

GENERAL PURPOSE DC ADJUSTABLE SPEED DRIVES
Varispeed-505G3 Drives
INSTRUCTION MANUAL

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

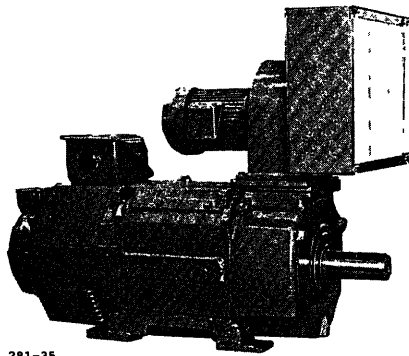


PREFACE

This instruction manual describes installation, operation, inspection and maintenance of YASKAWA's adjustable speed control drives Varispeed-505G3 (VS-505G3) for general industrial-use DC motor. Read this instruction manual thoroughly before operation for a lifetime of safe optimum operation.

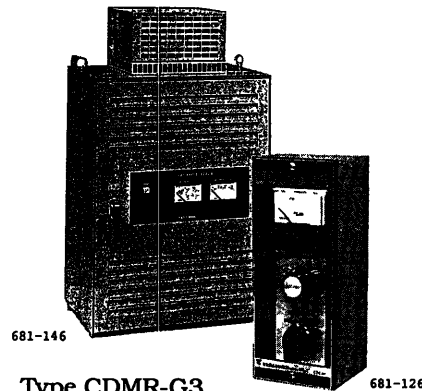
See manual No. "TOE-C435-3" for the detail of handling the industrial DC motors.

YASKAWA ELECTRIC CORPORATION



281-35

Type GBDR-K



681-146

Type CDMR-G3

681-126

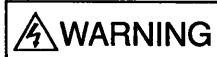
Type JVOP-51

General Precautions

- Some drawings in this manual are shown with the protective covers or shields removed, in order to describe details with more clarity. Make sure all covers and shields are replaced before operating this product.
- This manual may be modified when necessary because of improvement of the product, modification, or changes in specifications.
Such modifications are denoted by a revised manual No.
- To order a copy of this manual, if your copy has been damaged or lost, contact your YASKAWA representative.
- YASKAWA is not responsible for any modification of the product made by the user, since that will void your guarantee.

NOTES FOR SAFE OPERATION

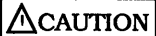
Read this instruction manual thoroughly before installation, operation, inspection or maintenance of this adjustable speed control drive VS-505G3 (hereafter control panel). In this manual, NOTES FOR SAFE OPERATION are classified as "WARNING" or "CAUTION".



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

Even items described in  may result in a serious accident in some situations. In either case, follow these important notes.


1. GENERAL




CAUTION

- Never modify the control panel or DC motor.
 - Transportation, installation, wiring, operation, inspection and maintenance of this control panel or DC motor should be performed only by, authorized, qualified personnel.
 - Never use a damaged control panel or DC motor.
 - Do not use the control panel or DC motor exceeding the rated specifications.
 - Do not insert a finger or any other object into the open portion of the control panel or DC motor.
- Failure to observe these cautions may cause electrical shock or burn-out, resulting in personal injury or fire or equipment damage or it may invalidate product guarantee.

2. RECEIVING

 CAUTION	
<ul style="list-style-type: none">• Verify that the received control panel or DC motor is the one you ordered. Operating a damaged or incomplete control panel or DC motor can result in personal injury.	(Ref. page) 10

3. TRANSPORTATION AND INSTALLATION

 CAUTION	
<ul style="list-style-type: none">• Use the control panel only in an environment specified in this instruction manual. Using the control panel in an inadequate place can result in electrical shock, or fire, or malfunction.• Check the weight of the control panel or DC motor to avoid hooking a weight exceeding the lifting lugs capacity. Otherwise the control panel or DC motor may drop or overturn, resulting in personal injury or equipment damage.	(Ref. page) 10 10

4. WIRING


WARNING


	(Ref. page)
• Wiring should be performed only by authorized, qualified personnel following this instruction manual.	12
• Be sure to perform grounding connection between the control unit earth terminal and the earth terminal of the control panel according to the local code.	12
• When connecting this control unit to power supply cable, perform the wiring following this instruction manual.	12
• When wiring the emergency stop circuit, be sure to check that the circuit functions normally before operation by the end user.	12
Failure to observe these warnings may cause electrical shock, or burn-out, resulting in personal injury or equipment damage.	

CAUTION


	(Ref. page)
• Close up the opening of the cable passing hole by calking compound.	12
• Do not perform withstand voltage test of the control panel. Since it may cause semi-conductor elements to be damaged.	12
• When installing a mechanical brake, be sure to check that the brake system functions normally. Failure to observe these cautions may result in personal injury or equipment damage.	12


5. OPERATION

 WARNING	
	(Ref. page)
• When performing operation, be sure to check that the field circuit wiring or connections are made correctly. Since the loss of DC motor field may cause overspeeding, resulting in personal injury or equipment damage.	16
• When opening the control panel door for handling the other units mounted in the control panel, be sure to handle them following their instruction manuals and avoid touching the irrelevant units.	16
• Never touch the internal terminals of the control panel since they are still energized with high voltage even when a portion of the circuits are turned "OFF".	16
• Do not open the front door or rear panel cover during operation.	16
• Do not remove partition cover or protective cover.	16
• At power failure, turn OFF the power supply switch positively. Failure to observe these warnings can result in severe personal injury by electrical shock or equipment damage.	16

 CAUTION	
	(Ref. page)
• Avoid contacting the thyristor heat sink or resistors, etc. with hands or the body during operation or immediately after stop since they are heated to high temperatures.	16
• When a malfunction occurs, stop the operation immediately.	16
• All the adjusting rheostat have been preset at the factory. Do not change the settings unnecessarily. Failure to observe these cautions can result in personal injury or equipment damage.	16

6. MAINTENANCE AND INSPECTION

 WARNING	
	(Ref. page)
• Perform inspection and/or maintenance work only after making sure that both the main circuit and control circuit are turned "OFF".	19
• When inspection work with the unit cover open during the energized status is inevitably necessary, perform only visual inspection, or smell inspection, or auditory inspection.	19
• Never insert fingers, measuring tools or any other objects into the open space of the control panel component. Failure to observe these warnings may cause electrical shock, resulting in severe personal injury.	19

 CAUTION	
	(Ref. page)
• Replace all protective covers which were removed during maintenance or inspection work before turning "ON" the control panel.	19
• Maintenance or inspection work for the other internal units should be performed only after reading thoroughly their instruction manuals.	19
• Be sure to wear protective glove for insulation when performing the work for the internals of the control panel.	19
• Tighten terminal screws to the adequate tightening torque.	19
• When insulation resistance test (megger test) is necessary, contact your YASKAWA representative since it requires special precautions.	19
• Replace spare parts of the same model No., of the same ratings, and of the same specifications within the specified replacement interval.	23
• Do not perform any disassembly or reassembly which is not described in the instruction manual. Failure to observe these cautions can result in personal injury due to electrical shock or malfunction or equipment damage due to burn-out, etc.	23

7. DISPOSAL

 CAUTION

- When disposing of this control panel, treat it as general industrial waste, abiding by local statutory legislation.

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1. RECEIVING

The equipment have been put through severe tests at the factory before shipped. After unpacking, however, check and see the following.

- Their nameplate data meet your equipments.
- They have sustained no damage while in transit.
- Fastening bolts and screws are not loosened.
- Remove shaft thrust block of the DC motor and hand rotate the shaft to see that the shaft rotates smoothly.
- Devices built in the cabinet are not damaged and loosened.

2. STORAGE

If the equipment are temporarily stored or machine stops for an extended length of time, the following precautions should be taken.

2.1 STORAGE LOCATION

Store the equipment under following conditions.

- Free from rainfall and drops of water
- Clean and dry
- Free from corrosive gas and liquid
- Ambient temperature: 0 to 40°C
- Less vibration

2.2 RUST-PREVENTION FOR DC MOTOR BEARING

If the DC motor is placed in storage for an extended length of time, rotate the shaft slowly by hand at least once in every three-month period.

This will distribute the grease and prevent bearing corrosion due to condensation or contaminating gases in the vicinity of the motor.

3. INSTALLATION

Select a location and install the equipment by proper procedure in keeping the equipment in good working condition.

3.1 INSTALLATION OF DC MOTOR

Refer to Instructions for Industrial DC Motors (TOE-C435-3).

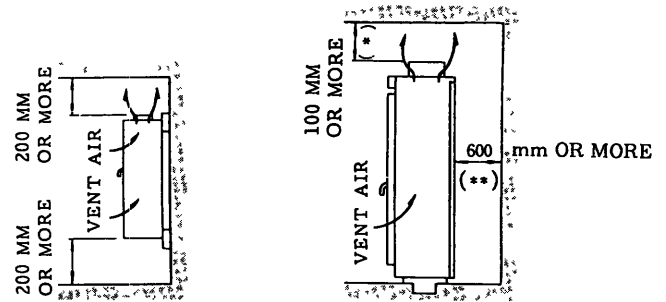
3.2 INSTALLATION OF POWER UNIT

ocation

Install the unit in such a location described in STORAGE.

Space

In order to avoid excessive temperature rise, ventilating holes are provided on the top of the unit. Give sufficient spase to keep adequate air flow and do not block ventilation passage. See Fig. 1.



(a) Wall-Mounted Type

(b) Floor-Mounted Type

Fig.1 Mounting Space for the Power Unit

- * For height 1800 mm or below, space top of 200 mm should be kept between panel top and ceiling
- ** For height 1800 mm or below, rear panel can contact the wall

Table 1 Dimensions and Weights of Power Unit

Rated Output kW		Wall-mounted type						Floor-mounted type					
		Operation Type*											
220 V	440 V	①	②	③	④	⑤	⑥	①	②	③	④	⑤	⑥
1.5	—												
2.2	—												
3.7	—												
5.5	11	W × H × D 600 × 800 × 380 (approx 95 kg)						W × H × D 600 × 1400 × 400 (approx 180 kg)					
7.5	15												
—	18.5												
11	22					W × H × D 600 × 1200 × 380 (approx 110 kg)							
15	30												
18.5	37												
22	45	W × H × D 600 × 1200 × 380 (approx 110 kg)										W × H × D 600 × 1800 × 400 (approx 230 kg)	
30	55												
37	75												
45	90												
55	110												
75	132										W × H × D 1000 × 2100 × 600 (approx 250 kg)		
90	160										W × H × D 1200 × 2100 × 600 (approx 460 kg)		
110	200												

Operation-types

- 1 Non-reversing.
- 2 Non-reversing, with DC main circuit contactor
- 3 Non-reversing, with manual DB
- 4 Non-reversing, with DC main circuit contactor and manual DB
- 5 Reversing, with DC main circuit contactor
- 6 Reversing, with DC main circuit contactor and manual DB

Handling

Power unit is shipped in an upright position and should keep the upright position and never give shock during all handling. Close the door and never try to lift or move the power unit other than the lifting member of floor sill channel.

Installation

The power unit must be installed on leveled horizontal or vertical flat surface.

3.3 INSTALLATION OF VS OPERATOR

Location

Refer to the Location for Power Unit.

Space

Give sufficient space to give access for maintenance and to open the door smoothly, see Fig. 2.

Handling

Never give shock during all handling.

Mounting

Install on the vertical flat surface, such as panel or beam by using four mounting holes in the rear of the unit.

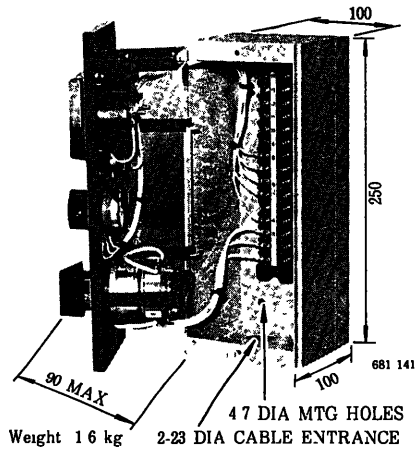


Fig. 2 Dimensions of VS Operator (mm)

4. WIRING

Make wiring in reference to the interconnection diagram furnished on your order and the following.

4.1 COMPONENT ARRANGEMENT OF POWER UNIT

Figs. 3 and 4 show component arrangement in the power unit.

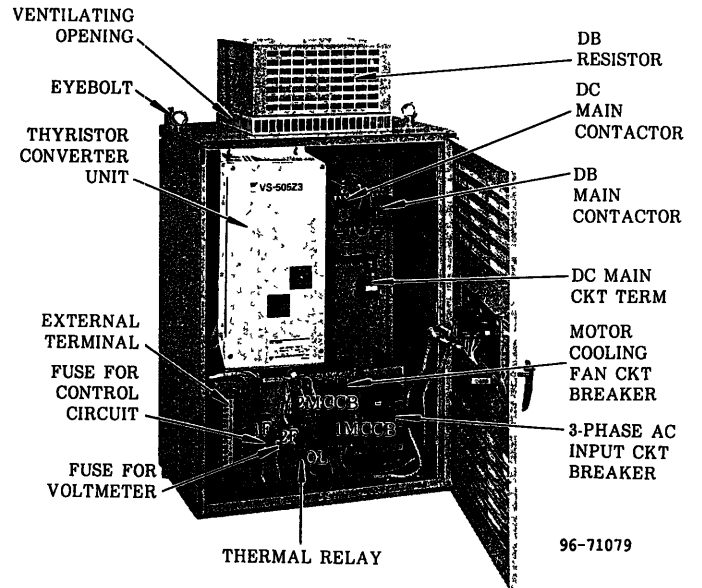


Fig. 3 Wall-Mounted Type

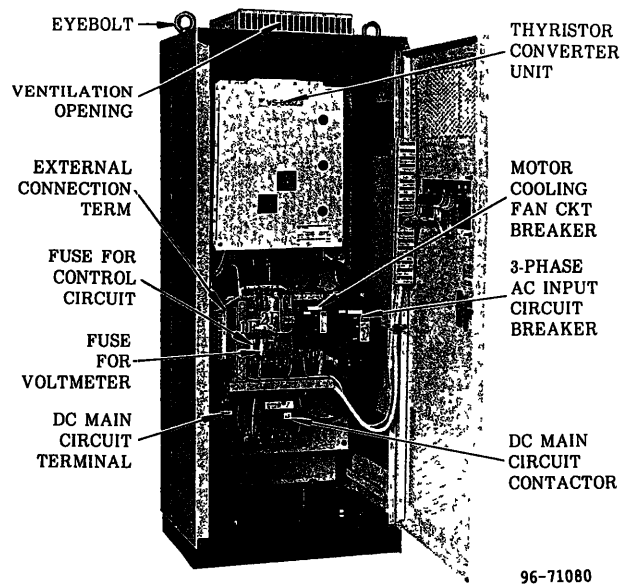


Fig. 4 Floor-Mounted Type

4.2 TERMINAL SIZES AND CARRYING CURRENTS

Table 2 shows the size and the current carrying capacities of the terminals of the power unit. Select leads with sufficient current carrying capacity. Refer to Cautions when Wiring.

4.3 INTERCONNECTIONS

Fig. 5 shows interconnections between the DC motor, power unit and VS operator. Make correct wiring referring to Cautions when Wiring.

Table 2 Terminal Size

Rated voltage V	Rated output kW	AC Main Circuit		DC Main Circuit		Field Circuit	
		Terminal size	Carrying current A	Terminal size	Carrying current A	Terminal size	Carrying current A
220	1.5	M5	11	M5	11	M4	2
	2.2		14		14		3
	3.7		21		22		3
	5.5		30		31		3
	7.5		40		42		5
	11	M6	50	M6	58		5
	15	M8	71	M8	78		6
	18.5		87		94		9
	22	M10	100	M10	113		8
	30		138		153		9
	37		168		188		8
	45		200		229		7
	55		246		278		10
	75	M16	329	M16	375		13
	90		397		454		15
	110		477		552		17
440	11	M5	29	M5	29	M4	5
	15		40		38		7
	18.5	M6	45	M6	48		6
	22		50		56		9
	30	M8	73	M8	76		9
	37		87		93		9
	45		100		113		11
	55	M10	127	M10	135		12
	75		173		186		16
	90		205		225		16
	110		247		274		18
	132		293		328		20
	160	M16	346	M16	395		19
	200		437		492		21

Note: Terminal size other than listed above is M3.5 and current capacity is 5 A or below at 200-volt class or below

4.4 PRECAUTIONS WHEN WIRING

Main and Control Circuits

Use 600 V PVC insulated wires or cabtyre cables with the current carrying capacities given in Table 2 for the following terminals:

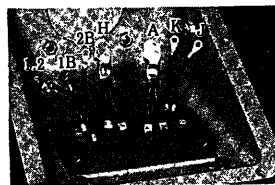
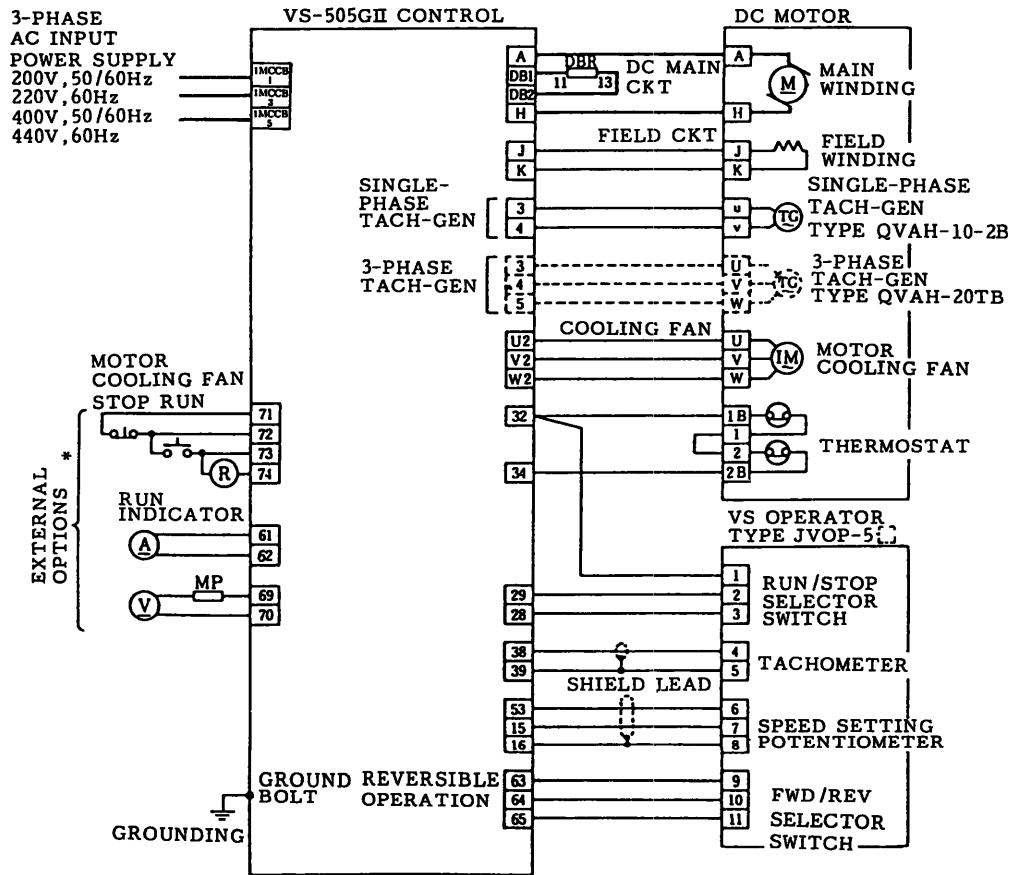
- AC main circuit terminals (1MCCB-1, -3, -5)
- DC main circuit terminals (A, H)
- Control circuit terminals (U₂, V₂, W₂)
- Cooling fan terminals
- Thermostat terminals

Field Circuits

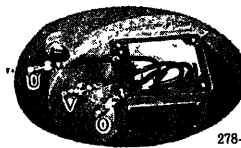
Use the same wires or cables as specified above. However, for this application, use stranded wires with a cross-section 5.5 mm² or larger.

Cooling Fan Carrying Current

Fan motor output kW	0.1	0.2	0.3	0.75	1.5	2.2	3.7
Supply voltage (3-phase) 200/220 V	1A	2A	2A	4A	7A	10A	15A
400/440 V	0.5A	1A	1A	2A	4A	5A	8A



Terminal Box For Main Circuit, Field Circuit, and Thermostat



Terminal Box For Tach-Gen



Terminal Box For Cooling Fan

*For panel-mounted control, connections for external options are not required.

Fig. 5 Interconnections

Wiring of speed feedback circuit and other circuits.

Use shielded wires or twisted wires of twisting pitches 20 mm or smaller (Fig. 6) for the speed setting circuit terminals (53, 15, 16), and the tachometer circuit terminals (38, 39). (In Fig. 5, indicates shielded wires.)

To avoid inductive interference from other cables, especially from the main circuit wires, install the shielded or twisted wires apart from these cables. PVC-insulated, PVC-sheathed cables (CVV-S) are recommended as shielded wires.



Fig. 6 Pitch of Twisted Wire

Lead Entrance

Wall-mounted type power units are provided with two each lead openings at the top and at the bottom. Either one can be used. All the lead entrances are closed with blank plates. Cut holes in the plates to fit the conduits used. Floor mounted type power units are provided with openings at the bottom for cable entrance.

Grounding

Ground the power unit using the ground bolt at a single point, observing the following rules or equivalent national standards.

Japan National Electrical code

200 V class ... Class 3 Grounding Work

400 V class ... Special Class 3 Grounding Work

NEC (National Electrical Code) Article 250

BS (British Standard) CP 1013 Grounding

Strictly avoid sharing common ground cables and conductors with welding machines, motors, and other power circuits. Install the ground wires apart from those of power circuits.

- Use ground wires of the sizes specified in "Indoor Wiring Rules," and make the length as short as possible.
- Even where the power unit is grounded through the mounting frame, make direct grounding from the ground bolt.
- Where two or more power units are installed, direct grounding from each ground terminal bolt is recommended, and series connection of all the ground bolts with grounding of one of the ground bolts is acceptable. However, do not make loop circuits as shown in Fig. 7.

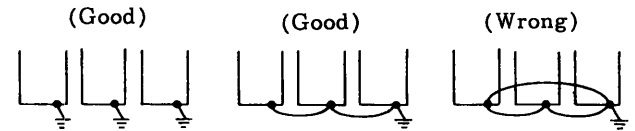


Fig. 7 Grounding of Three Power Units

— CAUTION —

After wiring, check interconnections and make insulation resistance tests. Use a 500 V Megger.

(1) Power unit

Measure the insulation resistance on the following circuits.

- Between AC main circuit terminals (1MCCB-1, -3, -5) connected together and the ground.
- Between DC main circuit terminals (A, H) connected together and the ground.

When the test result is 2 MΩ or more, the test is deemed satisfactory.

(2) DC motor

Disconnect external wiring to external terminals A, H, J, and K and measure the insulation resistance on the following circuit.

- Between main circuit terminal (A or H) and the ground
- Between field circuit terminal (J or K) and the ground

When the test result is 0.2 MΩ or more (at 200 V) and 0.4 MΩ or more (at 400 V), the test is deemed satisfactory.

5. TEST RUN

When the DC motors, the power units, and the VS operator have been installed and wired, the system shall be tested through a test run as follows.

If trouble is found during the test run, refer to "Check Before Test Run" and "Trouble-

shooting Guide" for necessary measures. If the cause of the trouble cannot be located, or repair is impossible, notify our service station, giving the details of trouble conditions.

5.1 CHECK BEFORE TEST RUN

Make the following checks prior to the test run.

Table 3 Check before Test Run

Check Points	Check Items
Interconnection Between Power Unit, VS Operator and DC Motor	Correct wiring, see Fig 5.
	Tightening of bolts for electrical connection
DC Motor	Disconnection from the driven machine
	Removal of thrust block
	Remove inspection covers and blow out with air to clean commutator (Fig 8)
Power Unit	Adhesion of dirt or dust on the enclosure
	Smooth hand rotation of thyristor cooling fan *.
	Correct adjustment of potentiometers on the control board (1PCB) of thyristor inverter unit Refer to red point.
	Correct insertion of the housing into the voltage selecting tap (Fig. 9).
	Correct insertion of the housing into the frequency selecting tap (Fig 10).
Supply Voltage at the Input Terminals of the Power Unit	Voltages between phases are complied with the values on Table 4 Check with a tester †.

* Power units 7.5 kW or larger at 220 V and 22 kW or larger at 440 V are provided with a thyristor cooling fan

† If the power unit is fed from the power supply which is commonly connected to an electric furnace controller or a large thyristor inverter, irregular control may arise. When any abnormality is found, inform us

Table 4 Permissible Variation of Supply Voltage

Rated Voltage of Power Unit	Permissible Voltage Variation
200 V, 50/60 Hz	170 - 220 V
220 V, 60 Hz	187 - 242 V
400 V, 50/60 Hz	340 - 440 V
440 V, 60 Hz	375 - 484 V

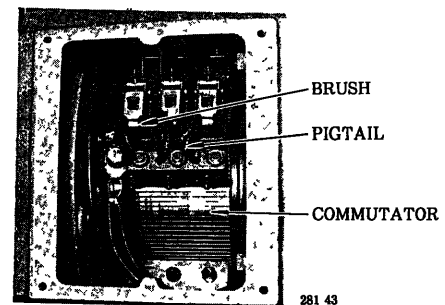


Fig. 8 Inspection Window of DC Motor

5.2 NO-LOAD OPERATION

system for safety. Then, run the motor without load according to Table 5

After making the checks specified before test runs, thoroughly check the environment of the

Table 5 No-load Operation

Order	Operation	Check Items
1	Turn the speed setting potentiometer on the VS operator full counterclockwise (For a preset start, adjust a desired value)	—
2	Turn on the 1MCCB, 2MCCB in the power unit	Trip of MCCB
		Smooth rotation of the thyristor cooling fan*
		Smooth rotation of the blower for DC motor
		Rotating direction of the blower meet with the marking on the blower†
3	Turn on the change-over switch on the VS operator	For the preset start, DC motor accelerates to the preset value
4	Gradually, rotate the speed setting knob clockwise	Smooth acceleration of DC motor
		Abnormal odor, smoke, vibration and noise on DC motor.
5	Remove the hand-hole cover and check the commutator	Brush chattering and sparking at the brushes
	To avoid excessive temperature rise of DC motor winding in frame 112, 132, reclose the window within 5 minutes	
6	Gradually, turn the speed setting potentiometer clockwise.	Smooth acceleration of DC motor
7	Turn the speed setting potentiometer full counterclockwise.	DC motor rotates at the maximum speed desired Confirm with a tachometer
8	Turn the speed setting potentiometer to various speed positions.	DC motor speed corresponds with the motion of the potentiometer
9	Turn off the change-over switch on the VS operator.	Stop of the DC motor
		When a dynamic brake circuit is provided, DC motor suddenly stops
10	Turn off the 1MCCB, 2MCCB in the power unit.	—

* Power units, rated 7.5 kW and above at 220 V, and 22 kW and above at 440 V, are provided with the thyristor cooling fan

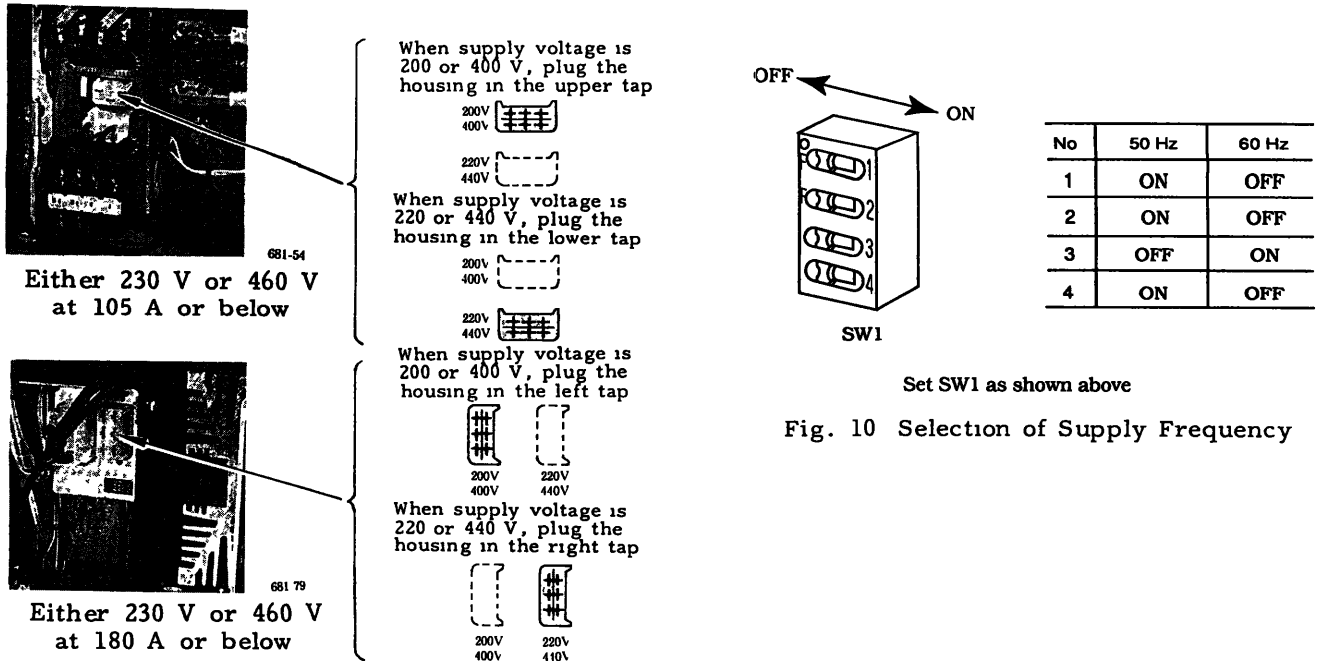


Fig. 9 Tap Selection of Control Supply Voltage

Fig. 10 Selection of Supply Frequency

5.2 NO-LORD OPERATION (Cont'd)

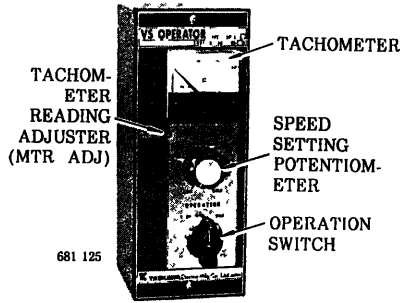


Fig. 11 VS Operator
(Type JVOP-51-11)

5.3 FULL-LOAD OPERATION

Before starting full-load operation, stop the power supply to the power unit, couple the DC motor to the driven machine, and check the motor and the driven machine for safe and obstruction-free conditions. Table 6 gives full-load operation procedure.

Table 6 Full-load Operation

Order	Operation
1	Turn the speed setting potentiometer on the VS operator full counterclockwise. (For a preset start, adjust to a desired value)
2	Turn on the 1MCCB, 2MCCB in the power unit.
3	Turn on the change-over switch on the VS operator
4	Gradually, turn the speed setting potentiometer to a desired position
5	Turn off the change-over switch on the VS operator
6	Turn off the 1MCCB, 2MCCB in the power unit

5.4 ADJUSTMENT OF FIELD CURRENT

Do not tamper unnecessarily with the potentiometers in the power unit since they are adjusted at the factory before shipped.

Change Of Direction Of Rotation

DC motors are reversed by interchanging leads at main circuit terminals (A, H) in the power unit (or J, K to the motor field winding).

Fine Speed Adjustment

If speed of the DC motor differs from the set value, make the following adjustment.

1. Start the DC motor in accordance with the procedure in Table 6 and turn the speed setting potentiometer full clockwise (approx. 100% speed).
Check the maximum speed desired of the DC motor with a tachometer.
2. Compare the checked speed with the desired maximum speed which is marked on the DC motor nameplate, Fig. 12.
3. When the indicated value by the tachometer is higher than the marked speed, turn the speed feedback adjusting potentiometer (N MAX) clockwise to match the maximum speed. If the indicated value is lower, turn the potentiometer counterclockwise, Fig. 13.
4. Adjust indication of the tachometer on the control station to match the actual motor speed by turning MTR ADJ potentiometer on the VS operator.

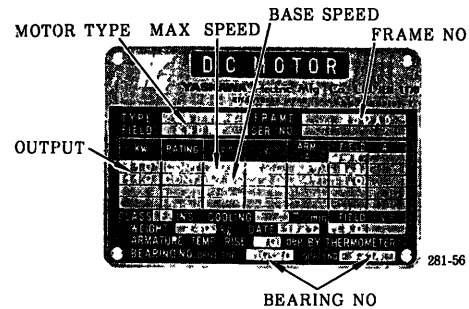


Fig. 12 DC Motor Nameplate

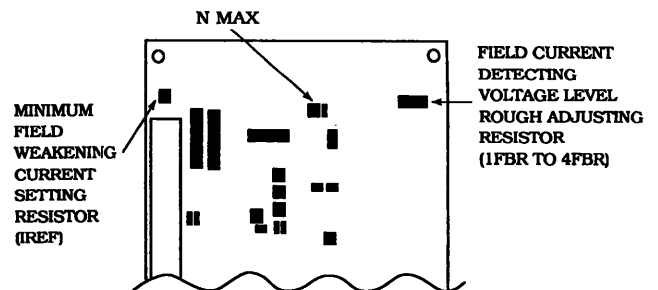


Fig. 13 Adjusting Potentiometers
on the Printed Board

Adjustment of Field Current

The manner of adjusting field current when field current is constant differs from that when field weakening control is made.

For Constant Field Current

1. Connect DC ammeter to field circuit.
2. Adjust the potentiometers (1FBR) to 4FBR) and IREF on the control board so that ammeter indicates rated field current.

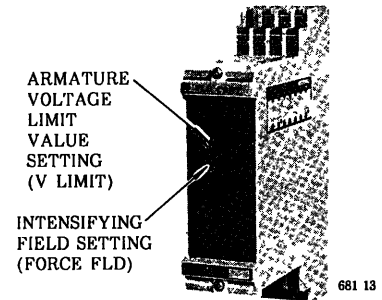
Field Weakening Control

Proceed as follows to adjust field current in combination with field adjuster type JGSM-51- [] .

1. Connect DC ammeter to field circuit and DC voltmeter to output terminals (P) and (N) .
2. Select the potentiometer (from 1FBR to 4FBR) which corresponds to the desired voltage level of field current detection. Remove those potentiometers not being used.
3. Turn the potentiometer I REF on the control board and FORCE FLD and V LIMIT of the field adjuster fully counterclockwise.
4. Set the minimum field weakening current using I REF. Set-value should be 80% field weakening current at maximum speed.
5. Set the rated field current (field intensifying) using FORCE FLD of field adjuster.
6. Increase speed reference gradually after motor starts.

The voltage across terminals (P) and (N) increases as speed rises and reaches the limited value.

Turn V LIMIT clockwise gradually so that the limited value is motor rated voltage (220V or 440V).



Field Adjuster Type JGSM-51- []

6. MAINTENANCE

Proper maintenance is indispensable for maintaining the system in the correct operating conditions. The users should prepare their own maintenance programs based on the following guidelines.

6.1 PERIODIC INSPECTION

Table 7 shows the minimum inspection items and the procedures for daily, monthly, quarterly and annual inspections. For further information, refer to our service representative.

Tactile Temperature Sensation Of DC Motor Frame

Fig 14 gives tactile temperature sensation of DC motor frame. Use this for checking motor frame temperature as a rule of thumb.

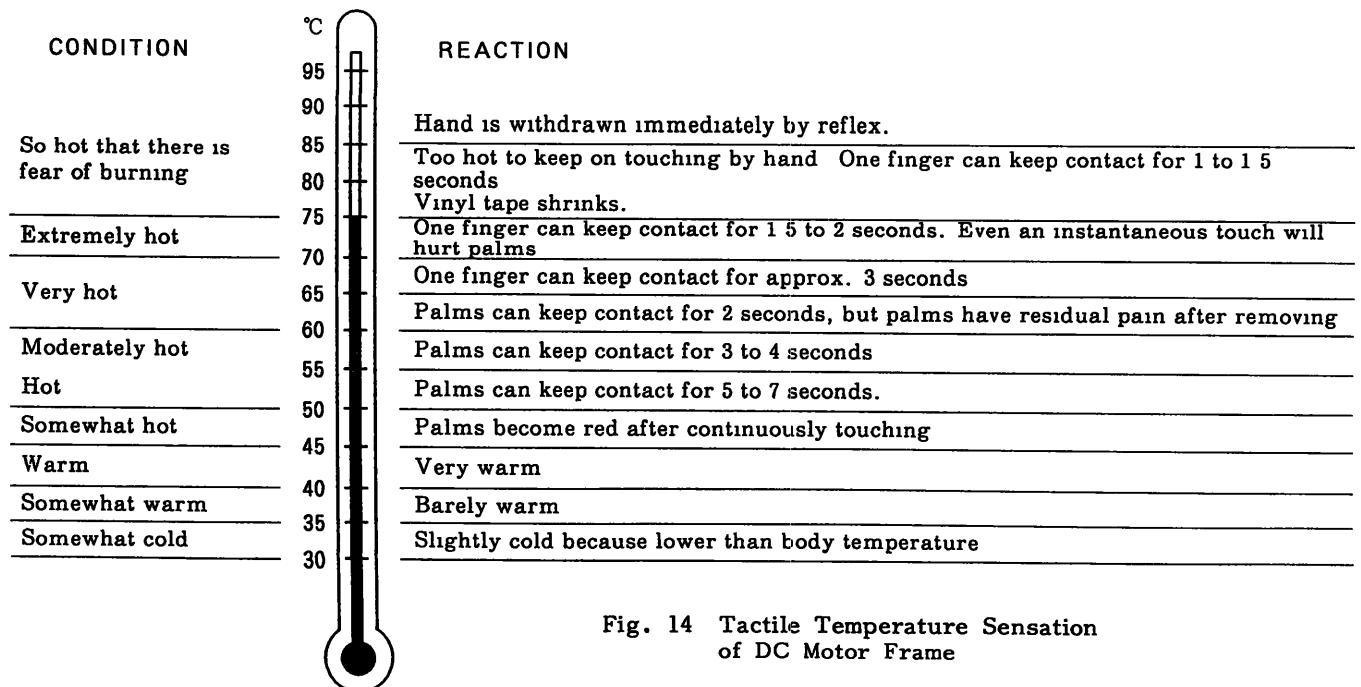


Fig. 14 Tactile Temperature Sensation of DC Motor Frame

Brush Life

Inspect the brush wearing condition. The following brushes should be replaced. For details, refer to the instructions for INDUSTRIAL DC MOTORS (TOE-C435-3). Use the same grade and size for renewal brushes.

1. Brushes worn to minimum allowable length.

- For DC motor frames 180 or below

Replace brushes before they wear down so far that the projecting parts of pigtail fastener on the brush head will be 17 mm.

PIGTAIL



17 MM Fig. 15 Brushes Worn to Minimum Allowable Length

- For DC motor frames 200 or above

Replace brushes before they wear down so far that the brush retaining finger will touch the brush retainer stopper of brush casing.

- Chipper or cracked brushes.
- Brushes whose sides eroded or worn out due to rubbing against brushholder.
- Brushes whose pigtails become loose connected, extremely corroded or discolored, or broken.
- Wet or sticky brushes.

Table 7 Inspection Schedule

	Schedule		Inspection Item	Inspection Procedure	Symptom	What to do
	With Power On	With Power Off				
Daily	○		Vibration of DC motor bearing	Feel by hand	Excessive vibration.	Contact the company
	○		Noise of DC motor bearing	Check for any intermittent or unusual noise	Unusual	Grease with a grease pump
	○		Temperature of DC motor bearing	Feel by hand	One can touch with finger for two seconds (70 - 80°C)	Contact the company
	○		Sparking at brushes of DC motor	Remove the hand hole cover and check for sparks under the brushes (Reclose the cover within five minutes, for frames 112, 132)	Within four small sparks	If unusual sparks be observed, contact the company
		○*	Commutator surface of DC motor	Remove the hand hole cover and check for dirt on the commutator surface	Contaminated with dirt, dust or oil	Blow out with compressed air or wipe it off with lintfree cloth
		○*	Worn-out brushes of DC motor	Remove the hand hole cover and check for worn-out	Refer to Brush Life.	Replace with new brush. (Refer to TOE-C435-3.)
	○		Air filter of DC motor.	Check for dust clogging	Excessive clogging (High exhaust-air temperature) (Low exhaust-air volume)	Clean or wash the filter
Monthly		○*	Tightening bolts of motor	Check for loosening of bolts	Loosening	Tighten with a wrench
		—	Bearing grease of DC motor (For the frame number 200 or above)	Check for greasing	Refer to Greasing Requirement for DC motor	Regreasing
Quarterly	○		Thyristor cooling fan in the power unit	Check for noise and vibration	Unusual noise or vibration	Contact the company
		○*	Thyristors in the power unit	Check for dust amounted on 1PCB of LSU	Excessive accumulation of dust or dirt.	Clean with suction type cleaner.
Yearly		○*	Electrical connecting terminals in the power unit	Check for loosening of interconnecting terminal screws	Loosening	Tightening

* Make sure that any maintenance work should be carried-out after disconnection of power supply (MCCB OFF)

Greasing Requirements for DC Motor

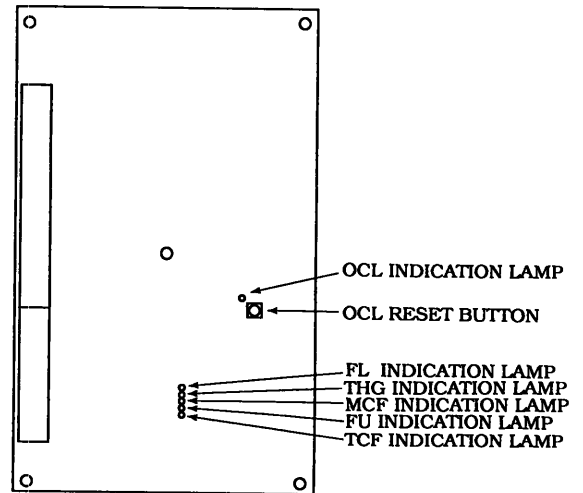
Table 8 gives a guide on greasing intervals for various bearings of the DC motor. Inject grease to the respective bearings at the indicated intervals. Under normal operating conditions, sealed ball bearings have a design life of 2 years, and regreasable bearings have a life of 30,000 hours.

Table 8 Lubrication Requirements

Bearing No	Motor Speed (r/min)				
	720 or below	720 to 900	900 to 1200	1200 to 1800	1800 to 2500
6312	Every 7000 hours of operation			Every 5000 hours of operation	Every 3000 hours of operation
6314					
6316					
NU316	Every 5000 hours of operation		Every 3000 hours of operation		For lubrication method, the instruction will be separately offered
NU318					
NU320					
NU322					

Note Bearing number is indicated in the nameplate

Locations of Indicator Lamps and Reset Pushbutton



Fault Indicator Lamps Location

6.2 TROUBLESHOOTING GUIDE

Troubles & Actions to be taken

Trouble	Possible cause	Check method	What to do	
Motor does not run	Power supply	Is voltage across 1MCCB input terminals ①, ③ and ⑤ correct? See Table 4	Use correct power supply	
		Is the voltage across 1MCCB output terminals ②, ④ and ⑥ correct? See Table 4.	Replace 1MCCB	
	Control circuit	Fuse blown	Check fuse(1F) See Fig.3 and 4.	Replace fuse.
	Command sequence	Unstable	Voltage across the VS-505G II terminals ⑩ and ⑪ is unstable.	Correct wiring. Replace potentiometer
	Control board	Poor ready signal	Is resistance across terminals ⑫ and ⑬ 0 Ω. (tester 1 Ω range)	Replace control board. See item CONTROL BOARD.
		Poor run signal	Is voltage across terminals ⑭ and ⑮ approx. 0 V when operation switch is placed to RUN.	Correct wiring Replace switch
			Is resistance across terminals ⑯ and ⑰ 0 Ω? (tester × 1 Ω range)* or, voltage across them approx 0 V?	Replace control board
		Poor answer-back signal for DC main circuit ON	* Is voltage across terminals ⑱ and ⑲ 0 V?	Correct wiring Replace magnetic contactor for main circuit
	Poor gate-block signal	Is check terminal (GB) voltage approx. 0 V?	Replace control board	
	Control printed board	Too low setting of "OL%", "OLT"	Is setting dial at the positions indicated by lock paint?	Set the setting dial to the position of lock paint
Too high setting of "LIMIT"		Refer to Table 11 and 12.	Readjust.	
Incorrect setting of "IFB"				
Thyristor	Defective (deteriorated)	Check thyristor (Fig. 26)	Replace thyristor (See Main Circuit Thyristor on page 23)	
OCL* lamp ON	Overloaded	Check load current.	Adjust load.	
		Run motor without load, and see if it locks	Repair motor.	
	Locking	Check load for locking.	Repair driven machine.	
		Layer shorting in motor	Run motor with terminals (A) and (H) disconnected. If OCL lamp does not light, the motor and its circuit are defective.	Repair motor.
Grounding of motor circuit	Measure resistance between terminal (A) (or H) and ground (E) with a multitester. If the reading is nearly ∞ on the largest scale of the tester, the circuit is normal.	• Repair motor • Correct wiring		

6.2 TROUBLESHOOTING GUIDE (Cont'd)

Troubles & Actions to be taken (Cont'd)

Trouble		Possible cause		Check method	What to do	
Motor dose not run	FU lamp* ON	Thyristor	Defective (deteriorated)	Check thyristor (Fig. 6)	Replace thyristor. (See Main Circuit Thyristor on page 23)	
		Motor	Layer shorting in motor	Operate only board with (A) and (H) disconnected. If fuse is not blown, motor circuit is defective	• Repair motor • Correct wiring	
			Grounding of motor circuit	Measure resistance across terminal (A) (or H) and ground (E) with a multimeter, and if the reading is nearly ∞ on the largest scale of the tester, the circuit is normal. (See Note)	(To replace fuses (1FU, 2FU, 5FU), refer to Replacement of Main Circuit Fuse)	
		Control board	Defective (phase control circuit)	—		If the motor is normal, replace control board. Refer to Control Board on page 25
		Fuse	Defective (deteriorated)	—		—
	FL lamp* ON	Motor	Layer shorting in field winding	Measure resistance across terminals J and K with converter terminals J and K disconnected with a tester. If it indicates ∞ , it means field circuit is disconnected	• Repair motor • Replace fuse (3FU or 4FU) See Replacement of Main Circuit Fuse on page 24	
			Grounding of field circuit	Measure resistance across terminal (J or K) and ground (E) with a multimeter, and if the reading is nearly ∞ on the largest scale of the tester, the circuit is normal †		
		Control board	Defective	If the motor is normal	Replace control board See Control Board on page 25.	
	THG lamp* ON	Motor	Overloading	Main circuit	Check load current	Adjust load.
				Field circuit	Check field current	Readjust (Table 11)
Locking				Run motor without load, and see if it locks	Repair motor	
				Check load for locking	Adjust load	
Blocked air filter			—	Refer to the instructions for Industrial DC Motors (TOE-C435-3)		
MCF lamp* ON	Motor	Stopped cooling blower	Check fan for locking or overloading	Repair or replace fan.		
			Check thermal relay for tripping			
Surge absorber fuse blown	Main CKT	Excessive surge	Check fuses (3FU, 4FU)	Eliminate cause of surge. Replace surge absorber and fuse		
Unstable motor speed	Defective tach-gen (TG) of motor	Disconnect power unit terminals (3 and 4) or (3, 4 and 5), and measure resistance on TG side Single phase TG approx 16.5 ohms 3-phase TG approx. 62 ohms		Replace tachometer generator		
		Measure TG voltage across terminals (3) and (4) or among (3), (4) and (5) Single phase TG 70 V/1800 r/min 3-phase TG 140 V/2000 r/min		Replace tachometer generator.		
	Power supply	Fluctuation of supply voltage	Check supply voltage according to Table 4	Correct the power supply voltage		
	Load	Load fluctuation.	Check load current for fluctuation	Adjust the load		
	Command system	Command system is unstable	Check command voltage across (15) and (16) for stability.	Correct loose or defective wiring, or replace command resistor		
Abnormal vibration of motor	Motor misalignment.	Refer to the instructions for Industrial DC Motors (TOE-C435-3).				

* Perform where DC main circuit magnetic contactor (M, F, R) and DB magnetic contactor

† If the reading is not ∞ , accurate measurement with a 500 V megger is required

Reading must be 3 megohms or above

7. PARTS REPLACEMENT

7.1 FIELD THYRISTOR

With all the Models, thyristor modules consisting of a thyristor and a diode are used as the field thyristor. Replace them as follows.

The same replacement procedure applies to all the models.

1. Loosen the bus bar screws and the lead clamping screws, and unclamp the leads. In this case, mark all the terminals for identification. (Fig. 16)
2. Loosen the two clamping screws, and remove the thyristor module.
3. Check the replacement thyristor module for type and capacity, and install it by reversing the removal procedure, making connections to the terminals identified by the marks made before removing the old thyristor module.

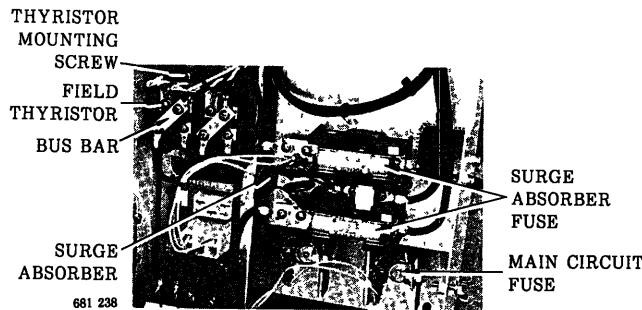


Fig. 16 Field Thyristor (230 V, 25 A)

7.2 MAIN CIRCUIT THYRISTOR

230 V, 25 A System (Fig. 17)

The system uses a thyristor module comprising two thyristors. Replace it as follows.

1. Remove the 6 bus bar clamping screws, and remove the bus bar.
2. Loosen all the thyristor lead screws, and unclamp all the leads. In this case, mark the terminals for identification.
3. Remove the two thyristor clamping screws.
4. Check the replacement thyristor module for type and capacity, and reinstall it by reversing the disassembly procedure, identifying the terminals by means of the marks made prior to disassembling.

Note:

When installing the thyristor module, apply thermal compound JOINTAL Z (made by Nippon Light Metal Co., Ltd.) to the thyristor mounting surface (reverse side).

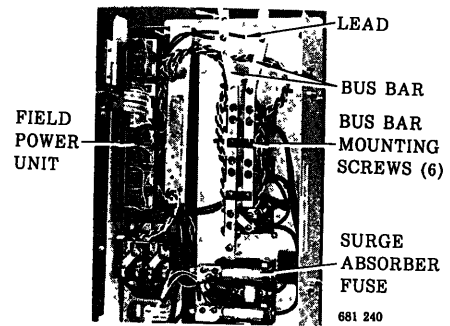


Fig. 17 Main Circuit Thyristor

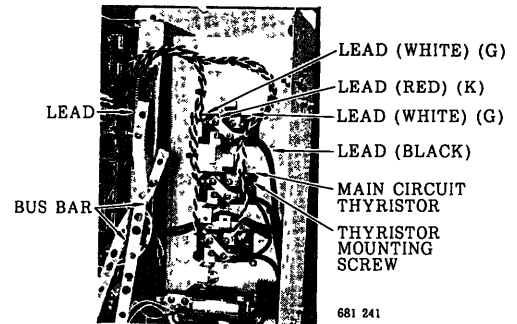


Fig. 18 Bus Bar Removal

230 V, 35 to 105 A/460 V, 50 to 105 A System

1. Remove the 6 bus bar mounting screws, and remove the bus bar. The leads connected to the bus bar need not be removed. (Fig. 19)
2. Loosen the thyristor connecting screws, and unclamp the leads. In this case, mark the terminals for identification.
3. Remove the two thyristor clamping screws.
4. Check the replacement thyristor for type and capacity, and reinstall it by reversing the disassembly procedure, identifying the terminals by means of the marks made prior to disassembling.

Note:

When installing the thyristor, apply thermal compound JOINTAL Z (made by Nippon Light Metal Co., Ltd.) to the thyristor mounting surface (reverse side).

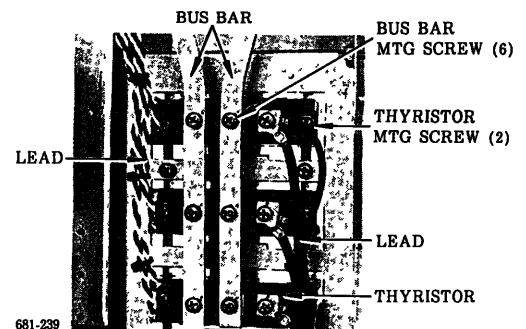


Fig. 19 Main Circuit Thyristor

230 V, 180 to 550 A/460 V, 180 to 550 A System

In these systems, flat thyristors are used. The thyristor modules differ in shape depending upon capacity, but their replacement procedure is the same, as given below.

1. Remove the 6 clamping screws for thyristor gate cathode terminal, and free the leads. In this case, mark the terminals for identification. (Fig. 20)
2. Remove the mounting bolts (5 for 230 V, 260 A and below and 7 for 230 V, 420 A and larger systems) for the thyristor module, and remove the main circuit thyristor.
3. Place the main circuit thyristor module on a work bench, and loosen the control board mounting screws (Fig. 21) for the thyristor assembly to be replaced, and then, loosen the gate wiring screws.
4. Loosen the fin mounting nuts alternately, turning 1/4 turn at a time. Then, remove the leaf spring.
5. Remove the fin and take out the thyristor.
6. Clean the contact surfaces of the new thyristor and the fin, and thinly coat these surfaces with thermal joint compound (JOINTAL Z, made by Nippon Light Metal Co., Ltd.).
7. Align the fin locating pin and the thyristor locating hole, after making sure that the polarity of the thyristor is correct.
8. Keeping the leaf spring and the fin parallel, finger-tighten the clamping nuts. Then, tighten them alternately through 1/4 turn at a time, three times each with a socket wrench. Now, the thyristor fin has been installed.
9. Tighten the control board mounting screws. Then, mount the thyristor module by reversing the disassembling procedure, tightening the screws firmly.

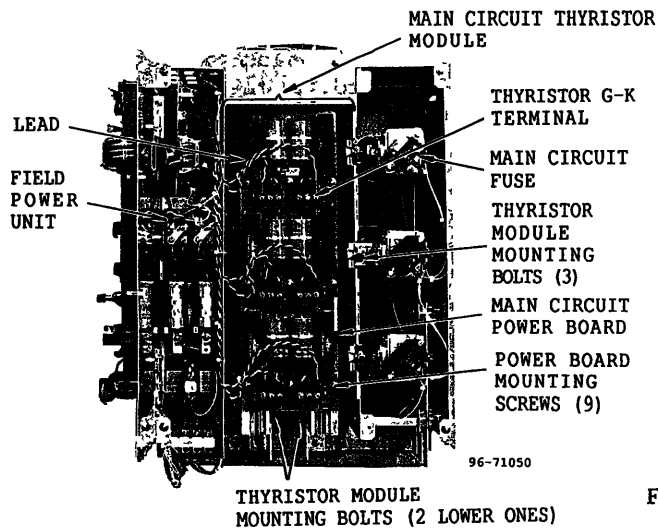


Fig. 20 Main Circuit Thyristor Assembly (230 V, 260 A System)

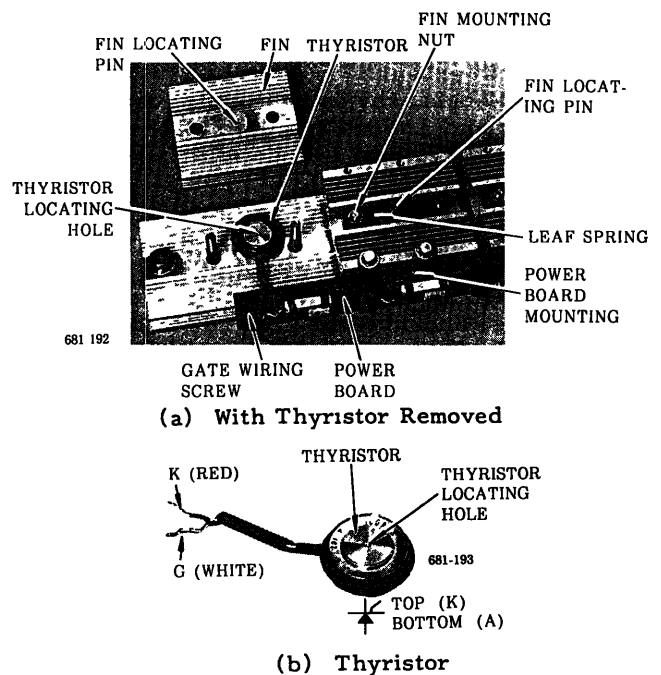


Fig. 21 Thyristor Replacement

7.3 MAIN CIRCUIT FUSE

230 V, 25 to 105 A/460 V, 50 to 105 A System

1. Remove the fuse blown indicating microswitch with the leads by pulling upward. (Fig. 22)
2. Remove the two fuse mounting bolts.
3. Mount a replacement fuse by reversing the removing procedure, after checking its model and capacity.

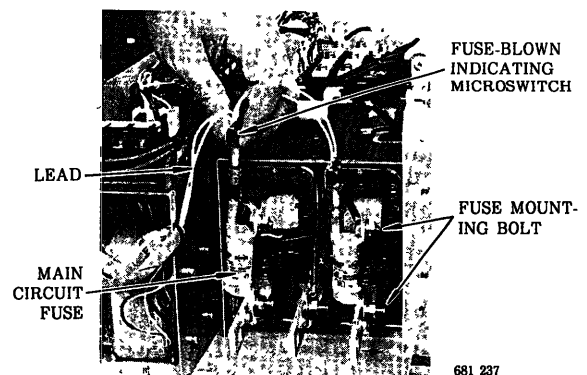


Fig. 22 Main Circuit Fuse (230 V, 25 A)

230 V, 180 to 550 A / 460 V, 180 to 550 A System
(Fig. 20)

1. Loosen the two lead clamping screws, and free the four leads of the fuse-blown indicating microswitch. (Fig. 23)
2. Remove the two fuse mounting bolts, and remove the fuse together with the fuse-blown indicating microswitch.
3. Check the replacement fuse for model and capacity, and install it by reversing the disassembling procedure.

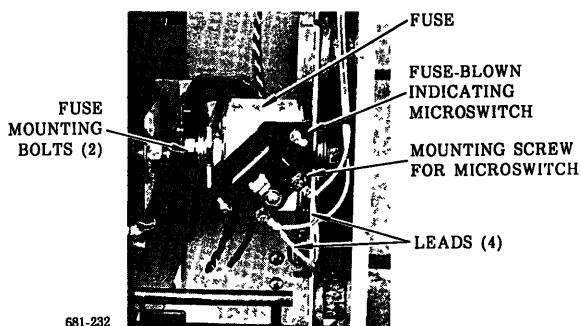
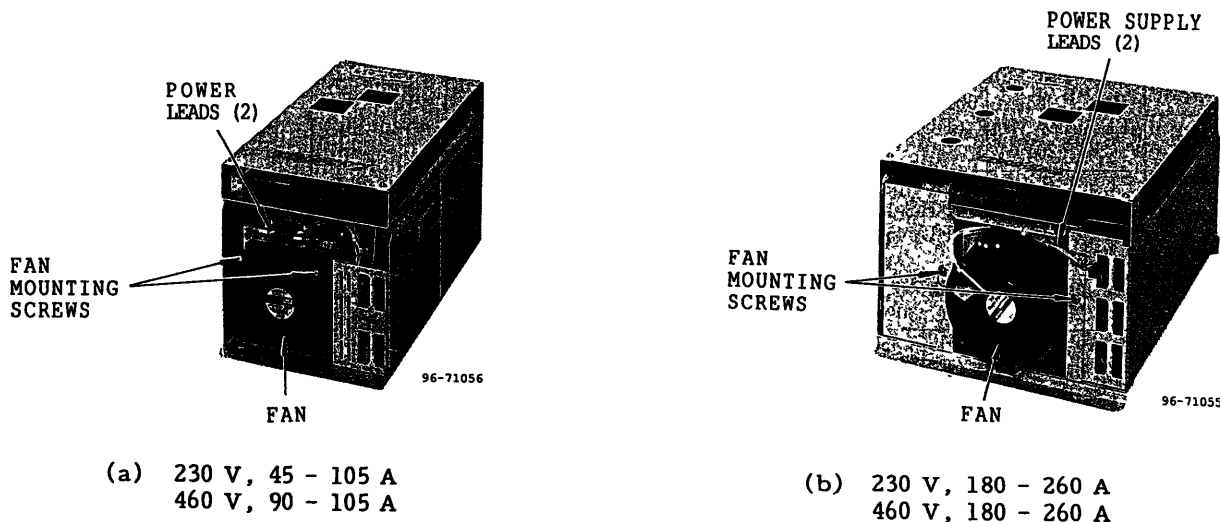


Fig. 23 Main Circuit Fuse Assembly

7.4 THYRISTOR COOLING FAN

Units for 230 V, 25 A, 230 V, 35 A, and 460 V, 50 A ratings are self-cooled. Replace the fans as follows. (Fig. 24)

1. Disconnect the two power leads.
2. Unscrew the two fan mounting screws, and dismount the fan.
3. Remove the fan by reversing the disassembling procedure.



(a) 230 V, 45 - 105 A
460 V, 90 - 105 A

(b) 230 V, 180 - 260 A
460 V, 180 - 260 A

Fig. 24 Thyristor Cooling Fan

CONTROL BOARD

Disconnect all the leads from the terminals. In this case mark the terminals for identification. Then, unplug the connectors shown in Fig. 25, and loosen the 6 control board mounting screws.

Mount the replacement board by reversing the disassembling procedure. Plug in the connectors firmly.

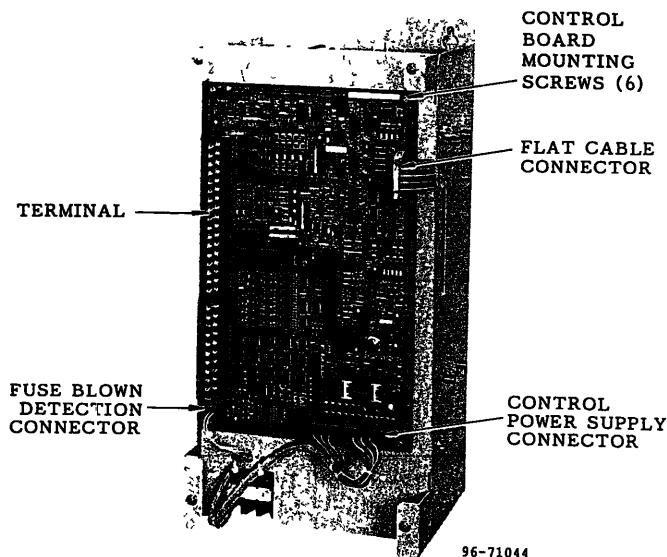


Fig. 25 Control Board

7.5 PRECAUTION WHEN REPLACING CONTROL BOARD

Make sure that the model designation and the potentiometer settings of new control board are the same as the one being placed. (Refer to "Control Board Adjustment" on page 18.)

8. SPARE PARTS

Table 9 lists the recommended spare parts for one VS-505GII, keep always minimum insurance spare parts on hand to protect the unit against costly downtime. When ordering spare parts,

specify complete nameplate rating and description (type, code no., etc.) of the parts required, and quantity desired.

Table 9 Spare Parts

Parts		Type or Specification
DC Motor	Bearing	Bearing number is described on the DC motor nameplate
	Brush	Use the same grade and size, or those recommended by YASKAWA (Code is generally marked on the brush)
	Brush holder	Constant force spring type (DC motor frame 180 and below) Helical spring type (DC motor frame 200 and above)
	Air filter	PS/400N (Made by Japan Vilene Co., Ltd.)
Control Panel	Indicating lamp on the control panel	CT-100W, 200/220 VAC (Made by Hakko Electric Co.)
	Others	See Table 10 Spare Parts for Control Panel

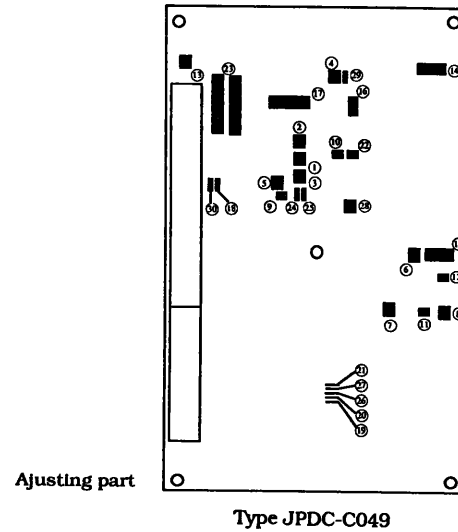
Table 10 Spare Parts for Control Panel

Thyristor converter unit Type CDMR-Z II	Main circuit thyristor	Thyristor protective fuse	Surge absorber fuse	Fan	Field thyristor diode	Surge absorber	Control board	Control circuit fuse
230 V, 25 A	TM20DA-H (SCR195)	60FHS-55 (FU642)	FCF2-20 (FU599)	—	TM20RA-H (SCR192)	TNR23G -471K (XX140)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
230 V, 35 A	TM25DZ-H (SCR196)							
230 V, 45 A	TM55DZ-H (SCR197)							
230 V, 90 A	TM90DZ-H (SCR198)	60FHS-110 (FU644)	FCF2-30 (FU600)	4715PS-22T -B30-B00 (FAN130)	TM20RA-H (SCR192)	TNR23G -471K (XX140)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
230 V, 105 A	N105CH08 (SCR259)	60FHS-150 (FU645)		5915PC-22T -B30-B00 (FAN131)				
230 V, 180 A	N195CH08 (SCR261)	CS5F-200 (FU609)		MRW18 -DTA (FAN107)				
230 V, 260 A	553PA80 (SCR263)	CS5F-350 (FU612)	FCF2-30 (FU600)	—	TM20RA-H (SCR192)	TNR23G -102K (XX167)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
230 V, 420 A		CS5F-450 (FU614)						
230 V, 550 A	553PA80 (SCR263)	CS5F-600 (FU616)						
460 V, 50 A	PKSSHB-160 (SCR244)	60FHS-110 (FU644)	FCF2-20 (FU599)	—	TM20RA-H (SCR192)	TNR23G -102K (XX167)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
460 V, 90 A	TM55DZ-2H (SCR201)							
460 V, 105 A	PK90HB-160 (SCR245)	60FHS-150 (FU645)	FCF2-30 (FU600)	HN4556MV (FAN110)	TM20RA-H (SCR192)	TNR23G -102K (XX167)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
460 V, 180 A	N105CH16 (SCR260)	CS5F-200 (FU609)		T756DXV (FAN206)				
460 V, 260 A	N195CH16 (SCR262)	CS5F-350 (FU612)		MRW18 -DTA (FAN107)				
460 V, 420 A	553PA160 (SCR264)	CS5F-450 (FU614)	FCF2-30 (FU600)	—	TM20RA-H (SCR192)	TNR23G -102K (XX167)	JPDC-C049 (ETC00986X)	FCF2-3 (FU595)
460 V, 550 A		CS5F-600 (FU616)						

REFERENCE

For operations at higher control accuracy, the control board potentiometers may be fine-adjusted according to the instructions given in Table 11.

When replacing parts, be sure to observe the "Cautions in Operation" posted on the inside of the control board door of the thyristor converter unit.



CONTROL BOARD ADJUSTMENT

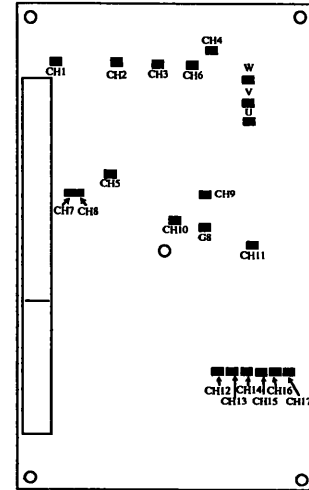
Table 11 Control Board Adjuster Locations and Functions

Type of adjusters	Adjuster location	Adjuster names	Adjuster functions	Adjusting method	Specifications	
Potentiometers	1	ACCEL	Acceleration time adjustment	Clockwise rotation increases acceleration time	3 - 75 sec	
	2	DECEL	Deceleration time adjustment	Clockwise rotation increases deceleration time	3 - 75 sec	
	3	GAIN	ASR Gain adjustment	Clockwise rotation increases gain	—	
	4	N MAX	Speed feedback adjustment	Clockwise rotation decreases speed	-6/100% speed	
	5	LIMIT	Current limit adjustment	Clockwise rotation increases limit value	150% (Standard)	
	6	IFB	Main circuit current feedback adjustment	Clockwise rotation decreases current	+3 V/100% current	
	7	SM	Speedometer adjustment	Clockwise rotation increases pointer swing	1 mADC max	
	8	AM	Ammeter adjustment	Clockwise rotation decreases pointer swing	1 mADC max	
	9	BIAS	ASR offset adjustment	⊖ voltage ← ⊕ voltage	—	
	10	KIPP	Phase shift lag limit adjustment	Clockwise rotation advances shift lag	155° el (Standard)	
	11	OL%	Setting overload detection start point	Clockwise rotation increases overload detection start point.	110% (Standard)	
	12	OLT	Setting overload.	Clockwise rotation increases operation time	150%, 60 sec (Standard)	
	13	I REF	Setting field current	Clockwise rotation increases the current	—	
Potentiometer selection (Open)	14	1FBR to 4FBR	Rough adjustment of field current detection voltage level.	Open the resistor according to specifications	Refer to motor specifications	
	15	5FBR to 9FBR	Rough adjustment of main circuit detection voltage level.			
Slide switch	16	1SW	Supply frequency selector.	Selection of 50 Hz or 60 Hz.	—	
Plug selection	17	A to D	Rough adjustment of speed detection voltage level	Selection of the voltage level according to type of tach-gen and motor rated speed.	—	
	18	E	Selection of soft start operation	E ₁	—	—
				E ₂	Soft start	—
	19	J	Selection of start interlock zero-speed condition	J ₁	Possible	—
				J ₂	—	—
	20	K	Selection of motor stopping method	K ₁	Gate block at zero speed when decelerating to stop	—
K ₂				Gate block at stop command	—	
21	N	Selection of zero-speed condition at motor cooling fan stopping	N ₁	Field half-reduced after motor zero-speeds by stop operation.	—	
			N ₂	Field half-reduced (Gate block)	—	

CONTROL BOARD CHECK TERMINALS

Table 12 Control Board Check Terminals

Signal names		Check terminals	Normal values		
Field power	Current command	CH1	Voltage value according to field current	-6 V/5 A	
	Current feedback	CH2		+3 V/5 A	
	Phase shifter input	CH3	Approx +5 V at 60 Hz, approx +6 V at 50 Hz when field blocked	+1 to +5 V at 60 Hz, +1 to +6 V at 50 Hz when controlling	
Main circuit power	Phase shifter input	CH4	Approx. +5.5 V at 60 Hz, approx. +6.5 V at 50 Hz when gate blocked	+1 to +5.5 V at 60 Hz, +1 to +6.5 V at 50 Hz when controlling	
	Current limit	CH5	+3 V /100% current limit		
	Speed feedback	CH6	-6 V/100% speed		
	Current command	CH7	-3 V/100% command		
	Speed command	CH8	+6 V/100% command		
	Gate block	CH9	(Gate block by OCL) 0 V normal, -24 V at gate block		
		GB	0 V normal, +12 V at gate block		
	Current controller output	CH10	Approx -1 V at gate block	0 to +6 V when controlling	
	Current feedback	CH11	+3 V/100% current		
	Stable power supply	CH12	0 V (SG)		
CH13		+15 V			
CH14		-15 V			
Unstable power supply	CH15	+24 V		Allowable variation range $\pm 20\%$	
	CH16	-24 V			
	CH17	+24 V (pulse amplifier power supply)			



Control Board Check Terminals
Type JPDC-C049

ROUGH CHECK OF THYRISTORS

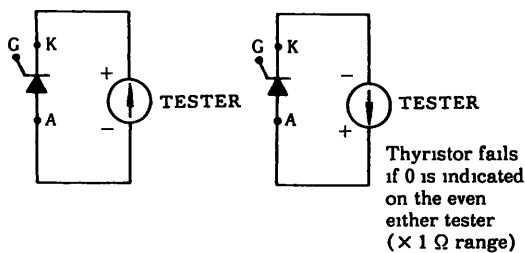
Where thyristors normally function, the following values are obtained.

More than several hundreds of kilohms across (A) and (K).

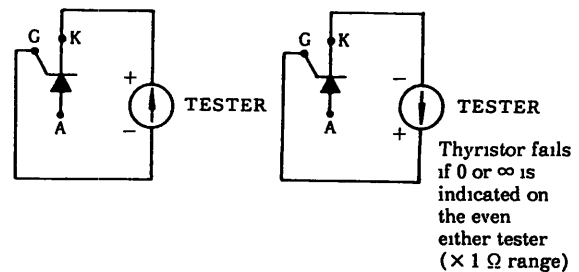
Several ohms to several hundreds of ohms across (G) and (K).

CAUTION IN CHECKING FLAT THYRISTORS

Apply pressure 5 to 10kg across thyristor polarities (A) and (K) so as to insure positive thyristor internal connections. Measure the resistance using a tester as shown in Fig. 26 (a) and (b).



(a) Resistance across thyristor terminals (A) and (K)

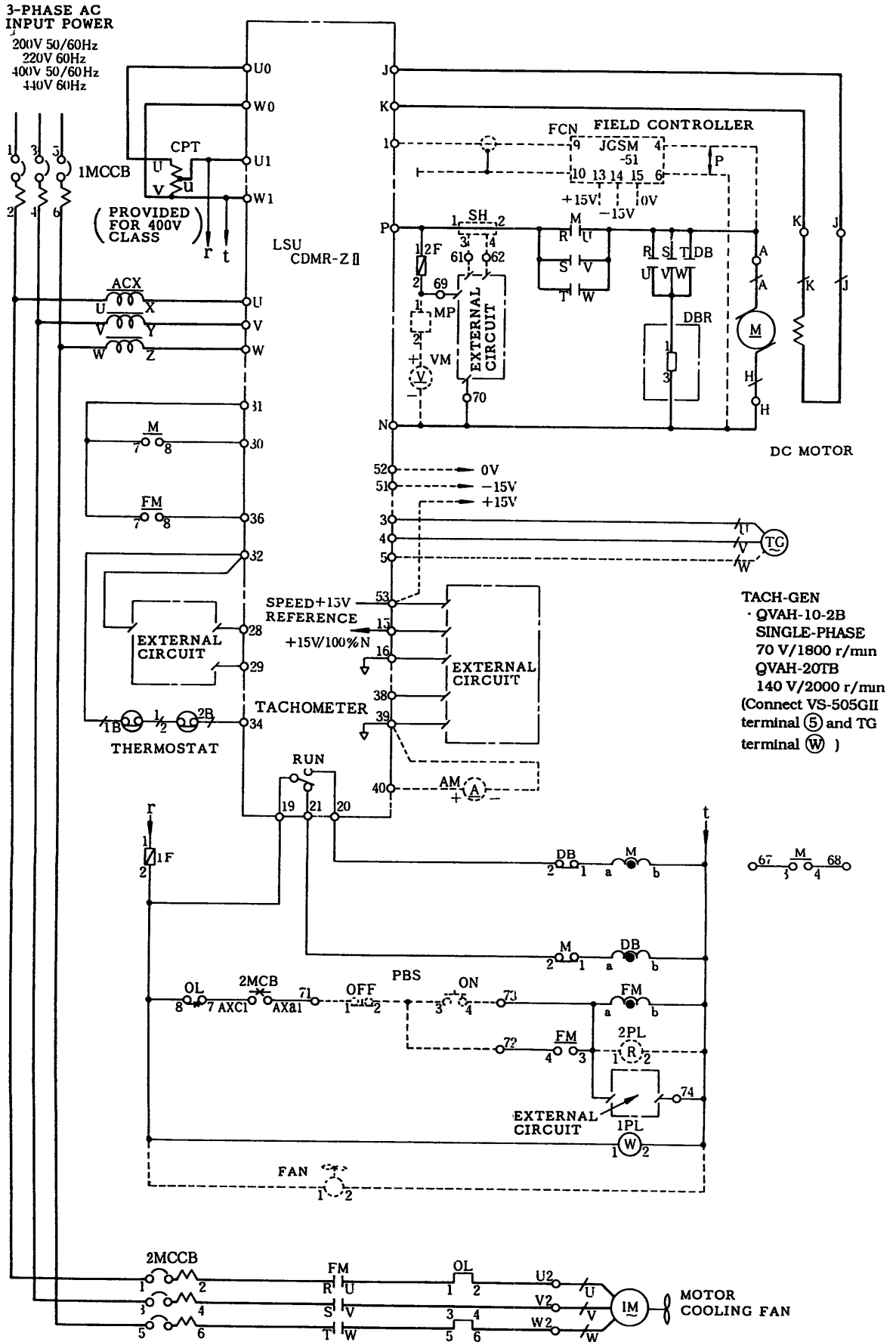


(b) Resistance across thyristor terminals (G) and (K)

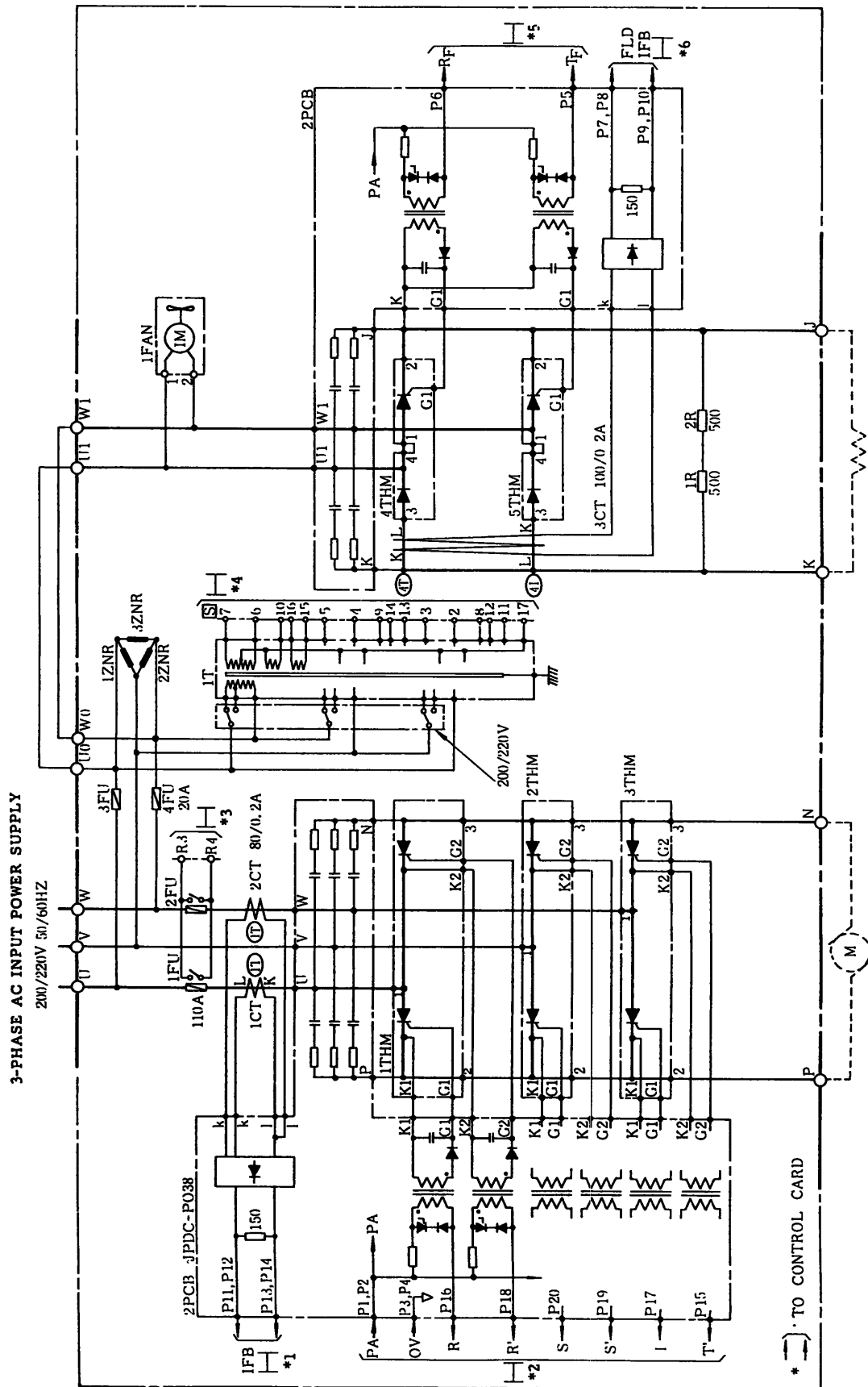
Fig. 26 Rough Check of Thyristors

INTERCONNECTIONS

Non-Reversing, with DC Main Circuit Contactor and Manual Dynamic Braking Unit



ELEMENTARY DIAGRAM OF THYRISTOR CONVERTER UNIT (TYPE CDMR-ZII, 230 V, 90 A)



Note. Asterisk shows the connections between main circuit and control circuit. It indicates that *1 of main circuit is connected to *1 of control circuit.

Main Circuit

GENERAL PURPOSE DC ADJUSTABLE SPEED DRIVES Varispeed-505G3 Drives INSTRUCTION MANUAL

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