FUJI ELECTRIC

Instruction Manual

Transvector controlled AC variable speed drive

200V

FRENIC® 5000VG

Fuji Electrc Co.,Lt

INR-HF 5696 d E

CONTENTS

NOTES

1. Do not connect the power supply unit to an output terminal (U, V, or W) of the drive unit.
2. A charge remains in the capacitor even after the power is turned off. Do not perform an internal check while the charging indicator is ON because it is dangerous.
3. Do not connect the drive unit to a 400-V power supply unit.
4. Never perform a dielectric strength test.
5. Make sure the drive unit and the pulse generator are connected correctly. (The pulse generator will burn out if a voltage is applied through a wrong connection.)

1. GENERAL

1-1 Foreword

Read this manual carefully so that you can use your drive unit correctly to achieve the best result.

1-2 Checking Equipment

When the unit is delivered, check the following.

(1) Whether the specifications and options of the unit you received are exactly the ones you ordered (voltage, capacity, external shape, etc.).
(2) Whether the equipment has been damaged during transportation, and whether the case has been bent, or any components missing.
(3) If there are any loose screws, nuts, and connectors.

1-3 Notes on Use

When using the FUJI general purpose vector control drive unit, note the following:

(1) Use the drive unit in a place where ambient temperature is from 0 to 50°C.
(2) Do not install the drive unit in a dusty location or expose it to oil splashes or corrosive gases.
(3) Check that the power satisfies the standard specification.
(4) Use the drive unit together with the special motor for vector control drive.
(5) Perform wire connection referring to the wiring diagram.
(6) When connecting the terminals, do not mistake the main circuit of the power supply unit (R, S, T) for that of the output side (U, V, W).
(7) Before starting up the unit after it has been installed, check that there is no incorrect wiring. Incorrect wiring may cause a malfunction, and may even damage the drive unit.
(8) The forward rotational direction of the motor is counterclockwise with respect to the shaft end. If you wish to change the rotational direction, do so by using an operation command signal (forward operation command, reverse operation command) without changing the phase sequence.
(9) Do no perform a dielectric strength test.
(10) To perform a megger test, see Section 6-5.

1-4 Standard Specification

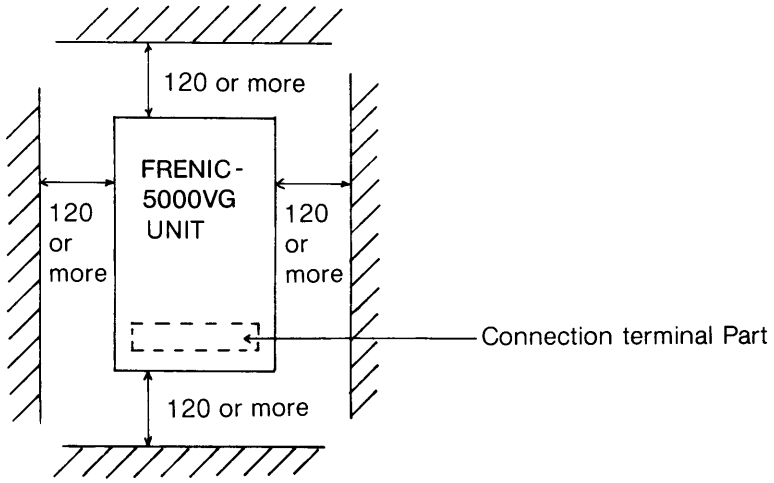
	Series name	General purpose vector control drive unit									
Motor	Form	MVK3115A	MVK3133A	MVK3135A	MVK3165A	MVK3167A	MVK3184A	MVK5187A	MVK5206A	MVK5207A	MVK5223A
	Continuous rating output [kW]	3.7	5.5	7.5	11	15	18.5	22	30	37	45
	Basic speed [rpm]	1500									
	Maximum speed [rpm]	3600							3000		
	Continuous rating torque [kg · m]	2.40	3.57	4.87	7.14	9.74	12.01	14.29	19.48	24.03	29.22
	Overload capacity	150% for 1 minute									
	Rotator GD²[kg·m²]	0.065	0.12	0.15	0.34	0.47	0.88	1.06	1.18	1.34	1.9 ~~1.73~~
	Cooling fan	1φ, 40/44W(50/60Hz)			3φ, 85/110W(50/60Hz)				3φ, 150/210W(50/60Hz)		
	Vibration	V10									
	Noise	75dB(A)							80dB (A)		85dB(A)
	Mounting method	Foot-mounted type F11 (IEC : IMB3)									
	Installation location	Indoor, not more than 1000 m above sea level									
	Ambient temperature humidity	−10~40°C, 20~90%RH (non-condensing)									
	Coating color	Munsell N5									
	Attachments	Forced air-cooling fan, pulse generator, NTC thermistor									
Drive unit	Form	FRN003VG −2	FRN005VG −2	FRN007VG −2	FRN011VG −2	FRN015VG −2	FRN018VG −2	FRN022VG −2	FRN030VG −2	FRN037VG −2	FRN045VG −2
	Power capacity [kVA]	6	9	12	17	22	28	34	45	55	67
	Power supply	3φ, 200/200~230V (±10%) 50/60Hz (±5%) (150% torque quaranteed when the power is 200V or above)									
	Generated heat [W]	290	510	550	870	860	1130	1430	1900	2160	2880
	Main circuit system	Transistor sinusoidal wave PWN-type VVVF inverter									
	Control method	Trans-vector control, ASR control with ACR minor									
	Speed control range [rpm]	15 ~ 1500 ~ 3600 15~1500~3000									
		Constant torque characteristics for 1500 rpm or less, constant output characteristics for more than 1500 rpm.									
	Speed control accuracy	±0.2% for load fluctuation 0 to 100%, +0.2% for power voltage fluctuation 200V±10% ±0.25% for ambient temperature fluctuation 25+10 C (percent for the maximum speed)									
	Allowable load GD²	20 times motor GD² or less									
	Control response	Response frequency 5Hz									
	speed command input	0~±10V (Maximum speed attained at ±10V) The maximum speed can be abjusted in the range from 1500 to 3000 or 3600 rpm.									
	Acceleration/ deceleration method	Torque limit acceleration/deceleration									
	Braking method	Resistance regenerative braking (150% torque, 5% ED resistor mounted externally)									

Operation method		Forward-reverse operation	FWD and REV commands
Speed feedback		Pulse generator (photoelection)	Pulse count: 512P/R, two phases
Acceleration/ deceleration time			Optional: 0.3 to 150 sec
External torque limit		One-point preset (adjustable between 10% and 150%)	
External output	Zero speed	The contact is open when the speed is less than 0.5% of the maximum speed, closed when it is 7% or more.	
	Speed attained	The contact is closed at 5% of maximum speed of specified speed and open when it is 7% or more.	
	DC intermediate voltage established	The contact is closed when the DC intermediate voltage established	
	Speed meter output	Analog: 0 to 10 V/±100% (3 mA), digital: Pulse output	
	Torque ammeter output	Analog: 0 to ±10 V/±150% torque (3mA)	Polsrity, accuracy: Approximately ±20%
	Overload	The motor stops its free run when overload occurs.	
	Overcurrent	The motor stops its free run when overcurrent occurs.	
	Fuse blown	The motor stop its free run when the fuse of the DC intermediate circuit blows.	
	Overvoltage	The motor stops its free run when an overvoltage is applied to the DC intermediate circuit.	
	Undervoltage	The motor stops its free run when the DC inter-mediate circuit voltage is insufficient.	
	Overspeed (high)	The motor stops its run when the speed reaches 119 to 129% of the maximum setting speed.	Switched by digital switch
	Overspeed (low)	The motor stops its free run when the speed reaches 112 to 120% of the maximum setting speed.	
	Motor overheat	The motor stops its free run when the thermistor overheats.	
	Inverter overheat	The motor stops its free run when the cooling fan overheats.	
	DB resistor overheat	The motor stops its free run when the braking resister overheats.	
	Thermistor disconnection	The motor stops its free run when the thermistor disconnects.	
	CPU fault	The motor stops its free run when a fault occurs in the CPU.	
	Protection opera-tion detection	Batch output (The contact is closed when a fault occurs)	
	External reset	Reset when a reset signal is ON	Fault reset PB also ±2 provide inside the unit
	Error display	Code displayed for each error	4-bit display
	Operation display	DC intermediatecircuit charge indicator, CPU in operation indicator	
Installation location		Indoor not more than 1000 m above sea level. Do not install it in a dusty location or expose it to oil splashes or corrosive gases.	
Ambient temperature humidity		0 to 50°C, 20 to 90%RH (non-condensing)	
Vibration		0.5G or less	
Structure		Mounted inside the board (external cooling enabled)	
Coating color		Munsell N1. 2, 1PB5/13 semigloss finish (for the unit cover, Munsell 1PB5/13 semigloss finish)	
Attachments		Braking resitance unit (5%ED), AC reactor for power coordination	

2. INSTALLATION

Correct installation of the unit greately affects its lift.
Please note the following:

(1) Check that the ambient temperature, humidity, and vibration of the installation location are within the specified value.
(2) Do not install the unit in a dusty location or expose it to oil splashes and corrosive gases.
(3) Install the unit vertically keeping the connection terminal part downward.



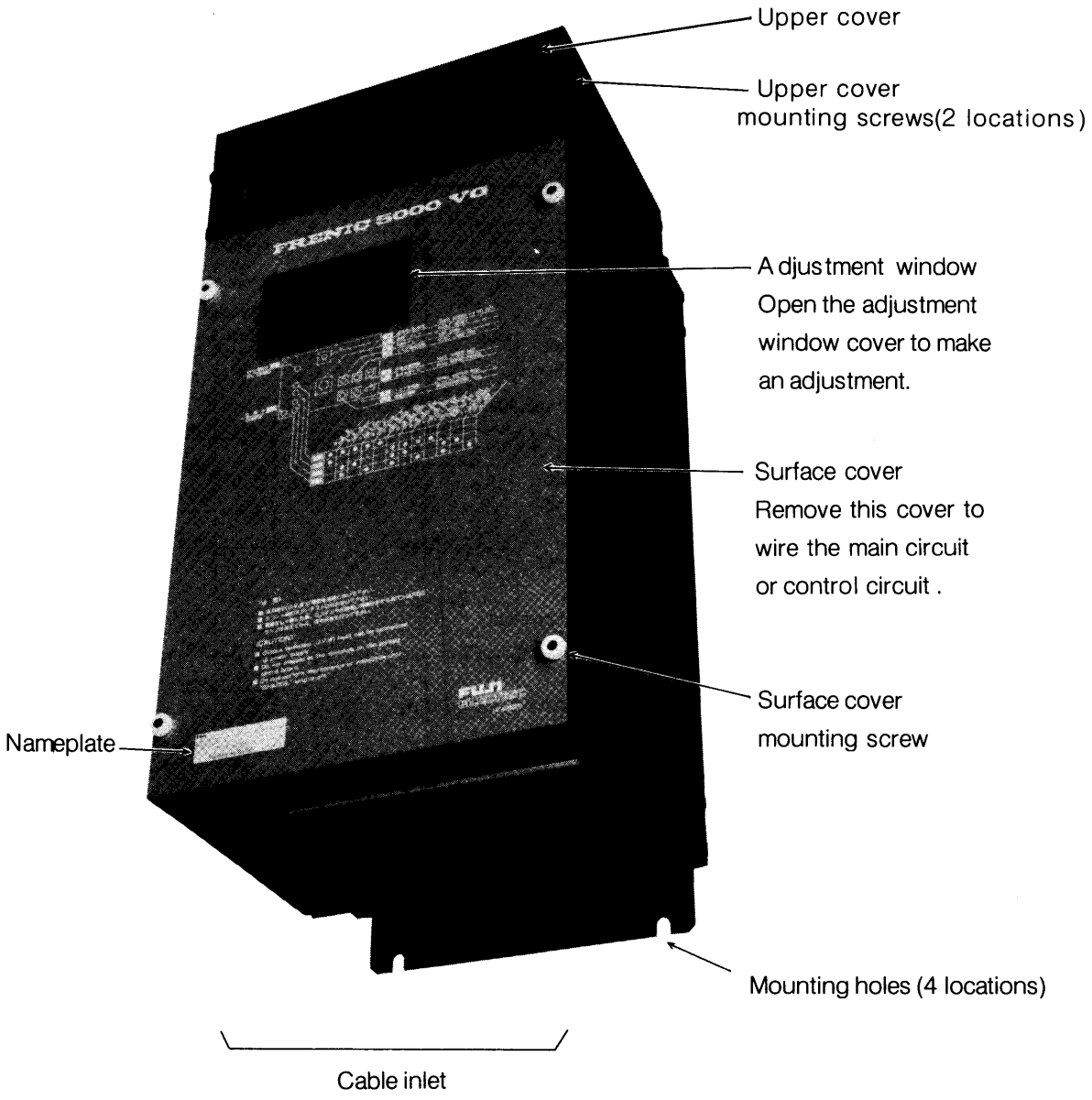
Unit : mm

(4) When mounting the drive unit inside the panel, refer to the specification table in Section 1-4 for the generated heat. Design the cooling system inside the panel so that the ambient temperature of the inverter will be 50°C or less. Leave at least 120mm as a service space between the drive unit and peripheral equipment.

3. CONFIGURATION AND WIRING

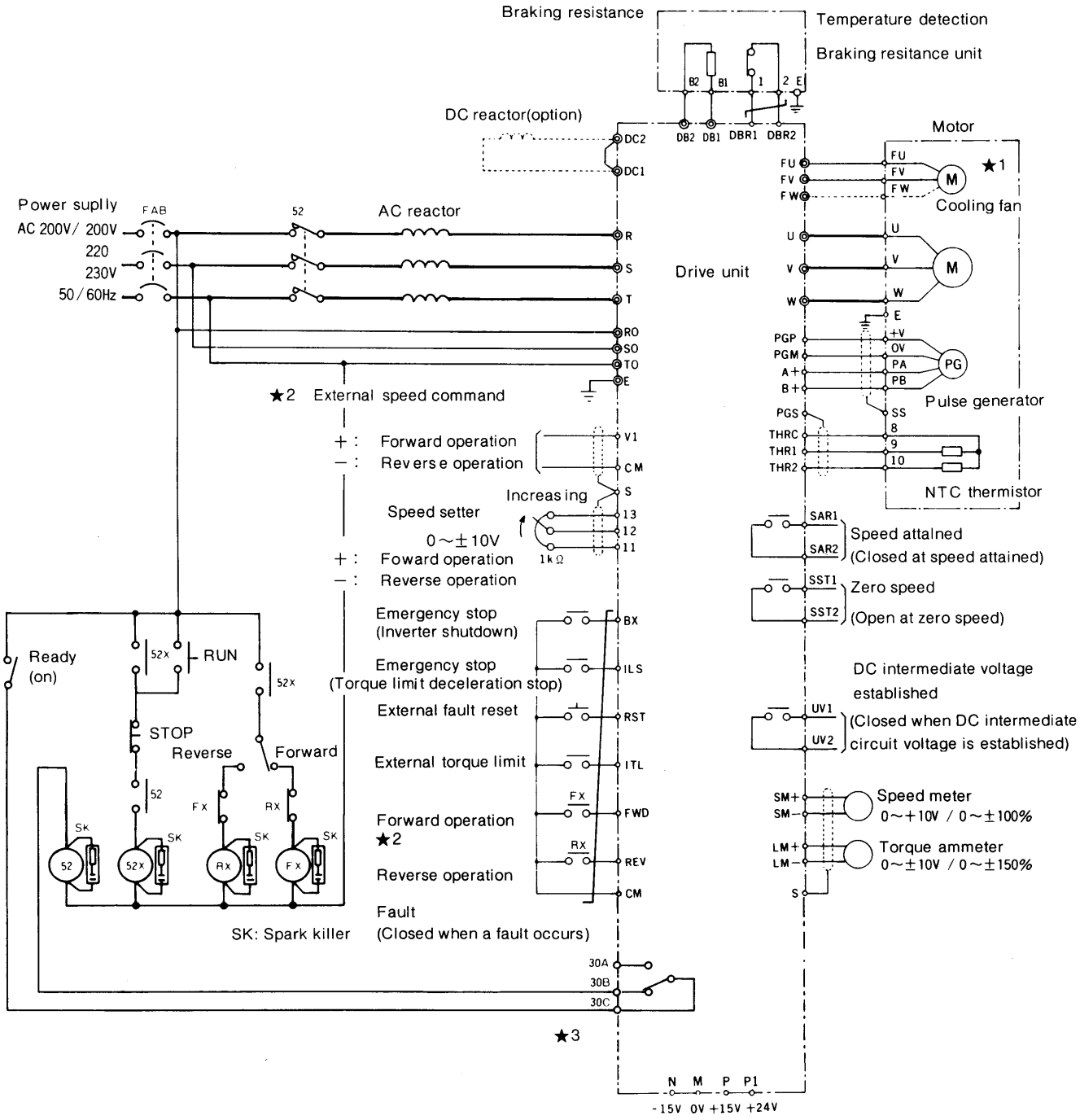
3-1 Drive Unit Configuration

The following figure shows the name of each part.



3-2 Wiring Connection

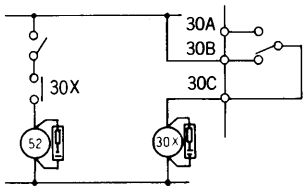
Perform wiring carefully referring to the following diagram.



*1 The motor cooling fan motor is single phase for 3.7 kW, 5.5 kW, and 7.5 kW. Connect the FU and FV terminals.

*2 When the drive unit is operated by an external speed command signal, the rotational direction cannot be changed between forward and backward by a contact signal (FWD, REV). Input an operation signal to the FWD or REV terminal and use an analog signal 0 to +10V (+: forward, −: backward) to change the rotational direction between forward and backward.

*3 Allowable capacity of relay contacts 30 are A.C. 250V 3A (power factor 1.0), A.C. 250V 0.3A (power factor 0.3). Amplify the relay contact capacity as follows when they drive the large capacity contactors.

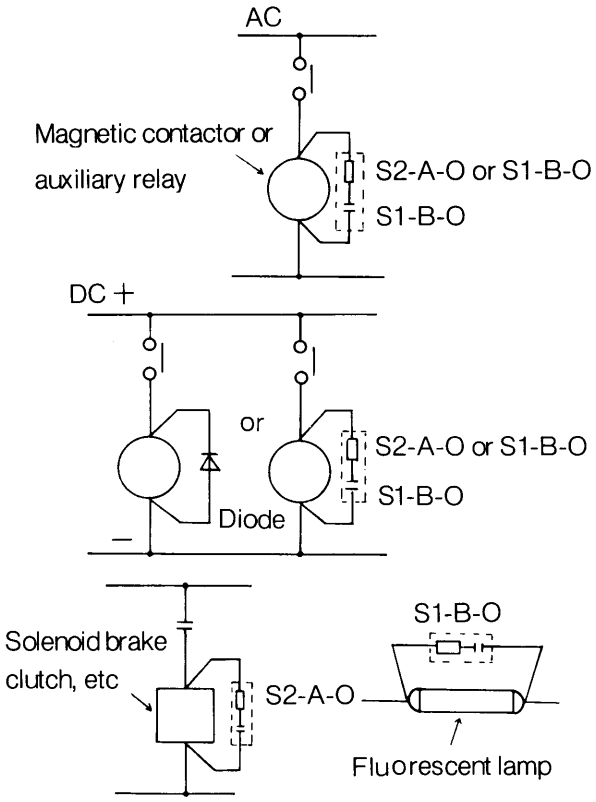


1) The diagram at left shows a standard connection where some optional units are included. For details of the terminals, see Section 3-3.
2) For a power supply unit (MCCB, MC, etc.), sequence RY, speed meter, and torque ammeter, use those recommended by FUJI or their equivalents.
3) When using an ELB (electrical leak breaker), use an ELB specially for inverters (FUJI SG series or EG-A series, for example).
4) For an AC circuit, connect the CR filter to the coils of MC (magnetic contactors) and RY in parallel, and for a DC circuit, connect the diode to reduce noise. The following shows and example of wiring.

a) Application of CR filter and diode (circuit voltage 250V or less)

Eguipment		CR filter or diode
Maqnetic conttor (Main circuit)	AC	S2-A-O or equivalent
	DC	Diode or S2-A-O
Auxiliary relay	AC	S1-B-O or equivalent
	DC	Diode or S1-B-O
Flourescent lamp		S1-B-O
Solenoid,brake clutch	AC	S2-A-O
	DC	Diode

b) Wiring example



Connect the CR filter or diode for killing sparks directly to the part where sparks are generated and make the wire as short as possible.

① CR filter capacity

S2-A-O C: 0.2μ F500VDC

R: 500Ω

(Manufactured by Okaya Electric Industries Co. Ltd.)

S1-B-O C: 0.1μ F500VDC

R: 200Ω

(Manufactured by Okaya Electric Industries Co. Ltd.)

② Diode capacity

(When operation coil current is 1A or less) ERB24-06C 600V, 1A (manufactured by FUJI) (Surge 45A/10 mS)

5) Use the power capacity and main circuit wire which match the drive unit capacity and loading motor output. (See "Recommended main circuit equipment and electric wiring" in Section 3-5.)
6) Use twisted or shielded wires to wire a prtion indicated as  . Keep the portion at least 10cm away from the main circuit. Do not place it in a duct together with the main circuit.
7) Be sure to ground the E terminal for the unit (including the motor) to prevent electric shock. Do not ground any other part and terminal.
8) Inserting a surge killer between the output terminals of the drive unit may cause some inconvenience. Do not insert such because it is not required.
9) Do not mount a phase advance capacitor to the output terminals (U, V, and W) of the drive unit.
10) After finishing the wiring work, check that the connections are correct. Incorrect wiring may cause maloperation, and may even damage the unit. Please take care.
11) Do not connect the power supply unit to output terminals U, V, and W of the drive unit.
12) The forward rotational direction of the drive unit is counterclockwise with respect to the shaft end. Even if you change the phase sequence, the rotational direction cannot be changed. If you wish to change the rotational direction, use an operation signal (forward operation command, reverse operation command).

3-3 Input Terminal List

(1) Main circuit and main circuit auxiliary terminal

Terminal symbol	Use	Specification
R. S. T.	Commercial power input terminal	3 φ, 200 / 200~230V, 50 / 60 Hz
U. V. W	Drive unit output terminal	Terminal for supplying power to motor
RO, SO, TO	Control power input terminal	The control circuit if RO, SO, and TO power is iuput when the R, S, and T power is turned off.
DB1, DB2	Terminal for connecting braking resistance unit	Connect a braking resistor.
DC1, DC2	Terminal for connecting DC reactor	The DC reaction (optional) can be connected to a 22-kW to 37-kW unit. If this is not used, jumper DC1 and DC2 with the strapping plug provided.
FU, FV, FW	Terminal for connecting motor cooling fan	Single phase (FU, FV) for 3.7 to 7.5 kW, 3 phases for 11 kW to 37 kW.
E	Ground terminal	

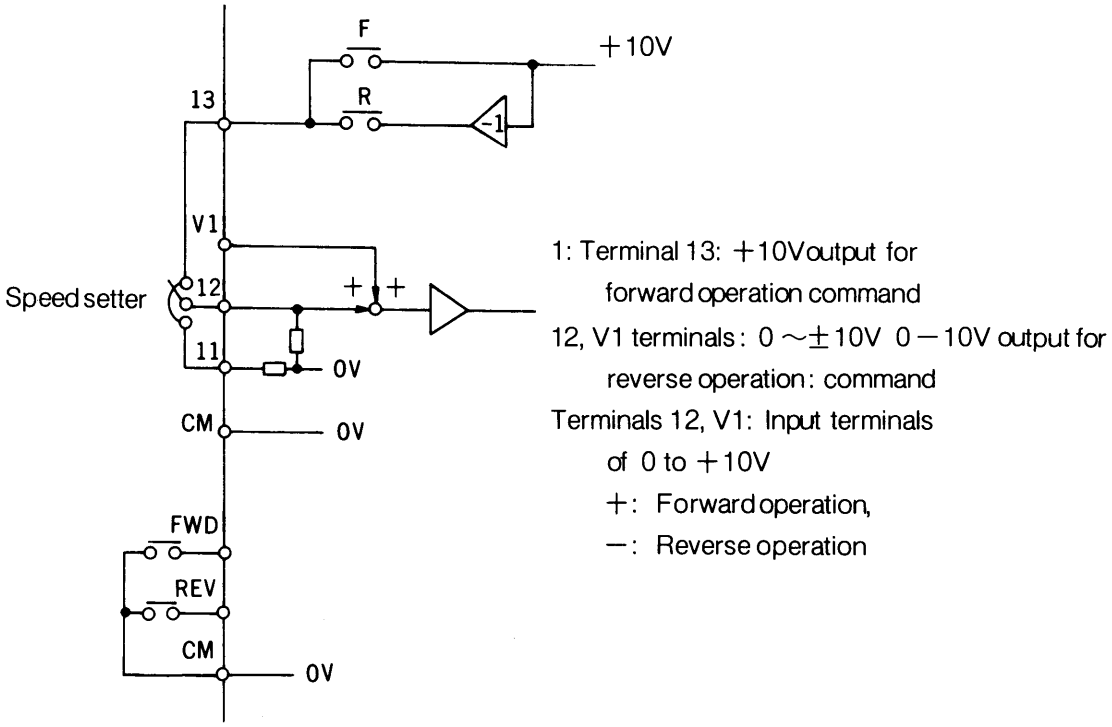
(2) Control circuit terminal (control PC board terminal)

Classification	Terminal symbol	Use	Specification
Contact input (*1)	FWD(CM)	Forward operation command	Forwsrd operation performed when contact is closed. See 3 to operate the unit with an external speed command.
	REV(CM)	Reverse operation command	Reverse operation performed when contact is closed.
	BX (CM)	Inverter shutdown command	The motor stops its free run when contact is closed.
	ILS (CM)	Torque limit dicele-ration stop command	The motor stops torque limit deceleration when contact closed
	ITL (CM)	External torque limit command	The torque is limited within the value set with VR2 when contact is closed.
	RST (CM)	External fault reset command	Releases the retained fault signal when contact is closed. (The signal can be reset using the fault reset PB on the PC board.)
	DBR1, DBR2	Braking resistance overheat signal	Overheating occurs when contact is open.
	EXT (CM)	Excitation input command	Used to perform backup excitation of the motor. To use this terminal, contact FUJI.
Contact output	SST1, SST2	Zero speed signal	Open when the speed is 0.5% or less of the maximum set speed, closed when it reaches 1%.
	SAR1, SAR2	Speed attained signal	When a speed command is issued, closed if the speed reaches 5% of the maximum set speed and open if it reaches 7% or more.
	30A, 30C	Fault signal	Contact when a fault (batch) occurs.
	30B, 30C	Fault signal	Open when a fault (batch) occurs.
	UV1, UV2	DC intermediate voltage established signal	Contact when a DC intermediate voltage is established.
Monitor output	SM+, SM−	Speed meter (analog) signal	• 0~10V/±100% A maximum of 3 speed meters can • 10V, 1mA be connected.
	SP (CM)	Speed signal: with polarity	• 0~±10V/±100% −: Forward operation +: Reverse operation
	LM+, LM−	Torque ammeter signal	• 0~±10V/±150% A maximum of 3 ammeters can • +10V,1mA be connected.
	DM+, DM−	Speed meter (digital) signal	A signal for digital speed meter is output. To use this terminal, contact FUJI.
Speed setting input (*3)	13	power terminal for speed setting	+10 VDC when FWD contact is input (closed) −10 VDC when REV contact is input (closed) Allowable load: 1K
	12	Input terminal for speed setting	0~±10V/±100% +: Forward operation −: Reverse operation
	11	Terminal for speed setting	Not 0 V
	V1	Auxiliary terminal for speed setting	0 to +10V/+100% +: Forward operation −: Reverse operation Connect the speed command between V1 and CM (0 V)
Speed detection input	PGP, PGM	Power for pulse generator (PG)	+15V DC
	A+(PGM)	PG A phase signal	
	B+(PGM)	PG B phase signal	
Motor temperature detection input	T H R 1	Terminal for standard thermister	
	T H R 2	Terminal for backup thermister	
	T H R C	Thermister common terminal	
	P G S	Shielded terminal for thermister	

Classification	Terminal symbol	Use	Specification	
External voltage power supply, etc.	P (M)	15V power terminal	15.0 VDC ± 0.8 V, 150 mA including the power of optional PC boards	To use this terminal, contact FUJI
	X (M)	−15V power terminal	15.0 VDC ± 0.8 V, 100 mA including the power of optional PC boards	
	P1 (M)	24V power terminal	20V to 20VDC, 400mA including the power of optional PC boards	
	M	External power supply common terminal		
	CM	Contact input common terminal		
	S	Shielded terminal		

*1 For contact input, use control relay HH23PW manufactured by Fuji electric or equivalent. The current passing through the contact is approximately 3mA, 24VDC.
*2 The contact output capacity is 220VAC, 0.5A (power-factor 0.3).
*3 Speed setting input connection.

The following shows a block diagram of the speed setting input part.



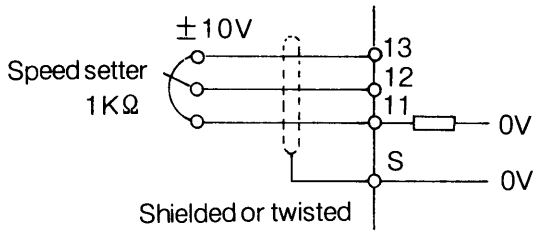
If contact input FWD signal is turned on, this drive unit starts operation, and +10V is output to terminal 13. The motor starts rotating in the forward direction at the speed set by the speed setter. If the REV signal is turned on in the same way, −10V is output to terminal 13 and the motor starts reverse operation.

When the contact input FWD or REV signal turns off, the voltage of terminal 13 becomes 0V and the motor stops braking. If FWD and REV signals are both turned on, the voltage of terminal 13 becomes 0V and the motor stops.

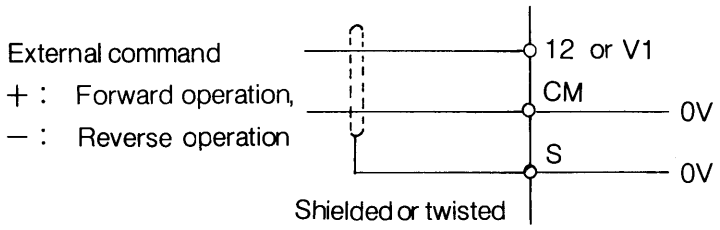
To operate the drive unit by an external speed command, input a voltage from 0 to ±10V between 12 and CM or V1 and CM, and input an operation contact signal to one of the FWD and REV terminals. Forward and reverse operation is performed at 0 to ±10V of analog signal (+: forward operation, −: reverse operation).

(i) Single operation

(Note) The allowable load of terminal 13 is 1 KΩ.



(ii) Serial operation or operation by external command

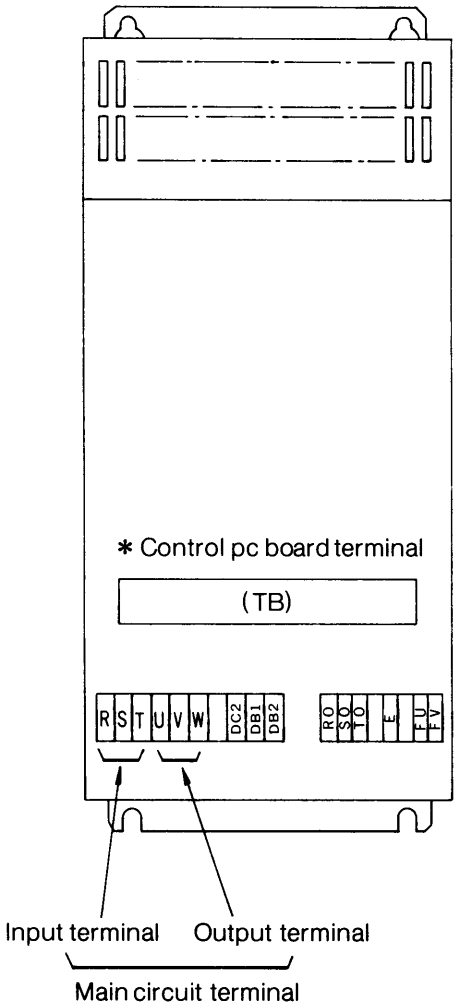


In this case, a contact signal (FWD, REV) cannot be used to change the operation between forward and reverse. Input an operation contact signal to the FWD or REV terminals. Use an analog signal 0 to ±10V (+: forward operation, −: reverse operation) of an analog signal to switch the operation between forward and reverse.

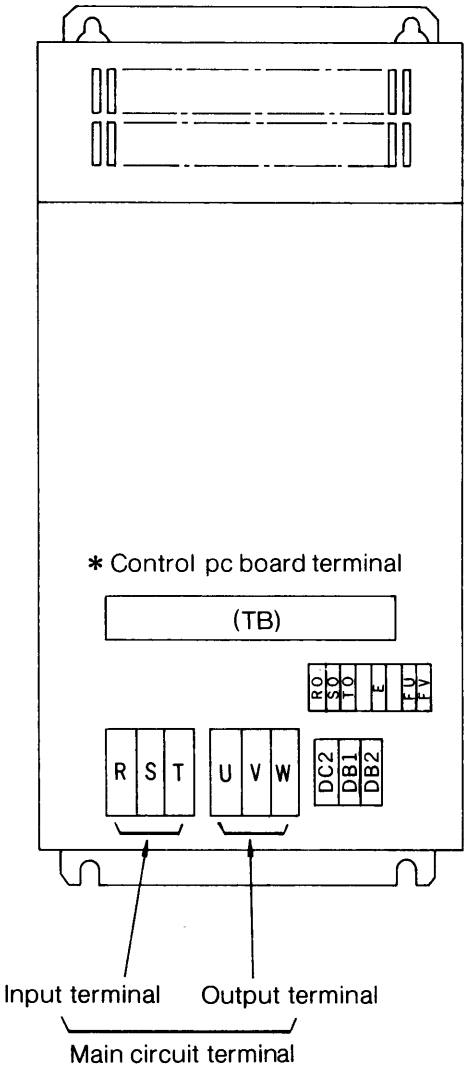
3-4 Terminal Array

The figure below shows the terminal array of each drive unit.

FRN003VG-2
FRN005VG-2



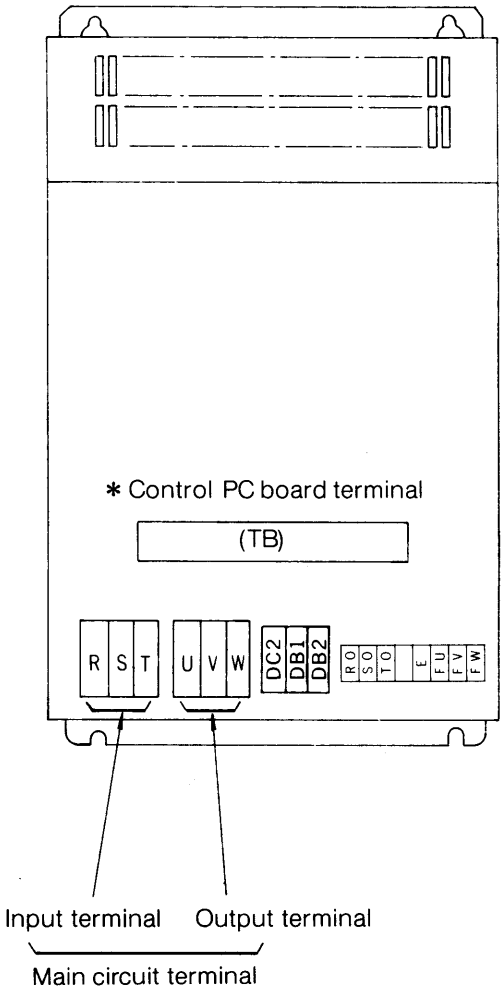
FRN007VG-2



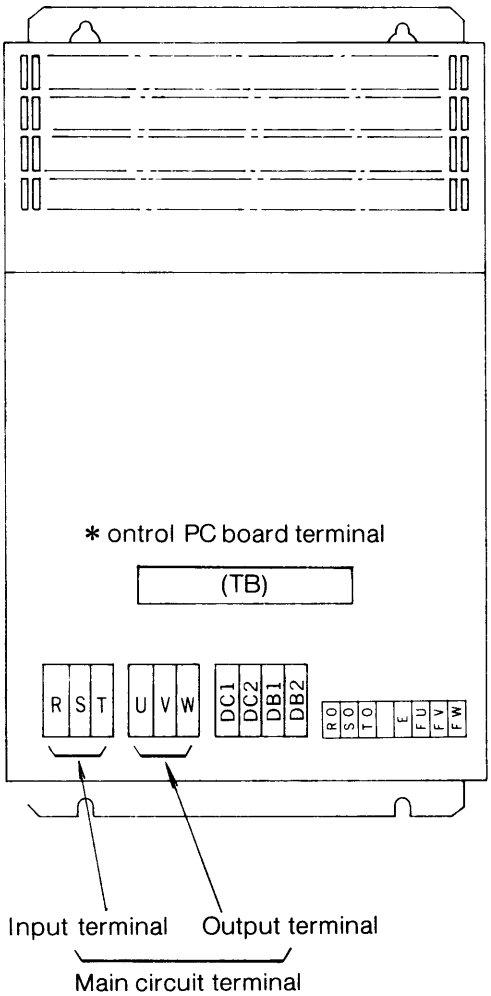
Control PC board terminal array (TB)

	DBR1	CM	CM	RST	REV	FWD	P1	N	SM+	LM+	DM+	S	V1	13	12	THR1	PGS	A+	PGM	SAR1	SST1	30A	30B	UV1			
	DBR2	CM	ILS	EXT	BX	ITL	P	M	SM−	LM−	DM−	CM	SP	11	S	THRC	THR2	B+	PGP	SAR2	SST2	30C	UV2				

FRN011VG-2



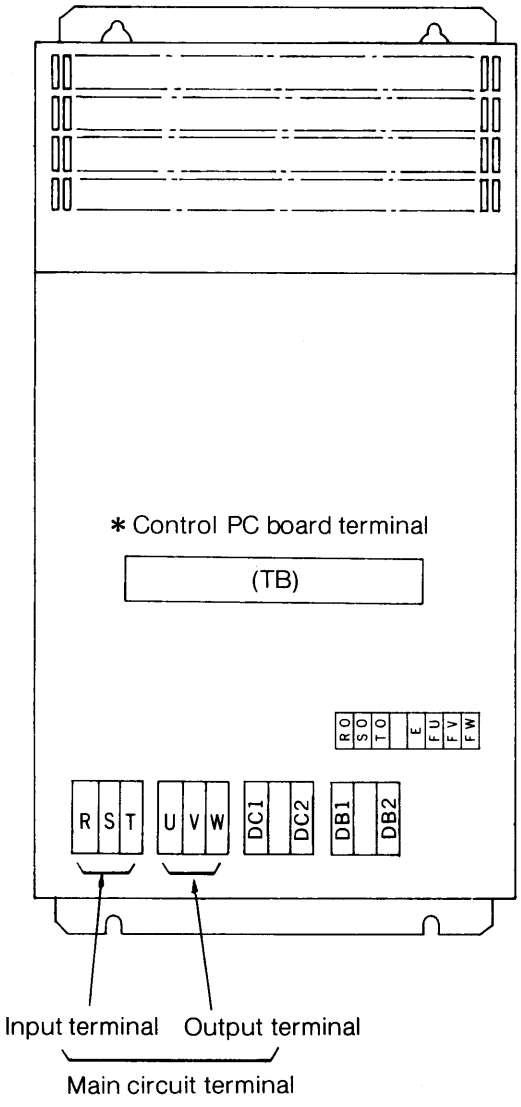
FRN015VG-2
FRN018VG-2
FRN022VG-2



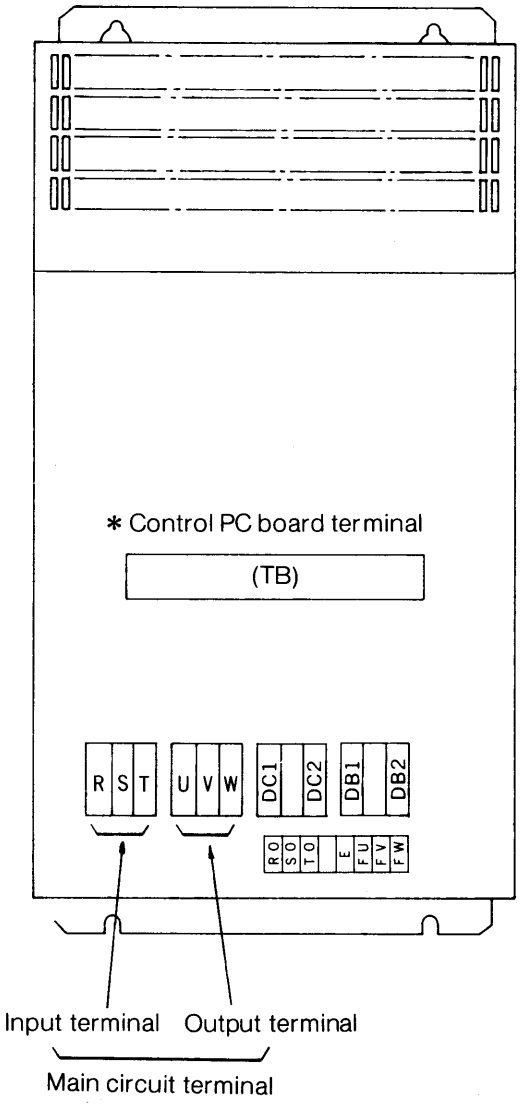
Control PC board termianl array (TB)

	DBR1	CM	CM	RST	REV	FWD	P1	N	SM+	LM+	DM+	S	V1	13	12	THR1	PGS	A+	PGM	SAR1	SST1	30A	30B	UV1						
	DBR2	CM	ILS	EXT	BX	ITL	P	M	SM−	LM−	DM−	CM	SP	11	S	THRC	THR2	B+	PGP	SAR2	SST2	30C	UV2							

FRN030VG-2



FRN037VG-2
FRN045VG-2



Control PC board termianl array (TB)

	DBR1	CM	CM	RST	REV	FWD	P1	N	SM+	LM+	DM+	S	V1	13	12	THR1	PGS	A+	PGM	SAR1	SST1	30A	30B	UV1	
	DBR2	CM	ILS	EXT	BX	ITL	P	M	SM−	LM−	DM−	CM	SP	11	S	THRC	THR2	B+	PGP	SAR2	SST2	30C	UV2		

3-5 Table for Recommended Main Circuit Equipment and Electric Wiring

Drive unit form			FRN003 VG-2	FRN005 VG-2	FRN007 VG-2	FRN011 VG-2	FRN015 VG-2	FRN018 VG-2	FRN022 VG-2	FRN030 VG-2	FRN037 VG-2	FRN045 VG-2
Applied motor [kW]			3.7	5.5	7.5	11	15	18.5	22	30	37	45
Main Circuit Epuipment		NCCB Electromagnetic contactor	SA33 / 30 SRC3631 -5-1N	SA53 / 50 SC-1N	SA63 / 60 SC-2N	SA63 / 60 SC-2SN	SA103K / 75 SC-3N	SA103K / 100 SC-4N	SA203K / 125 SC-5N	SA203K / 150 SC-6N	SA203K / 200 SC-7N	SA203K /225 SC-8N
Main circuit	Applied electric wire [mm²] (*1)	R. S. T. U. V. W.	5.5 (3.5)	8 (*2) (3.5)	14 (5.5)	22 (8.0)	38 (*3) (14)	38 (*3) (22)	38 (*3) (22)	60 (38)	60×2P (60)	60×2P (60)
		DC1, DC2	—	—	—	—	—	—	38 (*3) (22)	60 (38)	60×2P (60)	60×2P (60)
		DB1, DB2 (5%ED)	3.5 (3.5)	3.5 (3.5)	3.5 (3.5)	3.5 (3.5)	5.5 (3.5)	5.5 (3.5)	8 (3.5)	14 (5.5)	22 (8)	22 (14)
	Terminal screw diameter	R. S. T. U. V. W.	M4		M6					M8		
		DC1, DC2	Only the DC2 terminal is attached. (DC2 will be an (DC1 and DC2 will be an optional terminals in future.)				opptional ter minal in future.		M6	M8		
		DB1. DB2	M4		M5		M6			M8		
Motor fan, etc.	RO, SO, TO, E, FU, FV, FW	Applied electric wire	3.5mm²									
		Terminal screw diameter	M3.5									
PC board terminal		Applied electric wire	1.25mm² (*4)									
		Terminall screw diameter	M3									
DBR unit (5%ED)			M4				M5			M6		

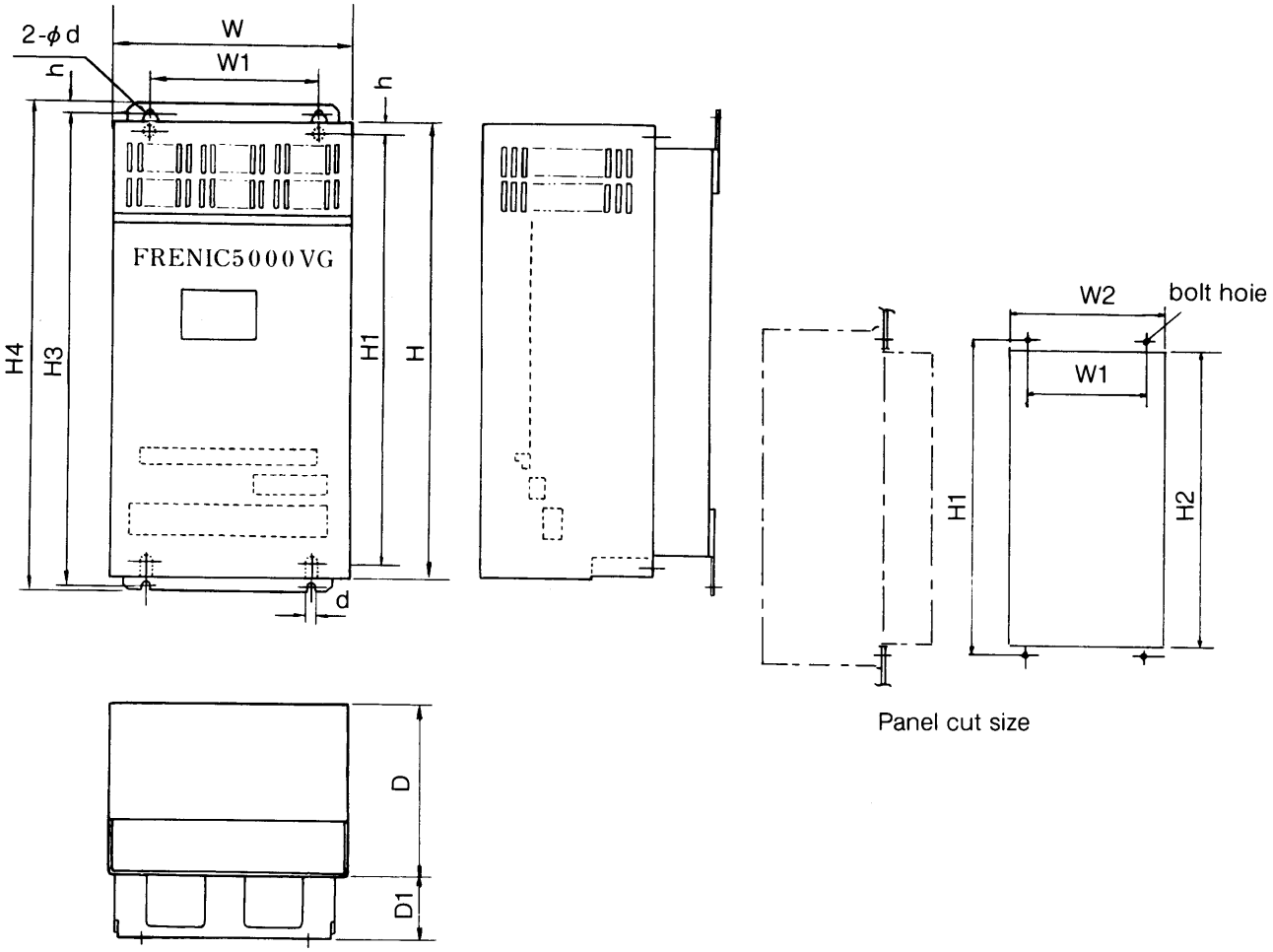
*1 The size indicated in this table is that of the electric wire of a 600-V polyvinyl chloride wire.

*2 Use an attached crimp terminal R8-NK4 for the item marked with ◤ .

*3 Do not use a standard crimp terminal as an M6 terminal for the items marked with ◤ . Use a smaller-size crimp termianl, for example, crimp terminal R8-NK4.

*4 For the shielded wiring parts of the pulse generator for speed detection, NTC thermistor, and analog meter, use 2mm² of (CVVS).

3-6 External Dimensions of Drive Unit



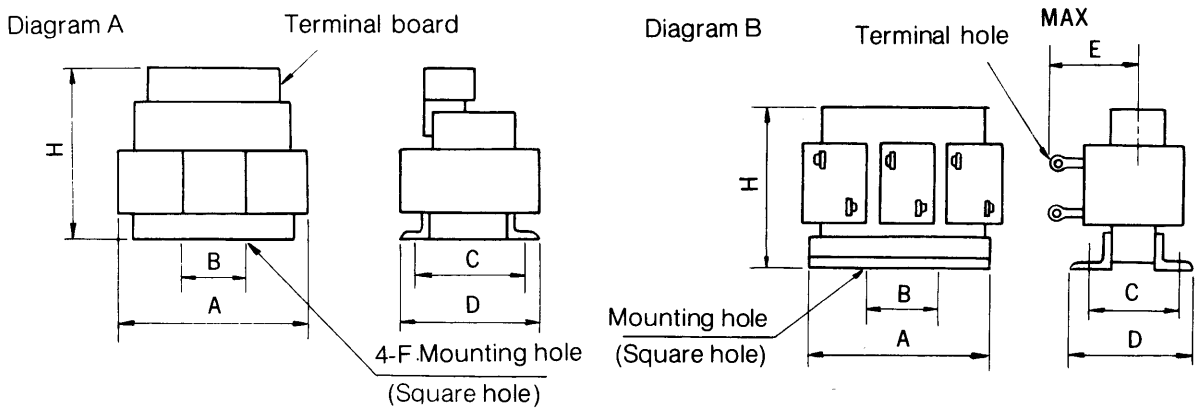
Motor (kW)	Form	Size (mm)												Mounting bolt	Weight (kg)
		W	W1	W2	H	H1	H2	H3	H4	h	D	D1	d		
3.7	FRN003VG-2	240	180	230	500	480	460	520	540	12	210	70	10	M8	15
5.5	FRN005VG-2														
7.5	FRN007VG-2	280	200	270	550	530	510	570	590	12	210	70	10	M8	25
11	FRN011VG-2	350	280	335	550	530	510	750	590	12	210	100	10	M8	30
15	FRN015VG-2	420	280	405	650	620	600	680	710	15	210	100	12	M10	45
18.5	FRN018VG-2														
22	FRN022VG-2														
30	FRN030VG-2	420	280	405	750	720	700	780	810	15	210	100	12	M10	60
37	FRN037VG-2	500	380	475	900	870	845	930	960	18	210	110	15	M12	80
45	FRN045VG-2														

3-7 Power Coordinating AC Reactor

(1) Connection

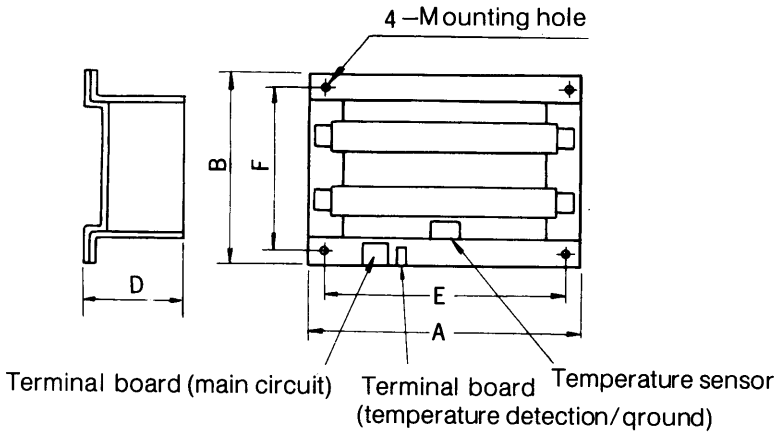
Connect the unit while referring to the connection diagram in Section 3-2.

(2) External dimensions



Applied motor (kW)	Form	Refer ence diagran	Dimension (mm)							Tetminal screw diameter	Weight (kg)
			A	B	C	D	E	F	H		
3.7 5.5	ACR2-5.5	A	185	60	80	100	—	7×10	157	M5	6
7.5	ACR2-7.5	B	120	65	80	96	98	6×10	93	M6	4
11 15	ACR2-15	B	180	60	75	96	102	7×11	115	M8	6
18.5	ACR2-18.5	B	180	60	75	96	102	7×11	115	M8	6.5
22	ACR2-22	B	180	60	75	96	102	7×11	170	M8	8
30 37	ACR2-37	B	190	60	90	120	170	7×11	190	M8	11
45	ACR2-55	B	190	60	90	120	200	7×10	190	M12	12

3-8 Braking Resistance Unit



	Motor (kW)	Form	Specification		Case size(mm)					Mounting hole	Number of cases	Terminal screw diamenter		Weight (kg)
			Capacity (kW)	Resis-tance (Ω)	A	B	D	E	F			Main circuit	Temperature detection ground	
Standard unit (5%ED)	3.5	DB003V-21	1.2	24	400	280	140	368	248	φ 8	1	M4		5
	3.7	DB005V-21	1.2	16										5
	7.5	DB007V-21	1.8	12	400	480	140	368	448	φ 10				7
	11	DB011V-21	2.4	8										8
	15	DB015V-21	3.6	6	400	660	140	368	628	φ 10		M5	M4	11
	18.5	DB018V-21	3.6	4.5										11
	22	DB022V-21	4.8	4	400	660	240	368	628	φ 10				15
	30	DB030V-21	6.0	2.5								M6	M4	20
	37	DB037V-21	7.2	2.25	400	750	240	368	718	φ 10				25
	45	DB045V-21	9.6	2	400	750	340	368	718	φ 10				30

4. TRIAL RUN

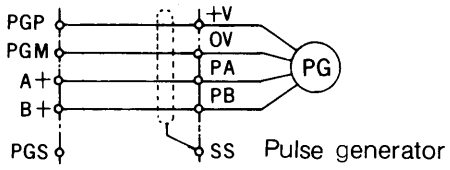
4-1 Preparation for Operation

Before performing a trial run, carry out the following:

(1) Check that the input AC satisfies the rating. (3ø, 200/200V to 230V, 50/60 Hz)

(2) Check that the input terminal and output terminal of the main circuit are connected correctly. (input power supply: R, S, and T; motor: U, V, and W)

(3) Check that the pulse generator is connected correctly.



(4) Make sure that the wiring of the main circuit and control circuit is not grounded or jumpered.

(5) Check that no foreign matter such as a piece of metal or electric wiring has fallen onto the plate or has become attached to it.

4-2 Trial Run

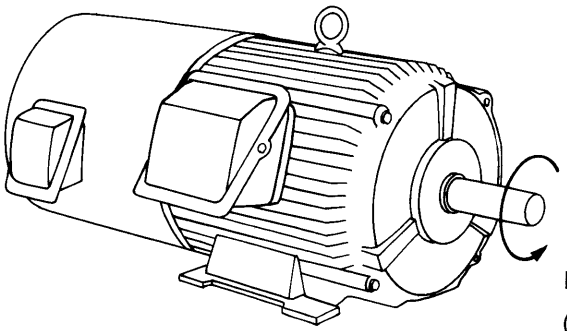
For safety, separate the coupling and belt that connect the motor and machine so that the motor can be operated independently. If you operate the motor while it is directly connected to the machine, take care so that they can operate without causing danger.

(1) Turn all the operation switches off.

(2) Set the minimum value for the speed setter.

(3) Apply power to the wiring shutdown unit. (The control circuit and the sequence circuit become active.) Wait a while, and check that there is no abnormality (such as heat, smoke, foreigh odor) in the control circuit and sequence circuit. At this time, LED9 (charging) of the adjustment window turns on and LED11 (CPU in operation) blinks on and off.

(4) Input a forward or reverse operation command. Turn the speed setter counterclockwise a little and check that the motor starts rotating. Check that the rotational direction of the motor is correct in this status. The rotational direction of the motor by a forward operation command is counterclockwise with respect to the shaft end of the motor. To reverse the rotational direction, input a reverse operation command. Even if the phase sequence of the motor is reversed, the motor starts hunting at a low speed without changing the operational direction.



Forward operation
(counterclockwise)

(5) If a forward operation command and reverse operation command are input at the same time, the motor stops regenerative braking. Please take care.
(6) Increase the st value of the speed setter gradually and check that the motor can operate at maximum speed. The maximum rotational speed of the motor is set to 1500 rpm at the factory. To change the maximum speed of the motor, perform the adjustments described in Section 3-2.
(7) If you have finished checking, stop the unit once. Set a relatively high value for the speed setter and check that acceleration/deceleration can be performed smoothly.

If you have performed (1) to (7), the trial run is completed. Connect the load and start operation. If readjustment is necessary after the trial operation, adjust by referring to Section 5-2 "Adjustment Procedure."

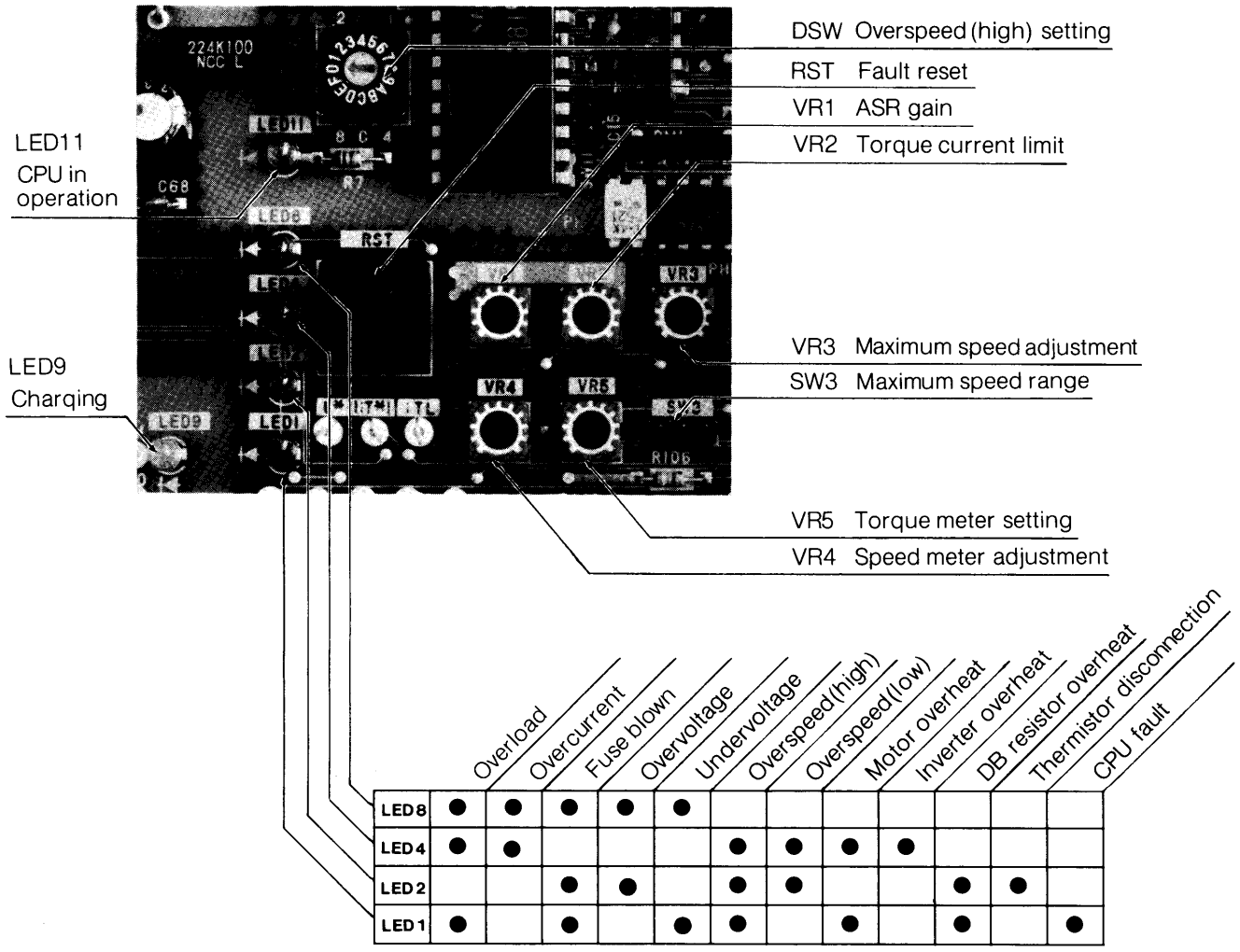
5. ADJUSTMENT AND CHECKS

This drive unit has been completely adjusted before being shipped from the FUJI factory.

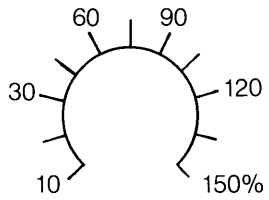
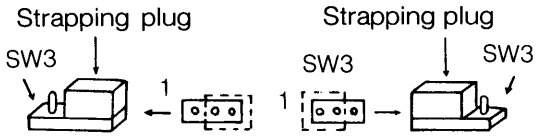
No adjustment is usually required for parts other than those printed on the unit cover. However, if adjustments are required due to a changer in operational conditions, note the following:

(1) Always contact FUJI when adjustments are required for components other than potentiometers and digital switches mounted on the adjustment section.

5-1 Layout of Adjustment Section



5-2 Adjustment Procedure

Adjustment point symbol	name	Adjustment procedure	Factory adjustment value
VR1	ASR P gain adjustment	Run the motor with a load at a speed of approximately 1500 rpm. Turn VR1 clockwise slowly and when the motor enters the hunting status, turn VR1 one notch counterclochwise to stop hunting. In the test run of the motor alone, if hunting occurs, turn VR1 counterclockwise to stop hunting.	
VR2	Adjustment of torque current limit value	1. Close the contact of the external torque limit. 2. The outline of the scale of VR2 and torque limit values (%) is shown below: 	VR2: 0 notch
VR3 SW3	Maximum speed adjustment	1. The maximum speed of the motor is set to 1500 rpm 10V at the factory. If the maximum Speed must be changed, follow the procedure shown below: VR3·····Turn counterclockwise to raise the maximum. SW3····· Depending on the value of the maximum speed, SW3 is set as shown below: (A) For 1500 to 2300 rpm Set the right end (factory setting). (B) For 2300 to 3600 rpm Set the strapping plug at the left end. 	VR3: Set to 1500 rpm for 10-V setting SW3: Strapping plug to be set at the right end

<table>
<tr><th>Adjustment point sym symbol</th><th>Name</th><th>Adjustment procedure</th><th>Factory adjustment value</th></tr>
<tr><td>V R 3

S W 3</td><td>Maximum speed adjustment (continued)</td><td>
(A) When the maximum speed of the motor is changed in the range from 1500 rpm to 2300 rpm.
1) Run the motor and set the speed setter to the maximum notch. Under this condition, the motor runs at a speed of approximately 1500 rpm.
2) Turn VR3 counterclockwise slowly while measuring the operating motor speed to increase the speed. When the required motor speed is obtained, the VR3 setting is completed.

(B) When the maximum speed of the motor is changed in the range from 2300 rpm to 3600 rpm (Note that the maximum speed of the 30 kW and 37 kW motors is 3000 rpm.)
1) Set the strapping plug of SW3 at the left end before operation, turn VR3 clockwise to set notch 10.
2) Run the motor and set the speed setter to the maximum notch. In this condition, the motor runs at approximately 2000 rpm.
3) Turn VR3 counterclockwise slowly while measuring the operating motor speed to increase the speed. When the required motor speed is obtained, the VR3 setting is completed.

Note: The motor speed can be measured by the two methods shown below:
1) Measure the motor speed directly by using s tachometer.
2) Measure the pulse count of the pulse generator by using a pulse counter or oscilloscope. To use this method, connect a pulse counter or oscilloscope across terminals DM+ and DM− (0V common) on the control PC board of the drive unit. The pulse frequencies and the pulse intervals are as follows:
<table>
<tr><td></td><td colspan="3">Motor speed (rpm)</td></tr>
<tr><td></td><td>1500</td><td>3000</td><td>3600</td></tr>
<tr><td>Pulse frequency</td><td>12.8kHz</td><td>25.6kHz</td><td>30.7kHz</td></tr>
<tr><td>Pulse interval</td><td>78.1μ S</td><td>39.1μ S</td><td>32.6μ S</td></tr>
</table>
When the motor speed is N rpm, the pulse frequency and pulse interval are determined by the following formuls:
Pulse frequency f [kHz] = $12.8[\text{kHz}] \times \frac{N[\text{rpm}]}{1500[\text{rpm}]}$
Pulse interval $T[\mu S] = \frac{1000}{12.8} \times \frac{1500[\text{rpm}]}{N[\text{rpm}]}$
</td><td></td></tr>
<tr><td>V R 4</td><td>Adjustment of speed meter level</td><td>1. Run the motor at maximum speed.
2. Adjust so that the pointer of the speed meter indicates the full scale value. The pointer deflects greatly in the clockwise direction.</td><td>10 V ± 2% between SM+ and SM− at maximum Speed adjustment of torque meter level</td></tr>
<tr><td>V R 5</td><td>Adjustment of torque meter level</td><td>1. The level between LM+ and LM− is set to ±10 V ± 5% by the 150% torque command at the factory.
2. When a torque meter with the overscale is used, adjust the counterclockwise direction to align with that scale.</td><td></td></tr>
</table>

<table>
<tr><th>Adjustment point symbol</th><th>Name</th><th>Adjustment procedure</th><th>Factory adjustment value</th></tr>
<tr><td>S W 3</td><td>Switching of maximum speed range</td><td>Setting depends on the maximum speed range.
See the item for the maximum speed adjustment (VR3 and SW3)</td><td></td></tr>
<tr><td>D S W</td><td>Overspeed (high) setting</td><td>1. Setting depends on the maximum speed.
2. Before the adjustment of the maximum speed, turn power off and change the notch, then turn power on again.
3. The notch and maximum speed are listed below:
<table>
<tr><th>Notch</th><th>Maximum speed</th><th>Notch</th><th>Maximum speed</th><th>Notch</th><th>Maximum speed</th></tr>
<tr><td>0</td><td>1500~ 1580 rpm</td><td>6</td><td>2070~ 2200 rpm</td><td>C</td><td>2900~ 3060 rpm</td></tr>
<tr><td>1</td><td>1580~ 1680</td><td>7</td><td>2200~ 2310</td><td>D</td><td>3060~ 3230</td></tr>
<tr><td>2</td><td>1680~ 1770</td><td>8</td><td>2310~ 2450</td><td>E</td><td>3230~ 3420</td></tr>
<tr><td>3</td><td>1770~ 1860</td><td>9</td><td>2450~ 2590</td><td>F</td><td>3420~ 3600</td></tr>
<tr><td>4</td><td>1860~ 1970</td><td>A</td><td>2590~ 2740</td><td></td><td></td></tr>
<tr><td>5</td><td>1970~ 2070</td><td>B</td><td>2740~ 2900</td><td></td><td></td></tr>
</table></td><td>Notch 0</td></tr>
<tr><td>R S T</td><td>Fault reset</td><td>1. Reset the fault display.
2. The fault display dose not appear while the RST button is deing pressed. If there are any remaining faults, the fault display appears again when the RST button is released.
3. If there are two or more faults, the first fault is displayed. When the RST bottun is pressed and the first fault is cleared, the higher–level fault of the second and third faults (the highest level fault is overload) is displayed.
*Note: See Section 6 "MAINTENANCE" for the low and high levels of the fault.
4. Before resetting the fault display, always record the details of a fault.</td><td></td></tr>
</table>

6. MAINTENANCE

6-1 Daily Maintenance

Satisfactory maintenance and inspections are required to give the user full performance of this drive unit, to prevent troubles from occurring, and to keep it operating for a long time with high reliability.

The following must be noted for the inspection:

(1) Be sure to turn power off.

(2) Smoothing capacitors (large electrolytic capacitors) do not discharge immediately after power is turned off.
Before starting inspection work, turn power off, wait several minutes, and check that LED9 (charging) is off.

(3) When connecting or disconnecting a connector, always hold the housing of the connector.

(4) Check items.

No.	Check item	Cycle	Contents	Action to be taken
1	Electromagnetic contactor Replay	Once a year	• Whether the contact wears • Whether the device performs smooth and correct operation	Replacement
2	Transistor Diode Smoothing capacitor	Once a year or one year and half	• Whether there is abnormality such as decoloration, foreign odor, and so on. • Whether there are any dits of metal or wirihg.	Replace defective parts after checking.
3	Unit cooling fan	Once a week	• Whether power is supplied to the fan ahd it turns powerfully. • Whether an abnormal noise is heard from the bearing psrt.	Replace the fan
4	Terminals and connectors	Once s year or one year and half	• Whether thhre is looseness	Retighten them

Remarks:

If a lot of dust is found inside the drive unit, remove it with compressed air while taking care not to hit any parts. However, if counductive dust or dust that may cause defective relay contacts is found inside the drive unit, use an electric vacuum cleaner to remove such dust.

6-2 Fault Diagnostic

If any abnormality should occur during operation or when starting operation, follow the notes given below, and get a good understanding of the symptoms so that a correct and appropriate action can be taken according to the list of fault diagnostics. If normal return could not be made or any parts were found to be damaged, contact FUJI.

(1) Notes

a) Only a responsible person can repair or adjust this drive unit.

b) Use a multimeter, digital voltmeter, oscilloscope, or other appropriate instruments to check circuits.

c) Do not connect or disconnect wires in the conductive status; otherwise a short-circuit may occur.

d) Do not touch already-adjusted VRs unnecessarily. If it is necessary to adjust a VR, record the position (notch number) before adjustment so that it can be restored to the original position.

e) When a fault display appears, always record the contents of the fault before resetting it.

6-3 List of Fault Diagnostics

When an LED (LED1, LED2, LED4, or LED8) indicating a fult on the adjustment window goes on, check the following. When two or more faults occur simultaneously, the fault display indicates the content of the highest level fault among the faults listed below. The highest-level fault is overload followed by overcurrent, fuse blown, etc. and the lowest is the CPU fault.

Fault display code				Contents of fault	Check point	Action to be taken
LED_8	LED_4	LED_2	LED_1			
○	○		○	Overload	Whether the motor runs at overload	Reduce the motor load.
					Whether the motor runs in the open-phase operation	Check wiring between the drive unit and the motor.
○	○			Over-current	Wherher there is a short circuit between the drive and the motor.	Eliminate the short circuit.
○		○	○	Fuse blown		Eliminate the short circuit. When a fuse blows, diodes or transistors may be damaged. Contact FUJI in this case.
○		○		Over-voltage	Whether there is disconnection between the drive unit and the braking resistor (DBR)	Check the wiring between the drive unit and the braking resistor.
○			○	Under-voltage	Whether there is momentary power interruption during operation.	Check that the line voltage did not drop to 180 V or less for 15 ms or more when another motor in the same power system was started. If this symptom occurs frequently, compensation for momentarypower interruption is required. Contact FUJI in this case.
	○	○	○	Over-speed (high)	Whether the fault occurs during acceleration	Turn VR1 for ASR gain adjustment clockwise to adjust so that the overshoot quantity of motor speed is not incleased is not increased during acceleration.
	○	○		Overspeed (low)		
	○		○	Motor overheat	Whether the motor runs at overload	Reduce the motor load.
					Whether the cooling fan turns	When the cooling fan does not turn, check the wiring of the fan.
	○			Inverter overheat	Whether the motor runs at overload.	Reduce the motor load.
					Whether the ambient temperature of fhe unit is 50°C or more.	When the temperature of the unit housing panel is high, cool th e panel.

Fault display code				Contents of fault	Check point	Action to be taken
LED_8	LED_4	LED_2	LED_1			
		○	○	DB resistor overheat	Whether the motor is accelerated or decelerated frequently	The standard specification of the braking resister (DB resistor) is 5%ED. If the Motor is overheated by frepuent acceleration and deceleration, contact FUJI.
					Whether the motor is driven in the continuous regenerative braking operation.	Do not place the motor in the continuous regenerative braking operation
		○		Thermistor disconnection	Whether the thermistor circuit between the drive unit and the motor is disconnected	Check the wiring. When the thermister in the motor is disconnection, a backup spare thermistor built-into the motor is used. Contact FUJI in this case.
			○	CPU fault	Whether the drive unit is installed in a location which generates excessive noise.	Install the drive unit fan from the noise source or eliminate the noise.

Notes:

1. When one of the protection display lamps shown above goes on and the protective function is performed, the motor stops its free run and the abnormality warning relay 30 operates. To rerun the motor, take appropriate action listed above (to fix the cause of the abnormality) and operate the reset (RST) switch.
   When the protection display lamp goes on even if the reset switch is pressed, turn the power off, check and fix the cause again, then apply power again.
2. When the power is turned off, the indicator goes off and the relay does not operate.

6-4 Examples Trouble and Action to be Taken

Trouble example	Check point	Action to be taken
When the input MCCB is turned on, the MCCB trips at the same time.	— Whether there is incorrect connection of line wires: Correct the wiring. — Whether there is a short circuit at the secondary MCCB caused by wire tailings: Eliminate the short circuit. — Whether the supplied line voltage is 200, 220, or 230 VAC ±10%: Note that the drive unit may be damaged whena different line voltage is supplied.	
After the MCCB is turned on, the MCCB trips if the operation button is pressed.	— Whether the MCCB has proper current capacity: Check the application list for each model. — Whether the drive unit output is short-circuited or grounded. — Whether the fuse in the drive unit blows. — Whether a part in the drive unit is discolored or is damaged: Inform FUJI of the damage condition.	
Pressing the operation button does not run the motor.	— Whether circuits are provided with correct wiring (particularly note the pulse generator (PG) circuit) — Whether the motor is locked by the load (the motor has too much load). — Reduce the load.	
The motor does not accelerate.	— Whether the speed setting voltage is normal: The voltage at terminal 12 is increased by turning the setting VR clockwise. — Whether the motor has too much load: Reduce the load. — Whether the pulse generator (PG) has incorrect wiring: Check pahses A and B.	
The motor speed is high or low.	— Whether the acceleration and deceleration ratios by gears are correct. — Whether the speed setting voltage is normal. — Whether the maximum speed setting voltage is normal. — Whether the maximum speed is correctly adjusted: See Section 5-2 and adjust the maximum speed again.	

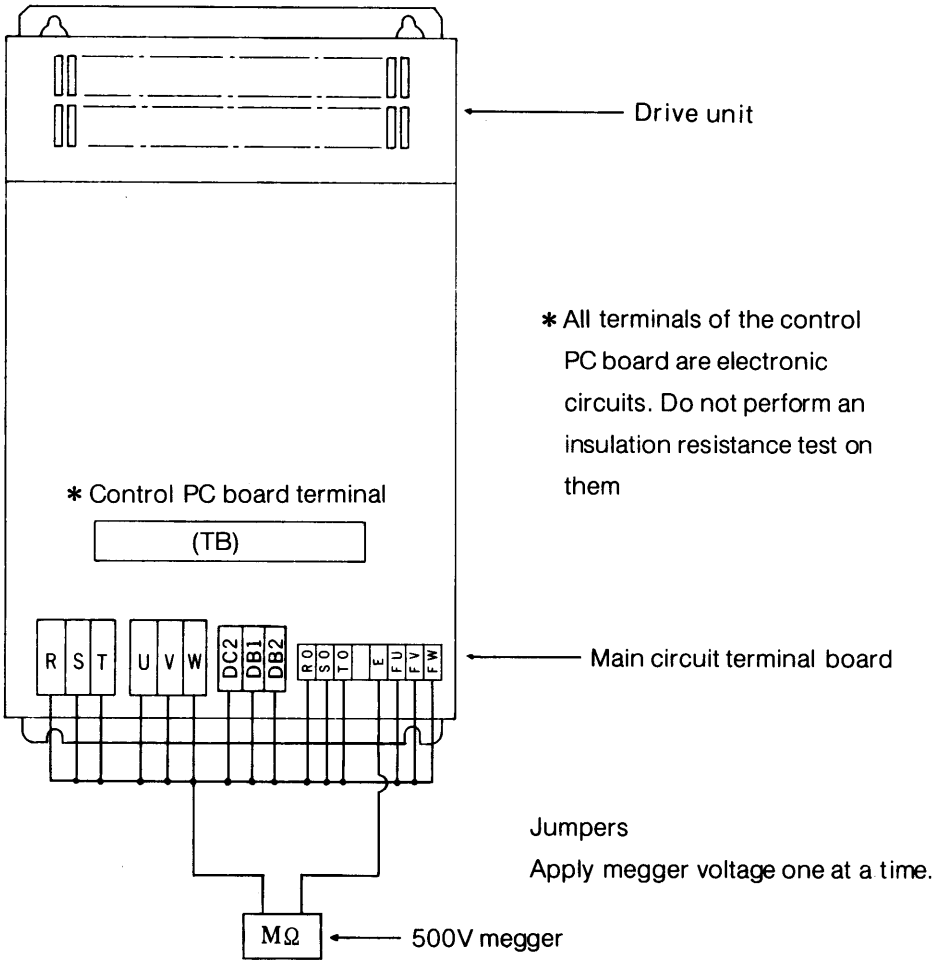
Trouble example	Check point	Action to be taken
Unstable speed during operation.	— Whether the speed setting voltage is normal. — Whether there is a defective relay contact for operation signal FWD or REV: Replace the relay. — Whether the load fluctuates: Reduce the load fluctuation. — Whether VR1 for ASR adjustment is adjusted incorrectly: See Section 5-2 and readjust VR1 for ASR adjustment.	
The motor stops by itself.	— Whether the motor is operated at overload: Fix the overload cause. Whether the motor is locked by a load. — Whether a fault display LED goes on: Fix the fault. — Whether the pulse generator is disconnected.	
Input MCCB trips during operation.	— Whether a part in the drive unit is discolored or is damaged: Transistor or diode is probably damaged. Contact FUJI. — Whether the intra-panel temperature is normal: Provide the panel with ventilation holes when the intra-panel temperature is abnormal.	
Input MCCB trips during operation.	— Whether the motor is operated at overload: Fix the overload cause. — Whether there is short-circuit or grounding at the output: Check the elements. — Whether there is any load at the secondary MCCB other than the drive unit.	
The motor does not stop when the stop button is pressed.	— Whether there is incorrect wiring in the external sequence circuit: Correct wiring. — Whether there is a defective relay contact for the FWD or REV operation signal: Replace the relay.	

6-5 Insulation Check

— Clean the parts of the drive unit and connect terminals as shown below.
— Use a 500 VDC megger.
— Do not perform an insulation resistance test for the control circuit terminals (control PC board terminals).
— Disconnect jumpers after testing.

* Control PC board terminal array (TB)

	DBR1	CM	CM	RST	REV	FWD	P1	N	SM+	LM+	DM+	S	V1	13	12	THR1	PGS	A+	PGM	SAR1	SST1	30A	30B	UV1	
	DBR2	CM	ILS	EXT	BX	ITL	P	M	SM−	LM−	DM−	CM	SP	11	S	THRC	THR2	B+	PGP	SAR2	SST2	30C	UV2		



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