON'T TAKE CHANCES!

CHANGE

No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 1 June 1983

ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL MOTOR GENERATOR PU-544/ A (Leland) (NSN 6125-00-985-7950) PU-544A /A (Bendix) (NSN 6125-00-119-4563)

TM 11-6125-239-15, 17 August 1964, is changed as follows:

1. Title of the manual is changed as shown above.
2. New or revised material is indicated by a vertical bar in the margin. Where an entire chapter, section, or illustration is added or revised, the vertical bar is placed opposite the identification number and title.
3. Remove old pages and insert new pages as follows:

Remove pages	*Insert pages*
None	A/(B blank)
l through 6	.l through 6
9 and 10	9and10
15 and 16	15 through 22
24. l through 34.3	.24.1 through 34.7/(34.8 blank)
37 through 42	37 through 42
45, 46 and 47	.45,46 and 47/(48 blank)
49/(50 blank)	None
51/(52 blank)	None
55	55/(56blank)
57 through 60	57 through 60. 1/(60.2 blank)
63	.63/(64 blank)
None	.64.1 /(64.2 blank) and 64.3/(64.4 blank)
65	.65/(66 blank)

4. File this change sheet in front of the publication.

By Order of the Secretary of the Army

EDWARD C. MEYER
General United States Army
Chief of staff

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Major General, United States Army
The Adjutant General

DISTRIBUTION:

To be distributed in **accordance with DA Form 12-36 Organizational Maintenance requirements for PU-544 /A.**

CHANGE No. 2

HEADQUARTERS
DEPARTMENT' OF THE ARMY
WASHINGTON, D, C., *14 September* 1970

Organizational, DS, GS, and Depot Maintenance. Manual

MOTOR GENERATOR PU-544/A

TM 11–6124-239-15, 17 August 1964, is changed as follows:

1. Remove and insert pages as indicated in the page list below.

Remove pages-	Insert pages
3 through 6	3 through 6
9 through 24	9 through 24.2
29 through 34	29 through 34.2
39 through 44	39 through 43
51 and 52	51 and 52
52.1 through 52.4	52.1 through 52.3
55 and 56	5 5
59 through 66	59 through 65

2. File this change sheet in the front of the manual for reference purposes.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Armv,
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Offical:

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Distribution:

To be distributed in accordance with DA Form 12-36 (qty rqr block #377) operator and crew maintenance requirements for all fixed and rotor wing aircraft.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *21 December 1965*

Organizational, DS, GS, and Depot Maintenance Manual

MOTOR-GENERATOR PU-544/A

TM 11–6125-239-15, 17 August 1964, is changed to add technical information and component nomenclature.

1. The title of the manual is changed as shown above.
2. Remove old pages and insert new pages as indicated below.

Remove pages-	Insert Pages-
2-4	2-4.
9-10	9-10.
13-14	13-14.
23-24	23-24.
27-30	27-30.
43-44	43-44.
47	47.
	52.1-52.3
55-60	55-60

3. Retain this transmittal sheet in the front of the manual for future reference.

By Order of the secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:
To be distributed in accordance with DA Form 12–36 requirements for Operator and Crew (Unclas) Maintenance Literature to all Fixed-Wing and Rotor Wing Aircraft accounts (2 copies) each).

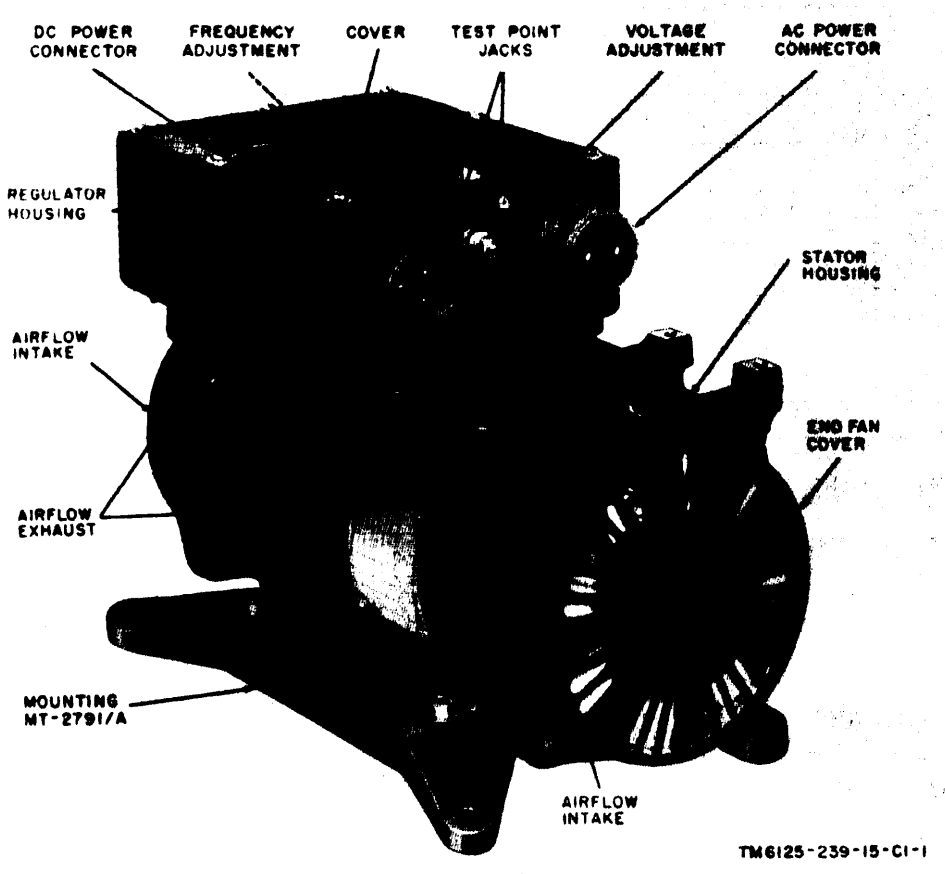


Figure 1. Motor-Generator PU-544/A on Mounting MT-2791/A

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1 DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2 IF POSSIBLE , TURN OFF THE ELECTRICAL POWER

3 IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL

4 SEND FOR HELP AS SOON AS POSSIBLE

5 AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

TECHNICAL MANUAL
No. 11-6125-239-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D. C., 17 August 1964

MOTOR-GENERATOR
PU-544/A (LELAND) (NSN 61 25-00-985-7950)
PU-544A /A (BENDIX) (NSN 6125-00- 119-4563)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help 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-Electronics Command and Fort Monmouth, ATTN: DRSEL-ME-MP, Fort Monmouth, New Jersey 07703. In either case, a reply will be furnished direct to you.

Figure 1. Motor Generator PU-544/A on Mounting MT-2791/A.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This manual describes Motor-Generator PU-544/A (fig, 1). Chapters 1, 2, and 3 provide information on operation and organizational maintenance, which includes cleaning, inspection of the equipment, and replacement of parts available to organizational maintenance. Chapters 4 through 6 include instructions applicable to direct and general support maintenance for troubleshooting, testing, repairing the equipment, and replacing maintenance parts. It also lists tools, materials, and test equipment, replacing maintenance parts. It also lists tools, materials, and test equipment for each category of maintenance. Detail functions of the equipment are covered in chapter 4.

2. Consolidated Index of Army Publications and Blank Forms

Refer to the latest issue of DA Pam 310-1 to determine whether there are new editions, changes or additional publications pertaining to the equipment.

3. Reports of Maintenance Forms, Records, and and Reports

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

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55 /NAVMATINST 4355.73 A/AFR 400-54/MCO 4430.3F.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 /NAVSUPINST 4610.33 C/AFR 75-18/MCO P461O.19 D/DLAR 4500.15.

3.1. Administrative Storage

Administrative Storage of equipment issued to and used by Army activities will have preventive maintenance performed in accordance with the PMCS charts before storing. When removing the equipment from administrative storage the PMCS should be performed to assure operational readiness. Disassembly and repacking of equipment for shipment or limited storage are covered in paragraphs 71 and 72.

3.2. Destruction of Army Electronics Materiel

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

3.3. Reporting Equipment Improvement Recommendations (EIR)

If your motor generator PU-544/A needs improvement, 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 why you do not like 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 Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703. We'll send you a reply.

Section II. DESCRIPTION AND DATA

4. Purpose and Use

a. *Purpose.* Motor-Generator PU–544/A (inverter) is a motor-driven inverter which converts the 28 volts direct current (dc) from the aircraft power supply to 116 volts, 400 cycles per second (cps) alternating current (at), single phase, or to 115/200 volts, 400 cps, three phase. The output of the inverter can be connected for either three-phase or single-phase operation, but not both at the same time.

b. *Use.* The inverter is used to supply alternating current to those items of the aircraft configuration which require ac power for operation.

5. Technical Characteristics

Voltage input	28 volts dc.
Current input	59.5 ampares
Voltage output, three-phase	115/200 volts ac.
Voltage output, single-phase	115 Volts ac.
Power output	750 volts-amperes
Frequency output	400 cycles per second.
Power factor	0.80 lag to 0.95 lead.
Operating speed	12,000 revolutions per minute.
Altitude range	0 to 66,000 feet.
Input phase rotation	A, B, C.
Surrounding temperature range	-55° to +85° C.
Weight (maximum)	25lb.

6. Components

(fig. 1)

The components of the inverter are listed in the basic issue items list (app. III).

7. Description

(fig. 1)

The inverter is a self-contained unit consisting of a static voltage and frequency regulator (a *below),* and a rotating section (b below).

a. Voltage and Frequency Regulator. The voltage and frequency regulator is housed in a rectangular metal box (regulator housing) permanently attached to the top of the stator housing of the inverter. The top of the regulator housing of the inverter. The top of the regulator housing is a cover which can be removed for inspection of the regulator by loosening the eight screw fasteners (three to each side and one on the center front and back). The power input and output are connected to the inverter through the ac and dc power connectors located on the tint of the regulator housing. (Refer to the applicable aircraft technical manual.) Also provided on the front of the regulator housing are two test point jacks for checking the ac output. The externally accessible voltage adjustment resistor is provided to permit manual setting of the output voltage. The frequency adjustment resistor provided to permit manual setting of the output frequency is mounted on the power circuit board assembly and is accessible by removing the cover. For inverters using 4B93-1-A regulator, all components are located on a single printed wiring board. To gain access to the frequency adjustment resistor, the 4B93-1-A regulator must be removed from its mounting spacers and flipped over to the component side.

b. Rotating Section. The rotating section of the inverter is contained in a heavy metal frame which is the stator housing. The inverter mounting plate is a fixed part of the bottom of the stator housing, and it has four holes *for* attaching the inverter to the aircraft mounting. A removable fan cover on each end of the inverter gives access for inspection of the rotating parts. Both end fan covers are slotted to provide an airflow through the rotating section for cooling. The airflow intake is through the end fan covers, and the airflow exhaust is through the end fan covers, and the airflow exhaust is through the vent screens on the regulator housing and the rotating section. Four electrical brush holders are installed on the ac end, with the brush caps external for checking and replacement of the ac brushes.

c. *Additional Equipment Required.*

(1) A 28-volt dc power source is required co supply the input power to the inverter.

(2) Inverter Mounting Plate MT-2791/A may be required for installation in some aircraft.

CHAPTER 2

INSTALLATION AND OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

8. Unpacking

(fig. 2)

a. Packaging Data. When packed for shipment, the inverter is mounted on a mounting board and placed in a cardboard carton. It is further protected with a side liner and top liner. The inverter consists of a single unit 8.0 inches high, 11.20 inches deep, 5.5 inches wide, and weighs 23 pounds.

b. Removing Contents. Perform the procedures given below when unpacking the equipment from the cardboard carton.

(1) Open the cardboard carton.
(2) Remove the side liner.
(3) Lift the inverter and mounting board from the cardboard carton.
(4) Remove the four stove bolts that attach the inverter to the mounting board, and remove the inverter.

9. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6 (para 3).

b. See that the equipment is complete as listed on the packing slip. If the packing list is not available, check the equipment against the basic issue item list (appx III). Report all discrepancies in accordance with TM 38-750. Shortage of a minor assembly or part that does not affect the proper functioning of the equipment should not prevent use of the equipment.

c. If the equipment has been used or reconditioned, see whether it has been changed by a modification work order (MWO). If the equipment has been modified, the MWO number will appear near the nomenclature plate. Check to see whether the MWO number (if any) and the appropriate notations concerning the modification have been entered in the equipment manual.

Note: Current MWO'S applicable to the equipment are Iisted in DA Pam 310-1.

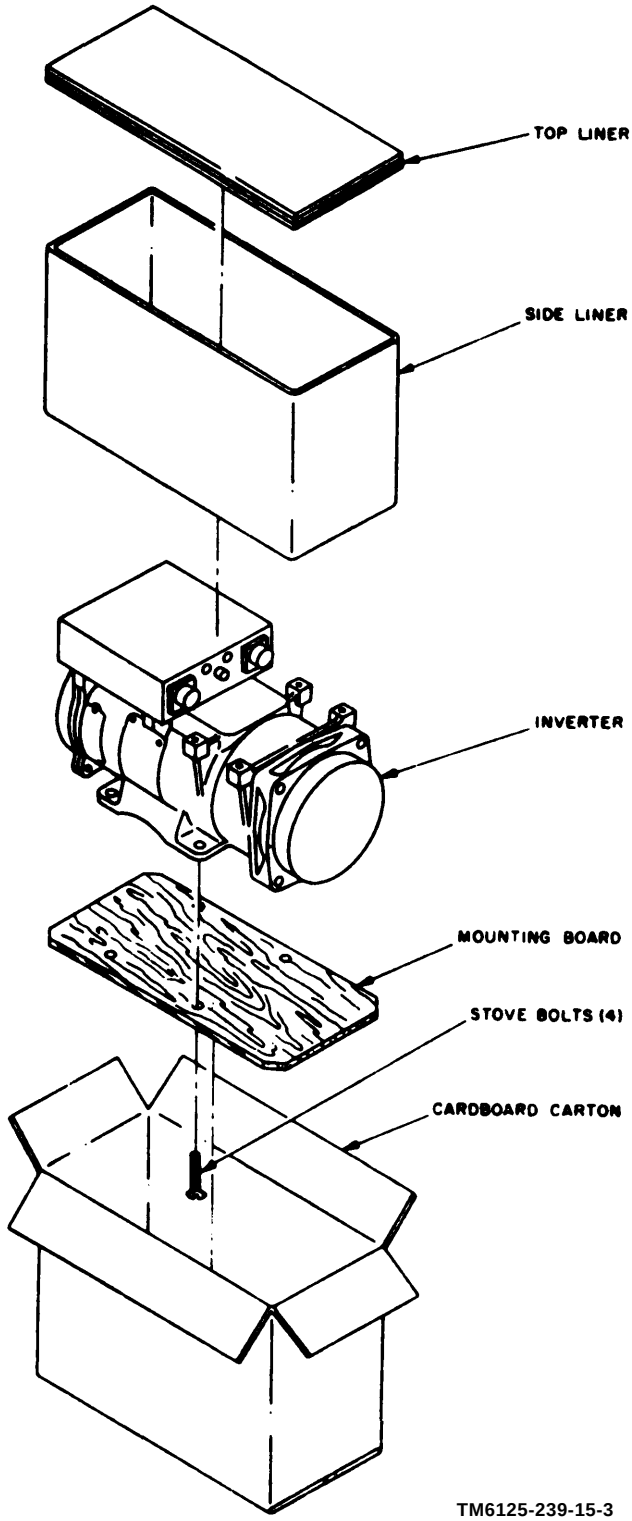


Figure 2. Typical packaging diagram.

Section II. OPERATIONAL PROCEDURES

10. General

a. The inverter must be energized before use and deenergized after use; no other operation is required. The inverter contains no on-off switch; it is energized automatically when the aircraft 28 volts dc is applied and deenergized when the 28 volts dc is removed. No warmup is required before use. The input and output power is routed through other circuits of the aircraft in which the inverter is installed. Refer to the applicable aircraft technical manual for the proper switching sequence for operating the inverter, and to *b* below for connecting the inverter output as required.

b. The following is a list of connections required at ac connector J2 (fig. 1) to provide the various outputs of the inverter.

Required ac volts	Ac power connector J2	
	Connection	Output
115, single phase		A-D
115, three phase	D to B, E to C, and F to A (delta).	A-II-C
115/200, three phase.	Band F to D (wye).	A-E (200 vat) C-D (115 vat) A-C (200 vat) E-D (115 vat) E-C (200 vat) A-1) (115 vat)

11. Starting and Stopping Procedures

a. Starting. Turn on the necessary aircraft switches and circuit breakers to apply the 28 volts dc to energize the inverter. The inverter should start.

Caution: After starting the inverter, visually check for smoke or any other sign of malfunction. If any malfunction is noted, immediately remove the 28 volts dc from the inverter *(b* below).

b. *Stopping.* Turn off the necessary aircraft switches to remove the 28-volt dc from the inverter.

12. Preflight Operational Check

Note: To prevent drain on the aircraft batteries, use an external power source to make the operational check. (Refer to the applicable aircraft technical manual.)

a. General. The operational check (b below) supplements the inspection procedures in the aircraft operator's condensed checklist. The operator's inspection consists of checking the inverter for serviceability by performing an operational check. The checks listed should be accomplished before the flight The pilot or copilot should report any malfunction or failure noted during flight, or any discrepancy noted in the preflight check. Refer to TM 38-750 for reporting deficiencies or malfunctions.

b. Operational Check. The following preflight checks should be made during engine warmup as an extension of the ground tests in the applicable aircraft operator's condensed checklist. The pilot or copilot should perform the checks in the order given.

(1) Start the inverter (para 11). If the aircraft in which the inverter is installed is equipped with panel meters for reading the ac voltage and frequency, check the output of the inverter on the meters. (Refer to the applicable aircraft technical manual.) If the inverter is performing satisfactorily, the voltmeter will read between 109 and 121 volts ac, and the frequency meter will read between 390 and 410 cps. Vary the load from no load to full load by turning on the aircraft equipment that operates from the ac supplied by the inverter. (Refer to the applicable aircraft manual.) The voltage indicated on the voltmeter should not vary more than 1-1/2 volts, and the indicated frequency variation should be less than 6 cps .

(2) If no ac panel meters are installed

in the aircraft, check to see that the inverter is running by listening to the motor. Turn on any aircraft equipment that operates from the ac supplied by the inverter and check to see that the equipment is operating. (Refer to the applicable aircraft technical manual.) Turn off the necessary aircraft switches to stop the inverter.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTION

Section I. ORGANIZATIONAL MAINTENANCE

NOTE

The pilot will not perform preventive or corrective maintenance.

13. Scope of Organizational Maintenance

The maintenance duties assigned to the organizational maintenance repairman of the inverter are listed below, together with a reference to the paragraphs covering the specific maintenance function, The duties include inspection, testing, servicing, and removal and replacement instructions for performing preventive maintenance services. The required tools and test equipment allocated at organizational maintenance are indicated in paragraph 14.

(2.) Preventive maintenance (para 15).

b. Intermediate preventive maintenance checks and services (para 16).

c. Intermediate preventive maintenance checks and services chart (para 17).

d. Cleaning and painting (para 18).

e. Periodic preventive maintenance checks and services (para 19).

f. Periodic preventive maintenance checks and services chart (para 20).

g. Lubrication (para 21).

h. Organizational troubleshooting chart (para 22).

i. Removal and replacement of inverter (para 23).

j. Adjustments (para 26).

i. Removal and replacement of inverter (para 23.

14. Tools, Test Equipment, and Materials Required

a. Tools. All the tools required for organizational maintenance of the inverter are contained in Tool kit, Electronic Equipment TK-101/G.

b. Test Equipment. The only items of test equipment required are Multimeter AN/URM–*105* and Test Set, Electrical Power AN/UPM–93. For operation of the multimeter and test set, refer to TM 11–6625–203–12 and TM 11–6625–303-12, respectively.

c. Materials. The materials required for maintenance consist of a cleaning cloth, fine sandpaper (No. 000) a soft-bristled brush, and trichlorotrifluoroethane.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of 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 dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician.

Section II. MAINTENANCE INSTRUCTIONS

15. Preventive Maintenance

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

sibility of all maintenance categories concerned with the equipment and includes the inspection, testing, and repair or replacement of parts or units that inspection and tests indicate would probably fail before the next scheduled service period. Preventive maintenance checks and services of the inverter at the organizational level are made at intermediate and periodic intervals unless otherwise directed by the commanding officer. The maintenance checks and services should be performed concurrently with the inspection schedules of the aircraft.

a. *Systematic Care*. The procedures given in paragraphs 16 through 20 cover systematic care essential to proper upkeep and operation of the equipment. The cleaning operation (para 18) should be performed before operating the equipment after any extended shutdown.

b. preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (para 17 and 20) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist the organizational repairman in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *References* column lists the illustrations, paragraphs, or manuals that contain additional information. If the defect cannot be remedied by the organizational maintenance repairman, a higher category of 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.

c. Maintenance Forms and Records. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750. Paragraph 3 contains additional information concerning submission of specific forms.

16. Intermediate Preventive Maintenance Checks and Services

Perform the maintenance functions in the intermediate preventive maintenance checks and services chart (para 17) once each intermediate interval. An intermediate interval is defined as approximately 25 flying hours. The intermediate preventive maintenance checks and servives should be performed concurrently with the intermediate preventive maintenance checks and services scheduled on the aircraft in which the equipment is installed. Adjustments 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 intermediate maintenance performed on it at least once every 30 days. Equip ment in limited storage (requires service before operation) does not require intermediate maintenance.

17. Intermediate Preventive Maintenance Checks and Services Chart

Sequence No.	Item to be inspected	Procedure	Referenee
1	External wiring	Inspect external wires and cables for loose or corroded connections and damaged jacketing or insulation.	
2	Air vents	Check the airflow intake and exhaust vents and louvers for obstructions.	Fig, 1.
3	Exterior surfaces	Inspect the exposed metal surfaces for rust, corrosion, and chipped paint.	Para 18.
4	Mountings.	*a.* Inspect the mountings for seating, cleanliness, and stability. *b.* Check bolts, screws, nuts, and other fastenings for loose or missing hardware.	Fig. 1.
5	Electrical caps and brushes . . .	Check the electrical caps for seating. Do not remove, twist, or rock to inspect. Use only direct pressure to insure that the cap is fully seated.	Paras 24 and 25.

Sequence No.	Item to be inspected	Procedure	Reference
6	Connections ----------	Check the power connectors, J1 and J2, for cleanliness, completeness, and tightness.	
7	Operation ----------	a. Check the inverter for normal operation, vibration, and overheating (para 11).	Para 22, item 2.
		b. Check to see that the voltage and frequency are within the specified limits (para 12).	Para 22, item 3.

18. Cleaning and Painting

All exterior surfaces of the inverter should be free of dirt, grease, and fungus. Perform the following procedures as specified in the preventive maintenance checks and service charts:

a. Remove the moisture and loose dirt with a clean soft cloth.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

b. Remove grease, fungus, and ground-in dirt from the exterior surfaces with a clean cloth dampened (not wet) with trichloroethane. Wipe dry with a clean, dry, lint free cIoth.

c. Remove dust or dirt from the power connectors (J1 and J2) with a soft-bristled brush,

d. Remove rust and corrosion from metal surfaces by lightly sanding with fine sandpaper (No. 000). Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB 746-10.

19. Periodic Preventive Maintenance Checks and Services

Perform the maintenance functions indicated in the periodic preventive maintenance checks and services chart (para 20) once each periodic interval in addition to the intermediate preventive maintenance checks and services (para 16). Periodic preventive maintenance will be scheduled in accordance with the requirements of TM 38–750. The periodic preventive maintenance inspection should be scheduled concurrently with the periodic maintenance service schedule of the aircraft in which the inverter is installed to reduce out-of-service time. Refer to the applicable aircraft technical manual for the hours between service periods. Equipment with a deficiency that cannot be remedied at the organizational category should be deadlined in accordance with TM 38-750.

20. Periodic Preventive Maintenance Chart

Sequence No.	Item to be inspected	Procedure	Reference
1	Installation ----------	Check to see that the inverter is properly secured with safety wire attached.	None.
2	Publications ----------	Check to see that all publications pertinent to this equipment are on hand, complete, and usable. See that all applicable changes are on hand.	DA Pam 310-4.
3	Modification work orders ----------	Check to see that all URGENT MWO's have been applied and that all NORMAL MWO's have been scheduled. MWO stencils on the equipment must be legible,	DA Pam 310-7.

21. Lubrication

The inverter does not require lubrication at the organizational maintenance category.

22. Organizational Troubleshooting Chart

Organizational troubleshooting of this equipment is based on the operational check (para

12). Refer to the troubleshooting chart for any trouble that appears while performing the operational check,

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
1	Inverter vibrates ----------	*a.* Loose or missing hardware ----	a. Tighten, or replace missing hardware.
		b. Inverter improperly seated ----	*b.* See that mounting surface is clean and free of foreign objects. If trouble is not corrected, a higher category of repair is required.
2	Inverter fails to start. (No output voltage or frequency.	*a.* Loose or blown fuse or open circuit breaker in dc line.	a. Check fuse; clean and tighten fuse contacts if applicable. Replace blown fuse. Reset circuit breaker if applicable.
		b. Short circuit in dc line ----	*b.* Check appropriate line fuses or circuit breakers. If blown, inspect wiring between fuses or circuit breaker and inverter.
		c. Dc brushes not making contact with commutator.	*c.* If visual inspection indicates this condition, or worn or broken brushes, refer to higher category maintenance.
		d. Dc input circuit open --------	*d* Check wiring and connectors to the inverter for an open circuit. Repair *or* replace defective wiring or connectors.
		e. Armature jammed ----------	*e.* Refer the inverter to the next higher category of maintenance for repair.
3	a. Inverter runs but fails to deliver ac voltage or frequency.	*a.* Probable troubles are as follows:	*a.* Checks and corrective measures are as follows:
		(1) Ac circuit open ----------	(1) Connect multimeter to the test point jacks on the front *of* regulator housing (fig. 1). Turn on necessary switches to start inverter. If multimeter indicates between 109 and 121 vat, check exterior wiring and connections for an open circuit. Repair or replace defective wiring. If multimeter does not indicate between 109 and 121 volts ac, refer inverter b a higher category of maintenance for repair.
		(2) Slipring brushes not making contact with sliprings.	(2) Refer to higher category maintenance.
		(8) Regulator failure -----	(3) Refer inverter to next higher category of maintenance for repair.
	b. Ac output voltage is low	*b.* Probable troubles are as folfolws:	Checks and corrective measures are as follows:
		(1) Dc input voltage -----	(1) Check dc voltage at power supply, Correct the supply voltage.

Item No.	Trouble symptom	Probable trouble	Checks and corrective measures
		(2) Voltage adjustment resistor (fig. 1) out of adjustment.	(2) Readjust voltage adjustment (para 26).
	c. Ac output voltage is high	c. Probable troubles are as follows:	c. Checks and corrective measures are as follows:
		(1) Input voltage higher than 30 v.	(1) Check dc voltage at power supply. Correct supply voltage.
		(2) Voltage adjustment resistor (fig. 1) out of adjustment.	(2) Readjustment voltage adjustment (para 26)
		(3) Regulator failure	(3) Refer inverter to higher category of maintenance for repair.
	d. Speed or frequency is above or below normal.	d. Frequency adjustment resistor out of adjustment.	d. Refer inverter to higher category of maintenance for repair.
	e. Output voltage unstable	e. Probable troubles are as follows:	e. Checks and corrective measures are as follows:
		(1) Loose connections	(1) Check for loose connections and tighten. If trouble cannot be corrected, refer to higher category of maintenance for repair.
		(2) Poor commutation or poor brush contact at sliprings.	(2) Check condition of commutator and sliprings. If trouble cannot be corrected, refer inverter to higher category of maintenance for repair.

23. Removal and Replacement of Inverter

a. Inverter Removal.

(1) Disconnect the power cables from connectors J1 and J2 on the inverter.

(2) Loosen and remove the four sets of mounting hardware that hold the inverter adapter base to the aircraft mounting.

(3) Lift out the inverter.

b. Inverter Replacement.

(1) Make sure that the portion of the aircraft mounting that corresponds with the inverter base or mounting MT-27917A is free from oil or grease to insure good contact.

(2) Position the inverter on the aircraft mounting; make sure that the four holes in the inverter or the MT–2791/A align with the holes in the aircraft mounting.

(3) Secure the inverter to the aircraft mounting with the four sets of mounting hardware.

(4) Connect the power cables to connectors J1 and J2 on the inverter.

24. Deleted

25. Deleted

26. Adjustments

a. Voltage Adjustment. The output voltage adjustment resist or (fig. 1) is adjusted to provide 1115-volt ac output. Follow the procedure given below.

(1) Turn on the necessary aircraft switches to start the inverter. Set the selector switch on the multimeter to 1000 A.C. VOLTS scale and connect the multimeter test leads to the test point jacks on the front of the regulator housing (fig. 1). Observe the output voltage reading.

(2) Loosen the locknut on the voltage adjustment (fig. 1). Use a screwdriver to turn the voltage adjustment shaft clockwise to increase and counterclockwise to decrease the output voltage until the multimeter indicates 115 volts ac.

(3) After adjustment, tighten the lock-

nut on the adjustment shaft. Disconnect the multimeter leads, and turn off the appropriate aircraft switches to turn off the inverter.

b. Frequency Adjustment. If frequency is *below* 400 cps, refer the unit to the next higher category of maintenance for adjustment.

CHAPTER 4

FUNCTIONING OF MOTOR-GENERATOR PU-S44/A

Section I. BLOCK DIAGRAM FUNCTIONING

27. General

(figs. 15.2, 16, 16.1 and 16.2)

a. The inverter consists of two sections: a mechanical section that consists of motor B 1 and generator G1; and an electrical regulator section that consists of a voltage and frequency regulator. Voltage and frequency regulators CSV1080-1 and CSV1186-3, installed on earlier units, consist of three circuit boards Al, A2 and A3. Regulator CSV2215-3 or 4B93-1-A is the latest version which uses a single circuit board to provide the same functions.

b. The purpose, operation, and interoperation of the two sections (electronic and electromechanical) in this equipment are explained in this chapter. Familiarity with the equipment, how it works and why it works that way are valuable tools in troubleshooting the equipment rapidly and effectively.

28. Block Diagram Analysis

(figs. 3 and 3.1)

a. Mechanical Circuits

(1) The 28-volt dc input is applied to the mechanical section of the inverter through connector J1 to motor B1 and the exciter portion of generator G1, causing current to flow in each of the components.

(2) The reaction of the magnetic fields established by the current flowing through motor B1 causes the armature to rotate. Since the generator exciter is mechanically coupled to motor B1 by a common shaft, the exciter also rotates.

(3) As the motor speed increases, an ac voltage is induced in the generator ac field coils by the sweep of the exciter. The ac voltage induced in the ac field coils is applied to power connector J2. In addition, a sample of the ac output is applied to the regulator section.

b. CSV1080-1 Regulator Circuits.

(1) Control of the voltage and frequency of the inverter output is accomplished in the voltage and frequency regulator by establishing the exact moment to turn on conduction through motor B1 and the exciter field of generator G1.

(2) The ac sample from the generator ac field coils is applied to voltage and frequency regulator circuit board AZ, where it is converted into voltage and frequency error signals.

(3) Circuit board Al contains two stages and the associated circuits for sensing and pulsing 28-volt dc power to the shunt field of motor B1 for frequency control.

(4) Circuit board A3 contains the same type stages and circuits as board Al and functions in the same manner except that it pulses 28-volt dc power through the exciter field of generator G1 for voltage control.

(5) Circuit board A2 contains the sensing transformer, parallel-resonant frequency-sensing circuit, and a circuit for biasing the reference Zener diodes on circuit boards Al and A3.

c. *CSV1186-3 Regulator Electronic Circuits.*

(1) Control of the voltage and frequency of the inverter output is accomplished in the voltage and frequency regulator by establishing the exact moment to turn on conduction through motor B11 and generator G1 exciter fields

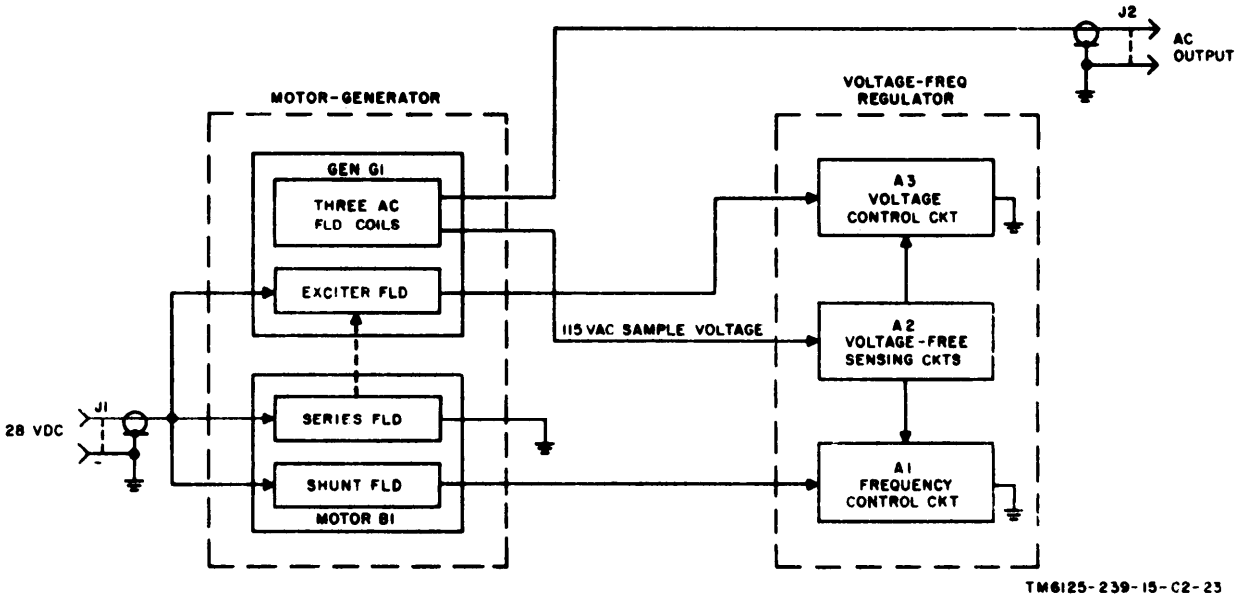


Figure 3. Inserter, block diagram

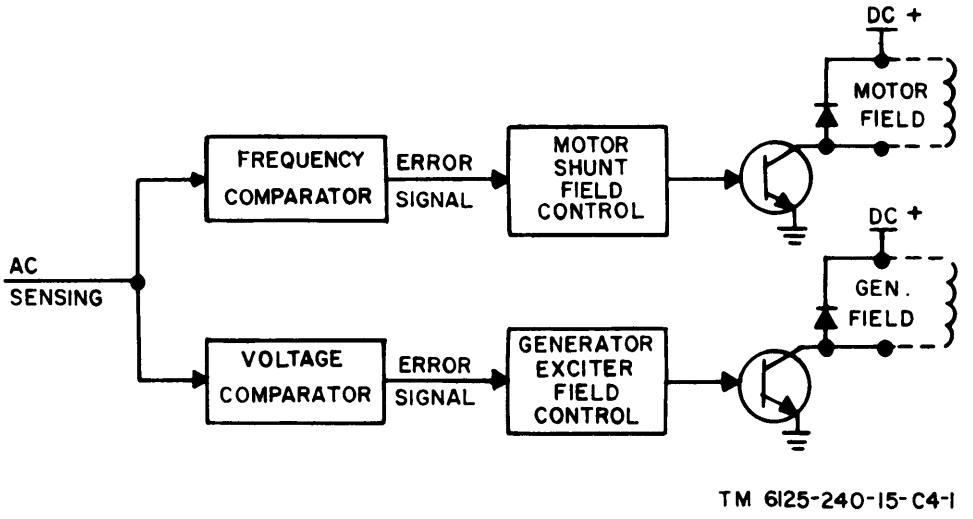


Figure 3.1 CS V2215-3 Regulator block diagram.

(2) The ac sample from the generator field coils is applied to circuit board Al, where it is converted into voltage and frequency error signals.

(3) Circuit board A2 contains shunt field power transistor Q3 which pulses 28-volt dc power to the shunt field of motor B1 for fre quency control.

(4) Circuit board A8 is identical with board A2 and functions in the same manner, except that it pulses 28-volt dc power through the exciter field of generator G1 for voltage control.

(5) Circuit board Al contains the circuit component for sensing and controlling the operation of the power transistors on circuit boards A2 and A9.

d. CSV2215-3 Regulator Circuits.

(1) The regulator senses one phase of the motor-generator's AC output separate parts of the regulator compare magnitudes of the sensed ac voltage and frequency to their respective preset values. If an error exists between either of the motor-generator's controlled entities and its preset comparator, She regulator will function to minimize that error, maintaining ac output frequency and voltage within the desired tolerance of the motor-generator application.

(2) The regulator controls the field currents by alternately switching the field transistor into saturated ON and OFF states. This switching rate is proportional to the ac frequency, due to the method of sensing used. The proportionality of ON-time and OFF-time, which determines the average field voltage, hence field current, is a function of the respective error signal.

(3) to provide continuous field current, essential for satisfactory motor-generator performance, each field is connected across a diode in the regulator, commonly called a freewheeling or commutating diode. During the time that the controlling transistor is in the OFF state, the field current flows through this diode, decaying only slightly until the next ON state occurs.

e. 4B93-1-A *Regulator Ciircuits.*

All components of the 4B93-1-A regulator are located on a single printed wiring board. This regulator functions basically the same as the CSV 1186-3 regulator except as described in paragraph 37.5 and 37.6.

Section II. CIRCUIT ANALYSIS

29. Electromechanical (figs. 16, 16.1 and 16.2)

The mechanical section of the inverter consists of motor B1 and generator G1. Both units share the same housing, with separate stationary windings. The dc armature of the motor and the ac rotor of the generator share a common shaft.

a. Motor B1. Motor B1 is a four-pole, series-shunt motor with windings wound in magnetic opposition to each other. It operates from the 28-volt dc input power applied to it from the aircraft electrical system.

(1) Power for operation of the motor is ap plied through a set of series dc field coils (L2 and L5) or a set of shunt coils (L3). The series coils and the shunt coils are connected so that they are always magnetically opposed to each other. Four dc brushes are located at the neutral point between the four pairs of coils (poles); therefore, adjacent commutator bars on the motor armature reach a dc brush when there is no voltage between brushes.

(2) When 28 volts dc is applied through connector J1, current flow is from ground through motor B1 armature, coild L2 and L5 to the aircraft power supply. Another path for current flow is from the shunt field power oscillator through shunt coil L3 to the aircraft power supply. The magnetic field, which results from the current flow through coils L2, L3, and L5, reacts with the magnetic field set up by current flow through the motor armature, and causes the armature to rotate. ‘

(3) By rotating through a magnetic field, the armature causes a counter electromotive

force (cemf) to be induced into the armature winding. The speed of rotation of the armature continues to increase until the cemf is almost equal to the dc input. The small difference between the cemf and the dc input permits the flow of enough current to keep the armature rotating.

b. Generator G1. The ac generator is a rotating field-type generator. Direct current from the external source is fed to the rotor through the sliprings and the four ac brushes.

(1) When the dc motor starts, it turns the rotor of the ac generator. As the rotor revolves, magnetic fields set up by the current through the rotor windings pass conductors in the ac stator and induce an alternating current in the ac stator winding.

(2) Alternating current is then available at power connector J2.

30. CSV1080-1 Regulator Circuits

(figs. 3 and 16)

u. The regulator consists of three interconnected module-type circuit boards (Al, A2, and A3). Mechanical and electrical connections between circuit boards are made by means of stainless steel screws and copper connections, which are part of the terminal board.

b. The regulator controls the inverter frequency output by governing the speed of the rotating section; this is done by controlling the strength of the motor-shunt field. The voltage output is regulated through control of the current in the ac generator exciter.

(1) As the mechanical speed of the inverter increases, the frequency of the inverter increases. To control the frequency output, the regulator controls the amount of current flow through the motor-shunt coils. The speed of the motor may be reduced by increasing the strength of the motor-shunt field.

(2) The current level in the generator exciter determines the magnitude of output voltage. Reducing the exciter current causes a reduction of ac output voltage. Output voltage is controlled by regulating the average current in the exciter.

c. The regulator performs the function of a rapidly operating switch which interrupts the flow of current in both motor and generator field windings at a rate of 260 cps with an effective ontime of 85 to 90 percent. Control is accomplished through the voltage- and frequency-sensing circuits, by establishing the magnitude of this current in proportion to the required voltage and frequency output. This function controls the offtime of the motor and exciter field power oscillator stages.

30.1 CVS1186-3 Regulator Circuits

The regulator consists of three interconnected module-type circuit boards. The boards are mechanically connected by screws. This regulator functions basically the same as the CSV1080-1 regulator except as described in paragraphs 37.1 and 37.2.

30.2 CSV2215-3 Regulator Circuits

(fig. 16.1)

a. The regulator controls the inverter frequency output by governing the speed of the rotating section; this is done by controlling the strength of the motor field. The voltage output is regulated through control of the current in the ac generator exciter.

(1) As the mechanical speed of the inverter increases, the frequency of the inverter increases. control the frequency output, the regulator controls the amount of current flow through the motor shunt coils. The speed of the motor may be reduced by increasing the strength of the motor shunt field.

(2) The current level in the generator exciter determines the magnitude of output voltage. Reducing the exciter current causes a reduction of ac output voltage. Output voltage is controlled by regulating the average current in the exciter.

b. The regulator performs the function of a rapidly operating switch which interrupts the flow current in both motor and generator field windings at a rate of 800 cps. Control is accomplished through the voltage- and frequency-sensing circuits, by establishing the magnitude of this current in proportion to the required voltage and frequency output. This function controls the OFF-time of the motor and exciter field power oscillator stages.

30.3 4B93-1-A Regulator Circuits

All components of the 4B93-1-A regulator are located on a single printed wiring board. This regulator functions the same as the CSV 1186-3 regulator except as described in paragraphs 37.5 and 37.6.

Section III. CSV1080-1 CIRCUIT BOARD STAGE ANALYSIS

31. Circuit Board A1, General
(fig. 16)

Circuit board Al contains the shunt field power oscillator stage and the circuit components for governing its operation.

32. Circuit Board A1, Shunt Power Oscillator Stage
(fig. 16)

a. When the 28 volts dc is supplied to the regulator, a current path exists from ground through the base-to-emitter junction of transistor A1Q2 and resistor A1R4 to the power supply. During this interval, the series combination of coil A1L2 and resistor A1R6, paralleling the base-to-emitter junction of transistor A1Q2, is effectively an open circuit because of the high initial impedance of coil A1L2; virtually all the current flow through A1R4 flows from ground through the base-to-emitter junction of transistor A1Q2. This current path establishes the base drive of transistor Q2 required to allow current to flow to connector J1 from ground through transistor A1Q2, the primary winding of transformer A1T2, motor shunt field L3, to the power supply.

b. The current flow through the primary winding of transformer A1T2 induces a voltage into the secondary (terminals 5 and 6) winding of transformer A1T2 so that current flows from terminal 5 through ground, the base-to-emitter junction of transistor A1Q2, rectifier Al CR4, and back to terminal 6 of transformer A1T2. This current flow increases th. base drive of transistor A1Q2 which allows more collector current to flow, inducing still more base current. This cycle continues until transistor A1Q2 has sufficient base drive to saturate the transistor.

c. During saturation of transistor A1Q2, the high initial impedance of the series combination of coil A1L2 and resistor A1R6 has diminished and current now flows from ground through resistor A1R6, coil A1L2, and resistor A1R4, to the power supply. The circuit will remain in this state until the core of transformer A1T2 saturates, at which time a voltage is no longer induced in the secondary winding of transformer AIT2. When this occurs, the base drive of transistor A1Q2 can no longer be sustained and the collector current rapidly decreases to zero. At this time, all the current flowing through resistor A1R4 is conducted from ground through resistor AIR6 and cc)il A1L2.

d. During the procedure described in *a* through c above, the magnetic core of transformer A1T2 has been driven toward saturation by the rise of the collector current of transistor A1Q2 from zero to maximum. While transistor A1Q2 remained in saturation, the core of transformer T2 was driven into saturation. When the collector current of transistor A1Q2 diminishes to zero, the core of transformer A1T2 is no longer saturited, and it becomes necessary to drive the core toward saturation in the opposite direction so that sufficient change in magnetic flux is generated on the next turn-on cycle to insure an adequate base drive to transistor A1Q2. This function is performed by the secondary (terminals 3 and 4) winding of transformer A1T2.

e. When the collector current of transistor A1Q2 diminishes to zero, the current path of the applied dc voltage is from ground through terminals 3 and 4 of the secondary winding of transformer A1T2 and resistor A1R5, to the power supply. The polarity of this current is such that the core of the transformer is driven to the reset condition. During the rest period, the series combination of coil A1L2 and resistor R6 returns to the high impedance state. Once again the current will flow from ground, through the base-to-emitter junction of transistor A1Q2, resistor A1R4, to the power supply. As the collector current rises again from zero to maximum, the core of the transformer is once again driven into saturation.

f. The oscillator stage will function as described in *a* through *e* above as long as dc is applied to the inverter. The motor field power oscillator stage will regulate current flow

through shunt field coil L3 to maintain a frequency below the desired range *of* l regulation. The function of lowering the current flow in proportion to the required output, in order for regulation to be accomplished, is performed by the frequency-sensing stages.

33. Circuit Board A1, General Sensing Stage
(fig. 16)

The function of the frequency-sensing stage is to regulate the frequency by controlling the ontime and offtime of the shung field power oscillator stage.

a. A sample of the output frequency is applied to the primary (terminals 1 and 2) of transformer A2T1. The secondary winding (terminals 8 and 4) is part of the frequency-sensing circuit.

b. Frequency sensing occurs when terminal 3 of transformer A2T1 is going positive with respect to terminal 4. As terminal 3 becomes increasingly positive relative to terminal 4 of transformer A2Tl, capacitor A1C3 charges at a rate determined by the setting of frequency-adjustment resistor A2R1. When the instantaneous value of the voltage across the secondary winding of transformer A2T1 is great enough, current will flow from terminal 4 through reference Zener diode A1CR6, ground, the base-to-emitter junction of transistor A1Q1, resistor A1R2, diode A1CR3, the tank circuit consisting of coil A2L1 and capacitor A2C1, and back to terminal 8 of transformer A2T1. The current flow through the base-to-emitter junction of transistor A1Q1 causes this transistor to conduct. When this occurs, the base drive of transistor A1Q2 is shorted out through transistor AIQ1 to ground and transistor A1Q2 is cut off.

c. Transistor A1Q2 will remain in cutoff as long as transistor A1Q1 is conducting. Transistor A1Q1 conducts when the incoming voltage wave nears its peak and will be held in conduction while this voltage peaks and decreases to a value equal to the charge on capacitor A1C3. Transistor A1Q1 will be held in conduction as capacitor A1C3 discharges through frequency adjustment resistor A2R1, diode A1CR6, the base-to-emitter junction of transistor A1Q1, and resistor A1R2. When the charge on capacitor AlC3 is no longer great enough to overcome the reference voltage on Zener diode A1CR6, base current will cease to flow into transistor A1Q1 and it will be cut off. Capacitor A1C3 will continue to discharge through resistors A1R8 and A1R2 and frequency-adjustment resistor A2R1. Transistor A1Q1 will remain in cutoff, allowing transistor A1Q2 to conduct, until the next half cycle of input voltage which drives terminal 3 positive with respect to terminal 4 of transformer A2T1. This is the manner by which the frequency-sensing stage controls the ontime and offtime of the shunt field power oscillater.

34. Circuit Board A2, General
(fig. 16)

Circuit board A2 contains sensing transformer A2Tl, the parallel-resonant frequency-sensing circuit and a circuit for biasing the reference Zener diodes located on circuit boards Al and A3.

u. Sensing Transformer. The sensing transformer accepts the ac sample and divides it into voltage and frequency error signals.

b. Parallel-Resonant Frequency-Sensing Circuit. The parallel-resonant frequency-sensing circuit is a tank circuit with a resonant frequency of 450 cps, and is frequency dependent. It is operated by signals from the secondary of transformer A2T1. This circuit controls the function of the shorting transistor of the. frequency-sensing stage.

35. Circuit Board A2, Reference Bias Network
(fig. 16)

The reference bias network is comprised of a conventional center-tapped winding which is full-wave rectified, each side of the center tap, and uses filter capacitor A2C2. Its function is to bias reference Zener diodes A1CR6 and A3-

CR6 of the frequency- and voltage-sensing stages. The discharge paths of capacitor A2C2 are through resistor A2R14, Zener diode A3-CR6, diode A3CR11, and ground to the positive side of capacitor A2C2 and through resistor A2R13, Zener diode A1CR6, and ground to the positive side of capacitor A2C2.

36. Circuit Board A3
(fig. 16)

Circuit board A3 contains the exciter field power oscillator stage and the voltage-sensing stage. The operation of the exciter field power oscillator is the same as that of the shunt field power oscillator. Refer to paragraph 32 and figure 16 for the functional description of the exciter field power oscillator stage.

37. Circuit Board A3, Voltage-Sensing Stage
(fig. 16.2)

a. Voltage sensing occurs when terminal 7 is going positive with respect to terminal 8 of the secondary of transformer A2T1. As terminal 7 becomes increasingly positive relative to terminal 8 of transformer A2T1, capacitor A3C3 charges at a rate determined by the setting of voltage adjustment resistor A2-R7. When the instantaneous value of the voltage across the secondary winding of transformer A2T1 is great enough, current will flow from terminal 8 through reference Zener diode A3CR6, temperature compensating diode A3CR11, ground, the base-to-emitter junction of transistor A3Q1, resistor A3R2, and diode A3CR3 to terminal 7 of the secondary of transformer A2T1. The current flow through the base-to-emitter junction of transistor A3Q1 causes this transistor to conduct. When this occurs, the base drive of transistor A3Q2 is shorted out through transistor A3Q1 to ground and transistor A3Q2 is cut off.

o. Transistor A3Q2 will remain in cutoff as long as transistor A3Q1 conducts. Transistor A3Q1 conducts when the incoming voltage wave nears its peak and will remain in conduction while this voltage crests and decreases to a value equal to the value of the charge on capacitor A3C3. Transistor A3Q1 will remain in conduction as capacitor A3C3 discharges through resistor A3R7, Zener diode A3CR6, temperature stabilizing diode A3CR11, the base-to-emitter junction of transistor A3Q1, and resistor A3R2.

c. When the charge on capacitor A3C3 is no longer great enough to overcome the reference voltage of Zener diode A3CR6, base current will cease to flow into transistor A3Q1 and it will be cut off. Capacitor A3C3 will continue to discharge through resistor A2R7, A3-R3, and A3R2. Transistor A3Q1 will remain in cutoff, allowing transistor A3Q2 to conduct, until the next half cycle of input voltage, which drives terminal 7 positive with respect to terminal 8 of transformer A2T1. This is the manner in which the voltage-sensing stage controls the ontime and offtime of the exciter field power oscillator.

Section IV. CSV1186-3 CIRCUIT BOARD ANALYSIS

37.1 Voltage Regulation
(fig. 15.2)

a. One side of the generator exciter field is connected to dc + and the other side is connetted to the collector of power transistor A3-Q6. When the power transistor is on, total dc voltage appears across the field. When the transister is *off,* total dc voltage appears across the transistor.

b. The sensing voltage is taken from the output terminal of the generator and applied to the primary of the sensing transformer. The stepped down ac voltage across the secondary is rectified by the full-wave center-tap arrangement of the transformer, and filtered to a dc level of approximately 15 volts. The differential of dc sensing voltage and a 12-volt Zener voltage is fed to the base of a driver transistor which determines the length of on-*time* or offtime of the power transistor. Any increase in differential voltage will cause a

decrease in ontime of the power transistor, which will result in a lower field current, with a resultant decrease in output voltage. Any decrease in differential voltage will increase the on the with a corresponding increase in output voltage.

c. The regulator reacts instantaneously to any change in output voltage and maintains the output voltage constant at a preset value. Freewheeling diode CR8 is used to provide a path for the field current during the *offtime* of power transistor A3Q6.

37.2 Frequency Regulation

a. One side of the motor-shunt field is connected to dc + and the other side is connected to the collector of power transistor Q3. When the power transistor is *on,* practically total dc voltage appears across the field. When the power transistor is off, total dc voltage appears across the transistor.

b. Frequency regulation is accomplished by sensing a potential (at) developed across a reactance-transformer of a series LC circuit tuned to approximately 570 CPS. The LC circuit operates at 400 cps on the low side of the resonance curve. The value of ac potential developed is proportional to the frequency and will continue to be constant for any one frequency so long as the values of L and C remain constant. This potential is then stepped down, rectified, and compared with another potential obtained by rectification of the ac sensing voltage. The two are approximately 1800 out of phase and are rectified, one positive and one negative. The difference between these potentials becomes a representation of the frequency, the level of which is independent of any change in ac voltage level; therefore, frequency control is independent of voltage change.

c. The signal obtained by comparison of the two above mentioned potentials is fed to the base of a driver transistor and is amplified. The amount of the differential voltage fed to the base of the drive transistor establishes the length of ontime or offtime of power transistor Q3. Any increase in frequency will cause decrease in the differential voltage which will increase the ontime of power transistor Q3 resulting in a higher field current, and a consequent reduction in frequency.

d. The regulator reacts instanteously to any change in output frequency and maintains the output frequency constant at a preset value.

e. Freewheeling diode CR9 is used to provide a path for the field current during the *offtime* of power transistor Q3. Anticipation to changes in input voltage and electric load are coupled into the speed control amplifier circuit by means of an ac network.

Section V. CSV2215-3 REGULATOR CIRCUIT ANALYSIS

37.3 Voltage Regulation
(fig. 16.1)

a. One side of the generator exciter field is connected to dc + while the other side is connected to the collector of power transistor Q7. When the power transistor is ON, total dc voltage appears across the field. When transistor Q7 is OFF, total dc voltage appears across the transistor Q7.

b. The sensing voltage is taken from the output terminal of the generator and applied to the sensing circuit, where it is compared with the voltage in the breakdown (Zener) diode (CR7) circuit. The differential of these voltages is fed to the base of driver transistor Q5, which determines the length of ON or OFF time of the power transistor Q7. Any increase in differential voltage will cause a decrease in ON time of the power transistor Q7, resulting in a lower field current in the generator, and a corresponding drop in output voltage. Any decrease in differential voltage will increase the ON time of Q7, with a corresponding increase in output voltage.

c. The regulator reacts instantaneously to any change in output voltage and maintains the output voltage constant to a preset value. Freewheeling or commutating diode CR8 is used to provide a path for the field current during the OFF time of power transistor Q8.

37.4. Frequency Regulation
(fig. 16.1)

a. One side of the motor shunt field is connected to dc + and the other side is connected to the collector of power transistor Q3. When the power transistor is ON, practically total dc voltage appears across the field. When the power transistor Q3 is OFF, total dc voltage appears across transistor Q3.

b. Frequency regulation is accomplished by sensing an ac potential developed in the frequency sensing circuit. The value of this ac potential is proportional to the frequency and is constant for any one frequency. This potential is rectified and compared with another potential obtained by rectification of the ac sensing voltage. The two are approximately 180° out of phase and are rectified one positive, and one negative. Thus, the difference between these potentials becomes a representation of the frequency, independent of any change in ac voltage level. Therefore, frequency control is independent of voltage change.

c. The signal obtained by comparison of the two above mentioned potentials is fed to the base of a driver transistor which is part of the amplifier circuit. The amount of the differential voltage fed to the base of the driver transistor establishes the length of ON time or OFF time of power transistor Q3. Any increase in frequency will cause a decrease in the differential voltage that will increase the ON time of power transistor Q3. This results in a higher motor shunt field current and a corresponding reduction in frequency.

d. Free-wheeling diode CR3 is used to provide a path for the field current during the OFF time of transistor Q4. The regulator reacts instantaneously to any change in output frequency to maintain the frequency at its preset level.

Section VI. 4B93-1-A REGULATOR CIRCUIT ANALYSIS

37.5 Voltage Regulation
(fig. 16.2)

a. AC generator single phase output voltage is sensed, half-wave rectified, reduced by a voltage divider and changed to a pulsating dc voltage with a ripple, via CR11, R24, R25 and C5. The superimposed ripple is further filtered into a sawtooth waveshape. This dc voltage with the superimposed sawtooth ripple varies directly with the ac voltage output of the ac generator and is compared with a zener reference composed of CR2, CR3, CR4, CR5, R7 and R17.

b. Since the top of the resultant applied dc voltage signal is a constantly varying sawtooth wave, it will automatically straddle the zener voltage reference line such that the width of the pulse formed will, just sustain it in a steady state, "closed loop" condition. Maximum excitation will be amplified to the generator when the pulse is maximum width or "full-on" and minimum excitation occurs at zero width or when "full-off" occurs. The average regulated voltage will then be dependent upon the time ratio of the "on" and "off" condition or pulse width.

c. When the ac generator output voltage increases, a larger negative voltage is seen at the wiper arm of R10 causing Q9 to turn Off (decrease pulse width). With Q9 Off, current amplifier transistors Q7, Q8 and Q11 turn Off, causing less current to flow through the alternating field winding thus decreasing the ac voltage to nominal value.

d. When the ac generator output voltage decreases, the less negative voltage is seen at wiper arm of R10 causing Q9 to turn On (increase pulse width). With Q9 On, Q7, Q8 and Q11 turn On allowing more current to flow through the alternating field winding thus increasing the ac voltage to nominal value. Variable resistor R10 is used to set the ac generator output voltage.

37.6. Frequency Regulation
(fig. 16.2)

a. AC generator output voltage is connected to the base of transistor Q1 through resistors R2 and R27. This signal overdrives Q1 such that the negative half-cycle will bias Q 1 into saturation and the positive half-cycle will bias Q1 Off. During the positive half-cycle when Q1 is Off, capacitor Cl is permitted to charge through R4 from the reference voltage created by zener diodes CR2

and CR5. When Q1 turns on, during the negative half-cycles, Cl is discharged and will not start charging again until the beginning of the next negative half-cycle. CR1 protects the base -emitter junction of Q1 during the positive half-cycles.

b. During the low frequency conditions, the time that C 1 is allowed to discharge is longer than the time allowed during higher frequency operation. This means that for each half-cycle that Q1 is On, at low frequency conditions, C 1 will discharge to a lower potential. Transistor Q10 is an emitter follower whose base voltage is adjusted by R5. The voltage across R5 is held constant by the reference voltage. The adjustment of R5 determines the voltage which Q10 applies across R6 and C7. The emitter of Q2 is also connected to R6 and C7.

c. The voltage across C 1 is connected to the base of Q2, thus the voltage level to which Cl must charge in order to bias Q2 Off is adjusted by R5. When the voltage across C 1 reaches the level required to bias Q2 Off, collect current decreases through R8, R9 and the base-emitter junction of Q3. When Q3 turns Off, a path is provided for Q4 base current to flow through R11 and result in Q4 being On. With Q4 On, current amplifier transistors Q5 and Q6 turn On allowing more current to flow through the shunt field to the dc motor, decreasing its speed thus lowering the frequency of the ac generator to nominal value.

d. During the high frequency conditions, the time that C 1 is allowed to discharge is faster than the time allowed at low frequency operation. This means that for each half-cycle that Q1 is Off, Cl will charge to a higher potential, biasing Q2 On. With Q2 On, base current is provided through R8 to Turn Q3 On. As Q3 turns On, the base of Q4 is reversed biased and Q4 turns Off, and in turn current amplifier transistors Q5 and Q6 turn Off. With Q5 and Q6 Off, less current flows through the shunt field of the dc motor increasing the frequency of the ac generator to a nominal value. Variable resistor R5 is used to set the ac generator output frequency.

CHAPTER 5

DIRECT SUPPORT TROUBLESHOOTING AND REPAIRS

Section I. GENERAL TROUBLESHOOTING TECHNIQUES

WARNING

When servicing the inverter, be extremely careful to avoid contact with the power connector and ac line connections.

38. General Instructions

The direct and general support and depot maintenance procedures in the following chapters supplement the procedures given in chapters 2 and 3. The systematic troubleshooting procedure, which begins with the operational and sectionalization check that can be performed at an organizational level is carried to a higher category in this chapter. Sectionalizing, localizing, and isolating techniques used in the troubleshooting procedures are more advanced. Section II provides intraunit (within the unit) troubleshooting procedures to be performed by general support maintenance facilities; section III describes intraunit (within the unit) general support maintenance and localizing, and isolating procedures.

39. Organization of Troubleshooting Procedures

a. General. The first step in servicing a defective inverter is to sectionalize the fault. Sectionalization means tracing the fault to a major component. The second step is to localize the fault. Localization means tracing the fault to a defective part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing brushes, burned electrical leads, and shorted stator windings can often be located by sight, smell, and hearing. Some faults, however, must be isolated by checking voltages.

b. Sectionalization. Listed below is a group of tests arranged to aid in tracing troubles in a defective inverter. Motor-Generator PU–544/A consists of two major components: The rotating section and the static regulator.

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without testing or measuring circuits. All meter readings or other visual signs should be observed and an attempt made to sectionalize the fault to a particular component.

(2) *Operational tests.* Operational test (para 41) frequently indicates the general location of trouble. These tests will often help in determining the exact nature of the fault.

c. *Localization.* The tests listed below will aid in isolating the trouble. First, localize the trouble to either the rotating section, or the regulator section, and then isolate the trouble as follows:

(1) *Voltage and frequency measurements.* Voltage and frequency measurements by direct and general support personnel are restricted. Make voltage and frequency measurements in this equipment only as *specified.* This equipment is transistorized. Observe all cautions given to prevent transistor damage. A momentary short can ruin a transistor. Use Test Set, Electrical Power AN/UPM–93, the functional check, and the inverter test point jacks as *specified* for voltage and frequency measurements. Compare

the readings taken from the AN/UPM–93 with those obtained from the aircraft voltage and frequency meters.

(2) *Troubleshooting chart.* The trouble symptoms listed in the direct support troubleshooting chart (para 47) will aid in localizing trouble to a component part.

(3) *Intermittent troubles.* In making any test, do not overlook the possibility of intermittent troubles. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. Check the external , and internal wiring connections to the inverter,

Section II. IN-AIRCRAFT TROUBLESHOOTING

CAUTION

Do not attempt removal Or replacement of parts before reading paragraph 51.

40. Test Equipment Required

The chart below lists the test equipment required for in-aircraft troubleshooting of the inverter. Also listed are the associated technical manual and the assigned common names for the equipment.

Test equipment	Technical manual	Common name
Test Set, Electrical Power AN/UPM–93.	TM 11–6625–303–12.	Power test set.
Multimeter TS–352B/U	TM 11–6625–366–15.	Multimeter.
Test Set, Armature TS–965/U.	TB 11–6625–434–12/1.	Armature test set.
Toolkit, Electronic Equipment TK–100/G.		
Test Set, Motor Generator AN/GSM–65.	TM 11–6625–680–15.	Test set.

41. Operational Test

Troubleshoot the inverter to determine if it is the faulty unit by following the procedure outlined below.

a. General. The operational test must be performed while the inverter is part of an aircraft installation. (Refer to the applicable aircraft manual.) If the inverter is determined to be the faulty unit, localize the trouble as outlined in paragraph 42. If no fault is indicated, the fault must be in the interconnecting wiring of the aircraft. Make continuity checks to determine if an open or broken connection exists. Refer to the applicable aircraft maintenance manual for the interconnecting wiring diagram.

b. Power Requirements. Connect an external power supply to the external power connector on the aircraft for making an operational test. (Refer to the applicable aircraft technical manual.) The power supply must be capable of supplying 59.5 amperes at 28 volts dc.

c. *Test Procedure.*

(1) Turn the main power switch and circuit breakers in the aircraft to apply power to the inverter, Check to see that the inverter starts and the aircraft dc voltmeter reads 28 volts dc.

(2) Plug the power test set prods into the inverter test point jacks (fig. 1).

(3) Press down on the power test set selector switch and turn the knob to the 150 position.

(4) Operate the inverter at no load (no ac components of the aircraft operating). Loosen the voltage adjustment locknut and turn the adjustment (fig. 1) through its full range. Voltage indicated on the VOLTS meter of the power test set must not be lower than 109 or more than 121.

(5) Apply A full load to the inverter by turning on all the aircraft equipment that operates from the ac supplied by the inverter. (Refer to the applicable aircraft technical manual) Repeat the procedure given in (4) above. There should be no variation in the adjustment range specified in (4) above. Turn off the aircraft ac components and set the voltage adjustment so that a reading of 115

is indicated on the VOLTS meter of the power test set. Tighten the voltage adjustment locknut.

NOTE

Frequency cannot be adjusted, at this maintenance level, on inverters having CSV2215-3 regulator installed. Read frequency value only.

lb gain access to the frequency adjustment resistor on 4B93-1-A regulator, remove regulator from its mounting and flip over to the component side.

(6) Remove the regulator housing cover assembly. Operate the inverter with no ac components of the aircraft energized. Turn the frequency adjustment (fig. 4 or fig. 4.1) through its full range. The limits of frequency regulation, as indicated on the FREQUENCY METER of the power test set, must be 400 Cps ± 10.

(7) Apply a full load. (Turn on all aircraft equipment which operates from the ac supplied by the inverter.) Turn the frequency adjustment through its full range. There should be no variation in the regulation range specified in (6) above. Turn off the aircraft components and" reset the inverter frequency adjustment to provide a 400-cps output.

(8) Turn on the aircraft ac components, one at a time, until the inverter is fully loaded. Voltage variation between no load and full load must be less than 1 1/2 volt ac. The frequency variation must be less than 6 cps.

(9) If any abnormal indications ((3) through (8) above) are noted, refer to the troubleshooting chart (para 42).

(10) Upon completion of the operational test, remove the power test set prods from the inverter test point jacks. Turn off the aircraft master switch and disconnect the external power source from the aircraft.

42. localizing Troubles

a. Use of Direct Support Troubleshooting Chart. The direct support troubleshooting chart will aid in localizing troubles to the components of the inverter. The direct support troubleshooting chart supplements the organ-

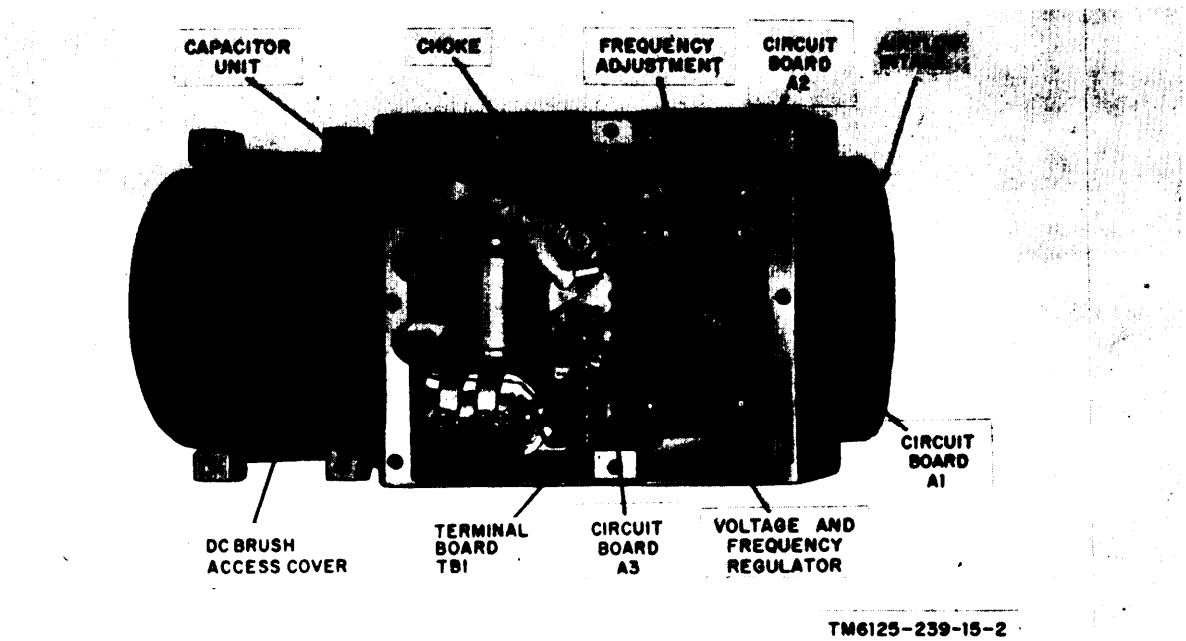


Figure 4. Inverter with CSV1080-1 regulator.

izational troubleshooting chart (para 22). When no operational symptoms are known, perform an operational test (para 41), and then proceed to the direct support troubleshooting chart until the trouble is located. If the localizing procedures in the direct support troubleshooting chart do not correct

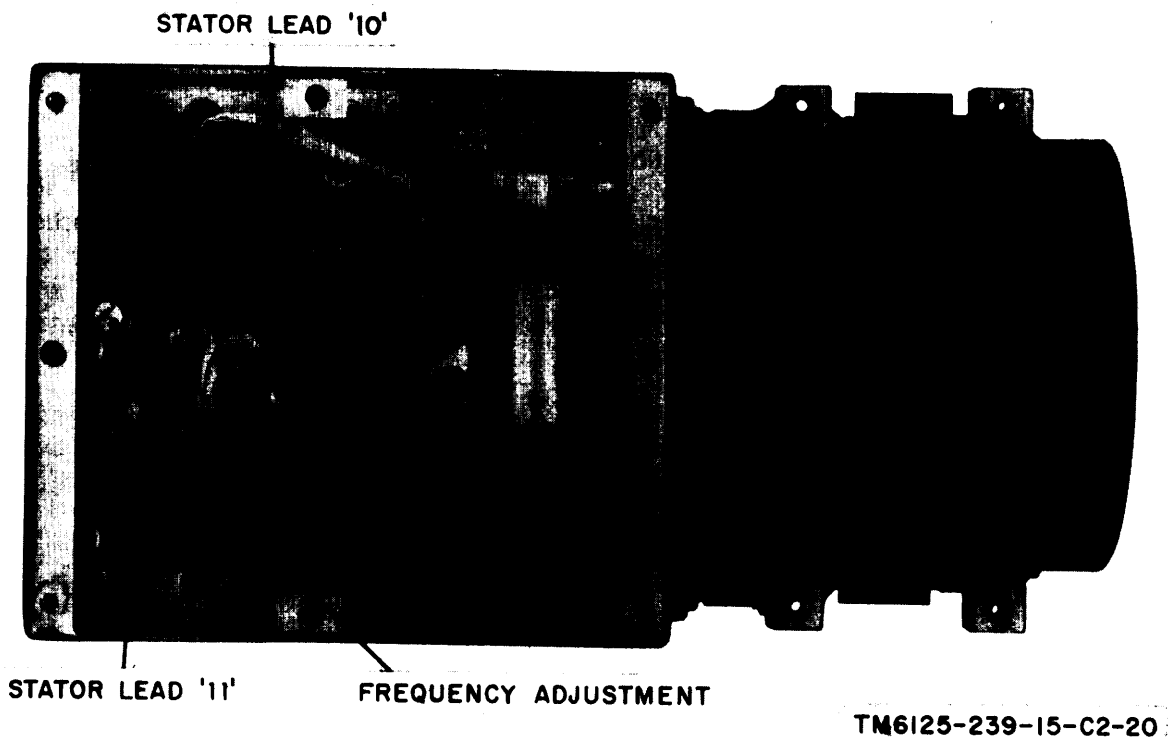


Figure 4.1 Inverter with CSV1186-3 regulator.

the fault, remove the inverter from the aircraft for bench testing and repair.

b. Conditions for Tests. A11 checks in the direct support troubleshooting chart (c below) are to be conducted with the inverter connected for normal use.

c. *Direct Support Troubleshooting Chart.*

Item	Indication	Probable trouble	Procedure
1	Inverter fails to start. (No output voltage or frequency.)	*a.* No dc input ----------	*a.* Check *dc* fuse or circuit breaker. (1) Clean and tighten fuse contacts. Replace blown fuse. (2) Reset circuit breakers.
		b. Short circuit in dc input circuit.	b. Check line fuses *or* circuit breakers. If blown, inspect wiring between fuses and inverter.
		c. DC brushes not making contact with commutator.	c. Check for weak or broken brush holder spring. Replace weak or broken spring (para 25). Check for sticking, worn, or broken brushes. Replace worn or broken brushes (para 25).
		d. DC input circuit open --------	d. Check wiring and input connection for open circuit. Repair or replace defective wiring or connection.
		e. Armature assembly jammed--	e. Remove dc end fan cover (para 53b) and try to turn armature assembly by hand. Check for obstructions in airgap. If jammed, remove armature assembly (para *53b)* and clear obstructions.
2	Inverter runs but fails to deliver ac voltage.	*a.* Ac circuit open ----------	a. Check exterior wiring and connections for open circuit. Repair or replace defective wiring.
		b. At contact brushes not making contact with sliprings.	*b.* Check for broken brushes and springs. Replace brushes if broken or worn (para 24). Check for sticking brushes. Clean brushes and brush holders.
		c. Short or open circuit in generator G1 exciter windings.	c. Use multimeter to check resistance between the slip-rings (fig. 5). Resistance must be between 4.43 and 4.83 ohms. If the multimeter indicate a much higher reading or indicates zero, the armature assembly should be replaced (para 53 and 54).
		d. Regulator failure ----------	*d.* Troubleshoot regulator (para 50).
3	Ac output voltage is low -------	*a.* De input voltage ----------	a. Check dc voltage at power supply. Correct the supply voltage.
		b. Voltage-adjustment resistor out of adjustment.	*b.* Readjust voltage adjustment. Check to see that resistance is between 80 and 110 ohms.

Item	Indication	Probable trouble	Procedure
4	Ac output voltage is high-------	a. Input voltage higher than 30 v	a. Check dc voltage at power supply. Correct supply voltage.
		b. Voltage-adjustment resistor out of adjustment.	b. Readjust voltage adjustment. Check to see that resistance is between 80 and 110 ohms on regulators CSV 1080-1 and CSV 1186-3. On CSV2215-3 regulator, the resistance should be between 9500 and 10,500 ohms. On 4B93-1-A regulator, the resistance should be between 4500 and 5500 ohms.
		c. Regulator failure ----------	c. Troubleshoot regulator (para 50).
		d. Shorted coil in dc armature windings.	d. Check armature for shorted coils with the armature test set. A thin strip of steel held over the armature core will vibrate if a short exists. Replace armature if short exists (para 36).
5	Speed or frequency is above or below normal.	a. Frequency adjustment out of adjustment.	a. Readjust frequency adjustment. Check to see that resistance is between 80 and 110 ohms on regulators CSV 1080-1 and CSV 1186-3. On 4B93-1-A regulator, the resistance should be between 9500 and 10,500 ohms. On CSV2215-3 regulator, frequency cannot be adjusted. Refer to higher category of maintenance for repair if outside limits.
		b. Open or short in shunt or series field.	b. Check resistance of shunt winding. Connect multimeter prods between the light leads. Shunt winding resistance must be 5.6 ohms. Check resistance of the series winding. Connect multimeter prods between the heavy leads. Resistance must be 0.068. Remove dc stator para 53 *b* and replace if open or shorted.
6	Output voltage unstable--------	a. Loose connections ----------	a. Check for loose connections in the inverter and tighten.
		b. Poor commutation or poor brush contact at sliprings.	b. Check condition of commutator and sliprings. Check brushes, brush springs, and brush holders. Clean commutator and sliprings with No. 000 sandpaper if dirty.
7	Excessive sparking at brushes--	a. Brushes stuck in holder -----	a. Check brushes, brush springs, and brush holders. Replace if defective. Clean brush holders.

Item	Indication	Probable trouble	Procedure
			Use a spring scale and check to see that spring develops between 18 and 22 ounce force when the end of the spring is rotated through a *34. 5"* arc from worn brush position.
		b. Commutator or sliprings dirty or pitted.	*b.* Check condition of commutator or sliprings. If dirty or pitted, refer unit to higher category of maintenance for repair.
		c. Grounded circuit in armature coils.	c. Check input current; if it is more than 59 amp, a short circuit is present. Replace the armature.
8	Inverter overheats ----------	9. Poor external ventilation ----	a. Check for adequate air circulation around unit. Provide ample circulation.
		b. Poor internal ventilation -----	*b.* Check to see that air vents and louvers are free of obstructions. Clean air vents and louvers.
		c. Faulty bearings ----------	c. Feel bearing housings in end-bell assemblies. If hot, remove bearings (para 53b) and replace them. *
		d. Excessive load ----------	d. Check and reduce load.
		e. Defective fan ----------	e. Remove fan *cover* (para 53b) and inspect condition of fan. Replace if defective.
9	Inserter is noisy ----------	a. Inverter not firmly mounted 01 parts are loose.	a. Check mounting bolts and other bolts and screws. Tighten if loose.
		b. worn bearings ----------	*b.* Remove dc end fan cover (para 53b) and rotate armature by hand; feel and listen for roughness in bearings. If bearings are worn, remove (para 53b) and replace them.
		c. Armature dragging or striking on pole piece.	c. Remove dc end fan cover (para *53b)* and rotate armature by hand; feel and listen for indications of interference. If interference is evident, remove armature (para 53b) and visually inspect stator housing and bearings. If defective, refer to a higher category of maintenance for repair.
		d. Shorted armature coil -------	d. Remove armature (para 53b) and replace armature.
10	Output voltage and frequency cannot be measured at test point jacks J3 and J4.	Defective test point jacks or wiring.	Check condition of test point jacks and continuity of internal wiring (fig. 16) for opens or shorts. Replace defective parts.

*Use MS type bearing, NSN 3110-00-089-7392.

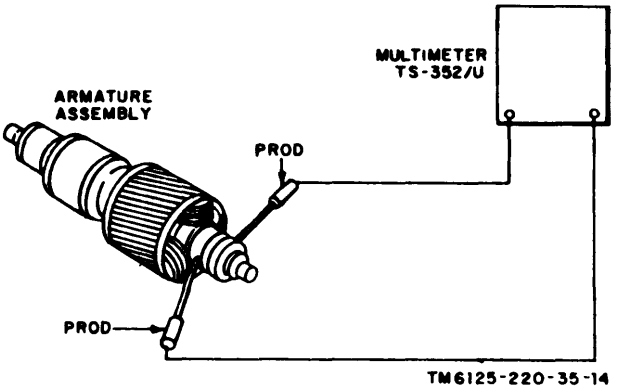


Figure 5. *Test setup for slipring resistance measurements.*

Section III. BENCH TROUBLESHOOTING PROCEDURES

Caution: **Do not attempt removal or replacement of parts before reading paragraph 51.**

43. Bench Testing Inverter

a. When to Bench Test. Bench to the inverter when any of the following conditions apply:

(1) When the inverter is being serviced apart from the aircraft and the nature of the abnormal symptoms is not known.

(2) When abnormal symptoms reported from operational tests (para 41) indicate the need for higher level repair.

b. Conditions for Bench Test. Prepare the inverter for bench testing as follows:

(1) Mount the inverter on a test bench; make sure that the areas of contact between the mounting base of the inverter and the corresponding areas of the test bench are clean and free of oil or grease to insure good electrical grounding.

(2) Interconnect the inverter and the test equipment (para 45).

c. Measurements. To localize troubles in the CSV1080-1 and CSV1186-3 regulators, make the voltage measurements indicated in the regulator voltage chart (para 49). If the voltage readings are above or below the readings in the chart, make the additional isolating checks outlined in paragraph 50. No voltage measurements may be made for the CSV2215-3 regulator because no junction terminals are externally located. Refer to the CSV2215-3 Troubleshooting Chart (para 50 d) for isolating checks. Refer to the 4B93-1-A Regulator Test (para 49.1). If values are outside limits, perform the Troubleshooting Procedures of paragraph 50 e. When the faulty part is found, repair the trouble and repeat the bench test until all troubles have been eliminated.

44. Test Equipment Required for Bench Testing

The following equipment is required for bench testing the inverter:

a. Test Set, Motor Generator AN/GSM-65 (bench test set).

b. Multimeter TS-352/U (multimeter).

c. Dc power source, 26 to 29 volts, 60 amperes.

45. Test Setup

Bench tests of the inverter require connection to the bench test set and to a 26- to 29-volts, 60-ampere dc power source. Prepare the bench test set for testing the inverter as outlined in a through *m* below.

Note. Fabricate a test cable as shown in figure 6 if the bench test set does not have a suitable cable for connection to the inverter.

a. Connect the bench test set cable to the inverter as shown in figure 14.

b. Adjust all bench test set meters for zero.

c. Set the AC METERS PHASE switch to position 1 or A. (See note.)

Note. To test the three-phase output, set the AC METER PHASE switch to A, B, or C (1, 2, or *3),* successively. The rated input output and frequency must be checked for each Setting.

d. Set the AC AMMETER RANGE switch to position *50.*

e. Set the LOAD switch to OFF.

f. Set the LOAD REGULATOR control to O.

g. Set the DC AMMETER RANGE switch to the start position.

f. Connect the 28-volt dc input power from the power supply to the plus (+) and minus (–) terminals of the test set. The green POWER ON lamp lights.

i. Set the POWER switch to ON.

j. Set the START switch to START.

k. Set the DC AMMETER RANGE switch to 200.

1. Set the LOAD switch to ON.

m. Adjust the 28-volt dc input power for a 28-volt indication on the DC VOLTS meter.

46. Test Procedure

a. Set the bench test set LIVE CIRCUIT switch to ON. The inverter starts.

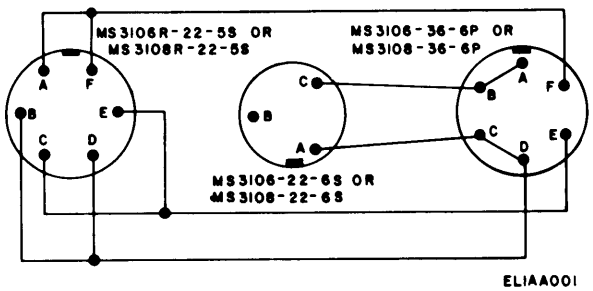


Figure 6. Test cable fabrication diagram

b. Loosen the inverter voltage adjustment (R7) locknut, and turn the voltage adjustment through its full range. The limits of the voltage regulation is less than 109 volts or more than 121 Volta.

c. Adjust the bench test set LOAD REGULATOR control until the A. C. AMPS meter indicates 6.5 amperes and the A.C. VOLTS meter indicates 115 volts. Turn the voltage adjustment through its full range. No variation in the regulation range (b above) is noted. Place the LOAD REGULATOR control at O, and set the inverter voltage adjustment to provide an output of 115 volts ac as indicated on the A. C. VOLTS meter. Tighten the voltage adjustment locknut.

Note: Frequency adjustment procedures described in steps d and e apply only to regulators CSV1080-1, CSV1188-3 and 4B93-1-A.

d. With the bench test set LOAD REGULATOR control at O, turn the inverter frequency adjustment through its full range. Limits of frequency regulation must be not less than 390 cps nor more than 410 cps.

e. Adjust the bench test set LOAD REGULATOR control until the A. C. AMPS meter indicates 6.5 amperes and the A. C. VOLTS meter indicates 115 volts, Turn the inverter frequency adjustment through its full range. No variation in the regulation range requirements (d above) on the FREQUENCY meter is noted. Return the LOAD REGULATOR control to 0, and set the frequency adjustment to provide a 400-cps output as indicated on the FREQUENCY meter.

f. With the bench test set LOAD REGULATOR control at 0, vary the input voltage from 26 to 29 volts as indicated on the D.C. VOLTS meter. The inverter output voltage, as indicated on the A. C. VOLTS meter, does not vary more than 1 1/2 volt. The frequency, as indicated on the FREQUENCY meter, does not vary more than 6 cps.

g. Adjust the bench test set LOAD REGULATOR control until the A. C. AMPS meter indicates 6.5 amperes and the A. C. VOLTS meter indicates 115 volts. Vary the inverter input voltage from 26 to 29 volts as indicated on the D.C. VOLTS meter. The inverter output voltage, as indicated on the A. C. VOLTS meter, does not vary more than 1 1/2 volts; the frequency, as indicated on the FREQUENCY meter does not vary more than 6 cps.

h. Adjust the inverter input voltage, as indicated on the D. C. VOLTS meter, to 28 volts.

i. If the indications given in *b* through *h* above are abnormal, refer to the troubleshoot ing chart (para 42c).

j. When satisfactory operation is obtained, place the bench test set LIVE CIRCUIT switch to OFF position. Turn off or place all switches in the lowest numbered or lettered position. Disconnect the inverter and the power supply leads.

47. Localizing. Troubles

Procedures for localizing trouble include all the techniques outlined for direct support maintenance troubleshooting (para 19). When use of the chart results in the discovery of trouble in the regulator section of the inverter, follow the isolating procedure given in paragraphs 49 and 50.

48. Isolating Troubles

When the trouble has been localized to the regulator, use the procedure outlined in paragraph 49a for bench testing the inverter and for making voltage measurements. The voltage measurements are to be used with the troubleshooting chart (para 50b) to isolate the defective terminal board.

49. Regulator Voltage Measurements

CAUTION

The regulator portion of the equipment is transistorized. When measuring voltages, use tape or sleeving to insulate the test prods, except for the extreme tip. A momentary short circuit can ruin the transistor. Make only those measurements specified to prevent transistor damage.

a. Conditions for Measurement.

(1) Interconnect the inverter, bench test set, and 28-volt dc power source, and position the switches on the bench test set as described in paragraph 45.

(2) Set the bench test set LIVE CIRCUIT switch to ON. The inverter starts.

(3) Remove the cover of the regulator housing (fig, 1).

Note: During the procedures given in *(4)* through (7) below, set the multi meter function switch to read dc volts and the range switch to the appropriate scale for the voltage measurements given in the voltage measurement chart *(b below).* Make these measurements at the junction terminals specified in the voltage chart and shown in figures 4 and 7.

(4) Adjust the power source for a 26-volt dc input to the inverter as indicated on the D. C. VOLTS meter on the bench test set. Adjust the bench test set LOAD REGULATOR control until the A. C. AMPS meter indicates 6.5 amperes and the A. C. VOLTS meter indicates 115 volts.

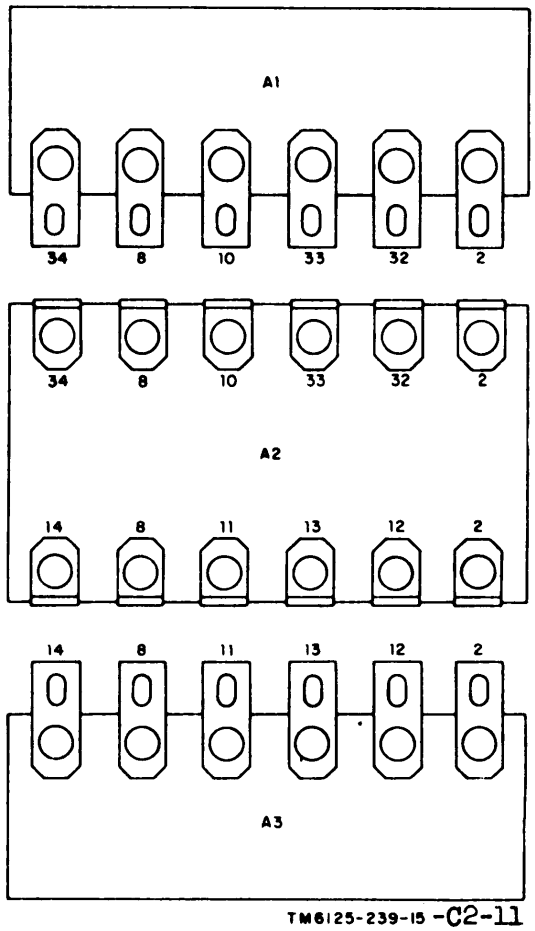


Figure 7. CSV1080-1 regulator junction terminals.

(5) Use the multi meter and measure the voltages specified in the Full load column of the voltage measurement chart.

(6) If all the readings agree, adjust the input voltage to 28 volts dc and repeat the measurements.

(7) Set the LOAD REGULATOR control to 0 and the input voltage to 29 volts dc. Use the multimeter and measure the voltages in the No load column of the voltage measurements chart.

h. Voltage Measurement Chart.

CSV1080-1 regulator voltage measurements

Terminals	26 vdc (full load)	28 vdc (full load)	29 vdc (no load)
2 to 33	9.3	9.3	3.3
2 to 10	17.7	18.1	14.3
2 to 8	24.5	26.4	27.5
2 to 13	9.9	9.9	9.9
2 to 11	16.3	18.0	22.4
10 to 8	6.7	8.5	13.3
11 to 8	8.2	8.3	5.1
2 to 14	9.9	9.9	9.9
2 to 34	9.3	9.3	9.3

49.1 4B93-1-A Regulator Test

a. Interconnect the equipment as described in paragraph 45.

b. Set the power supply to provide 28 volts dc input and obtain 115 volts ac, 400 Hz at no load.

c. Set the bench test set LIVE CIRCUIT switch to ON to start inverter. Apply a 750 VA load at a Power Factor of 1.0 and check if regulator operates within the following limits: EAB = 1 volt, Frequency = 4 cycles and Voltage Modulation = 1.0%.

50. Regulator Troubleshooting

a. Conditions.

(1) If any of the measurements vary from those given in the regulator voltage chart (para *49b),* make the measurements given in the regulator troubleshooting chart (b below). Set the multimeter to measure dc voltage as specified in the chart, and make the measurements as indicated.

(2) The abnormal conditions listed in the troubleshooting chart refer to the inverter output as indicated on the meters on the bench test set (para 46). The peak voltage measurements are made between the terminals indicated in the troubleshooting chart (b below). All measurements specified for each item must be made. Make *only* the voltage measurements listed. Any variation from the readings indicated for each item will indicate the defective circuit board. Follow the instructions given in the *Remedy* column of the troubleshooting chart.

NOTE

Steps (3), thru (7) apply only to the CSV2215-3 regulator.

(3) Abnormal conditions described in troubleshooting Chart are those which might be observed with the CSV22 15-3 regulator controlling a motor-generator operating under normal input/load conditions. Before removing the regulator for troubleshooting, regulator adjustments should be attempted to correct the abnormal conditions. Refer to figures 7.1 and 8.3 for location of component.

CAUTION

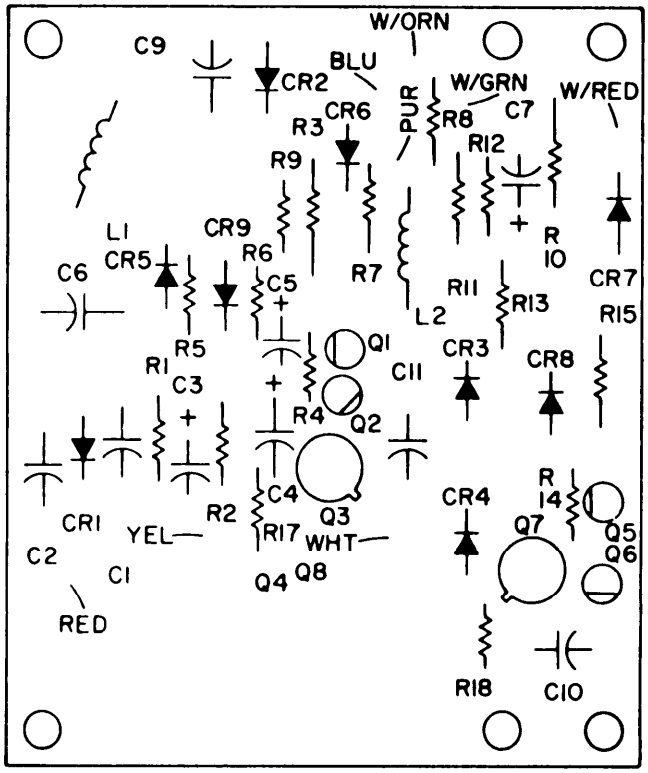
Reactor L1 is fragile. Use extreme care when adjusting.

(4) The voltage adjustment variable resistor R16 should be reset in cases of high or low voltage. For frequency variations of less than 15 hertz, the adjustable reactor L1 may require resetting.

(5) The circuit card assembly and connecting leads should be inspected for proper and unbroken connections before troubleshooting components. Unless it can be visually determined that a part is defective (burned, broken, etc.), the steps in locating the probable cause should be followed in numerical sequence, since these are listed in order of their probability.

(6) Refer to troubleshooting Chart (para 50 d) to isolate faulty components.

(7) In checking components on circuit card assembly, pointed probes will be required to puncture the coating on component leads. Replacement of components and repair of coating must be done at Depot maintenance level only.



REFERENCE DESIGNATION	NOMENCLATURE
C1	Capacitor 0.015 uf, 50 V
C2	Capacitor 0.15 uf, 50 V
C3	Capacitor 1.0 uf, 35 V
C4	Capacitor 22 uf, 15 V
C5	Capacitor 1.0 uf, 35 V
C6	Capacitor 0.33 uf, 100 V
C7	Capacitor 56 uf, 6 V
C9	Capacitor 1.0 uf, 100 V
C10	Capacitor 0.33 uf, 100 V

REFERENCE DESIGNATION	NOMENCLATURE
C11	Capacitor 0.33 uf, 100 V
CR1	Semiconductor 150 MA, 225 V
CR2	Semiconductor 150 MA, 225 V
CR3	Semiconductor 3 amp, 100 V
CR4	Semiconductor 250 MA, 100 V
CR5	Semiconductor 150 MA, 225 V
CR6	Semiconductor 150 MA, 225 V
CR7	Semiconductor 0.25 W, 18 V
CR8	Semiconductor 3 amp 100 V
CR9	Semiconductor 150 MA, 225 V
L1	Reactor
L2	Choke, Radio Frequency
Q1	Transistor 2N3415
Q2	Transistor 2N3415
Q3	Transistor 36885 (mfd by 02735)
Q4	Transistor EP174 (mfd by 01295)
Q5	Transistor 2N3415
Q6	Transistor 2N3415
Q7	Transistor 36885 (mfd by 02735)
Q8	**Transistor EP174 (mfd by 01295)**
R1	Resistor 6.81 K ohm 1/4 W
R2	Resistor 13 K ohm 1/4 W
R3	Resistor 1.0 K ohm 2 W
R4	Resistor 24 ohm 1/4 W
R5	Resistor 121 K ohm 1/4 W
R6	Resistor 22.1 K ohm
R7	Resistor 33.2 K ohm 1/4 W
R8	Resistor 33.2 K ohm 1/4 W
R9	Resistor 1.5 K ohm 1/4 W
R10	Resistor 12.1 K ohm 1/4 W
R11	Resistor 15 K ohm 1/4 W
R12	Resistor 3.01 K ohm 1/4 W
R13	Resistor 26.1 K ohm 1/4 W
R14	Resistor 24 ohm 1/4 W
R15	Resistor 1.0 K ohm 2 W
R16	Resistor 10 K ohm 2 W
R17	Resistor 100 ohm 1/4 W
R18	Resistor 100 ohm 1/4 W

TM 6125-240-15-C5 -3

Figure 7.1. CSV2215-3 Regulator Component Location Diagram

NOTE

Steps (8) thru (15) apply only to the 4B93-1-A regulator.

(8) Interconnect the equipment as described in paragraph 45.

(9) Set the power supply to provide 28 volt dc input and set the bench test set to supply a full load on the inverter.

(10) Operate the inverter as described in paragraph 46.

(11) The abnormal conditions noted in paragraph 50.e are those which might be observed with the regulalR controlling a motor-generator operating under normal input/load conditions as explained in paragraphs 42 and 46.

(12) Regulator adjustments should be attempted to correct the abnormal conditions. The voltage adjustment variable resistor (P/O 20B, figure 8.3) should be reset in cases of high or low voltage. The frequency adjustment variable resistor (P/O 20B, figure 8.3) should be reset in cases of high or low frequency.

(13) Refer to figures 7.2 and 8.3 for location of components. The circuit card assembly and connecting leads should be inspected for proper and unbroken connections before troubleshooting components. Refer to the "trouble" which is particular to the defective regulator. Unless it can be visually noted that a part is defective (burned, broken, etc.), refer to the troubleshooting paragraph 50.e below.

(14) In checking components on circuit card assembly, pointed probes will be required to puncture the coating. Replacement of components and repair of coating must be done at Depot maintenance level only.

(15) An alternate troubleshooting procedure using a slidewire test circuit is provided in paragraph 50.f.

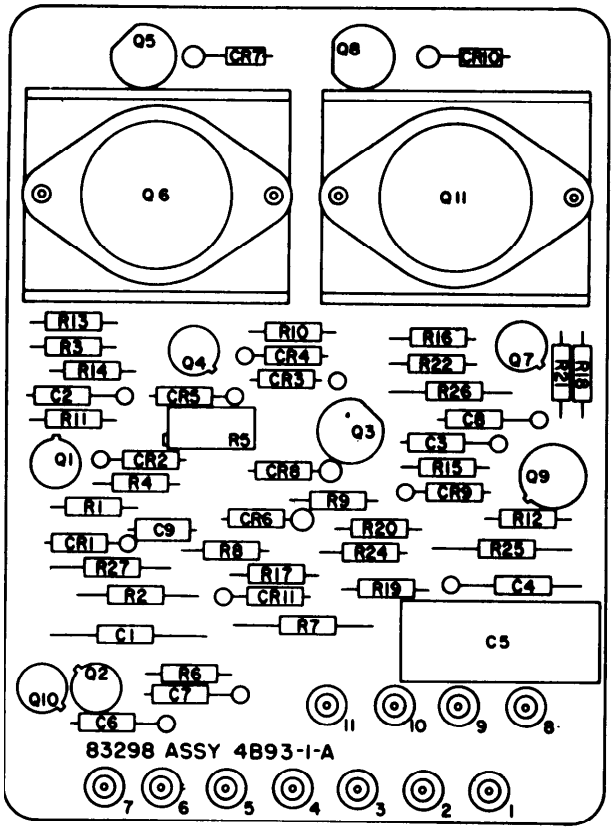
b. CSV1080–1 Troubleshooting Chart.

Item	Abnormal condition	Point of measurement		Dc voltage (volts)	Remedy
		From –	To +		
1	High voltage	2	13	More than 10	Replace A3
2	High voltage	2	11	Less than 1	Replace A3
3	High voltage	12	13	Less than 10.2 *	Replace A2
4	Low voltage	2	13	Less than 10	Replace A2
5	Low voltage	2	11	More than 20	Replace A2
6	High frequency	2	33	Less than 10	Replace A1
7	High frequency	10	8	More than 20	Replace A1
8	Low frequency	2	33	More than 10	Replace A1
9	Low frequency	2	10	Less than 1	Replace A1
10	Low frequency	32	33	Less than 12 *	Replace A2

* Indicates ac voltage.

c. CSV1186–3 Troubleshooting Chart.

Condition	Probable cause	Remedy
Low voltage	Power transistor Q6 open	Replace transistor Q6.
	Shorted free-wheeling diode CR8	Replace diode CR8.
High voltage	Power transistor Q6 shorted	Replace transistor Q6.
	Freewheeling diode CR8 open	Replace diode CR8.
Low frequency	Power transistor Q3 shorted	Replace transistor Q3.
	Open freewheeling diode CR9	Replace diode CR6.
High frequency	Open power transistor Q3	Replace transistor Q3.
	Shorted freewheeling diode CR9	Replace diode CR9.



REFERENCE DESIGNATION	NOMENCLATURE
C1	Capacitor 0.047 uf, 100V
C2	Capacitor 1.5 uf, 20V
C3	Capacitor 1 uf, 35V
C4	Capacitor 10 uf, 20V
C5	Capacitor 0.22 uf, 400V
C6	Capacitor 1 uf, 35V
C7	Capacitor 4.7 uf, 10V
C8	Capacitor 0.22 uf, 35V
C9	Capacitor 0.01 uf, 200V
CR1	Semiconductor 819782-22 (mfd by 83298)
CR2	Semiconductor 1543026-2 (mfd by 83298)
CR3	Semiconductor 819782-22 (mfd by 83298)
CR4	Semiconductor 819782-22 (mfd by 83298)
CR5	Semiconductor 1543026-2 (mfd by 83298)
CR6	Semiconductor 1546913-2 (mfd by 83298)
CR7	Semiconductor 1546913-2 (mfd by 83298)
CR8	Semiconductor 1546913-2 (mfd by 83298)
CR9	Semiconductor 819782-22 (mfd by 83298)
CR10	Semiconductor 1546913-2 (mfd by 83298)
CR11	Semiconductor 819782-26 (mfd by 83298)
Q1	Transistor 2N3251
Q2	Transistor 2N3251
Q3	Transistor 1544542 (mfd by 83298)
Q4	Transistor 2N2907A
Q5	Transistor 1544542 (mfd by 83298)
Q6	Transistor 2N3772
Q7	Transistor 2N2907A
Q8	Transistor 1544542 (mfd by 83298)
Q9	Transistor 1545843-3 (mfd by 83298)
Q10	Transistor 2N3251
Q11	Transistor 2N3772
R1	Resistor 10 K ohm 1/8 W
R2	Resistor 37.4 K ohm 1/4 W
R3	Resistor 10 K ohm 1/8 W
R4	Resistor 24.9 K ohm 1/8 W
R5	Resistor 10 K ohm 1 W
R6	Resistor 1 K ohm 1/8 W
R7	Resistor 499 ohm 1/2 W
R8	Resistor 1 K ohm 1/8 W
R9	Resistor 10 K ohm 1/8 W
R10	Resistor 100 ohm 1/8 W
R11	Resistor 12.1 K ohm 1/8 W
R12	Resistor 15 K ohm 1/8 W
R13	Resistor 2 K ohm 1/8 W
R14	Resistor 2490 ohm 1/8 W
R15	Resistor 750 ohm 1/8 W
R16	Resistor 2 K ohm 1/8 W
R17	Resistor 6810 ohm 1/8 W
R18	Resistor 10 K ohm 1/8 W
R19	Resistor 26.1 K ohm 1/8 W
R20	Resistor 49.9 K ohm 1/8 W
R21	Resistor 4990 ohm 1/8 W
R22	Resistor 3010 ohm 1/8 W
R24	Resistor 3010 ohm 1/8 W
R25	Resistor 69.8 K ohm 1/8 W
R26	Resistor 2 K ohm 1/4 W
R27	Resistor 37.4 K ohm 1/4 W

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Figure 7.2. 4B93-I -A regulator, component location diagram

d. CSV2215-3 Regulator Troubleshooting Chart.

Item	Trouble	Probable Cause	Remedy
1	Low frequency	1. Q4 shorted or CR4 shorted	Check Q4 collector to emitter and collector to base junctions with an ohmmeter. If either junction checks shorted, remove the emitter lead and check to ensure that CR4 is not shorted. If Q4 and/or CR4 require replacement, check Q3 per following procedure.
		2. Q3 shorted	Check Q3 from collector to emitter with an ohmmeter. If not shorted, check Q3 collector-base and emitter base for shorts. Replace Q3 if any junction checks shorted.
		3. Q1 and Q2 open	Check Q1 and Q2 base-emitter and base-collector junctions with an ohmmeter. If either junction is open, replace the defective transistor.
		4. CR3 shorted	Check CR3 from anode to cathode with an ohmmeter. Replace if it is shorted.
		5. RI shorted or low resistance	Measure R1 resistance with an ohmmeter; reverse ohmmeter leads and measure again. One of these readings must be in excess of 6000 ohms; replace R1 if both readings are low.
		6. R2 low resistance	Repeat previous procedure for R2. If both readings are less than 12K ohms, replace R2.
		7. R5 or R6 high resistance or open	Measure R5 and R6 with an ohmmeter. This resistance should be 130K and 24K maximum respectively. Replace as required.
		8. CR5 shorted or open	Check CR5 from anode to cathode with an ohmmeter. Replace if it is shorted or open.
		9. CR4 shorted	Check CR4 for a short with an ohmmeter. The meter reading should dip toward zero ohms, then as the capacitor charges, increase to at least 10K ohms. Replace if shorted.
		10. Cl or C2 defective	Remove Cl and C2 from the circuit and measure the capacitance with available equipment. The value should be 0.013 to 0.017 microfarads, respectively. Replace either capacitor that is out of tolerance.
2	High frequency	1. Q4 open, CR3 open, CR4 open	Check Q4 base-emitter and base-collector junctions with an ohmmeter. If either junction checks open, replace Q4. If Q4 is replaced, check CR3 and CR4 horn anode to cathode for open junctions and check Q3 per fourth procedure listed for this "trouble." Replace as required.
		2. Q1 or Q2 shorted	Check Q1 and Q2 collector-emitter and collectorbase junctions for shorts with an ohmmeter. Replace Q1 or Q2 if either junction checks shorted.
		3. L1 defective	Connect an ohmmeter across the two lead terminals of L1 reactor. (Preferablythe ohmmeter should be placed across the parallel capacitor, C2. Checking reactor in this manner will ensure a proper printed circuit connection and also eliminate the possibility of damaging the fine inductor wire with point probes.) The resistance should measure 200 to 300 ohms. Replace L1 if the resistante is outside these limits. **NOTE** If after completing all following procedures, the fault is not discovered, remove L1 and check the inductance on available equip ment with the adjustable core removed. Replace the core if the inductance is less than 0.4 henry.

d. CSV2215-3 Regulator Troubleshooting Chart (Continued).

Item	Trouble	Probable Cause	Remedy
		4. Q3 open, CR.3 open	Remove Q3 from the circuit board and check base-emitter and base-collector junctions with an ohmmeter. If either junction checks open, replace Q3. If Q3 is replaced, check CR3 from anode to cathode for an open or shorted junction.
		5. R3 open or high resistance	Measure R3 resistance with an ohmmeter; reverse ohmmeter leads and measure again. If either of the readings is in excess of 1200 ohms, replace R3.
		6. R1, R2 or R4 open or high	Repeat the preceding procedure for R1, R2 and R4. The greater reading must be less than 8000 ohms for R1, 15,000 ohms for R2 and 100 ohms for R4.
		7. CR1 open or shorted	Check CR1 with an ohmmeter. Replace if it measures either shorted or open.
		8. CR9 open	Check CR9 with an ohmmeter. Replace if it measures open.
		9. C1 or C2 defective	Remove C1 and C2 from the circuit and measure the capacitance with available equipment. The value should be 0.013 to 0.017 microfarads, and 0.13 to 0.17 microfarads, respectively. Replace either capacitor that is out of tolerance.
3	No output voltage	1. Q8 open	Check Q8 base-emitter and base-collector junctions with an ohmmeter. If either junction checks open, replace Q8. If Q8 is replaced, check Q7 and CR8 per fifth procedure listed for this "trouble." Replace parts as required.
		2. Q5 or Q6 shorted	Check Q5 and Q6 collector-emitter and collector-base junctions with an ohmmeter. If either junction checks shorted, replace the defective transistor.
		3. CR7 shorted	Check CR7 for a short from anode to cathode with an ohmmeter (use ohmmeter with less than 18 volt batteries). Injunction checks short, replace CR7.
		4. R15 open or high resistance	Measure R15 resistance with an ohmmeter. Reverse ohmmeter leads and measure again. If either reading is in excess of 1200 ohms, replace R15.
		5. Q7 open, CR8 open	Remove Q7 from the circuit board and check base-emitter and base-collector junctions with an ohmmeter. If either junction checks open, replace Q5. If Q5 is replaced, also check CR8 from anode to cathode for open junction.
4	Low output voltage	1. CR7 zener voltage low	Check CR7 zener diode either on or off the circuit board with device suitable for measuring the zener voltage. With reverse current of 50 micro-amps, remeasure the zener voltage. Replace CR7 if the zener voltage is less than 17 volts.
		2. R16 open (if connected to regulator)	Measure the resistance between the center tap (w/red lead) and the low potential (w/green lead) side of R16 variable resistor. This resistance must be less than 12K ohms; replace R16 if outside limit.
		3. R11 or R12 open or high resistance	Measure R11 and R12 resistance with an ohmmeter. The resistance must be less than 17K and 4K ohms, respectively. Replace parts as required.

d. CSV2215-3 Regulator Troubleshooting Chart (Continued).

Item	Trouble	Probable Cause	Remedy
		4. R7 or R8 shorted or low resistance	Mcasure R7 and R8 resistance with an ohmmeter. Each resistor must measure 30K ohms minimum. Replace either resistor that outside limit.
5	High output voltage	1.Q8 shorted, CR8 open.	Check Q8 collector-emitter and collector-base junctions with an ohmmeter. If either junction is shorted. replace Q8. Also. if Q8 is replaced. check CR8 from anode to cathode for open circuit and check Q7 per following procedure. Replace parts as required.
		2. Q7 shorted	Check Q7 collector-emitter and collector-base junctions for short circuits. Replace Q7 if either junction is shorted.
		3. Q5 or Q6 open	Check CR7 base-emitter and base-collector junctions with an ohmmeter. Replace Q5 or Q6 if either junction is open.
		4. CR7 zener open or high zener voltage	Check CR7 as a normal diode with an ohmmeter, from anode to cathode for an open circuit. If it checks good, measure the zener voltage, using any suitable device! either in or out of the circuit, with 50 micro-amps reverse current. Replace CR7 if the zener voltage is greater than 19 volts or if it checks open as a normal diode.
		5. R16 open or high resistance (if connected to regulator)	Connect an ohmmeter to the centertap (w/red lead) terminal Of variable resistor R16 and to the high potential (w/orn lead) terminal of same. Change setting to both ends of travel, The resistance must read less than 10 ohms at one end and 10K to 12K at the other end of travel. If not, remove and replace R16.
		6. CR6 defective	With an ohmmeter check CR6 from anode to cathode for a short or open. Replace as required.
		7. R7 or R8 open or high resistance	Measure R7 and R6 resistances with an ohmmeter. Replace either resistor if it measures greater than 35K ohms.
		8. R11 shorted or low resistance	Measure R11 resistance with an ohmmeter. If it measures less than 13K ohms, replace it.
		9. R12 shorted or low resistance (C 12 de fective)	Measure resistance of R12 with an ohmmeter. If it measures less than 2.5K ohms, remove and recheck it. If it checks greater than 2.5K out of the circuit, it is good. C7 then should be replaced since it will either be shorted or have excessive leakage.
6	Frequency unstable	1. C5 defective	Remove C5 from circuit and measure the capacitance by any convenient means. The value should be between 0.8 and 1.2 microfarads. Replace, if not within tolerance.
		2. C4 defective	Remove C4 from circuit and measure the capacitance by any convenient means. The value should be between 18 and 26 microfarads. Replace, if not within tolerance.
		3. R9 defective	Measure the resistance of R9 with an ohmmeter. The resistance should be between lK ohms and 2K ohms. Replace, if not within tolerances.
7	voltage unstable	1. C6 defective	Remove C6 from circuit and measure the capacitance by any convenient means. Replace C6 if its value is not between 0.27 and 0.39 microfarads.

e. *4B9-1-A Troubleshooting Chart*

Item	Inverter Abnormal (Condition)	Probable Cause	Remedy
1	Frequency out of tolerance	Frequency adjustment resistor R5 incorrectly set	Set variable resistor R5 for correct frequency
		Zener reference changed	Check (X2, CR3, CR4 and CR6. Replace faulty components.
2	Poor frequency regulation	Zener reference changed	Check CR2, CR3, CR4 and CR5. Replace faulty components.
		Incorrect capacitor values	Check all capacitors in frequency section. Replace faulty components.
3	Low frequency	shorted transistors	Check Q4, Q5, Q6 and associated components. Replace faulty components.
4	High frequency	Open transistors	Check Q4, Q5, Q6 and associated comp nents. Replace faulty components.
5	AC output voltage out of tolerance	Voltage ac adjustment resistor R10 incorrectly set	Set variable resistor R10 for correct voltage.
		Zener reference changed	Check CR2, CR3, CR4 and CR5. Replace if faulty.
6	Excessive modulation of ac output voltage	Faulty feedback capacitor C4	Check C4. Replace faulty component.
7	Poor voltage regulation	Faulty input capacitor C5	Check C5. Replace faulty component.
		Faulty reference	Check CR2, CR3, CR4 and CR5. Replace faulty components.
8	High output voltage	Shorted transistors	Check Q7, Q8, Q9, Q11 and associated components Replace faulty components.
9	Low output voltage	Open transistors	Check Q7,Q8,Q9andQ11. Replace faulty components.

50.1 4B93-1-A Regulator Slidewire Troubleshooting Test Procedure.

(figs. 7.3 and 16.2)

a. General. If the inverter provides an output, but the voltage level or frequency is out of tolerance and cannot be adjusted by using variable resistors R10 and R5, perform the slidewire test given in paragraph c below to determine if the fault lies in the rotary portion or control circuits. Use schematic diagram figure 16.2, and component location diagram figure 7.2 to assist in troubleshooting.

b. Test Equipment. In addition to test equipment listed in paragraph 44, the following is required to setup the slidewire test circuit shown in figure 7.3:

(1) Two 50-ohm slidewire resistors,

(2) Two 50-ohm, 25 watt resistors,

(3) Oscilloscope,

c. Slidewire test. Setup the test circuit as shown in figure 7.3 and proceed as follows:

(1) Set slidewire resistor R2 for minimum resistance and set slidewire resistor R4 for maximum resistance. Apply 28 volts dc to input connector of the inverter.

(2) S1OW1Y increase the resistance of slidewire resistor R2 until the output frequency is 400 Hz.

(3) slowly decrease the resistance of slidewire resistor R4 until the output voltage is 115 volts ac.

(4) Check that the indications on ammeters M5 and M6 and voltmeters M2 and M4 are within the limits specified below:

Meter	*Value*
M2	18 to 21 volts-de
M5	0.6 to 0.8 amps dc
M4	7.5 to 9.5 volts dc
M6	0.9 to 12 amps dc

(5) If the inverter cannot be controlled by the slidewire resistors, or if conditions of instability, such as excessive voltage modulation exist, the fault is probably in the rotary portion of the inverter and not in the regulator portion. If the values specified in step (4) are obtained, the rotary section is probably good and the test may be continued.

(6) Apply inverter input power and adjust slidewire resistor R4 until the ac output voltage is 115 volts. Adjust slidewire resistor R2 until frequency is 400 Hz. Turn variable resistor R10 (on inverter) clockwise until voltmeter M3 indicates approximate y 28 volts dc and waveshape, as indicated on an oscilloscope connected across voltmeter M3, is a sine wave of l-volt amplitude, riding on a 28 volt dc level. Turn variable resistor R10 counterclockwise 'until voltmeter M3 indicates approximately 0 volts and the waveshape, as indicated on an oscilloscope connected across voltmeter M3, is a straight line at the 0-volt reference.

NOTE

Variable resistor R5 is mounted on the regulator board. Variable resistor R10 is mounted on the control box.

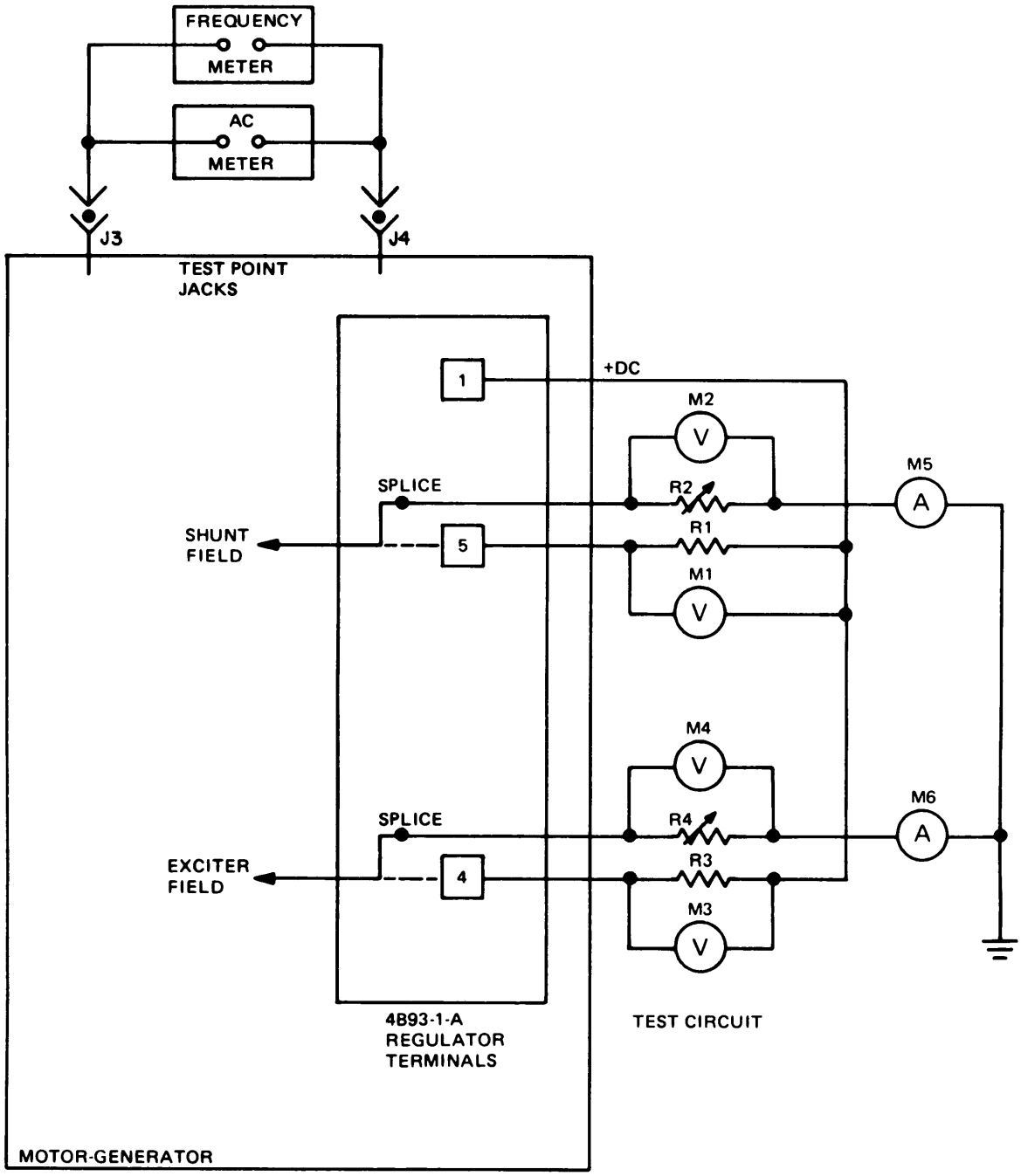
(7) If the voltage and waveshape obtained in step (6) are not as specified, the ac voltage regulator section is operating abnormally. The abnormal operation may be due to an undervoltage or overvoltage condition existing in the regulator. Check transistors Q7, Q8, Q9, Q10 and associated circuit components.

(8) To test the frequency regulator section, proceed with step (9).

(9) Adjust slidewire resistor R4 until the ac output voltage is 115 volts. Adjust slidewire resistor R2 until the frequency is 400 Hz. Turn variable resistor R5 (in regulator) counterclockwise until voltmeter Ml indicates approximately 0 volts and the waveshape, as indicated on an oscilloscope connected across voltmeter Ml, indicates a straight line at the 0-volt reference. Turn variable resistor R5 clockwise until voltmeter Ml indicates approximately 28 volts dc and the waveshape, as indicated on an oscilloscope connected across voltmeter Ml, is a sine wave of 1-volt magnitude riding on a 28-volt dc level.

(10) If the voltages and waveshapes obtained in step (9) are not as specified, the frequency regulator section is operating abnormally. The abnormal operation may be due to an underfrequency or over-frequency condition existing in the regulator. Check transistors Q4, Q5, Q6 and associated circuit components.

(11) When troubleshooting is completed, disconnect the inverter from test setup and reconnect all leads.



NOTES:
1. DISCONNECT EXISTING WIRES FROM TERMINALS 4 AND 5, SPLICE AND REROUTE TO TEST CIRCUIT.
2. CONNECT NEW WIRES FROM TERMINALS 4 AND 5 TO TEST CIRCUIT.

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Figure 7.3. Slidewire troubleshooting test circuit for 4B93-1-A regulator

Section IV. REPAIRS

51. General Parts Replacements Techniques

a. The disassembly, repair, replacement, and reassembly of the inverter in described in b(1) through (5) below. Before proceeding with overhaul, check to see that replacement parts are available.

b. Most of the parts of the inverter can easily be removed and replaced without special procedures. The following precautions apply:

(1) Disconnect the inverter from the power source before attempting removal and replacement of parts.

(2) Before a part is unsoldered, observe the position of every lead to that part, and identify each lead that is to be removed with reference to its soldered terminal. Tag each lead, or draw a small sketch of the wiring to the component and note the color coding and lead designation.

(3) Use a pencil-type soldering iron and a heat sink (such as long-nosed pliers) when unsoldering and soldering leads to prevent damage to adjacent components.

(4) Where damaged parts must be replaced, use identical replacement parts. The new part must be placed in the same mounting position as the one it replaces.

(5) Before soldering, carefully clean the terminals and lead connections. Use sufficient heat to make a well-soldered connection. A poorly soldered connection that causes faulty operation is difficult to locate.

52. Special Tools and Equipment

The following special tools are required for repair of the inverter,

a. Bearing puller,

b. Spring scale.

c. Dummy brushes.

52.1 Removal and Replacement of Ac Electrical Contact Brushes

Remove the inverter from the aircraft (para 23).

WARNING

Make sure that the 28-volt dc input power to the inverter is turned off.

a. *Removal of A c Contact Brushes.* Remove the two brush access covers. Remove a nut, lead, and brush cap from each of the ac brush holders. Remove the brushes one at a time. Two straight and two angle electrical contact brushes are installed in the ac endbell. Attach a tag to each brush as it is removed, and attach a tag to the endbell indicating brush position to facilitate reinstallation of the brushes.

b. *Inspection of AC Contact Brushes.*. Check the length and condition of the brushes. If they are worn down below the wear mark, replace them with new brushes.

c. *Replacement of Ac Contact Brushes.* If the brushes are in satisfactory condition, reinstall them in their origins] position. If the brushes are unsatisfactory, install two new straight brushes and two new angle brushes in the respective brush holders as tagged at removal. Install an electrical brush cap, lead, and nut on each holder to secure the brushes.

d. Ac *Contact Brush* Run-In. After installing new brushes, run in the brushes to obtain a proper seating. Seat the brushes as follows:

(1) Apply 28 volts dc to energize the inverter.

(2) Use a load bank and apply a load to the inverter.

(3) Operate the equipment until the brushes contact the sliprings surface at least 75 percent in direction of rotation and 100 percent in the longitudinal direction.

(4) Remove the load. Turn off the 28 volt dc to the inverter.

(5) Install inverter (para 23).

52.2 Removal and Replacement of Dc Electrical Contact Brushes

Remove the inverter from the aircraft (para 23).

WARNING

Make sure that the 28-volt dc input power to the inverter is turned off.

a. Removed of Dc Contact Brushes. Remove the dc brush access cover (fig. 4 or 4.1) from the inverter, Remove the dc brushes, one at a time, and attach a tag to each brush as it is removed; attach a tag to the dc endbell assembly, indicating the dc brush position to facilitate reinstallation of the dc brushes.

b. Inspection *of Dc Contact Brushes.* Check the length and condition of the brushes. If they are worn clown below the wear mark, replace them with new brushes.

c. Replacement of Dc Contuct Brushes. If the brushes are in a satisfactory condition, reinstall them in their original position. If the brushes are unsatisfactory, install four new brushes in the respective brush holders as tagged at removal.

d. Dc Contact Brush Run-In. After installing new brushes, run in the brushes to obtain a proper seating. Seat the brushes as follows:

(1) Apply 28 volts dc to energize the inverter.

(2) Use a load bank and apply a load to the inverter.

(3) Operate the inverter until the brushes contact the commutator surface at least 75 percent in the direction of rotation and 100 percent in the longitudinal direction.

(4) Remove the load. Turn off the 28 volts dc to the inverter.

53. Disassembly of Inverter Components

a. Voltage and Frequency Regulator Housing, CSV1080-1 and CSV1186-3 (fig. 8).

(1) Remove the eight machine screws (1), the Lockwashers (2), and the flat washers (3). Lift off the regulator housing cover (4).

(2) Remove one nut (6), the lockwasher (6), and the flat washer (7) to disconnect the regulator capacitor (62) and rotating section dc plus leads from the terminal board (43). Remove the one machine screw (8), the lockwasher (9), and the flat washer (10) from each corner of the regulator housing (67) to disconnect the ground leads of connector J2 (39), and the rotating section (72).

(3) Remove the nut (12), lockwasher (13), two flat washers (14), and one machine screw (15) to detach each loop clamp (16) from connector J2 (39). Remove the four machine screws (36), lockwashers (37), flat washers (38), and then remove connector J2 (39) from the regulator housing (67).

(4) Back out the five terminal board screw terminals to disconnect the test point jack lead and the ac stator leads from the terminal board (51).

(5) Remove the adjustment locknut (73), panel nut (74), flat washer (75), and the instruction plate (11) from voltage adjustment resistor A2R7 (33). Withdraw voltage adjustment resistor A2R7 (33) rearward from the regulator housing (67).

(6) Remove the two nuts (17) and lockwashers (18) to detach the alternator leads and shunt leads from the regulator. Remove four machine screws (19), lockwasher (20), flat washers (21), two machine screws (22), lockwashers (23), and flat washers (24), Lift out the CSV1080-1 regulator.

NOTE

For removal and disassembly of 4B93- 1-A regulator refer to paragraph 53c.

(7) To disassemble the CSV1080-1 regulator, remove four self-locking nuts (25), lockwashers (26), flat washers (27) and machine screws (28, 29, and 30) to separate the circuit board assemblies (31, 32, and 34) from the regulator base (35). Note the position and unsolder the leads from voltage adjustment resistor A2R7 (33) to free it from the power circuit board assembly (34).

NOTE

Do not attempt to disassemble the circuit board assemblies.

(8) To remove the CSV1186-3 regulator, remove two machine screws (35A), lockwashers (35B), and flat washers (35C) to disconnect the two leads connected to the regulator.

(9) Remove four machine screws (35D), lockwashers (35E), flat washers (35F) and two machine screws (35G), lockwashers (35-H), and flat washers (35I). Lift out CSV1186-3 regulator (35J).

NOTE

If the CSV1186-3 regulator tests proved satisfactory, do not disassemble. If regulator fails tests, disassemble only to the extent necessary to replace defective circuit board transistor or semiconductor.

(10) Cut tie cords only if necessary to ease removal of defective components.

NOTE

Use a heat sink during soldering operations to avoid overheating electrical components.

(11) Before unsoldering leads from semiconductors (13) or transistors (20), note disposition and routing of leads to facilitate reassembly.

(12) Remove on machine screw (40, figure 8), lockwasher (41), and flat washer (42) to free terminal board (43). Remove one machine screw (44), lockwasher (45), and flat washer (46) to detach the regulator housing assembly from the rotating section (72).

(13) Back off locknuts (76) from test point jacks (47 and 48) and remove test point jacks and leads from the regulator housing. Do not remove the leads or terminals from the test point jacks.

(14) Remove two screw assembled washers (49) and flat washers (50) to detach terminal board (51), and designation plate (52) from bottom of the regulator housing (67).

(15) Remove one nut (53), flat washer (54), lockwasher (55), and machine screw (56), to disconnect the connector lead from the radiofrequency choke (61). Remove two machine screws (57), lockwashers (58), and flat washers (59), to radiofrequency choke (61), and regulator capacitor (62). Separate the radiofrequency choke (61) from the regulator capacitor (62) only if replacement is required.

(16) Remove four machine screws (63), lockwashers (64), and flat washers (65), and then remove connector J1 (66) from the regulator housing (67).

(17) Remove four nuts (68) and flat washers (69) from the stud (70), and then remove adapter (71) from rotating section (72).

b. Voltage and Frequency Regulator Housing, CSV2215-3 (fig. 8.2).

(1) Remove the eight machine screws (1), the lockwashers (2), and the flat washers (3). Lift off the regulator housing cover (4).

(2) Remove one nut (5), the lockwasher (6), and the flat washer (7) to disconnect the regulator capacitor (47) and rotating section dc plus leads from the terminal board (28). Remove the one machine screw (8), the lockwasher (9), and the flat washer (10) from each corner of the regulator housing (52) to disconnect the ground leads of connector J2 (24), and the rotating section (57).

(3) Remove the nut (12), lockwasher (13), two flat washers (14), and one machine screw (15) to detach each loop clamp (16) from connector J2 (24). Remove the four machine screws (21), lockwashers (22), flat washers (23), and then remove connector J2 (24) from the regulator housing (52).

(4) Back out the five terminal board screw terminals to disconnect the test point jack lead and the ac stator leads from the terminal board (36).

(5) Remove the adjustment locknut (58), panel nut (59), flat washer (60), and the instruction plate (11) from voltage adjustment resistor R16 (part of item 20). Withdraw voltage adjustment resistor rearward from the regulator housing (52).

(6) Remove screws (17), lockwashers (18), flat washers (19), and CSV2215-3 regulator (20) from housing (52).

(7) Before disassembling the regulator, inspect for mechanical damage. Examine for loose connections to variable resistor (R16), (part of item 20). Check printed wiring board for cracks, chips, blisters, discoloration, and scored or chipped protective coating.

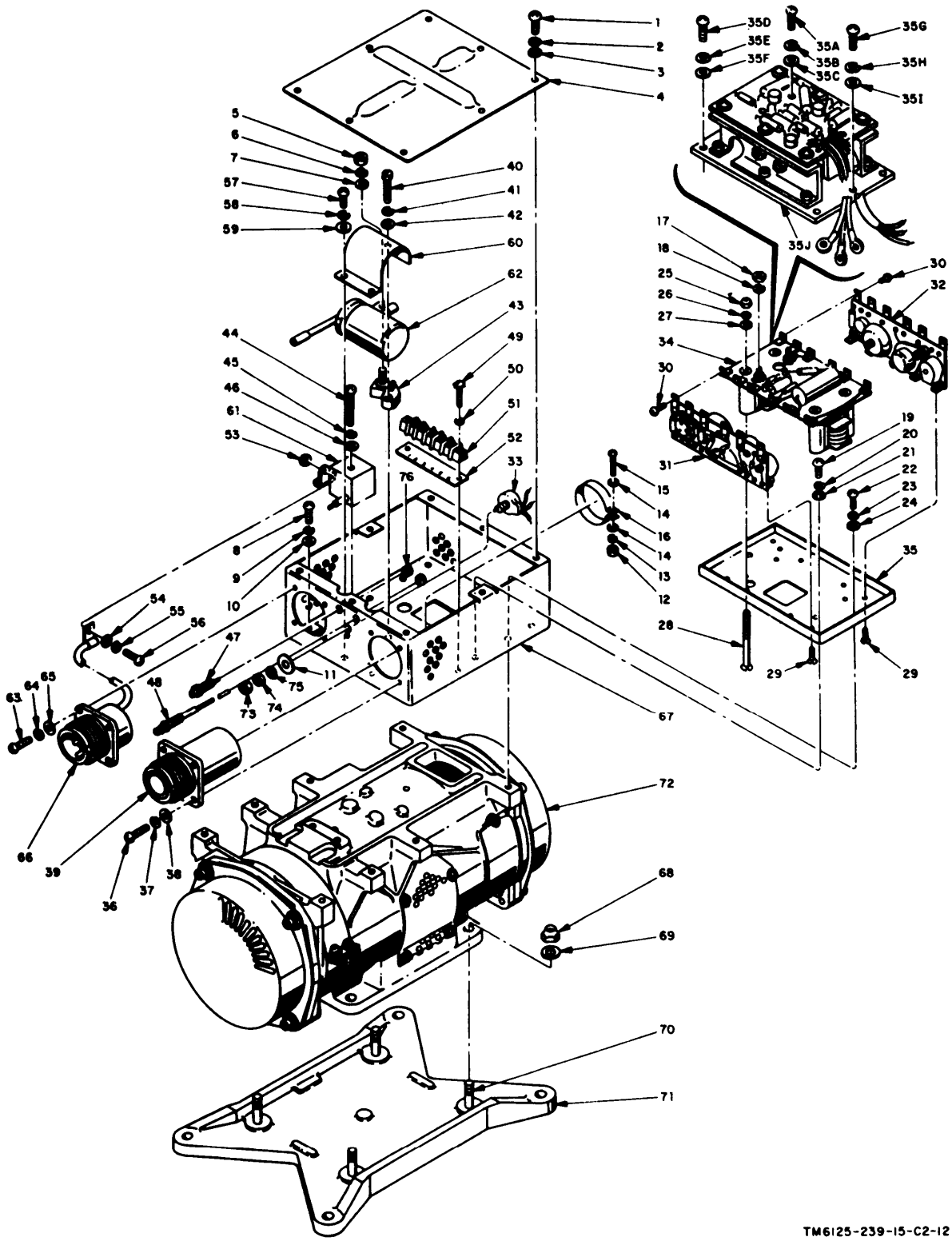
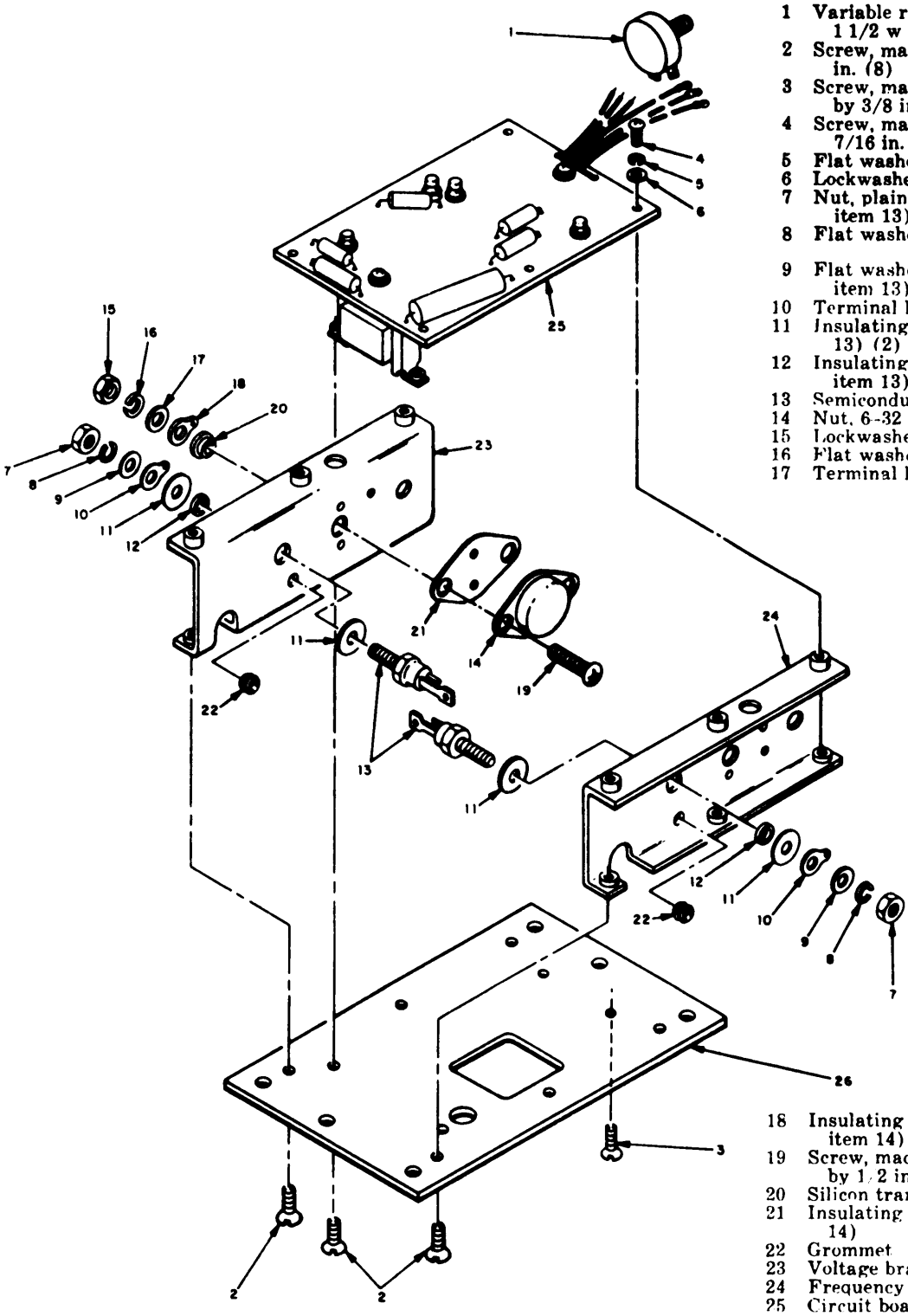


Figure 8. Inverter components, exploded view.

1 Screw, machine, rh, No. 6-32 by 1/4 in. (8)
2 Lockwasher, No. 6 (8)
3 Flash washer, No. 6 (8)
4 Regulator housing cover
5 Nut, plain hex, No. 10-32 (1)
6 Lockwasher, No. 10
7 Flat washer, No. 10
8 Screw, machine, rh, No. 8-32 by 5/8 in. (2)
9 Lockwasher, No. 8 (2)
10 Flat washer, No. 8 (2)
11 Instruction plate
12 Nut, electrical hex, No. 4-40 (2)
13 Lockwasher, No. 4 (2)
14 Flat washer. No. 4 (2)
15 Screw, machine, rh, No. 4-40 by 3/8 in. (2)
16 Loop c!amp (2)
17 Nut, plain hex, No. 8 (2)
18 Lockwasher, No. 8 (2)
19 Screw, machine, rh, No. 6–32 by 7/16 in. (4)
20 Lockwasher, No. 6 (4)
21 Flat washer, No. 6 (4)
22 Screw, machine, No. 8-32 by 7/16 in. (2)
23 Lockwasher, No. 8 (2)
24 Flat washer, No. 8 (2)
25 Nut, self-locking, hex, No, 6-32 (4)
26 Lockwasher, No. 6 (4)
27 Flash washer, No. 6 (4)
28 Screw, machine, No. 6-32 by
29 Screw, machine, No. 4-40 by 3/16 in. (8)
30 Screw, machine, rh, No. 4-40 by 3/16 in. (12)
31 Voltage circuit board assembly
32 Frequency circuit board assembly
33 Voltage adjustment resistor A2R7
34 Power circuit board assembly
35 Regulator base
35A Screw, machine, rh, No. 4-40 by 5/16 in. (2)
35B Lockwasher, No. 4 (2)
35C Flat washer, No. 4 (2)
35D Screw, machine, rh, No. 6-32 by 3/8 in. (4)
35E Lockwasher, No. 6 (4)
35F Flat washer, No. 6 (4)
35G Screw, machine, rh, No. 8-32 b 7/16 (2)
35H Lockwasher, No. 8 (2)
35I Flat washer, No. 8 (2)
35J CSV1186-3 regulator
36 Screw, machine, rh, No. 4-40 by 3/8 in. (4)
37 Lockwasher, No. 4 (4)
38 Flat washer, No. 4 (4)
39 Connector J2
40 Screw, machine, rh, No. 8-32 by 1 3/8 in. (1)
41 Lockwasher, No. 8 (1)
42 Flat washer, No. 8 (1)
43 Terminal board
44 Screw, machine, rh, No. 8-32 by 1 3/8 in. (1)
45 Lockwasher, No. 8 (1)
46 Flat washer, No. 8 (1)
47 Test point jack (red)
48 Test point jack (black)
49 Screw assembled washer, rh, No. 6-32 by 1/2 in. (2)
50 Flat washer, No. 6 (2)
51 Terminal board TB1
52 Designation plate
53 Nut, plain hex, 8-32 (1)
54 Flat washer, No. 8 (1)
55 Lockwasher, No. 8 (1)
56 Screw, machine, rh, No. 8-32 by 5,/16 in. (1)
57 Screw, machine, rh, No. 6-32 by 3/8 in. (2)
58 Lockwasher, No. 6 (2)
59 Flat washer, No. 6 (2)
60 Capacitor clamp
61 Radiofrequency choke
62 Regulator capacitor
63 Screw, machine, rh, No, 4-40 by 3/8 in. (4)
64 Lockwasher, No. 4 (4 reqd)
65 Flat washer, No. 4 (4 reqd)
66 Connector J1
67 Regulator housing
68 Nut, self-locking, hex, 5/16-24 (4 reqd)
69 Flat washer, 5/16 in. (4 reqd)
70 Stud, plain, 5/16-24 by 1 1/4 in. (4 reqd)
71 Adapter
72 Rotating section
73 Locknut, hex, 1/4-32, thin
74 Panel nut, 1/4–32, thin
75 Flat washer, 1/4 in.
76 Locknut, hex

Figure 8—Continued.



1 Variable resistor, 1K ohm, 1 1/2 w
2 Screw, machine, 6–32 by 5/16 in. (8)
3 Screw, machine, rec hd, 4–40 by 3/8 in. (2)
4 Screw, machine rd hd, 6–32 by 7/16 in. (6)
5 Flat washer, No. 6 (6)
6 Lockwasher, No. 6 (6)
7 Nut, plain hex, No. 10 (part of item 13)
8 Flat washer, No. 10
9 Flat washer, No. 10 (part of item 13)
10 Terminal lug
11 Insulating washer (part of item 13) (2)
12 Insulating bushing (part of item 13)
13 Semiconductor
14 Nut, 6-32 (2)
15 Lockwasher, No. 6 (2)
16 Flat washer, No. (2)
17 Terminal lug
18 Insulating bushing (part of item 14) (2)
19 Screw, machine, rd hd, 6–32 by 1/2 in. (2)
20 Silicon transistor
21 Insulating washer (part of item 14)
22 Grommet
23 Voltage bracket unit
24 Frequency bracket unit
25 Circuit board assembly
26 Regulator base assembly

Figure 8.1 CSV1186-3 regulator exploded view.

TM6125-239-15-C2-21

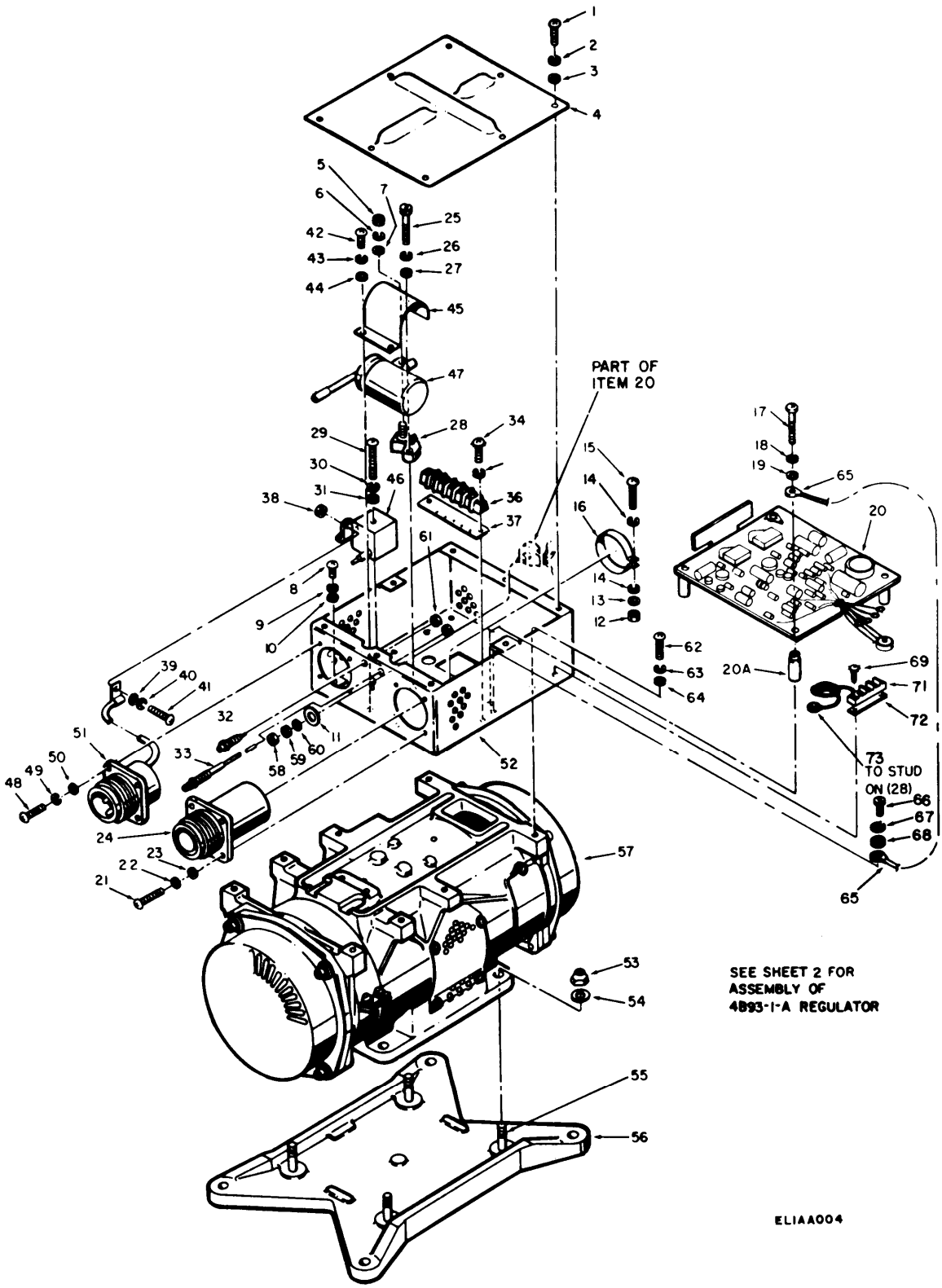


Figure 8.2. (Sheet 1 of 2) Inverter with CSV2215-3 Regulator, Exploded View

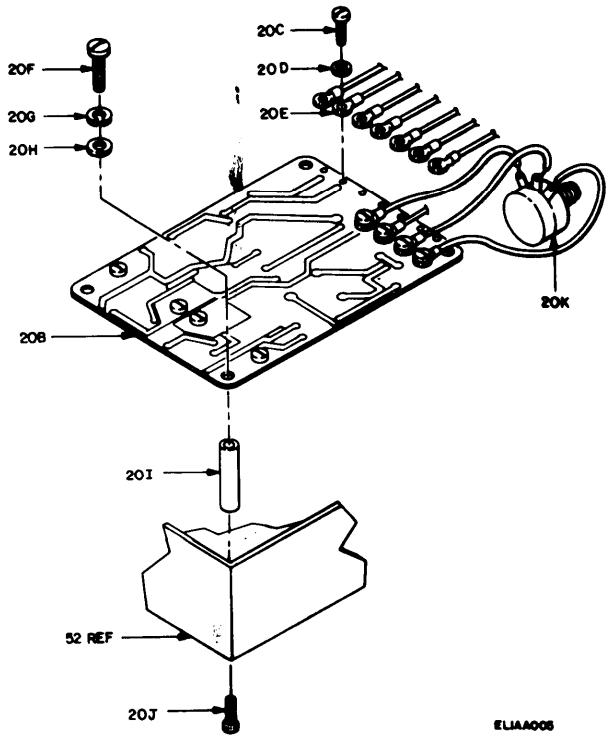


Figure 8.2. (Sheet 2 of 2) Inverter with 4B93-1-A Regulator exploded view

1 Screw, machine, rh, No. 6-32 by 1/4 in. (8)
2 Lockwasher, No. 6 (8)
3 Flat washer, No. 6 (8)
4 Regulator housing cover
5 Nut, plain hex, No. 10-32 (1)
6 Lockwasher, No. 10
7 Flat washer, No. 10
8 Screw, machine, rh, No. 8-32 by 5/8 in. (2)
9 Lockwasher, No. 8 (2)
10 Flat washer, No. 8 (2)
11 Instruction plate
12 Nut, electrical hex, No. 4-40 (2)
13 Lockwasher, No. 4 (2)
14 Flat washer, No. 4 (2)
15 Screw, machine, rh, No. 4-40 by 3/8 in. (2)
16 Loop clamp (2)
17 Screw, machine, pan-head, No. 6-32 x 1-1/2 in. (4)
18 Lockwasher, No. 6 (4)
19 Flat washer, No. 6 (4)
20 CSV2215-3 regulator
20A Spacer, sleeve
20B 4B93-1-A regulator
20C Screw, machine
20D Lockwasher
20E Lug terminal
20F Screw, machine
20G Lockwasher
20H Flat washer
20I Threaded spacer
20J Screw, machine
20K Variable resistor R10
21 Screw, machine, No. 4-40 by 3/8 in. (4)
22 Lockwasher, No. 4 (4)
23 Flat washer, No. 4 (4)
24 Connector J2
25 Screw, machine, rh, No. 8-32 by 1-3/8 in. (1)
26 Lockwasher, No. 8 (1)
27 Flat washer, No. 8 (1)
28 Terminal board
29 Screw, machine, rh, No. 8-32 by 1-3/8 in. (1)
30 Lockwasher, No. 8 (1)
31 Flat washer, No. 8 (1)
32 Test point jack (non-ins.) J4
33 Test point jack (red) J3
34 Screw assembled washer, rh, No. 6-32 by 1/2 in. (2)
35 Flat washer, No. 6 (2)
36 Terminal board TB1
37 Designation plate
38 Nut, plain hex, 8-32 (1)
39 Flat washer, No. 8 (1)
40 Lockwasher, No. 8 (1)
41 Screw, machine, rh, No. 8-32 by 5/16 in. (1)
42 Screw, machine, rh, No. 6-32 by 3/8 in. (2)
43 Lockwasher, No. 6 (2)
44 Flat washer, No. 6 (2)
45 Capacitor clamp } capacitor assembly
46 Radio frequency choke }
47 Regulator capacitor
48 Screw, machine, rh No. 4-40 by 3/8 in. (4)
49 Lockwasher, No. 4 (4 req'd)
50 Flat washer, No. 4 (4 req'd)
51 Connector J1
52 Regulator housing
53 Nut, self-locking, hex, 5/16-24 (4 req'd)
54 Flat washer, 5/16 in. (4 req'd)
55 Stud, plain, 5/16-24 by 1-1/4 in. (4 req'd)
56 Adapter
57 Rotating section
58 Locknut, hex, 1/4-32, thin } Furnished with variable resistor (P/O Item 20)
59 Panel nut, 1/4-32, thin }
60 Flat washer, 1/4 in. }
61 Locknut, hex (2)
62 Screw, machine, No. 8-32 by 7/16 in. (2)
63 Lockwasher, No. 8 (2)
64 Flat washer, No. 8 (2)
65 Ground lead unit (Black)
66 Screw, machine, No. 6-32 by 5/16 (1)
67 Lockwasher, No. 6 (1)
68 Flat washer, No. 6 (1)
69 Screw, assembled washer, No. 6-32 by 9/16 (2)
70 Flat washer, No. 6 (2) (Not Shown)
71 Terminal board TB2
72 Designation plate
73 DC + Lead unit (Purple)

(8) Analyze equipment as described in paragraph 50.d to determine scope of maintenance required. If necessary to repair regulator, refer regulator to higher level of maintenance.

c. Voltage and Frequency Regulator Housing, 4B93-1-A (fig. 8.2). Removal of the 4B93-1-A regulator is very similar to the CSV2215-3. Follow instructions of paragraph 53.b and the additional steps below.

(1) Disassemble or remove components only to the extent necessary to effect the repair. Proper troubleshooting procedures will isolate defective components rapidly and will minimize the possibility of overlooking damaged or malfunctioning components.

(2) Before disconnecting regulator leads from their terminations, make certain that the leads are tagged or marked and that the markings agree with those on the circuit board as shown in figure 7.2.

(3) Disconnect the electrical leads from 4B93-1-A regulator (20B, fig. 8.2) by removing screws (20 C), and lockwashers (20D) from lug terminals (20 E).

(4) Remove screws (20 F), lockwashers (20G), and flat washers (20H). Lift regulator circuit card assembly (20B) from regulator housing (52).

(5) If necessary, remove four threaded spacers (201) by removing screws (20J).

d. Inverter Rotating Section (fig. 9.).

(1) Remove four machine screws (1), lockwashers (2), and flat washers (3) to detach two ac end brush access covers (4) from stator housing (67).

(2) Remove four nuts (5) and electrical cap (6), and then remove two angle and two straight electrical contact brushes (7 and 8).

(3) Remove four machine screws (9) and flat washers (10), and then remove the two dc end brush access covers (11).

(4) Remove two machine screws (12), lockwashers (13), and flat washers (14), and then remove the lead access cover plate (15).

(5) Remove a screw assembled washer (16) to detach each brush lead from its respective brush holder (55), and then remove the four dc end electrical contact brushes (17).

(6) Remove four screws (18) and flat washers (19) to detach ac end fan cover (21) from stator housing (67). Remove four screws (18) and flat washers (19 and 20) to detach dc end fan cover (22) from stator housing (67).

(7) Remove a bearing retaining nut (23) and key washer (24) from each end of the armature shaft and then remove ac and dc end fans (25 and 26) and two machine keys (27) from the armature shaft.

NOTE

Before disassembling the stator housing beyond this point, perform the test for a grounded armature (para 67).

(8) Remove the ac endbell (36), bearing and bearing plates and armature from the stator housing as a group. Remove two self-locking nuts (28), lockwashers (29), flat washers (30 and 31), and screws (32) to free sleeve spacers (33) and ball bearing (34) from ac endbell (36). Cut the cord which ties the electrical lead (35) to the ac endbell (36), and then remove the leads.

Note: Do not attempt to disassemble the armature assembly. Provide suitable protection for the commutator, sliprings; and bearing journal surfaces.

(9) Remove the dc endbell from the stator housing (67). Slide the dc endbell (56) off the armature shaft. Remove the four screws (37) and the lockwashers (38) to free the bearing plates (39 and 40) and the ball bearing (41) from the dc endbell (56).

Note: Attach a tag to each brush holder, its attaching parts, and the endbell to indicate brush holder position to facilitate reassembly.

(10) Remove the two screw aasembled washers (16) to detach the capacitor terminals from the brush holder assemblies. Remove the two screws (42), the lockwasher (44), the flat washers (45), and the nuts (46). Remove the fixed capacitors (47) and the loop clamps (48). Remove the three electrical lead units (49 and 50).

(11) Remove the six screws (43), the four lockwashers (44), the flat washers (45), the eight sleeve bushings (51), and the four brush holder assemblies from the dc endbell (56). Back out a setscrew (52), push out the spring pin (53), and remove the brush spring (54) from each brush holder (55).

(12) Remove the four screws (58), the lockwashers (59), and the flat washers (60) to detach each vent screen (61) from the stator housing (67).

(13) Unstake and remove the setscrews (68). Set the stator housing on the ac stator assembly (66) end, on a fixture which provides clearance beneath the stator housing to allow the stator to drop free. Using a torch or other means to heat the stator housing, apply heat in a circular manner until the ac stator (66) drops free. Turn the stator housing to stand on the dc stator end and repeat the procedure for the dc stator (65).

Note: Do not remove the plates (62 and 63).

54. Reassembly of Inverter Components (fig. 9)

a. Inverter Rotating Section.

(1) Place the stator housing (67) in an oven at 218° C (450° F) for 10 minutes. Remove the stator housing from the oven and set it on the ac stator end. Install the dc stator (65) in the stator housing (67) so that the scribe mark on top of the stator stack aligns with the scribe mark on the top of the stator housing (67). Install the setscrew (68). Set the stator housing (67) on the dc stator end. Install the ac stator assembly (66) into the housing so that the leads align with the openings in the top of the housing. Set the ac stator assembly (66) against the shoulder inside the stator housing (67). Install and stake the setcrews (68).

Note: The housing may be reheated with a torch to facilitate installation of the ac stator assembly.

(2) Place each vent screen (61) in position on the stator housing (67) and secure with the eight flat washers (60), the lockwashers (59), and the screws (58).

(3) Center the spring pin (53) in each of the brush holders (55). Slip a brush spring (54) on each spring pin (53). Install the setscrew (52).

Caution: Be sure to reassemble the sleeve bushings and washers in the exact sequence and in the original location. If these parts are installed in the wrong location, polarity of the inverter can be reversed and damage to the inverter will result.

(4) Assemble the four brush holder assemblies to the dc endbell (56). Secure each insulated brush holder with the two screws (43), the lockwashers (44), the flat washers (45), and the four sleeve bushings (51). Locate the attaching parts as shown in figure 10. Secure each grounded brush holder with one screw (42, figure 9), the lockwasher (44), and the flat washer (45); then place a

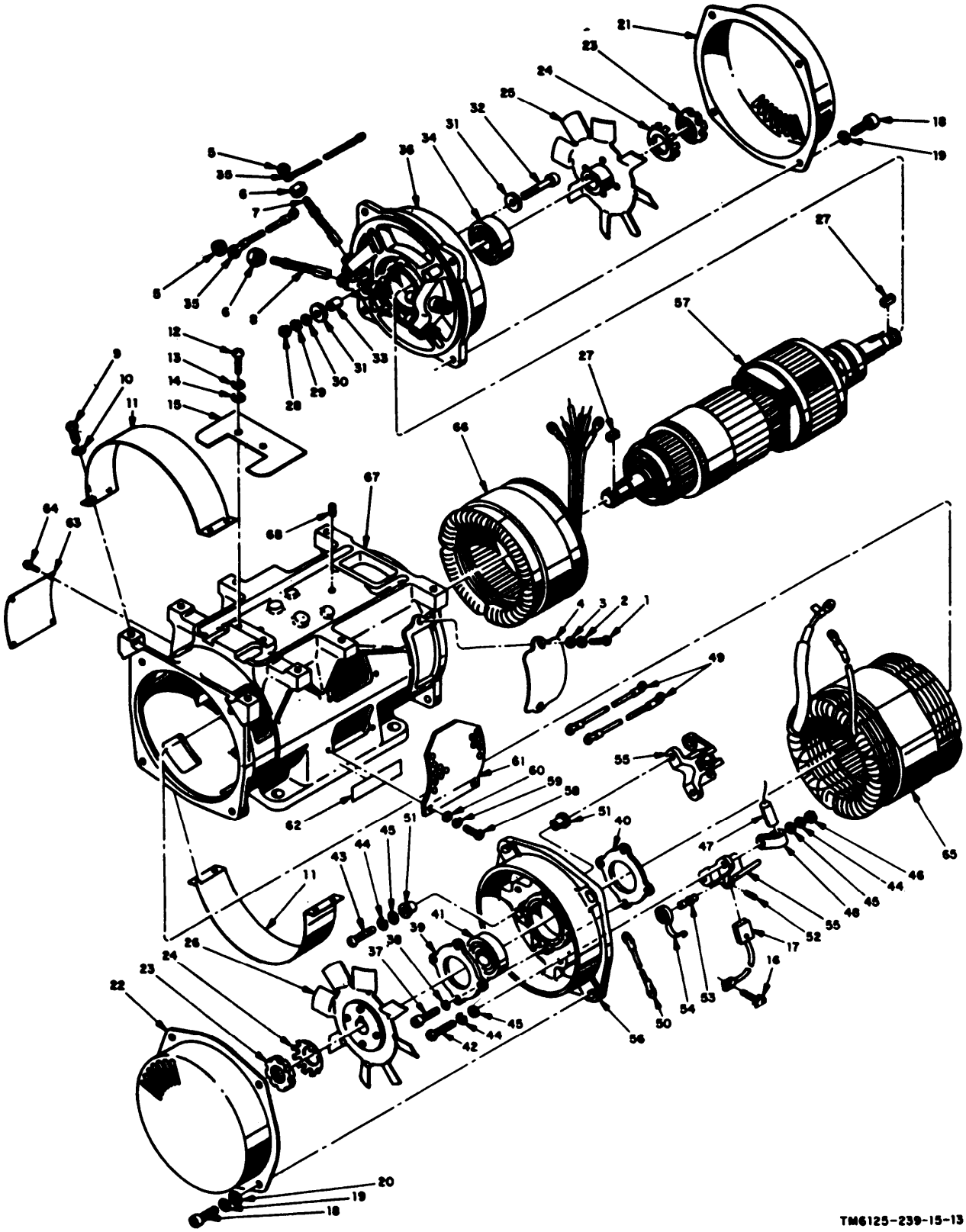


Figure 9. Inverter rotating section, exploded view.

1–Screw, machine, rh, No. 6-32 by 5/16 in. (4)
2–Lockwasher, No. 6 (4)
3–Flat washer, No. 6 (4)
4–Brush access cover (2)
5–Nut, self-locking hex, No. 6-32 (4)
6–Electrical cap (4)
7–Angle electrical contact brush (2)
8–Straight electrical contact brush (2)
9–Screw, machine, rh, No. 6-32 by 7/16 in. (4)
0–Flat washer, No. 6 (4)
11–Brush access cover (2)
12–Screw, machine, No. 6-32 by 5/16 in. (2)
13–Lockwasher, No. 6 (2)
14–Flat washer, No. 6 (2)
15–Lead access cover plate
16–Screw assembled washer, rh, No. 10-32 by 3/8 in. (6)
17–Electrical contact brush (4)
18–Screw, cap hex, socket hd, 8-32 by 3/4 in. (8)
19–Flat washer, No. 8 (8)
20–Flat washer No. 10 (4)
21–Ac end fan cover
22–Dc end fan cover
23–Bearing retaining nut (2)
24–Key washer (2)
25–Ac end fan
26–Dc end fan
27–Machine key (2)
28–Nut, self-locking hex, No. 8-32 (2)
29–Lockwasher, No. 8 (2)
30–Flat washer, No. 8 (2)
31–Flat washer 0.171 ID by 0.060 OD by 0.090 in. thk (2)
32–Screw, cap hex, socket hd, No. 8-32 by 3/4 (2)
33–Spacer, sleeve (2)
34–Ball bearing
35–Electrical lead (2)
36–Ac endbell
37–Screw, cap hex, socket hd, No. 8-32 by 3/4 in. (4)
38–Lockwasher, No. 8 (4)
39–External bearing plate
40–Internal bearing plate
41–Ball bearing
42–Screw, machine, rh, No. 10-32 by 1-1/8 in. (2)
43–Screw, machine, rh, No. 10-32 by 7/8 in. (6)
44–Lockwasher, No. 10 (10)
45–Flat washer, No. 10 (10)
46–Nut, plain hex, No. 10-32 (2)
47–Fixed capacitor (2)
48–Loop clamp (2)
49–Electrical lead (2)
50–Electrical lead (1)
51–Sleeve bushing (8)
52–Setscrew (4)
53–Spring pin (4)
54–Brush spring (4)
55–Brush holder (4)
56–Dc endbell
57–Armature
58–Screw, machine, rh, No. 6-32 by 5/16 in. (8)
59–Lockwasher, No. 6 (8)
60–Flat washer, No. 6 (8)
61–Vent screen (2)
62–Designation plate
63–Identification plate
64–Screw, machine, fil hd, No. 4-40 by 3/16 in. (4)
65–Dc stator
66–Ac stator assembly
67–Stator housing
68–Setscrew

Figure 9–Continued

loop clamp (48) and a fixed capacitor (47) in position on the brush holders as shown in figure 10 and install the two nuts (46, fig. 9), the flat washers (45), the lockwashers (44), and the machine screws (42). Refer to figure 10 for location of capacitors and capacitor terminals. Attach the three electrical leads (49 and 50, fig. 9) to the dc endbell (56) as shown in figure 10.

(5) Place the internal bearing plate (40, fig. 9) on the dc end of the armature (57) shaft.

NOTE

See bearing handling procedure, paragraph 58.1

(6) Press the new ball bearing (34 and 41) onto the armature shaft. Apply force to the inner race of the ball bearing until seated against the shoulder of the armature shaft.

(7) Place the two electrical lead units (35) in position on the ac endbell (36) and tie them in the position shown in figure 11. Work the ac endbell over the end of the armature and onto the ball bearing (34, fig. 9). Tap lightly with a mallet if necessary to seat on the bearing. Lock the bearing outer race in the ac endbell with the two sleeve spacers (33), the screws (32), the flat washers (30 and 31), the lockwashers (29), and the self-locking nuts (28). Tighten the screws (32) and the flat washer (31) to a torque between 35 and 40 pound-inches (lb-in.).

(8) Install the ac endbell and armature in the stator housing (67) from the ac end. Work the dc endbell (56) into position over the ballbearing and onto the stator housing (67). Tap the endbell (56) gently with a fiber mallet to fully seat it. Position the external bearing plate (39) over the armature shaft to seat

against the ball bearing and the dc endbell (56). Install the four screws (37) wit h the lockwashers (38) through the external bearing plate (39), the dc endbell (56) and into the internal bearing plate (40). Tighten the screws to a torque between 35 and 40 lb-in.

Note: If the armature, the dc endbell or the stator was replaced or if the armature commutator was remachined, set the neutral position of the dc brushes as described in paragraph 57 before installing the fans and fan covers.

(9) Install a machine key (27) into the slot in each end of the armature shaft. Slide the dc and ac end fans (25 and 26) over their respective ends of the armature shaft to seat over the keys and lock each in position with a key washer (24) and the bearing retaining nut (23). Bend one tooth of each key washer (24) to lock the bearing retaining nut (23) on the armature shaft. Rotate the fan slowly by hand to check to see that the armature rotates freely.

(10) Place the ac and dc end fan covers (21 and 22) in their respective positions on the endbells and secure the dc end fan cover with the four flat washers (20), the flat washers (19), and the four capscrews (18). Secure the ac end fan cover (21) with the four flat washers (19) and the capscrews (18). Torque both groups of screws to between 35 and 40 lb-in.

Note: Refer to paragraph 59 for brush run-in procedure.

(11) Lift the brush tension arms and insert each of the four electrical contact brushes (17) into the brush holders (55). Secure each electrical lead (49 and 50) and brush (as shown in figure 10) to its holder with a crew assembled washer (16, fig. 9). The brush faces must fit the contour of the commutator.

(12) Install the lead access cover plate (15), and secure the plate with the two flat washers (14), the lockwashers (13), and the screws (12).

(13) Install the two dc end brush access covers (11), and secure with the two flat washers (10) and the screws (9).

(14) Install the two new straight and the two new angle electrical contact brushes (8 and 7), in their respective positions in the ac endbell (36). Install an electrical cap (6) on each brush holder. Connect the electrical leads (35) as shown in figure 11, and install the four nuts (5, fig. 9).

(15) Install each brush access cover (4), and secure each with the two flat washers (3), the lockwashers (2), and the screws (1).

b. Completing Assembly with CSV1080-1 and CSVI186-3 (fig. 8).

(1) Install connector J1 (66) through the front of the regulator housing (67) with the keyway at the 6 o'clock position and secure with the four flat washers (65), the lockwashers (64), and the screws (63).

(2) Position the regulator capacitor (62) inside the regulator housing (67), and secure with the capacitor clamp (60), the two flat washers (59), the lockwashers (58), and the screws (57), Attach the plus lead from connector J1 (66) to the radiofrequency choke (61) with a screw (56), the lockwasher (55), the flat washer (54), and the nut (53).

(3) Install the designation plate (52) and terminal board TB1 (51) on the inside of the regulator housing (67), and secure with the two flat washers (50) and the screw assembled washer (49).

(4) Install the test point jacks (48 and 47) in the front end of the regulator housing (67). The test point jack (47) is installed in the hole adjacent to connector J1 (66). The test point jack (48) is installed in the hole adjacent to connector J2 (39).

(5) Position the regulator housing (67) on the rotating section (72). Group the dc end lead labeled 10 with the lead labeled 11 at the ac end of the rotating section (72). Make sure that the dc end lead lies flat along the top of the rotating section. Work these two leads up through the circular hole in the bottom of the regulator housing (67).

(6) Work the lead labeled *DC plus* up through the elongated hole which is in line with the circular hole. Work the bundle of the ac leads up through the remaining elongated hole.

(7) Place a flat washer (46), lockwasher (45), and machine screw (44) through radio-frequency choke (61), and thread the screw into the rotating section (72) to hold the regulator housing (67) in position.

(8) Install the terminal board (43), and secure it and the loose end of the capacitor clamp (60) with a flat washer (42), lockwasher (41), and machine screw (40). Attach the free end of the regulator capacitor (62) lead, stator assembly lead, and regulator lead labeled dc plus to the stud on the terminal board with a flat washer (7), lockwasher (6), and plain nut (5).

(9) Install connector J2 (39) through the f rent of the regulator housing (67), with the keyway at the 12 o'clock position. Secure connector J2 with four flat washers (38), lockwashers (37), and machine screws (36).

(10) Attach power circuit board assembly (34) to regulator base (35), with four machine screws (28), flat washers (27), lockwashers (26), and self-locking nuts (25). Attach frequency circuit board assembly (32) and self-locking nuts (25). Attach frequency circuit board assembly (32) and voltage circuit board assembly (31) to regulator base (35) with 8 machine screws (29), and to power circuit board assembly (34) with 12-machine screws (30).

(11) Position the regulator inside the regulator housing (67), and thread the stator leads labeled 10 and 11 up through the regulator base. Place lead 10 on the stud terminal nearest the rear of the regulator housing (67), and lead 11 on the remaining stud terminal. Secure each with lockwasher (18) and nut (17).

(12) Attach the CSV1080–1 regulator inside the regulator housing (67) with two flat washers (24), lockwashers (23), machine screws (22), and four flat washers (21), lockwashers (20), and machine screws (19). The regulator lead labeled GR and the lead labeled D of connector J2 (39) are secured with flat washer (21), lockwasher (20), and machine screw (19) at the corner of regulator base nearest connector J2 (39). Solder regulator leads labeled 13 and 14 to voltage adjustment register A2R7 (33). Install voltage adjustment resistor A2R7 (33) through the front of the regulator housing and through the instruction plate (11), and secure it with flat washer (75), panel nut (74), and locknut (73) at the exterior of its shaft.

(13) To install part No. CSV1186-3 regulator inside housing (67), thread stator leads labeled 10 and 11 up through the regulator base. Attach lead 10 to front hole in circuit board (25, fig. 8.1) with flat washer (35C, fig. 8), lockwasher (35B), and machine screw (35A). Attach lead 11 to rear hole in circuit board with remaining flat washer (35C), lockwasher (35B), and machine screw (35A). Refer to figure 17 for wiring connections.

NOTE

Be sure to secure red regulator ground lead connector lead D, and ac stator ground lead to corner of regulator base nearest connector J2 (39, fig. 8) with machine screw (8), lockwasher (9), and flat washer (10).

(14) Position the leads from the test point jack (48) and voltage adjustment resistor to lay against connector J2 (39) and secure in this position with two loop clamps (16), machine screws (15), flat washers (14), lockwashers (13), and nuts (12).

(15) Attach the stator assembly and connector J1 (66) ground leads in the corner of the regulator housing (67) adjacent to connector J1 (66) with a flat washer (10), lockwasher (9), and machine screw (8). The ac end ground lead is attached to the regulator at the opposite front corner with the machine screw (8), lockwasher (9), and flat washer (10).

(16) Install the regulator housing cover (4) and secure with eight flat washers (3), lockwashers (2), and machine screws (1).

NOTE

Repair and assembly of regulator (CSV2215-3 or 4B93-1-A) itself is assigned to a higher level of maintenance. Install new or repaired regulator as directed in subparagraphs c or d below.

c. Completing Assembly of Inverter with CSV2215-3 Regulator, (fig. 8.2).

NOTE

Be sure inside of housing is clean and free of dust or other foreign objects. Vacuum clean the area if necessary.

(1) Install connector J1 (51) through the front of the regulator housing (52) with the keyway at the 6 o'clock position and secure with the four flat washers (50), the lockwashers (49) and the screws (48).

(2) Position the regulator capacitor (47) inside the regulator housing (52), and secure with the capacitor clamp (45), the two flat washers (44), the lockwashers (43), and the screws (42). Attach the plus lead from connector J1 (51) to the radiofrequency choke (46) with a screw (41), the lockwasher (40), the flat washer (39), and the nut (38).

(3) Install the designation plate (37) and terminal board TB1 (36) on the inside of the regulator housing (52), and secure with the two flat washers (35) and the screw assembled washer (34).

(4) Install designation plate (72) and terminal board TB2 (71) and secure with two flat washers (70) and screws (69). Temporarily attach the purple lead unit (73) to TB2-8 using screw furnished with terminal board. DO NOT tighten this screw pending final assembly instructions. Leave other end of lead free for subsequent assembly.

(5) Install the test point jacks (33 and 32) in the front end of the regulator housing (52). The test point jack J4 (32) is installed in the hole adjacent to connector J1 (51). The test point jack J3 (33) is installed in the hole adjacent to connector J2 (24).

(6) Position the regulator housing (52) on the rotating section (57). Group the dc end lead labeled 10 with the lead labeled 11 at the ac end of the rotating section (57). Make sure that the dc end lead lies flat along the top of the rotating section. Work these two leads up through the circular hole in the bottom of the regulator housing (52).

(7) Work the lead labeled *dc plus* up through the elongated hole which is in line with the circular hole. Work the bundle of the ac leads up through the remaining elongated hole.

(8) Place a flat washer (31), lockwasher (30), and machine screw (29) through radiofrequency choke (46), and thread the screw into the rotating section (57) to hold the regulator housing (52) in position. DO NOT tighten screw pending further instructions.

(9) Install the terminal board (28), and secure it and the loose end of the capacitor clamp (45) with a flat washer (27), lockwasher (26), and machine screw (25). Attach the free end of the regulator capacitor (47) lead, stator assembly lead, and purple lead unit (70) to the stud on the terminal board with a flat washer (7), lockwasher (6), and plain nut (5).

(10) Install connector J2 (24) through the front of the regulator housing (52), with the keyway at the 12 o'clock position. Secure connector J2 with four flat washers (23), lockwashers (22), and machine screws (21).

NOTE

DO NOT tighten screws inserted in steps (11), (12), and (13) pending further instructions.

(11) Insert two screws (62), lockwashers (63) and flat washers (64).

(12) Combine one screw (8), lockwasher (9) and flat washer (10) with ground (or "A") lead from dc connector J1 (51) and insert into housing under connector J1.

(13) Combine remaining screw (8) and washers (9 and 10) with AC stator (GND) lead from rotating section. Insert screw into housing under connector J2.

(14) Tighten the one screw inserted in step (8) and the four screws inserted in steps (11), (12), and (13).

(15) Combine screw (66), lockwasher (67) and flat washer (68) with the black lead unit (65) and the ground (or "D") lead from ac connector J2 (24). Insert screw into bottom of housing and tighten, leaving other end of lead unit (65) free for subsequent assembly.

(16) Replace the exciter and DC+ leads from the rotating section and capacitor C1 (47) lead back on to the stud of terminal board (28). Add the free end of the lead unit added in step (4) and secure with flat washer (7), lockwasher (6) and nut (5).

(17) Reconnect leads "2", "3", "5'" and "6" from the rotating section and from the ac connector J2 (24) to respective points on TB1 (36).

(18) Connect additional leads as follows:

a. Rotating section lead "11" and WHT regulator lead to TB2-11.

b. Rotating section lead "10" and YEL regulator lead to TB2-10.

c. Rotating section lead "1", lead "1" from connector J2, lead from test jack J3 (33) and BLU regulator lead to TB1-1.

d. (Ref: step 4). PUR lead unit (73) and PUR regulator lead to TB2-8.

NOTE

Before completing assembly, check connectors against schematic diagram, figure 16.1.

(19) Place a lockwasher (18) and flat washer (19) on to one screw (17). Now insert this screw thru the RED regulator (20) lead, the BLK lead unit (65) (ref: step 15) and the corner hole in the circuit board.

(20) Position the loose sleeve spacer (20A) so that its small end will fit into the hole in the board. Slip spacer over screw and into the board. Insert another set of parts (17, 18 and 19) at the lead end of the regulator.

(21) Bend heatsink tabs slightly and insert the two remaining sets of parts (17, 18 and 19) at the other end of the regulator.

(22) Before proceeding, pre-clean screw (17) threads and threads in bottom of housing with LOCQUIC (mfd. by LOCTITE CORP, Newington, Corm. 06111, FSCM 05972). When dry, apply LOCTITE, GRADE A (MIL-S-22473) uniformly to screw threads.

(23) Set regulator into housing. Insert screws into threaded holes provided and tighten to 8-12 IN-LB torque. Straighten heatsink tabs. If surface has been scratched, touch up with zinc-oxide primer or Alodine 1200 in accordance with MIL-C-5541.

(24) Insert variable resistor (P/O item 20) into hole in end of housing. Replace instruction plate (11) and secure with lockwasher (60) and nut (59). Screw on outer locknut (58) *fingertight only*.

(25) Route the three variable resistor leads and the one lead from test jack J3 (33) along the body of ac connector J2 (24). Secure with two loop clamps (16) and attaching parts group (12 thru 15).

d. Completing Assembly of Inverter with 4B93-1-A Regulator (fig. 8.2). Installation instructions for the 4B93-1-A regulator are very similar to the CSV2215-3. Follow instructions of paragraph 54c and the additional steps below.

(1) Install four threaded spacers (201) to housing (52) and secure with four screws (20J).

(2) Apply Loctite sealant (MIL-S-22473, Grade A) to screws (20J) before assembly.

(3) Place 4B93-1-A on top of four threaded spacers and secure with four screws (20F), lockwashers (20G) and flat washers (20H).

(4) Connect the ten electrical lead terminals (20E) and secure with ten screws (20G) and lockwashers (20D). Refer to figure 16.2 for wiring connections.

NOTE

Bend electrical lead terminals (20E) upward before installing regulator inside housing to provide clearance from side of housing.

55. Cleaning

CAUTION

Do not wash or soak the regulator board assemblies in cleaning solvent.

a. Clean all plastic and metal parts with cleaning solvent (NSN 7510-00-527-1458), and blow dry with compressed air.

b. Remove all dirt, dust, grease, carbon dust, and other foreign matter. Make sure that all electrical connections are clean to insure good electrical conductivity.

CAUTION

Do not soak the assemblies in cleaning solvent.

c. Wipe the armature and stator with a clean cloth dampened with cleaning solvent, and clean thoroughly with a brush.

d. After cleaning, dry out the armature and stator assemblies by baking for 2 to 4 hours at 93° C. (200° F.).

56. Repair and Replacement

a. Replace any part that is damaged or defective.

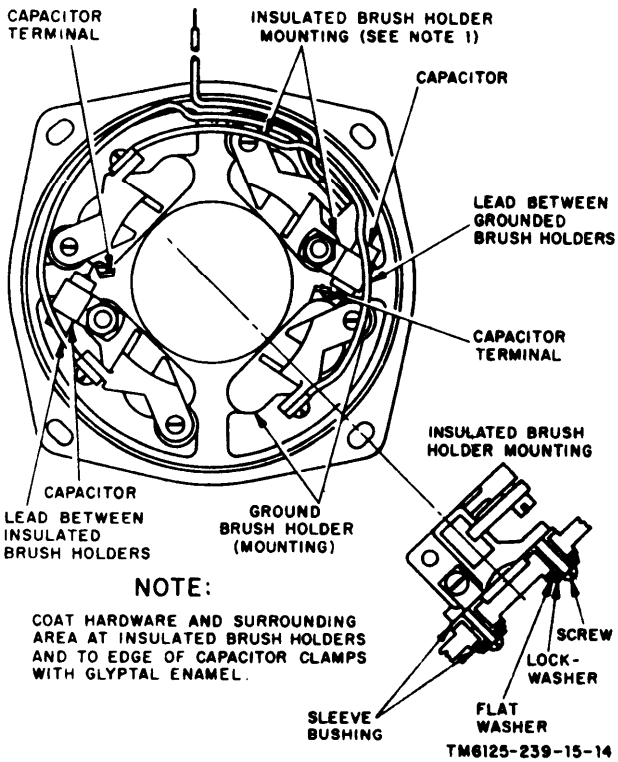


Figure 10. Dc endbell assembly.

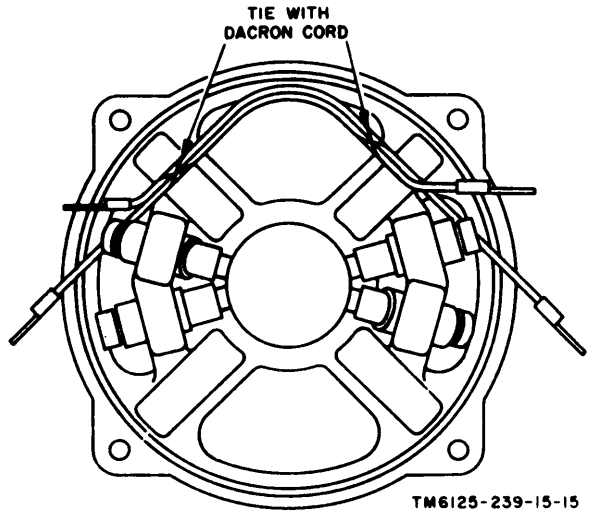


Figure 11. Ac endbell assembly.

b. Replace the bearings and brushes at each overhaul.

CAUTION

Be careful that soldering operations at terminations do not result in excessive thermal transfer through leads or supporting members.

c. Solder junctions with the use of the conductive transfer heating methods (irons, guns, or pencils). Do not apply direct flame to any component.

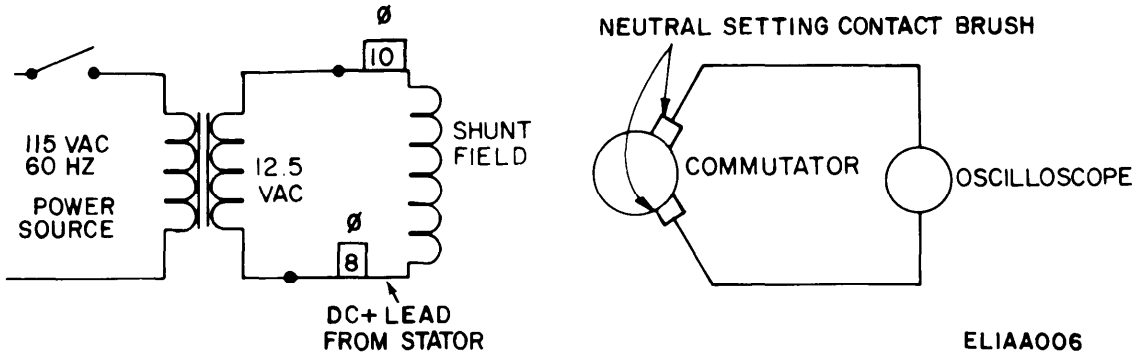
d. If the commutator surface is rough or in a condition that cannot be restored by cleaning, refer to higher category of maintenance for repair.

57. Setting Brush Neutral

(figs. 12 and 13)

Brush neutral must be reset if the dc endbell, dc stator or armature has been replaced or if armature commutator has been remachined. Do not set neutral for repair or replacement of items which are not part of the rotating section. Refer to figure 12 for connections.

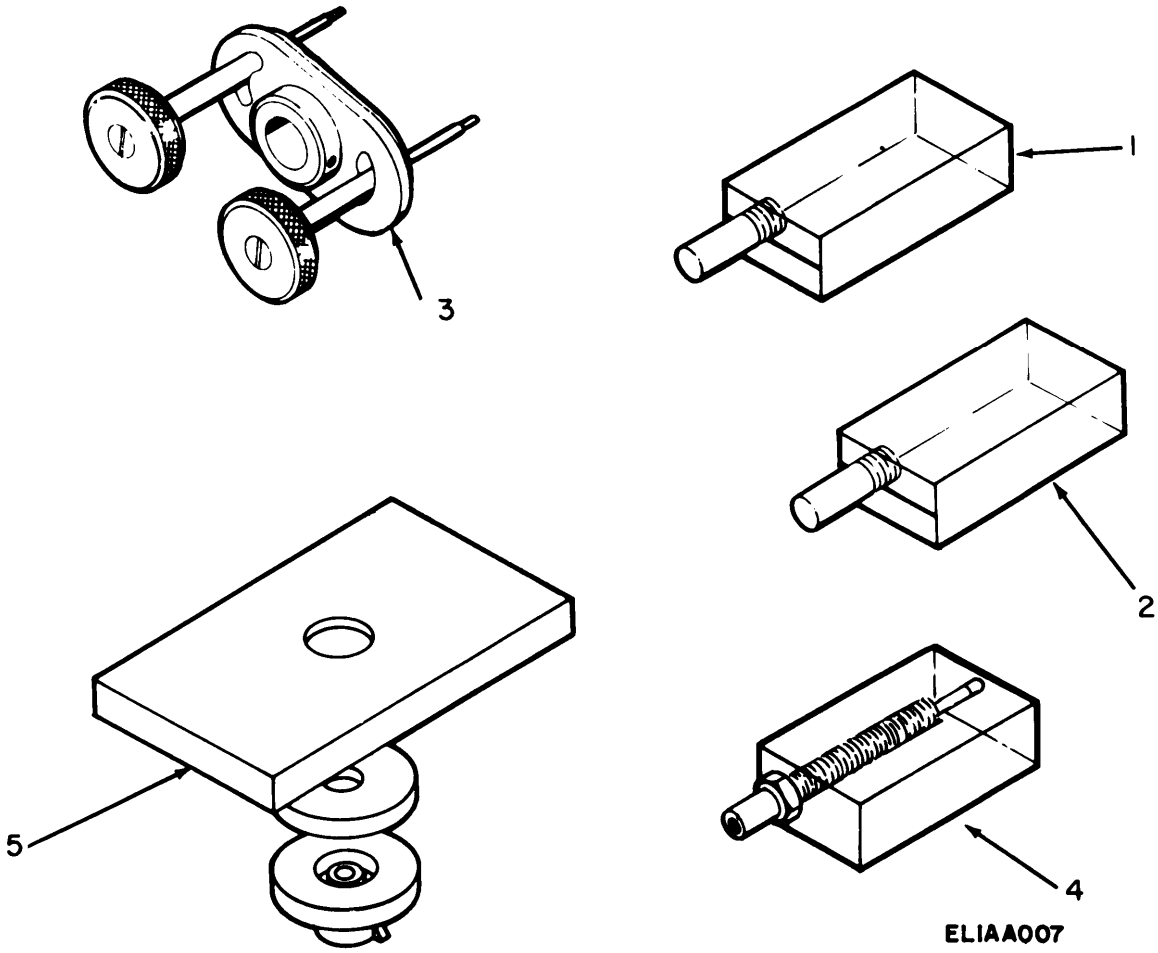
a. The dc endbell position must be set with respect to the armature and stator to locate the brushes at electrical neutral.



Ø FOR INVERTERS WITH THE 4B93-1-A REGULATOR, THESE LEADS ARE DESIGNATED "5" AND "2" RESPECTIVELY.

Figure 12. Neutral Setting Diagram

Equipment	Description
Standard step-down transformer:	60 hz, 115/12.6 vac
Oscilloscope:	Tektronix, Dumont 304-A or equivalent having sensitivity set 10 mv/cm minimum for the full scale. This is the preferred item of equipment.
AC VTVM:	Set for sensitivity of 10 millivolts for the full scale. This may be used if suitable oscilloscope is not available.
Brush Alignment Gages: (1, fig. 13)	Part No. ATB25853-1 provided with black lines for use with armature commutator having a machined, unfilmed surface.
(2, fig. 13)	Part No. ATB25853-2, provided with red lines for use with commutator having an already filmed surface. **NOTE** The top and bottom ends of the plastic must be kept clean and free from scratches. Polish as necessary using jeweler's rouge or wet fine crocus cloth.
Contact Brush, Neutral Setting: (4, fig. 13)	Part No. ATA25854 to ensure accurate armature location. **NOTE** The threaded copper pin of the alignment gage must protrude at least 1/32 inch. The contact end must be kept smooth and free from burrs and sharp edges by filing as necessary. Scribe lines may be retouched with black or red ink. To avoid diminishing the sensitivity of the gage do not widen or deepen these lines.
Magnifying Glass:	An illuminated magnifying glass is most helpful in sighting through the gages.
Fixture, Neutral Setting: (3, fig. 13)	Part No. ATC25629, designed to lock endbell to armature.



1. Gage, brush alignment, black line Part No. ATB25853-1
2. Gage, brush alignment, red line Part No. ATB25853-2
3. Fixture, neutral setting Part No. ATC25629
4. Contact brush, neutral setting Part No. ATA25854
5. Fixture, bearing pressing Part No. ATD25503

Figure 13. Special Tools.

b. Set neutral prior to assembling the dc end fan (26, figure 9) and fan cover (22).

c. Set neutral with dc brushes removed and the dc endbell assembly screws loosened. Hold endbell temporarily with two screws while handling and applying match marks.

d. The equipment, with sensitivity and calibration as described in table below, must be used to set neutral. Accuracy of the equipment must be three percent or better.

e. Insert the appropriate brush alignment gage (red line or black line as indicated) into a brush box.

CAUTION

To prevent damage to commutator, lower the brush holder spring gently. Move the armature slowly and only enough to accomplish neutral setting.

f. Sight down through the gage and align the two scribe lines visually with the center of any commutator bar.

g. Use the neutral setting fixture to lock the armature and endbell together to prevent relative rotation of these parts during subsequent steps.

h. Remove alignment gage and insert the neutral setting contact brushes into the top brush holders.

i. See figure 12. Connect leads from the oscilloscope (or VTVM) to the terminals of the contact brushes.

j. Connect the ac power supply to the shunt field in accordance with figure 12.

NOTE

Should it be desired to check neutral on a completely assembled machine, connect power supply leads to the shunt field at TB2-8 and TB2-10. Disconnect these regulator leads. See schematic diagrams 15.2, 16 and 16.1.

k. Loosen the two screws (ref: step c) holding endbell to housing.

WARNING

To minimize electrical shock hazard from exposed leads keep the power supply voltage "on" only long enough to observe the oscilloscope or VTVM. Turn off while making adjustments.

l. Close the switch on the power supply and observe the trace of the oscilloscope or note the meter reading. Shut off the switch. Any ripple or ac signal on the scope or any meter deviation from zero indicates that the unit is not in the true neutral position.

CAUTION

Use a fiber drift bar and a non-metallic hammer for rotating the endbell per step m. below.

m. Using the hammer and drift, tap on the corner of the endbell causing it and the armature to rotate in steps of 0.015 inch. Check the scope or meter and repeat as necessary until a straight line or zero reading is obtained.

n. Tighten two diagonally opposite screws just enough to hold the unit together. Check that neutral setting has not been disturbed. Repeat step m. above, if necessary.

o. Replace neutral setting contact brushes with four new dc brushes. Make certain that the brushes slide freely in the holders without binding, and that pressure arms engage brushes at center point.

p. Complete assembly of rotating section in accordance with instructions of steps 54.a (9) thru (15).

q. An index mark appears on all motor-generators on which neutral has been set. This mark is on the rating nameplate side of the stator housing and consists of a notch or match mark that extends across the end of the stator housing and the edge of the endbell. Apply a new set of match marks using a small cold chisel.

r. Obliterate previous match marks by filling with black paint. Identify new marks by means of contrasting color paint (bright red, orange or yellow)

57.1. Deleted

58. Brush Run-In

a. Connect the motor-generator to a power source and load bank.

b. Set the voltage adjustment resistor and frequency adjustment resistor at midpoint.

c. Start inverter. Allow approximately 10 seconds for units to warm up if power was not previously connected to input terminals. Adjust dc input to 27.5 volts.

d. Set the voltage and frequency-adjustments so that motor-generator output is 115 volts, 400 cps.

e. Measure and record dc input current during brush run-in. If current exceeds established maximum values given in paragraph 5 by more than 10 amperes, shutdown unit and investigate.

f. Run in brushes by applying approximately 25 percent load until there is evidence that the brushes contact the commutator and slipring surfaces at least 100 percent in the direction of rotation and 75 percent in the longitudinal direction. After obtaining proper seating, apply full load to effect proper filming of the commutator which will be evidenced by darkening or discoloration of the commutator surface.

58.1. Bearing Handling Procedure

CAUTION

Before pressing new bearings into place on the armature shaft, read the following procedure thoroughly. Bearings are a critical item. Failure to observe the following procedure may result in premature bearing failure and damage to the motor-generator.

a. DO NOT SUBSTITUTE. Use only MS type bearing specified in parts list TM11-6125-239-34P.

b. Rotate bearing stock. Use oldest first.

c. The life of bearing lubricant is 5-3/4 years from the date imprinted on the bearing package wrapper. This factor must be considered prior to installing a new bearing.

d. It is recommended that the equipment not be assembled with a bearing older than 3-3/4 years.

e. Each equipment having the bearings replaced shall be marked "(date) AGE CONTROLLED ITEM." The date entered shall be the date code shown on the outside of the bearing container. Newer equipment may already have been designated "AGE CONTROLLED"-necessitating date change only.

f. It is recommended that unused bearings older than 3-3/4 years be returned to the motor-generator manufacturer for rehabilitation.

g. The work area must be neat and clean and free of lint and abrasive or other harmful particles.

h. The bearing must not be removed from the storage container (bearing package) until immediately prior to installation on the shaft and the rotor is ready to be installed in the unit. If necessary to lay the bearing down temporarily, place it on its own wrapper or on a piece of clean oilproof paper or plastic film.

i. Be sure the shaft journal surface, locating shoulder and undercut are free of dirt. roughness or burrs which might interfere with complete and proper seating of the bearing. Shaft shoulder shall not be nicked, rolled or damaged and shall meet the requirement defined in figure 15.

j. Leave the packaging grease on the bearing.

k. When pressing bearings onto shaft, position so that when practical the bearing trademark or identity is outward, away from the shaft shoulder. Utilize bearing pressing fixture, Part No. ATD22503 (5, figure 13), or equivalent, for pressing bearings onto the shaft. APPLY PRESSURE UNIFORMLY TO THE INNER RACE ONLY. Avoid any pressure to the outer race and be extremely careful not to touch the shield or seal with the pressing tool.

l. If the rotor with bearings cannot be installed into the inverter in the same working day, cover the bearings with plastic film or oilproof paper.

m. Prior to assembling rotor, endbell, and housing with the bearings, apply a thin film of high temperature molysulphide (surfcote 1000 or equivalent, manufactured by Hohman Plating, Dayton, Ohio, FSCM01094) to the endbell bearing bore. Use the finger or clean paper. Remove any excess lumps of compound.

n. Slide the endbell gently over the bearing outer race. DO NOT hammer or otherwise force this operation.

CAUTION

If a bearing must be removed from the shaft for any reason, replace it with a new approved bearing even though the bearing removed is new and unused. The removal procedure has a damaging effect on the bearing.

CHAPTER 6

GENERAL SUPPORT TESTING PROCEDURES

59. General

a. The following testing procedures are prepared for use by general support maintenance shops and service organizations responsible for general support maintenance of electronic equipment to determine the acceptability of repaired electronic equipment. These procedures set forth specific requirements that repaired electronic equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide for the testing of equipment that has been repaired at direct support maintenance level if the proper tools and test equipment are available. A summary of the performance standards is given in paragraph 64.

b. Comply with the instructions preceding each chart before proceeding to the chart. Perform each test in sequence, *do not vary the sequence.* For each step, perform all the actions required in the *Test equipment control settings* and *Equipment under test control settings* columns; then perform each specific test procedure and verify it against it performance standard.

60. Tools, Test Equipment, and Materials Required

No materials are required to perform the tests in this chapter. The only tools and test equipment required are listed below.

a. Tools. All the tools required for the tests are contained in Toolkit, Electronic Equipment TK-100/G.

b. Test Equipment. The only test equipment required to perform the tests is Test Set, Motor-Generator AN/GSM-65.

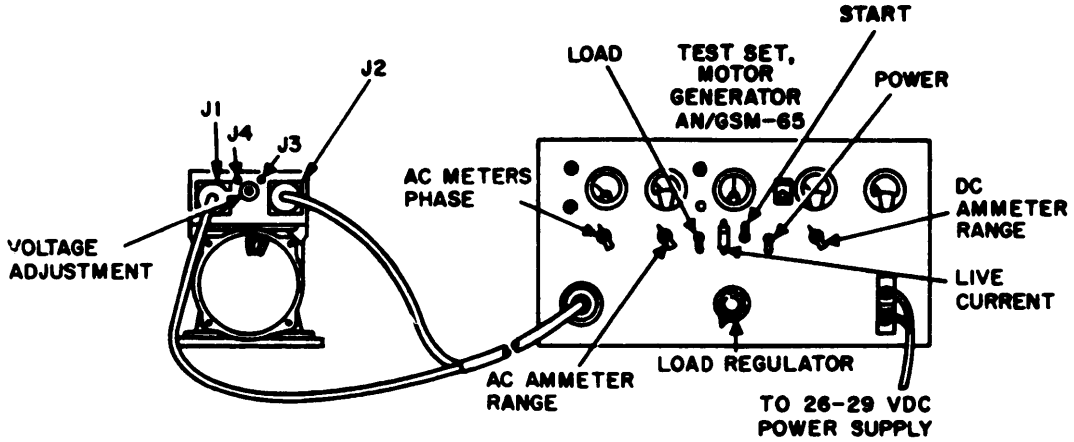
61. Test Facilities

A dc power supply, capable of supplying 26 to 29 volts dc at 59.5 amperes is required to furnish the dc input voltage for the inverter and the bench test set. The interver must be mounted on a test bench that provides a common ground between the inverter and the bench test set. Make sure that the areas of contact between the inverter mounting plate and the corresponding areas of the test bench are clean and free of oil or grease to insure good electrical grounding.

62. Physical Tests and Inspection

a. Test Equipment and Material. None.
b. Test Connections and Conditions. Inverter disconnected and removed from aircraft.
c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	N/A	N/A	a. Inspect all mechanical assemblies for loose or missing screw, bolts, or nuts. b. Inspect connectors and test jacks for looseness and damage. c. Remove each brush cap in turn and examine brushes for proper length and seating.	a. Screws, bolts, and nuts will be tight; none missing. b. No looseness or damage evident. c. Brushes must match contour of sliprings and must not be worn below wear mark.
2	N/A	N/A	a. Loosen locknut and rotate voltage adjustment through its full range of travel. b. Remove housing unit cover Rotate frequency adjustment throug its full range of travel.	a. Voltage adjustment will rotate freely without binding or excessive looseness. Tighten locknut. b. Frequency adjustment must rotate freely without binding or excessive looseness.
3	N/A	N/A	a. Inspect all components for cracked, burned, or damaged insulation. b. Check voltage and frequency regulator for secure mounting. c. Check all leads inside housing unit for looseness	a. No damage evident. b. No looseness evident. c. No looseness evident.



NOTE:
FABRICATE A TEST CABLE PER TM11-6125-239-15, FIG 6, IF THE TEST SET DOES NOT HAVE A SUITABLE CABLE FOR CONNECTION TO THE INVERTER.

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63. Inverter Voltage and Frequency Output Test.

a. Test Equipment and Materials.
Test Set, Motor-Generator AN/GSM-65
Power Supply PP-1104A/G
Test cable (fig. 14)

b. Test Connections and Conditions. Mount the inverter on a test bench; make sure that the areas of contact between the mountings base of the inverter and the corresponding areas of the test bench are clean and free of oil or grease to insure good electrical grounding. Interconnect the inverter and the AN/GSM-65 as shown in figure 14. Connect Power Supply PP-1103A/G to the test set. Adjust all test set meters to zero.

c. Procedure.

(1) Using the appropriate test cable, connect the inverter to Test Set, Motor Generator AN/GSM-65 (test set) and connect the dc power supply to the test set.

(2) Place the test set controls in the prescribed start positions and position the inverter voltage and frequency adjustment potentiometers at approximately the midpoint of their range.

(3) Apply input power and adjust for an indication of 27.5 volts on the test set D.C. VOLTS meter. Allow the inverter to operate until all test set meters give steady indications.

(4) Adjust the test set LOAD REGULATOR control for an indication on the A.C. AMP meter of 1.88 amps, equivalent to one-half full load, three phase delta operations.

(5) Adjust the inverter voltage adjustment potentiometer, if necessary, for a 115-volt indication on the test set A.C. VOLTS meter. Tighten the adjustment locknut.

(6) Set the inverter frequency adjustment potentiometer for a 400-Hz output as indicated on the test FREQUENCY meter.

(7) With the test set LOAD REGULATOR control set at 0, adjust the dc input voltage to 29 volts as indicated on the D.C. VOLTS meter. Note the output voltage and frequency of the inverter as indicated by the test set A.C. VOLTS AND FREQUENCY meters.

(8) Reduce the dc input voltage to 26 volts and adjust the test set LOAD REGULATOR control for an A.C. AMPS meter indication of 3.75 amps, equivalent to full load, three phase delta operation.

(9) The performance standards for all inverters as indicated by test set A.C. VOLTS and FREQUENCY meter readings are as follows:

Output frequency: 400 ± 10 Hz

Output voltage: 115 ± 2-1/2 VAC

64. Summary of Test Data

The test data recorded during the voltage and frequency output tests must meet the required performance standards stated in paragraph 63.(9).

CHAPTER 7.1

DEPOT INSPECTION STANDARDS

70.1 Applicability of Depot Inspection Standards

The tests outlined in this standard are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

70.2 Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

b. Technical Publication. This manual is the only technical publication applicable to this equipment.

c. Modification Work Orders. Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310-7 lists all authorized MWO's.

70.3 Test Facilities Required

The following equipment, or suitable equivalents, will be employed in determining compliance with the requirements of this Specific Standard.

Test equipment	FSN	Technical manual
Test Set, Motor-Generator AN/GSM-65 or Aircraft Motor-Generator Tester type L-1A.	6625-348-5793	
Spectrum Analyzer TS-723(*)/U.*	6625-668-9418	TM 11-5097.
Oscilloscope AN/USM-140A.	6625-892-4401	TM 11-6625-535-15.
Power supply PP-1104A/G.	6130-542-6385	TM 11-5126.
Test cable (fig. 6).		
Resistor, variable, 35-ohm, 25-watt.		

* TS-723(*)/U denotes TS-723A/U, TS-723B/U, TS-723C/U, and TS-723D/U.

70.4 General Test Requirements, Motor-Generator PU-544/A

All of the tests will be performed with the motor-generator mounted on a test bench; make sure that the area of contact between the mounting base of the motor-generator and the corresponding areas of the test bench are clean, and free from oil or grease to insure good electrical grounding. Testing will be simplified if connections and tester control settings are made initially and modifications are made as required for the individual tests.

a. Interconnect the motor-generator and Test Set, Motor Generator AN/GSM-65 with the test cable as shown in figure 14.

b. Connect Power Supply PP-1104A\G to the test set.

c. Adjust all test set meters to zero.

d. Set the AC METER PHASE switch to position 1 or A. (See note, para 45c).

e. Set the LOAD switch to OFF.

f. Set AC AMPS METER RANGE switch to 50.

g. Set LOAD REGULATOR control to 0.

h. Turn DC AMPS METER RANGE switch to START.

i. Set the POWER switch to ON.

j. Set the START switch to START

k. Turn the DC AMPS METER RANGE switch to 200.

l. Set the LOAD switch to ON.

m. Adjust the dc input to 28 volts.

n. Operate the inverter for 10 minutes before proceeding with any tests.

70.5 Tests on Motor-Generator PU-544/A

a. Voltage Regulation Check. Make the voltage regulation check as follows:

(1) Set the test set LIVE CIRCUIT switch to ON. The motor-generator must start.

(2) Loosen the voltage adjustment (fig. 1) locknut on the PU-544/A.

(3) Turn the voltage adjustment control through its full range of travel. The range of adjustment at no load must be from 109 to 121 volts ac. Set the voltage adjustment control at midpoint of its range of travel.

(4) Adjust the LOAD REGULATOR control for 6.5-ampere indication on the AC AMPS meter, and 115-volt indication on the AC VOLTS meter. Turn the voltage adjustment control through its full range of travel. The range of adjustment must be from 109 to 121 volts ac.

(5) Vary the dc input from 26 volts at full load to 29 volts at no load. The maximum phase voltage change must not exceed 2.0 volts.

(6) Check the slow drift of frequency at either full or no load with the dc input at any stable value between 26 and 29 volts dc at 115-volt ac output. The slow drift must not exceed 1.0 cps.

(7) With the motor-generator Delta connected (para 10b), read and record the input current indicated on the DC AMPS meter at full load with a 28-volt dc input. The input current must not exceed 53.6 amperes during load. Return the LOAD REGULATOR control to 0, and set the voltage adjustment control to provide a 115-volt ac indication on the AC VOLTS meter. *Lock the adjustment.*

b. Frequency Regulation Check. Remove the regulator housing cover to reach the frequency adjustment. Make the frequency regulation check as follows:

(1) Loosen the frequency adjustment (fig. 4) locknut.

(2) Adjust the dc input to 28 volts.

(3) Set the frequency so that no-load and full-load frequencies bracket 400 cps. The zero to full-load (1.0 pf) frequency variation should not exceed 6 cps.

(4) Vary the dc input from 26-volts full-load to 29-volts no-load. The frequency must bracket 400 cps between 395 and 405 cps.

c. Overload Check.

(1) Adjust the input to 26 volts dc.

(2) Adjust the LOAD REGULATOR control for a 13.1-ampere indication on the AC AMPS meter. The *regulated phase* voltage indicated on the AC VOLTS meter must be not less than 50 volts dc.

(3) Set the LOAD REGULATOR control too.

(4) Set the LIVE CIRCUIT switch to OFF. The motor-generator should stop.

d. Overspeed Check.

(1) Disconnect the shunt field from terminal 10 and the 28-volt dc + lead from terminal 8 (fig. 16).

(2) Connect a 35-ohm, 25-watt variable resistor between the shunt field and ground.

(3) Set the LIVE CIRCUIT switch to ON. The motor-generator must start.

(4) Vary the resistor to decrease the field current until the FREQUENCY meter on the test set indicates 500 cps. Run at rated output voltage at no load for 5 minutes. There must be no mechanical or electrical failure.

(5) Vary the resistor to increase field current until the motor-generator is operating normally.

(6) Set the LIVE CIRCUIT switch to OFF. The motor-generator must stop.

(7) Disconnect the variable resistor from the shunt field and ground. Reconnect the shunt field and 28-volts dc + lead to the regulator as shown in figure 16.

e. Output Voltage and Frequency Modulation Checks.

(1) Connect the TS-723(*)/U input to terminal No. 1 of TB1 and the ground connection of test point jack J4 (fig. 16).

(2) Connect the oscilloscope AN/USM-140A input to the AUDIO input of the TS-723 (*)/U.

(3) Adjust the TS-723(*)/U and the AN/USM–140A for 115 volts ac 400 cps.

(4) Set the LIVE CIRCUIT switch of the test set to ON.

(5) See that the output voltage modulation does not exceed 1.0 percent.

(6) Set the LOAD switch on the test set to ON.

(7) Set the LOAD REGULATOR control to no load.

(8) Operate the inverter for 25 seconds, observing the frequency indication on the TS-723(*)/U. No cyclic modulation is permissible (fig. 15.1).

(9) Repeat the procedure given in (8) above for half load and full load.
(10) Place the LOAD and LIVE CIRCUIT switches at OFF.
(11) Disconnect the test equipment.
(12) Recheck all adjustment locks and seal with Glyptol enamel.
(13) Replace the regulator housing cover.

f. Dynamic Balance Test. Perform the dynamic balance test as outlined in paragraph 69.

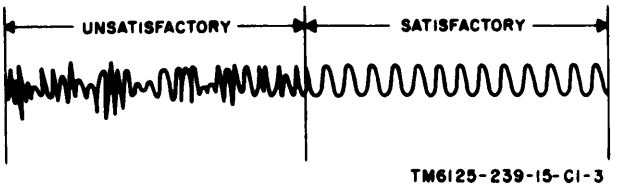


Figure 15.1. Satisfaction and unsatisfactory frequency indication on TS-723(*)/U.

g. Temperature-Rise Test. Perform the temperature-rise test as outlined in paragraph 70.

CHAPTER 8

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. PACKAGING FOR SHIPMENT AND LIMITED STORAGE

71. Packaging for Shipment

The exact procedures for packaging depends on the material available and the exact conditions under which the equipment is to be shipped or stored. Adapt the procedures outlined below whenever possible. The information concerning the original packaging will also be helpful (para 8).

a. Material Requirements. The following materials are required for packaging the inverter. For stock numbers of materials, consult SB 38-100.

Material	Quantity
1 corrugated cardboard pad (top).	19 x 11 x 1/2 inches.
1 corrugated cardboard liner (inner).	19 x 11 x 11-1/2 x 1/2 inches.
1 plywood mounting base with double thickness of corrugated cardboard.	19 x 11 x 3/4 inches.
1 corrugated cardboard carton (outer).	19-1/2 x 11-1/2 x 13-1/4
Adhesive tape	Sufficient quantity to seal outer carton.

b. Packing for Shipment. Repack the inverter in the reverse order of removal. If the original cardboard carton, inner liners, and mounting board are not available (para 8), use a mounting board, liner, and cardboard carton to fit the inverter. Pack the inverter as shown in figure 2. Seal the outer corrugated carton.

72. Packing for Limited Storage

Follow the same procedure outlined in paragraph 71, except that the outer cardboard carton need not be sealed.

Section II. DEMOLITION TO PREVENT ENEMY USE

73. Authority for Demolition

Demolition of the equipment will be accomplished only upon the order of the commander. The destruction procedures outlined in paragraph 74 will be used to prevent further use of the equipment.

74. Methods of Destruction

If the inverter is installed in an aircraft, the standard procedures for destruction of the aircraft include destruction of the inverter. If the inverter is not installed in an aircraft, use any of the following methods for destruction.

a. Preferred Methods. Explosives and mechanical means, either alone or in combination, are the most effective methods to use. Listed below are the preferred methods:

***Warning:* Be extremely careful when using explosives. Do not use explosives unless extreme urgency demands their use.**

(1) *Explosives.* Tape explosives to the stator housing underneath the regulator housing. Detonate from safe distance.

(2) *Mechanical means.*

(a). Bend or crush the inverter; use a sledge hammer, rocks, or heavy tools.

(b) Dispose of the destroyed parts by burying or submerging in a stream, pond, or nearby body of water.

b. Other Methods. If the situation prohibits either of the preferred methods of destruction, use the following methods, either singly or in combination.

(1) *Weapons fire.* Fire on the unit with the heaviest weapons available.

(2) *Scattering or concealment.* Remove all easily accessible parts, and scatter them over a wide area, bury them in dirt or sand, or throw them in a stream, pond, or other nearby body of water.

(3) *Burning.* Pack rags, clothing, or canvas between the regulator housing and stator, saturate with gasoline or oil, and ignite.

APPENDIX I

REFERENCES

DA Pam 310-1	Consolidated Index of Army Publications and Blank Forms.
SB 38-100	Preservation, Packaging, Packing and Marking Materials, Supplies, and Equipment used by the Army.
TB Sig 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB Sig 355-2	Depot Injection Standard for Refinishing Repaired Signal Equipment.
TB Sig 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
TB 11-6625-434-12/1	Preventive Maintenance Checks and Services: Test Set, Armature TM-965/U.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM 11-5126	Power Supplies PP-1104A/G and PP-1104B/G (NSN6130-00-542-6385).
TM 11-6625-203-12	Operator's and Organizational Maintenance Manual: Multimeter AN/URM-105 and AN/URM-105C (Including Multimeter, ME-77/U and ME-77C/U).
TM 11-6625-255-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual: Spectrum Analyzer TS-723A/U, TS-723B/U, TS-723C/U and TS-723D/U (NSN 6625-00-668-9418).
TM 11-6625-273-12	Operator and Organizational Maintenance: Insulation Breakdown Test Sets AN/GSM-6A.
TM 11-6625-298-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual for Ohmmeters, ZM-21/U (NSN 5950-00-645-2191), ZM-21A/U (6625-00-643-1030) and ZM-21B/U (6625-00-581-2466).
TM 11-6625-303-12	Operator's and Organizational Maintenance Manual: Electrical Power Test Sets, AN/UPM-93A, AN/UPM-93B, AN/UPM-93C and AN/UPM-100.
TM 11-6625-366-15	Operator's, Organizational, Direct Support, General Support and Depot Maintenance Manual Multimeter TS-352B/U (NSN 6625-00-553-0142).
TM 11-6625-535-15	Operator, Organizational, Direct Support, General Support and Depot Maintenance Manual: Oscilloscope AN/USM-140A.
TM 11-6625-680-15	Organizational, Direct Support, General Support, and Depot Maintenance Manual: Test Set, Motor Generator AN/GSM-65.
TM 38-750	The Army Maintenance Management System (TAMMS)

APPENDIX II

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

II-1. General

This appendix provides a summary of the maintenance operations for the PU-544/A. 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.

II-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.

f. Calibrate. To determine and cause corrections to be made or 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 service (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 (service/action) 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.

II-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 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 listed maintenance function vary at different 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, troubleshooting 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 are as follows:

C – Operator/Crew

O — Organizational

F – Direct Support

H – General Support

D – Depot

e. Column 5, Tools and Equipment. 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 6, Remarks. Column 6 contains an alphabetic code which leads to the remarks in section IV, Remarks, which is pertainent to the item opposite the particular code.

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

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column 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 allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or 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.

II-5. Remarks (Sect. IV)

a. Reference Code. This code refers to the appropriate item in section II, column 6.

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

Section II. MAINTENANCE ALLOCATION CHART FOR

MOTOR GENERATOR PU-544/A

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIP.	(6) REMARKS
			C	O	F	H	D		
00	MOTOR-GENERATOR PU-544/A	Inspect		0.1					
		Service		0.1				1	A
		Test		0.1				1,2,3	B
		Adjust		0.1				1,2	C
		Replace		0.1				1	
		Inspect			0.2			4	
		Replace			3.0			4,7,8	D
		Service			0.5			4	E
		Adjust				0.3		4,7,8	F
		Replace				2.0		4,17 thru 21	G
		Test				1.5		3 thru 16	H
		Overhaul					12.0	3 thru 32	
01	REGULATOR, VOLTAGE & FREQUENCY	Test			0.2			3 thru 10	
		Adjust			0.2			3,4,5	B
		Replace			1.0			4	
		Repair				1.5		4	
	NOTE 0 represents AVUM F/H represents AVIM								

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
2	O	MULTIMETER AN/URM-105 ( )	6625-00-581-2036	
3	O,F,H,D	TEST SET, ELECTRICAL POWER AN UPM-93	6625-00-581-2097	
4	F,H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
5	F,H,D	MULTIMETER AN/USM-223/U (RS TS-352B/U)	6625-00-999-7465	
6	F,H,D	MULTIMETER ME-26 ( )	6625-00-913-9781	
7	F,H,D	TEST SET, MOTOR-GENERATOR AN GSM-65	4920-00-348-5793	
8	F,H	POWER SUPPLY PP-4606 G OR EQUAL	6130-00-504-0327	
9	H,D	BRIDGE, RESISTANCE ZM-4B U	6625-00-500-0937	
10	H,D	TEST SET, CAPACITOR ZM-3( )U	6625-00-229-1060	
11	H,D	TEST SET, TRANSISTOR TS-1836( )U	6625-00-893-2628	
12	H,D	MOTOR-GENERATOR	6125-00-	
13	H,D	OHMMETER ZM-21A U	6625-00-643-1030	
14	H,D	OSCILLOSCOPE AN USM-281A	6625-00-228-2201	
15	H,D	TEST SET, ARMATURE TS-965( )U	6625-00-828-5810	
16	H,D	TEST SET, INSULATION BREAKDOWN AN GSM-6	6625-00-542-1331	
17	H,D	PLIERS, RETAINING	5120-00-288-9717	
18	H,D	WRENCH, TORQUE	5120-00-541-3002	
19	H,D	ARBOR PRESS, GREENERD MODEL NO. 3 OR EQUAL	*	
20	H,D	BEARING PUSHER, BASE AND TOP	*	
21	H,D	BEARING RETAINER PULLER ASSEMBLY	*	
22	H,D	OVEN	*	
23	D	BALANCING MACHINE, GISHOLT TYPE IS		
24	D	DIAL INDICATOR, LUFKIN MODEL 2-B25-5 (DIAL CALIBRATED TO READ 0.001 INCH)		
25	D	PHASE SEQUENCE INDICATOR, ASSOCIATED RESEARCH INC. MODEL 44 400HZ OR EQUAL		
26	D	MODULAR PRECISIONAIRE COLUMN, SHEFFIELD 9 IN. MODEL		
27	D	CIRCUIT BREAKER, 180 AMPS	5925-00-257-7072	
28	D	DIAMOND-TIPPED OR CARBOLOY-TIPPED CUTTING TOOL		
29	D	POWER SUPPLY, SORENSON MODEL DCR40-500A OR EQUAL		
30	D	PAINT BOOTH		
31	D	SPRING SCALE	6635-00-791-5915	
32	D	ULTRASONIC CLEANER		

* The National Stock Numbers that are missing from this list have been requested and will be added by a change to the list upon receipt.

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	EXTERIOR.
B	OUTPUT VOLTAGE AND FREQUENCY.
C	OUTPUT VOLTAGE ONLY.
D	BRUSHES, INCLUDING RUN-IN.
E	REMOVE INTERIOR BRUSH CARBON AND DUST.
F	BRUSH NEUTRAL.
G	BEARINGS AND ASSOCIATED COMPONENTS.
H	COMPREHENSIVE TESTS.

APPENDIX III

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

General

This appendix lists items supplied for initial operation. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

2. Columns

Columns are as follows:

a. Federal Stock Number. This column lists the 11-digit Federal stock number.

b. Designation of Model. Not used.

c. Description. Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning, enter the nomenclature and description.

d. Unit of Issue. The unit of issue is each unless otherwise indicated and is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances, and iss u e purposes.

e. Expendability. Nonexpendable items are indicated by NX. Expendable items are not annotated.

f. Quantity Authorized. Under "Items Comprising an Operable Equipment," the column lists the quantity of items supplied for the initial operation of the equipment.

Section II. FUNCTIONAL PARTS LIST

FEDERAL STOCK NUMBER	DESIGNATION BY MODEL	DESCRIPTION	UNIT OF ISSUE	EXP	QTY AUTH	ILLUSTRATION	
						FIGURE NO.	ITEM NO.
6125-985-7950		MOTOR GENERATOR PU-544/A: output data: ac, 400 cycles, 750 VA; rating 200 V line to line, 115 V line to line, 115 V line to neutral, 1 ph and ph, input data; dc 28 V, 12,000 rpm rated speed; full load rating, dim. data; 11.3 in. lg. X 6.00 in. w X 8.00 in. h; MIL type 17406				1	
		ITEMS COMPRISING AN OPERABLE EQUIPMENT					
Ord thru AGC		TECHNICAL MANUAL TM 11-6125-239-15 Requisition through pinpoint account number if assigned; otherwise through nearest Adjutant general facility. A quantity of two technical manuals is packed with each equipment. Where a valid need exists, additional copies may be requisitioned and kept on hand.			2		

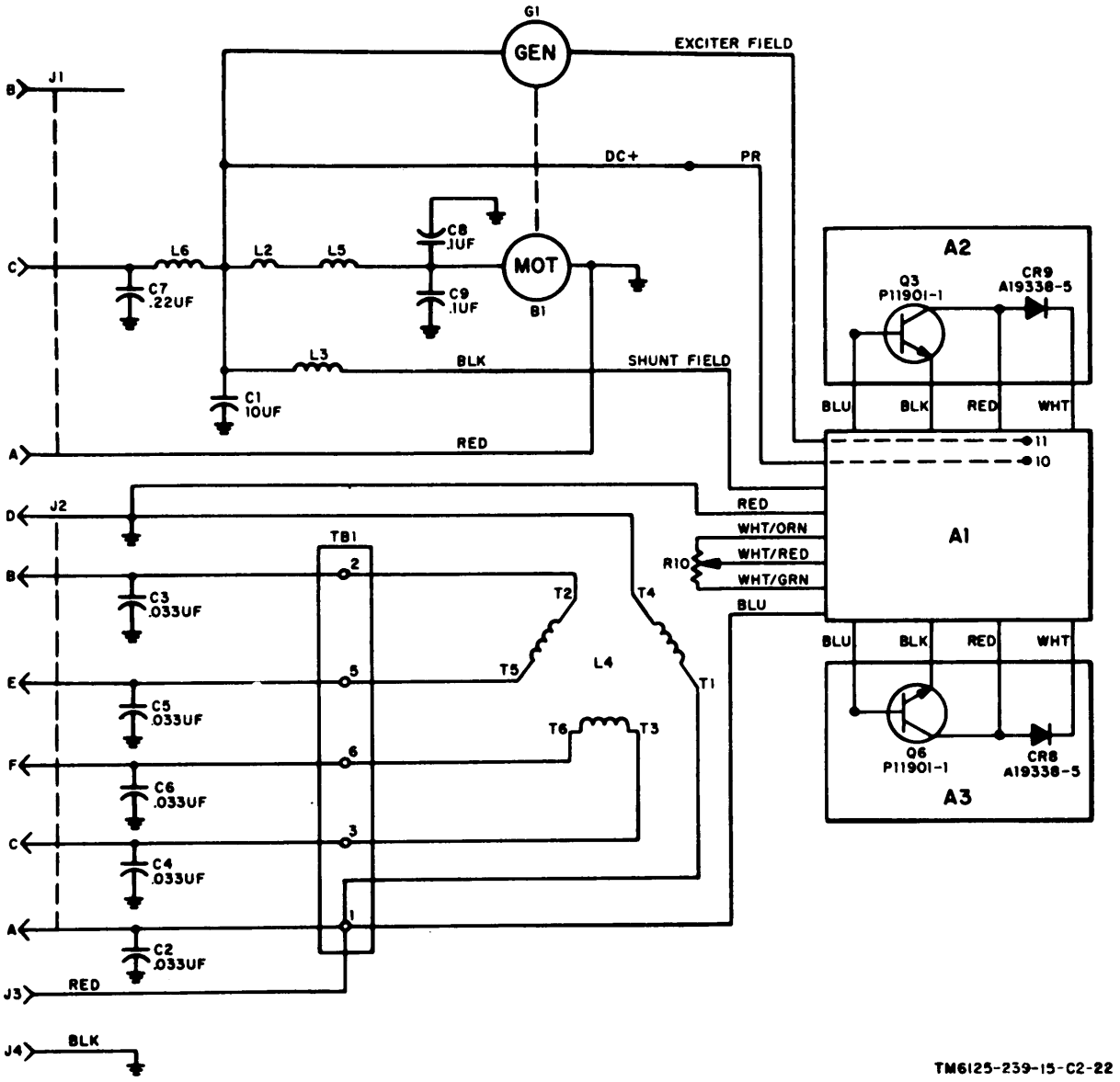
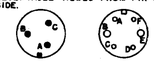


Figure 15.2 Motor-Generator PU-544/A with CSV1186-3 regulator, schematic diagram.

NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UUF.
2. UNLESS OTHERWISE INDICATED, ALL WATTAGE RATINGS OF RESISTORS ARE 1/2 WATT.
3. RESISTORS A1R5, A2R13, A2R14, AND A3R5 ARE 3 WATT.
4. ▭ INDICATES EQUIPMENT MARKING.
5. JUNCTION TERMINALS CORRESPOND TO CIRCUIT BOARD ELECTRO-MECHANICAL CONNECTIONS.
6. REFERENCE DESIGNATIONS ARE ABBREVIATED ON CIRCUIT BOARDS A1, A2 AND A3. PREFIX THE REFERENCE DESIGNATION WITH THE CIRCUIT BOARD DESIGNATION.
7. RECEPTACLE VIEWED FROM PIN OR RECEPTACLE SIDE.



8. T1 TERMINAL RESISTANCES
   1-2 = 45Ω
   3-4 = 7.9Ω
   5-6 = 12Ω
   7-8 = 1.53Ω
   T2 AND T3 TERMINAL RESISTANCES
   1-2 = .10Ω
   3-4 = 4.2Ω
   5-6 = 2.2Ω

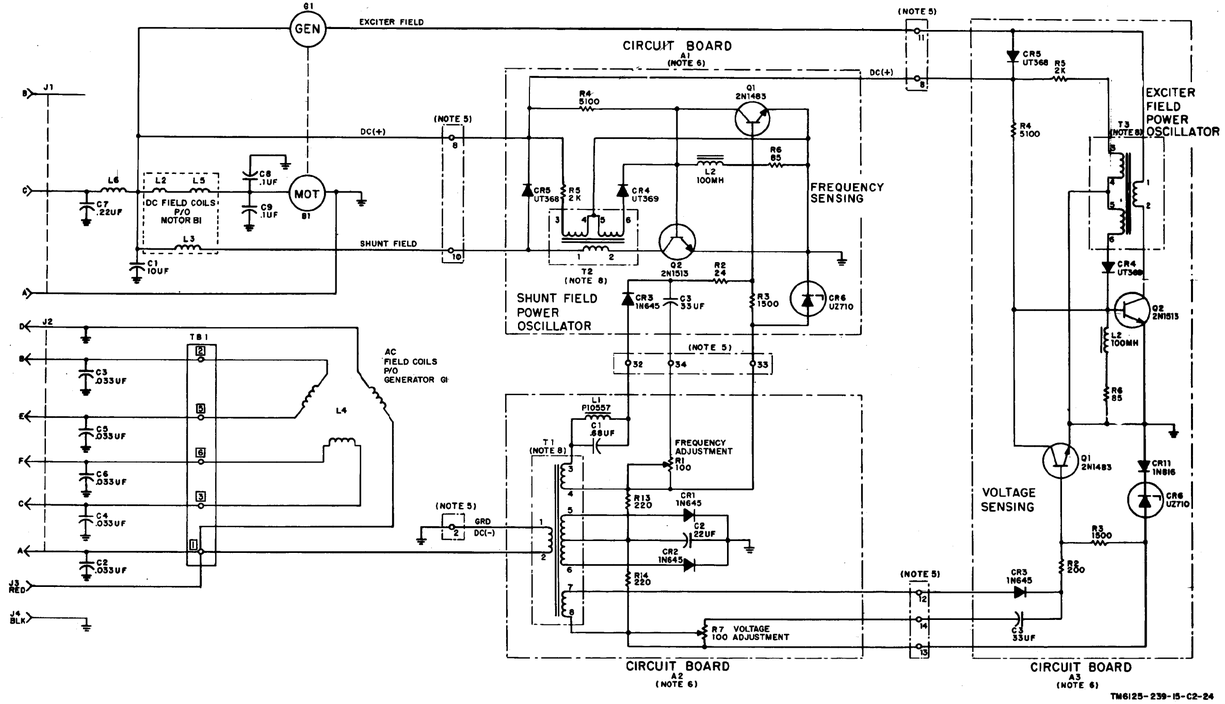
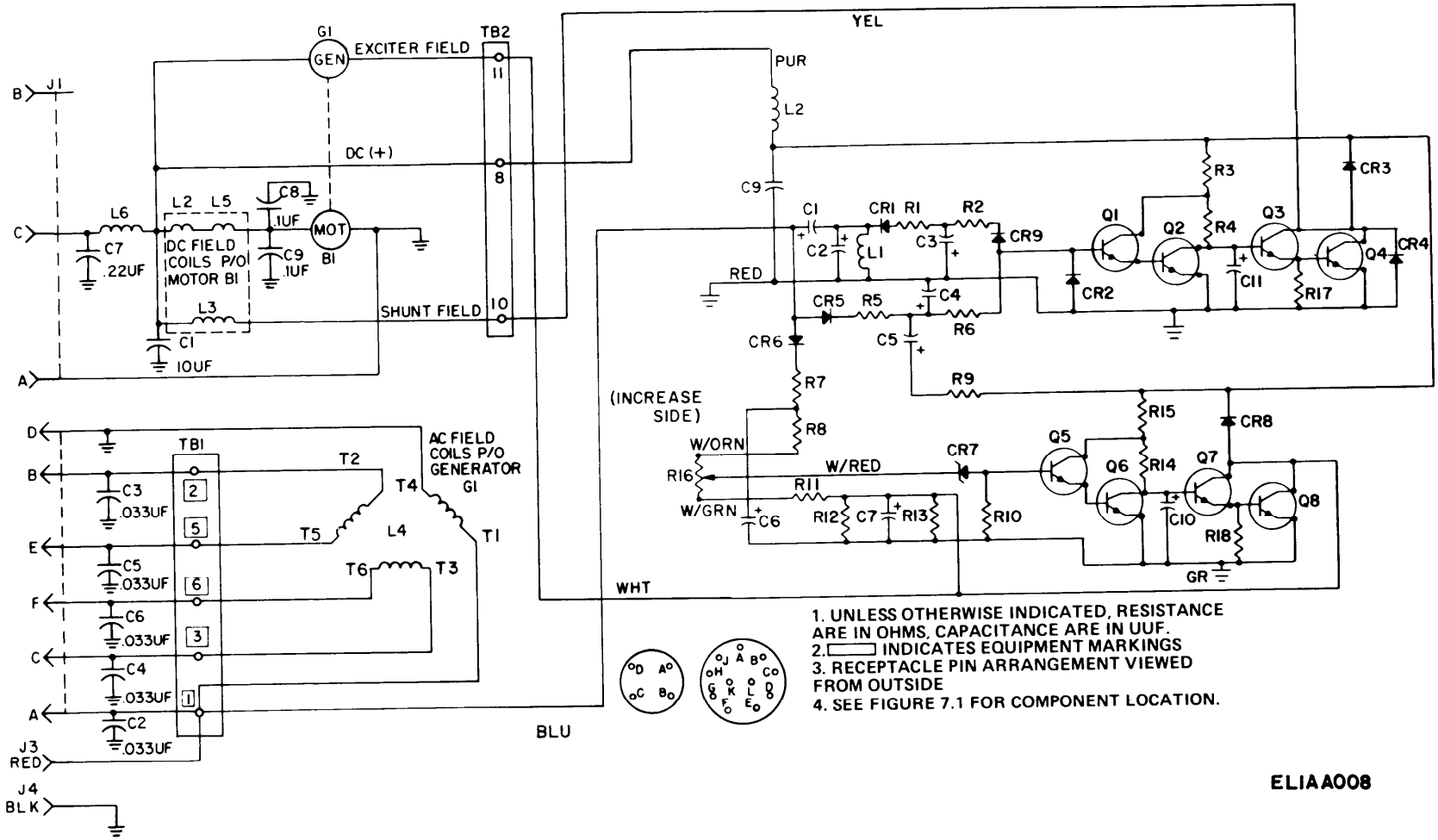


Figure 16. Motor-Generator PU-544/A with CSV1080-1 regulator, schematic diagram.



Figurc 16.1. Motor-Generator PU-544/A with CSV2215-3 regulator, schematic diagram.

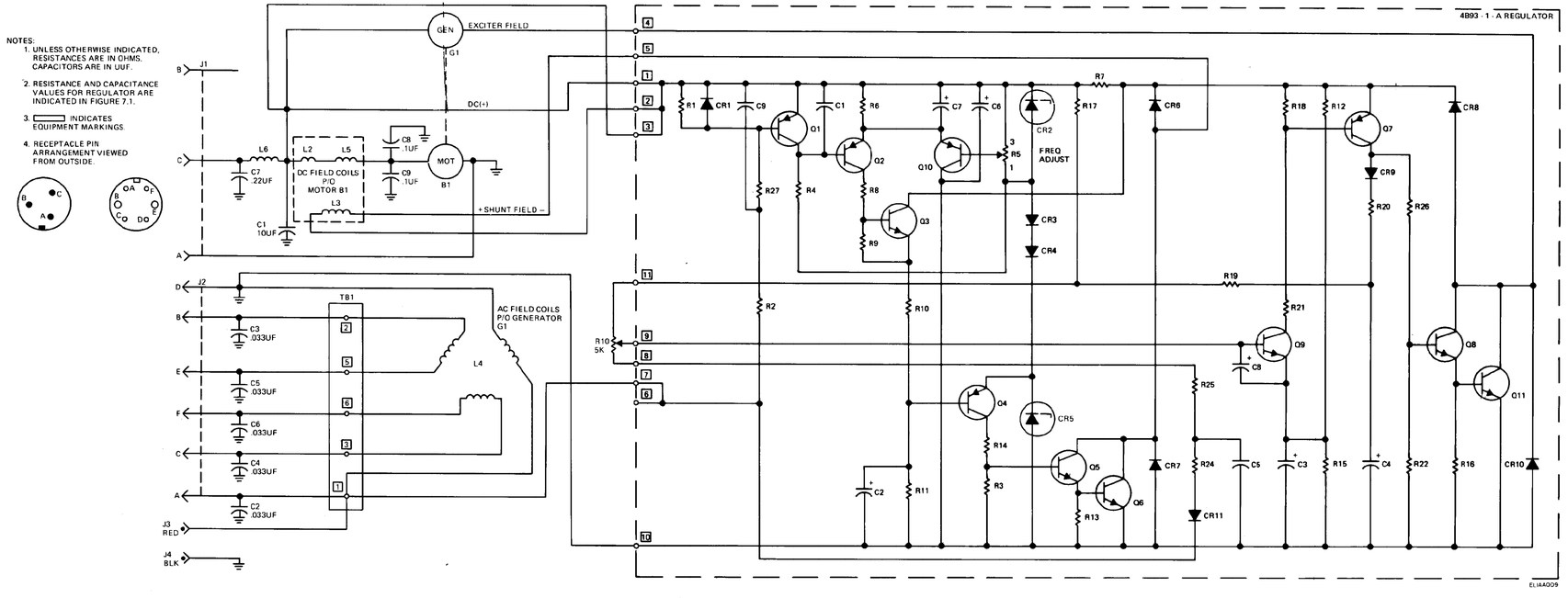


Figure 16.2. Motor-Generator PU-544/A with 4B93-1-A regulator, schematic diagram

INDEX

By Order of Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

DASA (6)
USASA (2)
CNGB (1)
CofT (1)
CofEngrs (1)
TSG (I)
CofSptS (1)
OCC-E (7)
USAARMBD (2)
USAARTYBD (2)
USCONARC (5)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
LOGCOMD (2)
USAMC (5)
USAECOM (7)
USAMICOM (4)
USASMCOM (2)
USASCC (4)
USA CD Agcy (1)
Armies (2)
Corps (2)
USA Corps (3)
MDW (1)
GENDEP (OS) (2)
Sig Sec GENDEP (OS) (5)
Sig Dep (OS) (12)
A Dep (2) except
Lexington (12)
Sacramento (28)
Tobyhanna (12)
Ft Worth (8)
Letterkenny (5)
Sharpe (3)
Navajo (5)
Savanna (5)
Charleston (3)
Svc Colleges (2)
Br Svc Sch (2)
Instl (2) except
Ft Monmouth (63)
Ft Hancock (4)
Ft Gordon (5)
Ft Huachuca (10)
Yuma PC (2)
WSMR (5)
USASTC (3)
USATC AD (2)
USATC Armor (2)
USATC Engr (2)
USATC Inf (2)
WRAMC (3)
Army Pic Cen (2)
CRREL (2)
USAERDL (2)
USAELRDA: White Sands (13)
Chicago Proc Dist (1)
11th Air Assault Div (3)
AMS (1)
1st USASA Fld Stn (5)
USARSOUTHCOM Sig Agcy (1)
USAEMA (9)
USA Tml Comd (1)
Army Tml (1) except
Oakland (5)
POE (1)
Sig Fld Maint Shop (3)
Units org under fol TOE:
(2 copies each UNOINDC)
11-16
11-57
11-98
11-117
11-155
11-157
11-500 (AA-AE) (4)
11-557
11-587
11-592
11-597

NG: State AC (3).
USAR: None.
For explanation of abbreviations used, see AR 320-50.

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