

Transvector controlled AC variable speed drive

400V

FRENIC[®] 5000VG

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NOTES

1. Do not connect the power supply to an output terminal (U, V, or W) of the drive unit.
2. Charged voltage 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. Never perform a dielectric strength test.
4. Make sure that the drive unit and the pulse generator are connected correctly. (The pulse generator will burn out if voltage is applied with 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 of 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 specifications.
- (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 (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 not perform a dielectric strength test.
- (10) To perform a megger test, see Section 6-5.

1-4 Standard Specifications

Series name		General purpose vector control drive unit											FRENIC5000VG
Motor	Form	MVK 3115A	MVK 3133A	MVK 3135A	MVK 3165A	MVK 3167A	MVK 3184A	MVK 5187A	MVK 5206A	MVK 5207A	MVK 5223A	MVK 5254A	MVK 5256A
	Continuous rating output [kW]	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
	Basic speed [rpm]	1500											
	Maximum speed [rpm]	3600						3000			2400		
	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	35.71	48.70
	Overload capacity	150% for 1 minute											
	Rotor GD ² [kg·m ²]	0.065	0.12	0.15	0.34	0.47	0.88	1.06	1.18	1.34	1.73	4.9	5.7
	Cooling fan	1 ϕ ,40/44W(50/60Hz)			3 ϕ ,85/110W(50/60Hz)				3 ϕ ,150/210W(50/60Hz)			3 ϕ ,270/390W(50/60Hz)	
	Vibration	V10											
	Noise	75dB(A)						80dB(A)		85dB(A)	90dB(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											
Accessories	Forced air-cooling fan, pulse generator, NTC thermistor												
Drive unit	Form	FRN003 VG-4	FRN005 VG-4	FRN007 VG-4	FRN011 VG-4	FRN015 VG-4	FRN018 VG-4	FRN022 VG-4	FRN030 VG-4	FRN037 VG-4	FRN045 VG-4	FRN055 VG-4	FRN075 VG-4
	Power capacity [kVA]	6	9	12	17	22	28	34	45	55	67	84	104
	Power supply	3 ϕ , 400/400~460V (\pm 10%) 50/60Hz (\pm 5%) (150% torque guaranteed when the power is 400V or more)											
	Generated heat [W]	280	450	560	800	850	1100	1370	1870	1930	2500	3150	3650
	Main circuit system	Transistor sinusoidal wave PWM-type VVVF inverter											
	Control method	Trans-vector control, ASR control with ACR minor											
	Speed control range [rpm]	15 ~ 1500 ~ 3600						15~1500~3000			15~1500~2400		
		Constant torque characteristics for 1500 rpm or less. Constant output characteristics for more than 1500 rpm.											
	Speed control accuracy	\pm 0.2% for load fluctuation 0 to 100%, \pm 0.2% for power voltage fluctuation 400V \pm 10% \pm 0.25% for ambient temperature fluctuation 25 \pm 10°C (percent for the maximum speed)											
	Allowable load GD ²	20 times motor GD ² or less											
	Control response	Response frequency 5Hz											
	speed command input	0~ \pm 10V (Maximum speed attained at \pm 10V) The maximum speed can be adjusted in the range from 1500 to 2400, 3000 or 3600 rpm.											
	Acceleration/ deceleration method	Torque limit acceleration/deceleration											
	Braking method	Resistance regenerative braking (150% torque, 5% ED resistor mounted externally ,Braking unit for the 55kW or more also mounted externally)											

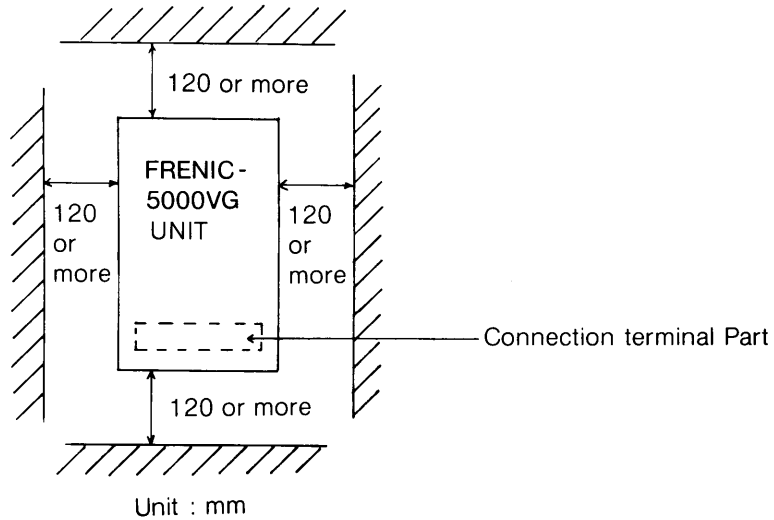
Drive unit	Operation method		Forward-reverse operation	FWD and REV commands	
	Speed feedback		Pulse generator (photoelection)	Pulse count: 512P/R, two phases	
	Acceleration/ deceleration time			Optional: 0.5 to 200 sec	
	External torque limit		One-point preset (adjustable between 10% and 150%)		
	External output	Zero speed		The contact is open when the speed is less than 0.5% of the maximum speed, closed when it is 1% 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)	with Polarity, accuracy: Approximately ±20%
	Protection	Overload		The motor stops with free running when overload occurs.	
		Overcurrent		The motor stops with free running when overcurrent occurs.	
		Fuse failure		The motor stop with free running when the fuse of the DC intermediate circuit blows.	
		Overvoltage		The motor stops with free running when overvoltage is applied to the DC intermediate circuit.	
		Undervoltage		The motor stops with free running when the DC intermediate circuit voltage is insufficient.	
		Overspeed (high)		The motor stops with free running when the speed reaches 119 to 129% of the maximum setting speed.	Switched by digital switch
		Overspeed (low)		The motor stops with free running when the speed reaches 112 to 120% of the maximum setting speed.	
		Motor overheat		The motor stops with free running when the thermistor overheats.	
		Inverter overheat		The motor stops with free running when the cooling fin overheats.	
		DB resistor overheat		The motor stops with free running when the braking resistor overheats.	
		Thermistor disconnection		The motor stops with free running when the thermistor disconnects.	
		CPU fault		The motor stops with free running when a fault occurs in the CPU.	
		Protection output detection		Batch output	
		External reset		Reset when a reset signal is ON	Fault reset PB also provided inside the unit
	Indication	Error display		Code display for each error	4-bits display
		Operation display		DC intermediate circuit 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 panel (external cooling enable)			
Coating color		Munsell N1. 2, semigloss finish (for the unit cover, Munsell 1PB5/13 semigloss finish)			
Attachments		Braking resistor unit (5%ED), Line side AC reactor for power coordination			

2. INSTALLATION

Correct installation of the unit greatly affects its life.

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 mist and corrosive gases.
- (3) Install the unit vertically keeping the connection terminal part downward.

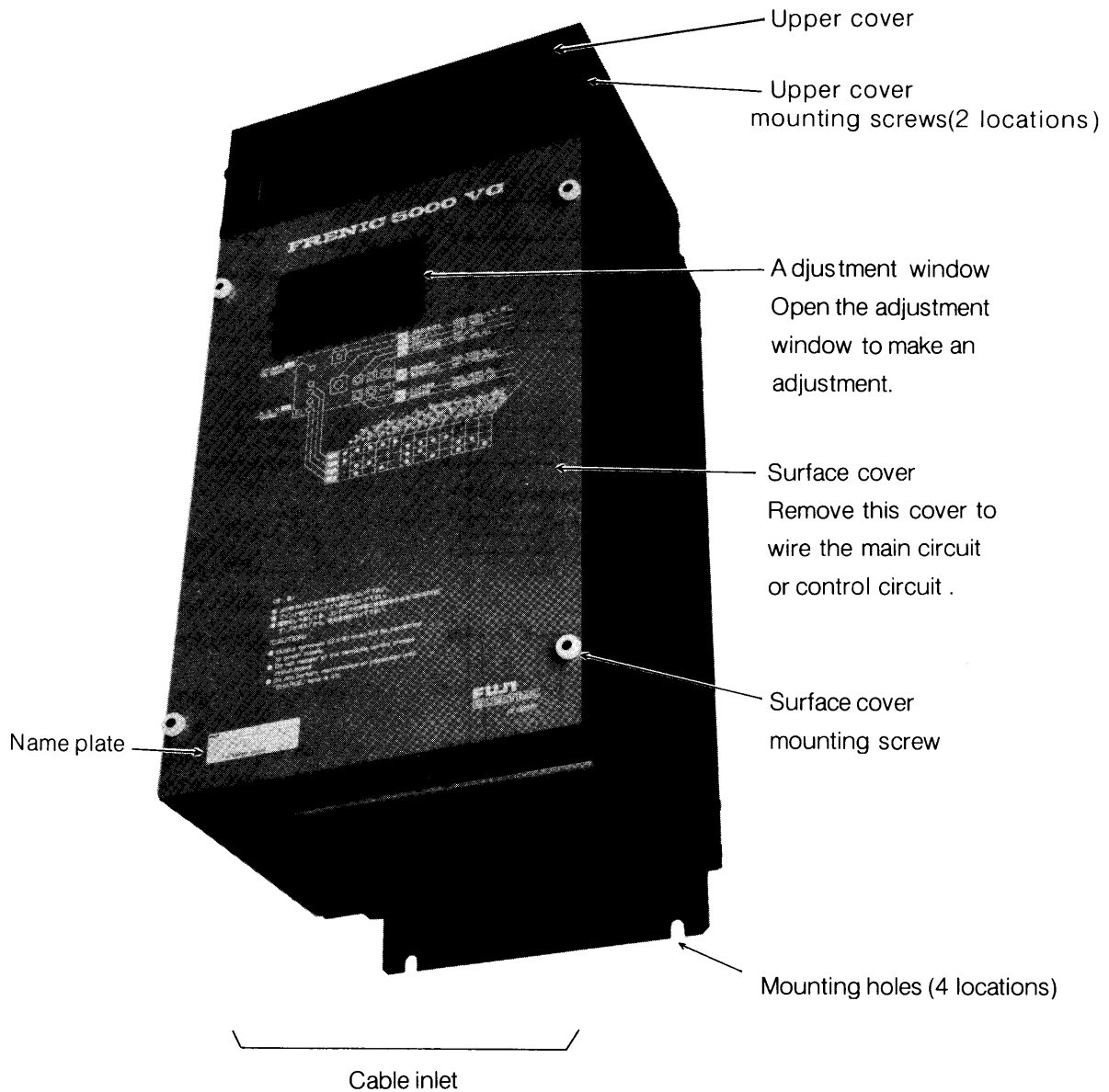


- (4) When mounting the drive unit inside the panel, refer to the specification table in Section 1-4 for the generated heat. Design the cooling system inside the panel so that the ambient temperature of the inverter will be 50°C or less. Leave at least 120mm as a service space between the drive unit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

3. CONFIGURATION AND WIRING

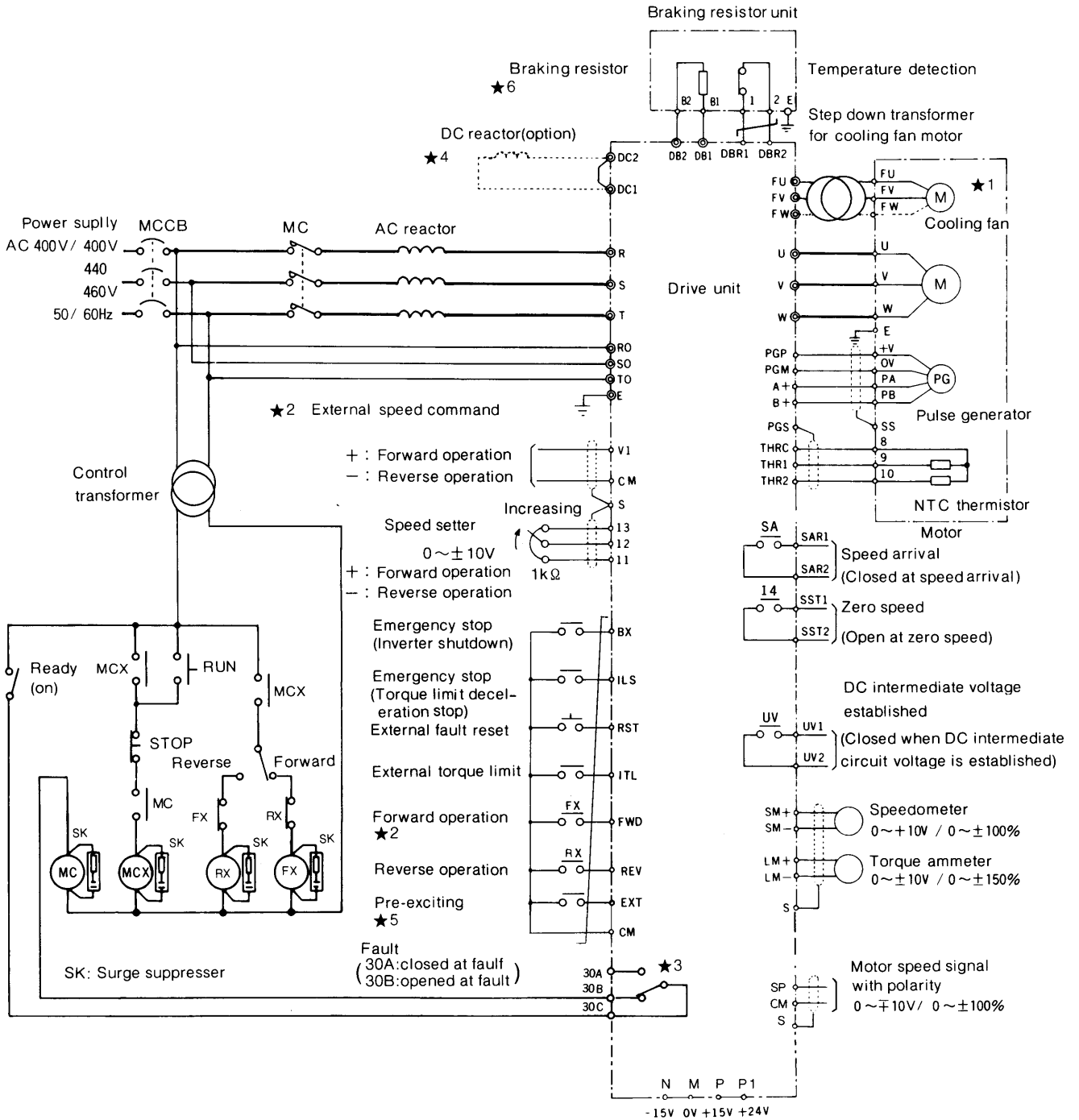
3-1 Drive Unit Configuration

The following figure shows the name of each part.

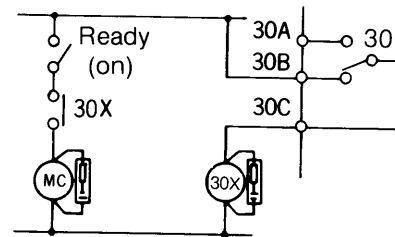


3-2 Wiring Connection

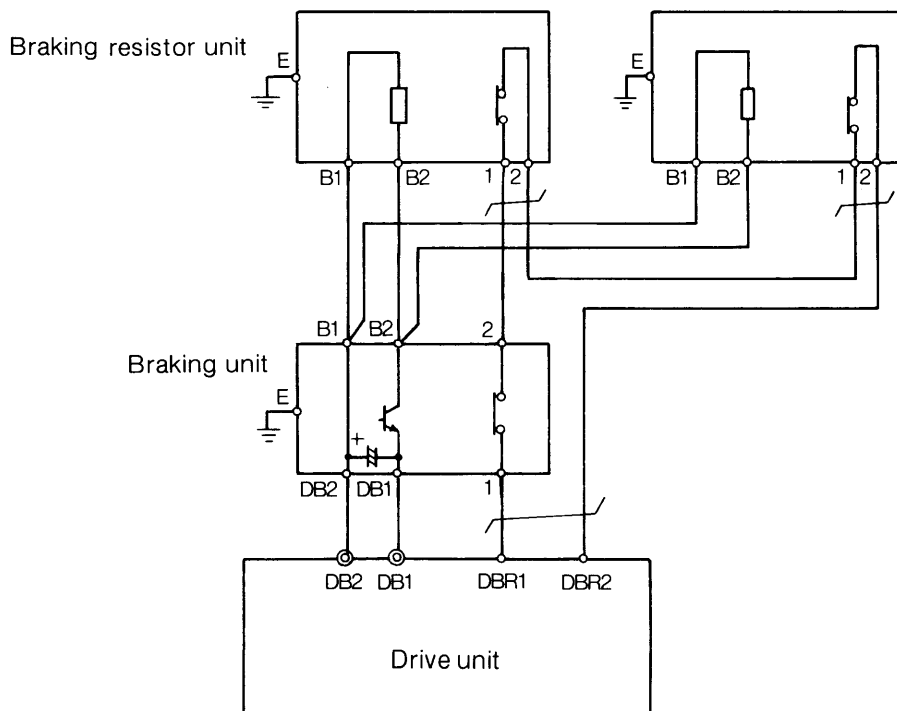
Perform wiring carefully referring to the following diagram.



- ★1 The motor cooling fan motor is single phase for 3.7kW, 5.5kW and 7.5kW. Connect the FU and FV terminals. Please refer to Section 3—5 as to the specifications of step down transformer of cooling fan motor. It is available to connect the cooling fan motor on 200/220V(50/60Hz) power supply directly.
- ★2 When the drive unit is operated by an external speed command signal, the rotational direction cannot be changed by a contact signal (FWD, REV). Input an operation signal to the FWD or REV terminal and use an analog signal 0 to $\pm 10V$ (+: forward, -: reverse) to change the rotational direction.
- ★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.



- ★4 The drive units rated from 3.7kW to 11kW have no DC1 terminal for DC reactor (optional) and are not provided the jumping bar between the terminals DC1 and DC2.
- ★5 Pre-exciting command should be applied with the mechanical braking.
- ★6 In case of FRN055VG-4, FRN075VG-4 drive unit, the braking units are mounted separately. And there are no FU, FV, FW and SO terminals on these driving unit.

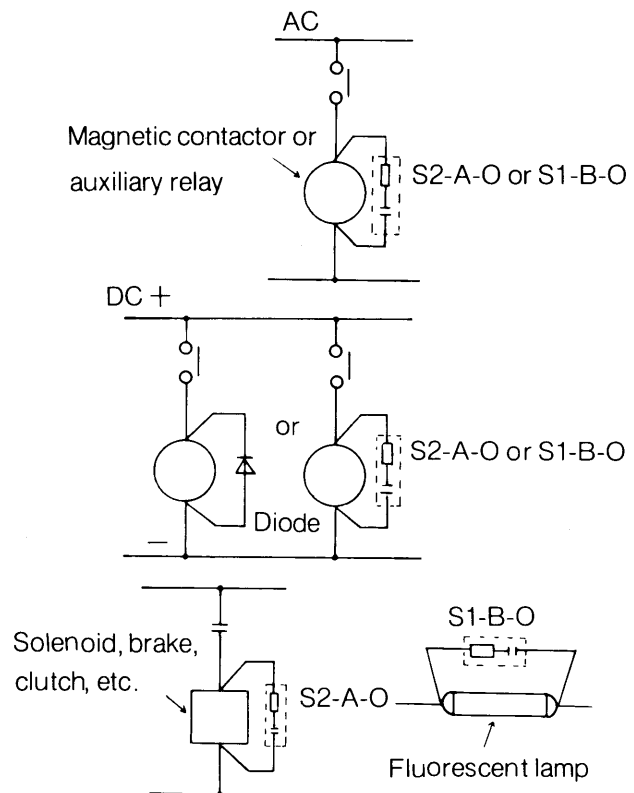


- 1) The diagram at left shows a standard connection where some optional units are included. For details of the terminals, see Section 3-3.
- 2) For a power supply unit (MCCB, MC, etc.), sequence RY, speedometer, and torque ammeter, use those recommended by FUJI or their equivalents.
- 3) When using 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 an example of wiring.

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

Equipment		CR filter or diode
Magnetic contactor (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
Fluorescent lamp		S1-B-O
Solenoid, brake, clutch	AC	S2-A-O
	DC	Diode

b) Wiring example



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

① CR filter capacity

S2-A-O C: $0.2\mu\text{F}$ 500VDC

R: 500Ω

(Manufactured by Okaya Electric Industries Co.,Ltd.)

S1-B-O C: $0.1\mu\text{F}$ 500VDC

R: 200Ω

(Manufactured by Okaya Electric Industries Co.,Ltd.)

② Diode capacity

(When operation coil current is 1A or less) ERB44-06C 600V, 1A (manufactured by FUJI)

(Surge 30A/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 portion indicated as $\frac{f}{\oplus}$. 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 suppresser 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 Terminal List

(1) Main circuit and main circuit auxiliary terminals

Terminal symbols	Use	Specification
R, S, T	Commercial power input terminals	3 ϕ , 400/400~460V, 50/60Hz
U, V, W	Drive unit output terminals	Terminals for supplying power to motor
RO,(SO),TO	Control power input terminals	The control circuit acts if RO,(SO) and TO is input when the R, S, and T power is turned off. The SO terminal is not mounted on the drive unit 55kW or more.
DB1,DB2	Terminals for connecting braking resistor unit	Connect a braking resistor. In case of drive unit 55kW or more connect the braking unit.
DC1,DC2	Terminals for connecting DC reactor	The DC reactor (optional) can be connected to a 22kW to 75kW unit. If this is not used, makes short DC1 and DC2 with the jumping bar provided.
FU,FV,FW	Terminals for connecting motor cooling fan	Single phase (FU, FV) for 3.7 to 7.5kW, 3 phases for 11 kW to 45kW. These terminals are not provided on the drive unit 55kW or more.
E	Ground terminal	

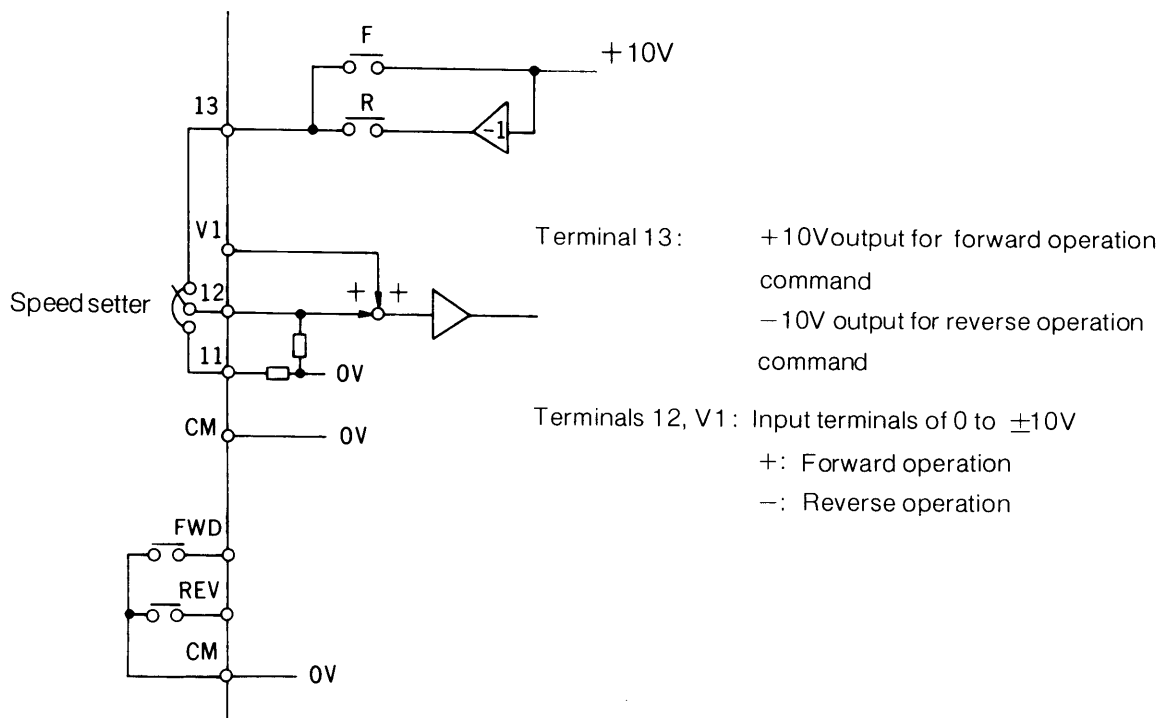
(2) Control circuit terminals (control PC board terminals)

Classification	Terminal symbols	Use	Specifications
Contact input (★1)	FWD(CM)	Forward operation command	Forward operation performed when contact is closed.
	REV(CM)	Reverse operation command	Reverse operation performed when contact is closed.
	BX (CM)	Inverter shutdown command	The motor stops with free running when contact is closed.
	ILS (CM)	Torque limit deceleration stop command	The motor stops with 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 fault signal can be reset using the fault reset PB on the PC board.)
	DBR1, DBR2	Braking resistor overheat signal	Overheating occurs when contact is open.
	EXT (CM)	Pre-excitation input command	Used to perform Pre-excitation of the motor. These terminals should be used with mechanical brake.
Contact output (★2)	SST1, SST2	Zero speed signal	Open when the speed is 0.5% or less of the maximum set speed, closed when it reaches 1% or more.
	SAR1, SAR2	Speed arrival 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	Closed when a fault (batch) occurs.
	30B, 30C	Fault signal	Open when a fault (batch) occurs.
	UV1, UV2	DC intermediate voltage established signal	Closed when a DC intermediate voltage is established.
Monitor output	SM +, SM -	Speedometer (analog) signal	•0~10V/±100% Maximum of 3 speed meters (10V, 1mA) can be connected.
	SP (CM)	Speed signal with polarity	•0~±10V/±100% - : Forward rotation + : Reverse rotation
	LM +, LM -	Torque ammeter signal	•0~±10V/±150% Maximum of 3 ammeters (±10V, 1mA) can be connected.
	DM +, DM -	Speedometer (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	+10VDC when FWD contact is input (closed) -10VDC when REV contact is input (closed) Allowable load: 1KΩ
	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~+10V/+100% + : Forward operation - : Reverse operation Connect the speed reference between V1 and CM (0V)
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	THR1	Terminal for standard thermistor	
	THR2	Terminal for backup thermistor	
	THRC	Thermistor common terminal	
	PGS	Shielded terminal for thermistor	

Classification	Terminal symbols	Use	Specifications
External voltage power supply, etc.	P (M)	15V power terminal	15.0VDC \pm 0.8V, 150 mA including the power of optional PC boards
	N (M)	-15V power terminal	15.0VDC \pm 0.8V, 100 mA including the power of optional PC boards
	P1 (M)	24V power terminal	20V to 30VDC, 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 HH54PW manufactured by Fuji electric or equivalent. The current passing through the contact is approximately 3mA, 24VDC.
- ★2 The contact output capacity is 250VAC, 3A(power factor 1), 250VAC, 0.5A(power factor 0.3)
- ★3 Speed setting input connection.

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



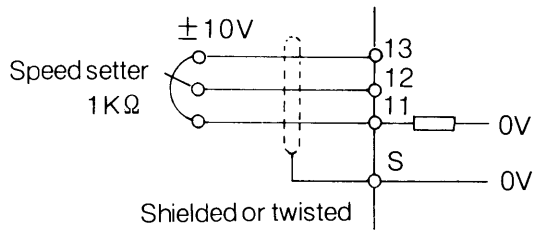
If contact input FWD signal is turned on, this drive unit starts operation, and +10V is output to terminal 13. The motor starts rotating in the forward direction at the speed set by the speed setter. If the REV signal is turned on in the same way, -10V is output to terminal 13 and the motor starts reverse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

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

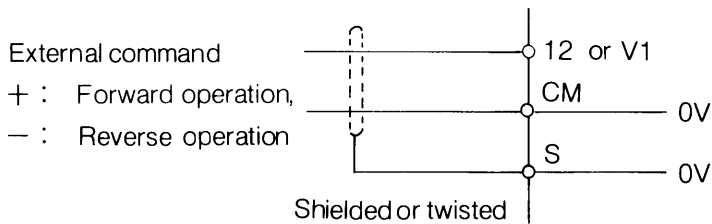
To operate the drive unit by an external speed command, input a voltage from 0 to $\pm 10V$ between 12 and CM or V1 and CM, and input an operation contact signal to one of the FWD and REV terminals. Forward and reverse operation is performed at 0 to $\pm 10V$ of analog signal (+: forward operation, -: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

(i) Single operation

(Note) The allowable load of terminal 13 is $1K\Omega$.



(ii) Operation by external command



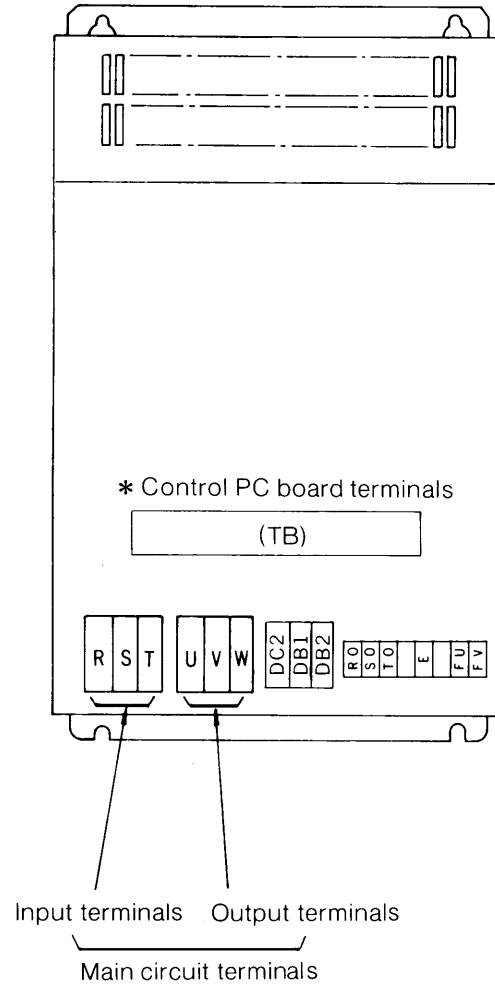
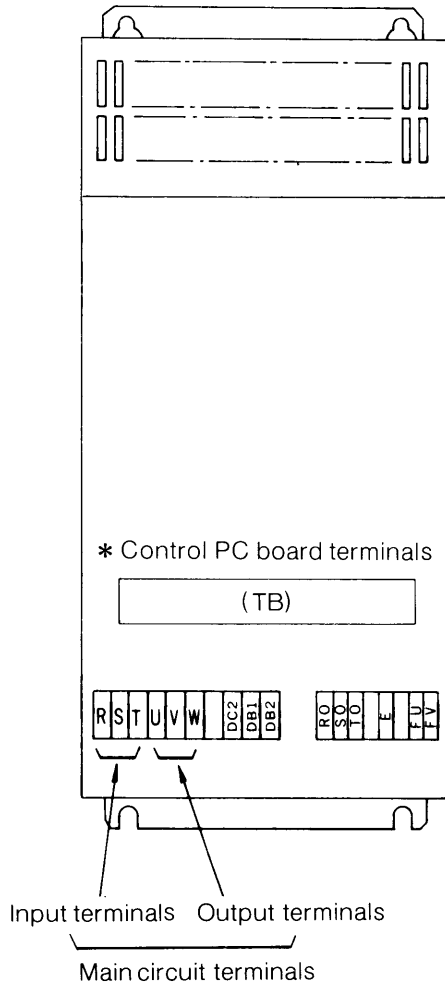
In this case, a contact signal (FWD, REV) cannot be used to change the operation between forward and reverse. Input an operation contact signal to the FWD or REV terminals. Use an analog signal 0 to $\pm 10V$ (+: forward operation, -: reverse operation) of an analog signal to switch the operation between forward and reverse. When you stop the driving unit, apply the speed command to be 0V and operation command FWD or REV to be switched off.

3-4 Terminal Array

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

FRN003VG-4
FRN005VG-4

FRN007VG-4



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	

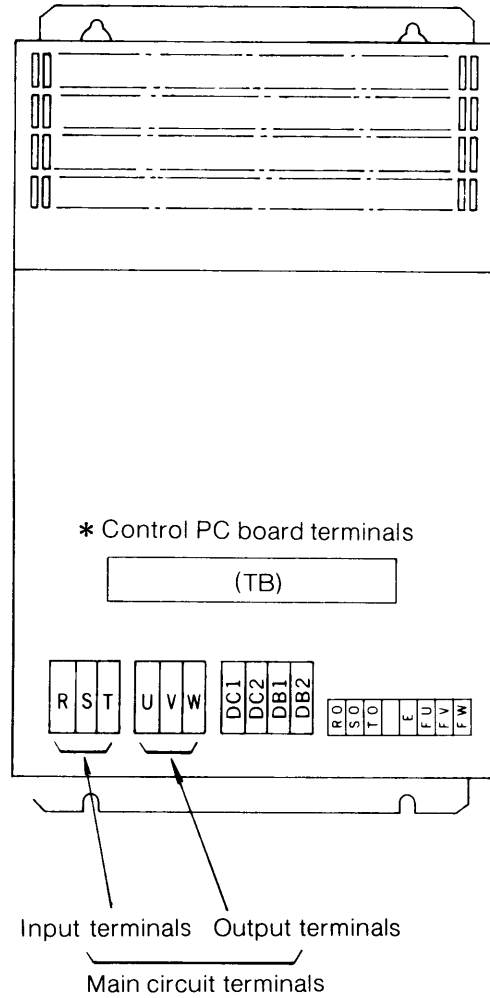
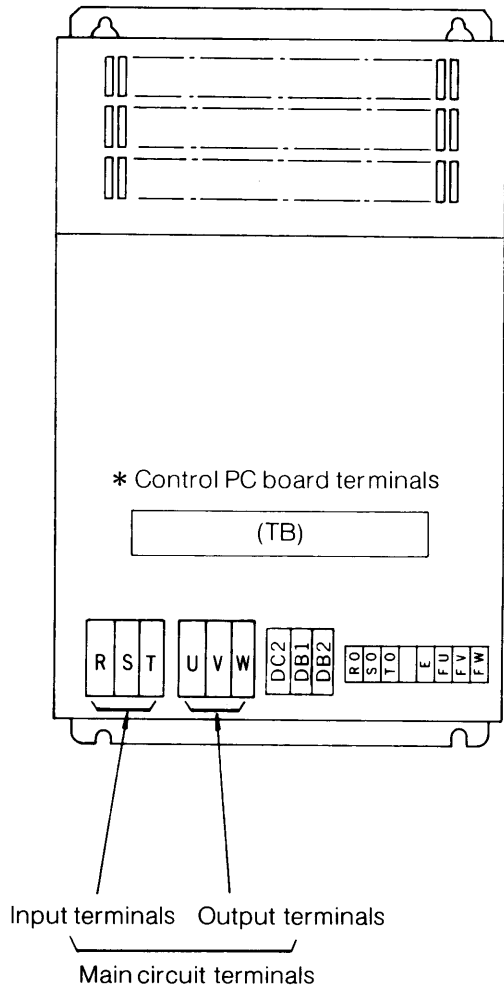
FRN011VG-4

FRN015VG-4

FRN018VG-4

FRN022VG-4

FRN030VG-4

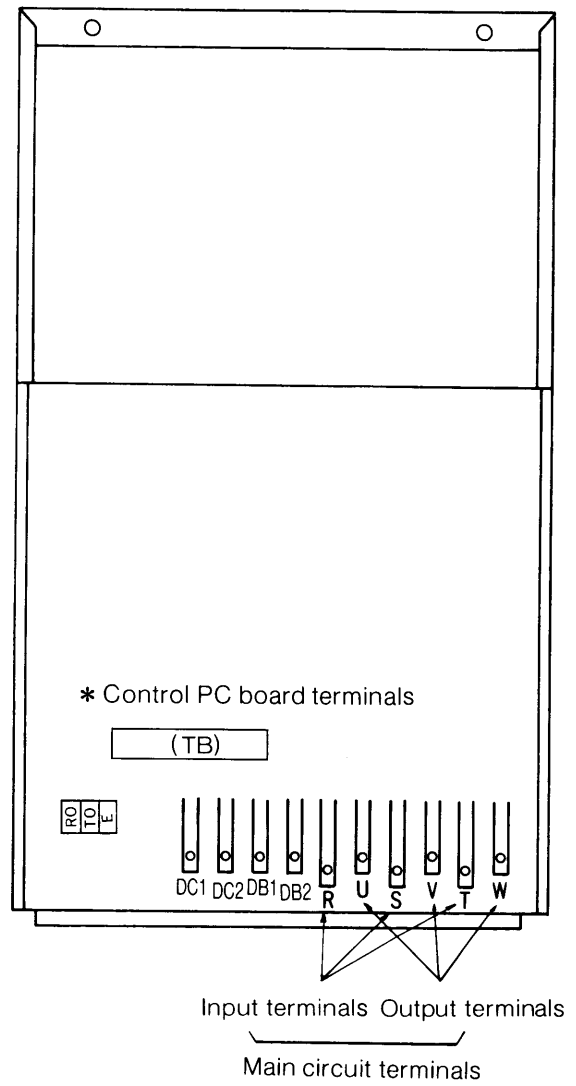
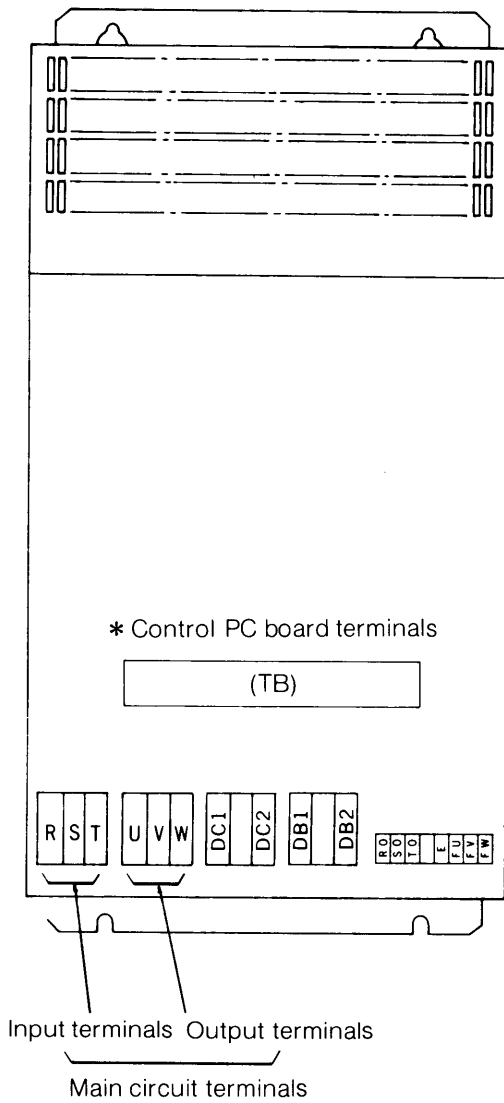


Control PC board terminal array (TB)

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	

FRN037VG-4
FRN045VG-4

FRN055VG-4
FRN075VG-4



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	

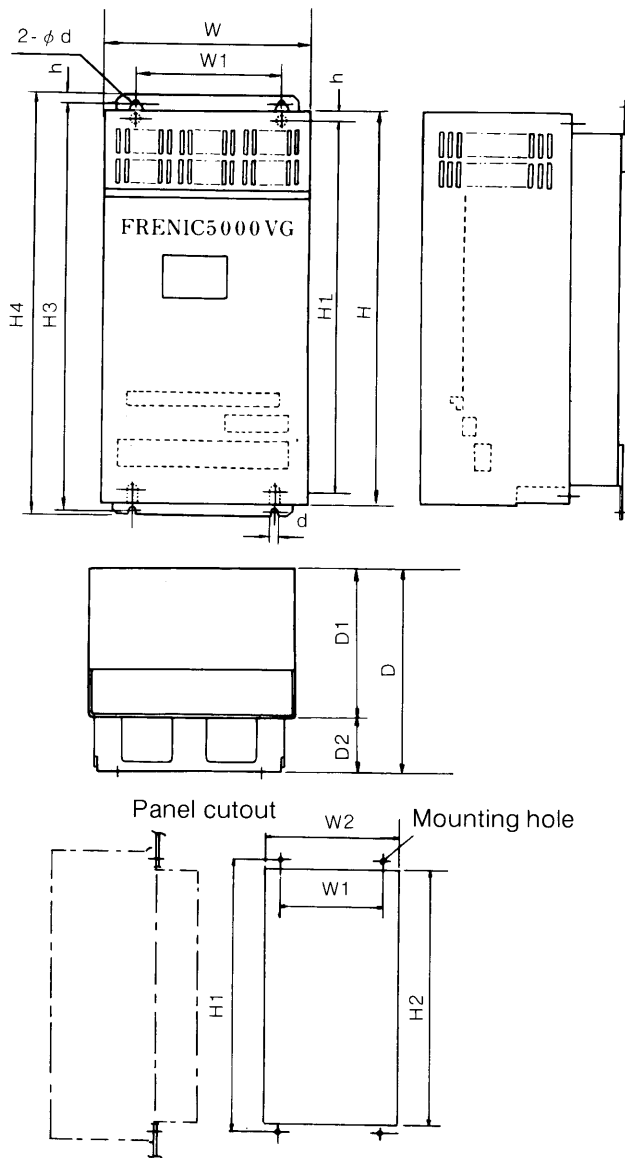
3-5 Table for Recommended Main Circuit Equipment and Electric Wiring

Drive unit type		FRN003 VG-4	FRN005 VG-4	FRN007 VG-4	FRN011 VG-4	FRN015 VG-4	FRN018 VG-4	FRN022 VG-4	FRN030 VG-4	FRN037 VG-4	FRN045 VG-4	FRN055 VG-4	FRN075 VG-4	
Applied motor [kW]		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	
Main circuit device	MCCB	SA33 /15	SA33 /30	SA33 /30	SA53 /40	SA53 /50	SA63 /60	SA103K /75	SA103K /100	SA103K /100	SA203K /125	SA203K /150	SA203K /200	
	Magnetic contactor	SRCa3631-05	SRCa3631-05	SRCa3631-5-1N	SC-1N	SC-2S	SC-2SN	SC-2SN	SC-3N	SC-4N	SC-5N	SC-6N	SC-7N	
Transformer for motor Cooling fan	Voltage	1. The primary voltage should be determined depend on the line voltage(400~460V). 2. Secondary voltage: 200(50Hz), 220V(60Hz)												
	Capacity required	1 ϕ , 70VA or more			3 ϕ , 190VA or more				3 ϕ , 320VA or more			3 ϕ , 800VA or more		
Main circuit	Applied electric wire [mm ²] ★1	R. S. T. U. V. W.	3.5	3.5	5.5	8	14	14	22	★2 38	38	60	100	100
		DC1, DC2	—	—	—	—	—	—	22	★2 38	38	60	100	100
		DB1, DB2 (5%ED)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	8	8	14	14	22
	Terminal screw	R. S. T. U. V. W.	M4		M5		M6			M8		ϕ 9	ϕ 10	
		DC1, DC2	Only the DC2 terminal is attached (DC2 will be optional terminals.)				optional terminals		M6		M8		ϕ 9	ϕ 10
		DB1, DB2	M4		M5		M6			M8		ϕ 9	ϕ 10	
Motor fan, etc. ★4	RO, SO, TO, E, FU, FV, FW	Applied electric wire	3.5mm ² ★5											
	Terminal screw	M3.5										M4		
PC board terminal	Applied electric wire	1.25mm ² ★3												
	Terminal screw	M3												
DBR unit (5%ED)		M4						M5			M5			
Braking unit		—											M6	

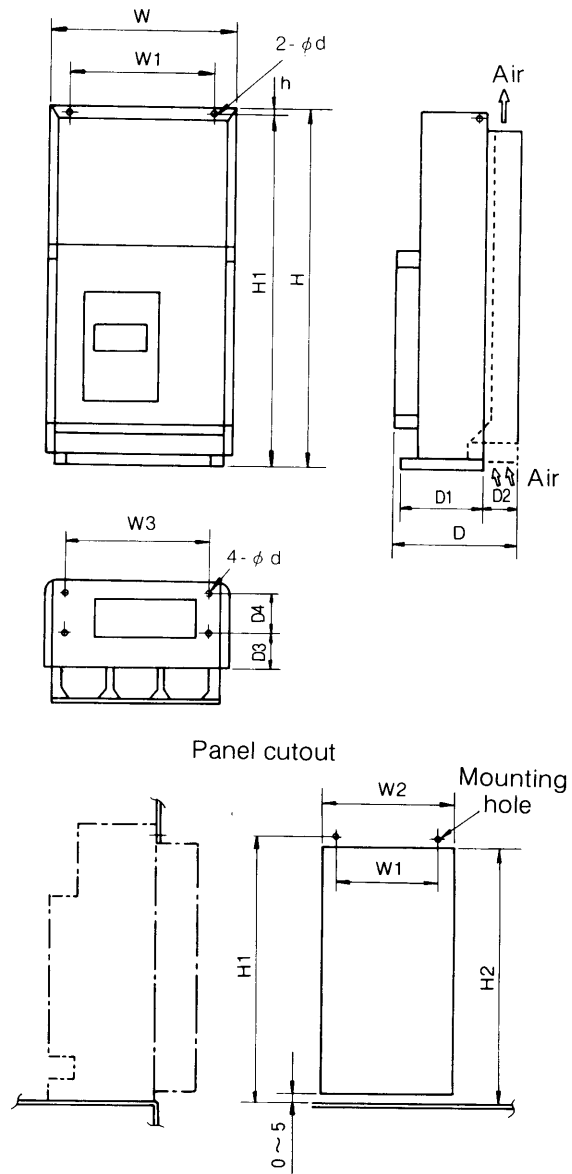
- ★1 The size indicated in this table is that of the electric wire of a 600V polyvinyl chloride wire.
- ★2 Use the crimp terminal which width is smaller than the regular one for the 6mm terminal.
- ★3 For the shielded wiring parts of the pulse generator for speed detection, NTC thermistor and analog meter, use 2mm² of (CVVS).
- ★4 Terminals SO, FU, FV and FW are not provided for the driving units 55kW or more.
- ★5 Use the crimp terminal which width is smaller than the regular one for the 3.5mm terminal.

3-6 Dimensions of Drive Unit

For motor output 3.7 to 45kW



For motor output 55 and 75kW



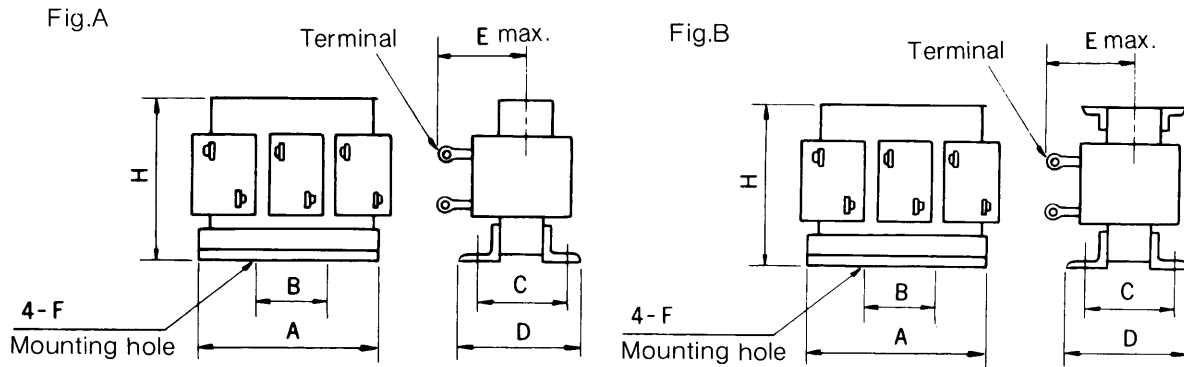
Motor output [kW]	Type	Dimensions [mm]															Mounting screw	Weight [kg]	
		W	W1	W2	W3	H	H1	H2	H3	H4	h	D	D1	D2	D3	D4			d
3.7	FRN003VG-4	240	180	230	—	550	530	510	570	590	12	295	225	70	—	—	10	M8	20
5.5	FRN005VG-4																		
7.5	FRN007VG-4	350	280	335	—	600	580	560	620	640	12	340	240	100	—	—	10	M8	35
11	FRN011VG-4																		
15	FRN015VG-4	420	280	405	—	700	670	650	730	760	15	360	260	100	—	—	12	M10	50
18.5	FRN018VG-4																		
22	FRN022VG-4																		
30	FRN030VG-4	420	280	405	—	800	770	750	830	860	15	360	260	100	—	—	12	M10	65
37	FRN037VG-4	500	380	475	—	900	870	845	930	960	18	370	260	100	—	—	15	M12	85
45	FRN045VG-4																		
55	FRN055VG-4	580	450	550	490	1150	1125	1110	—	—	25	410	240	112	95	120	15	M12	110
75	FRN075VG-4	730	600	700	640	1150	1125	1110	—	—	25	415	268	112	110	120	15	M12	150

3-7 Line side AC Reactor

(1) Connection

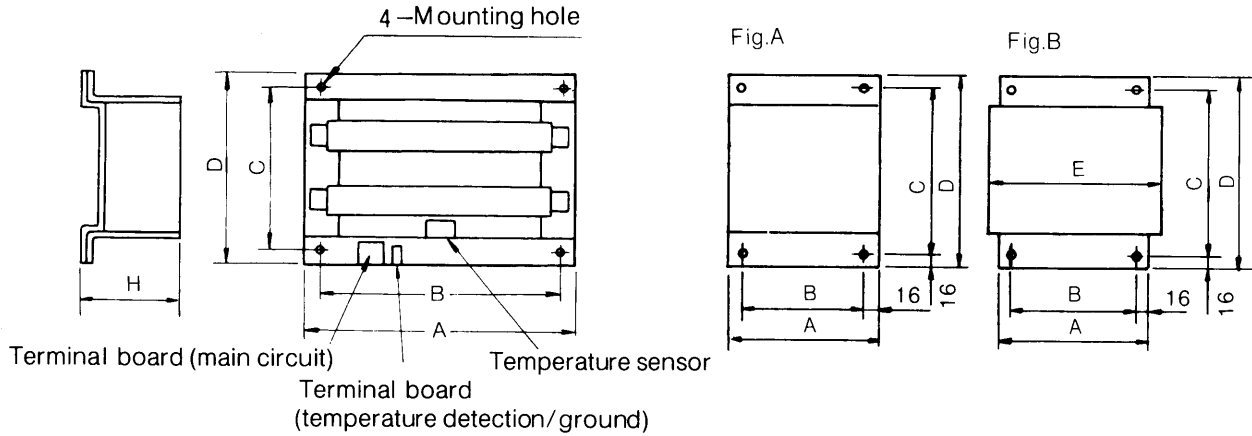
Connect the unit referring to the connection diagram in Section 3-2.

(2) Dimensions



Motor output [kW]	Type	Fig. NO.	Dimensions [mm ²]							Terminal screw	Weight [kg]
			A	B	C	D	E	F	H		
3.7	ACR4-5.5	A	120	65	70	90	98	6×10	93	M6	3
5.5											
7.5	ACR4-7.5	A	120	65	80	96	98	6×10	93	M6	4
11	ACR4-22	A	180	60	75	96	102	7×11	170	M6	8
15											
18.5											
22											
30	ACR4-37	A	190	60	90	120	170	7×10	190	M8	11
37											
45	ACR4-55	B	190	60	90	120	200	7×10	190	M10	12
55											
75	ACR4-75	B	190	60	90	120	200	7×10	190	M12	12

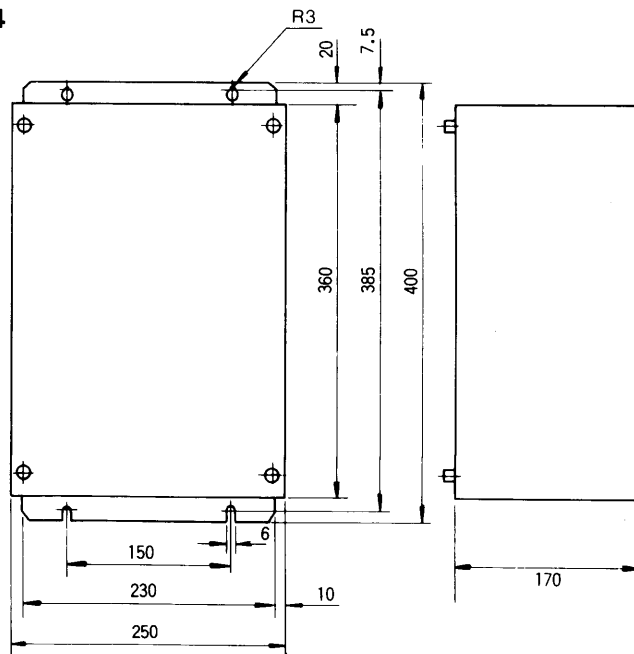
3-8 Braking Resistor Unit



	Motor output [kW]	Type	Specification		Dimensions [mm]						Mounting hole	Terminal screw		Weight [kg]	Fig. NO.	Quantity
			Capacity [kW]	Resistance [Ω]	A	B	E	D	C	H		Main circuit	Temperature detection / ground			
Standard unit (5%ED)	3.7	DB003V-41	0.8	96	420	388	—	280	248	140	$\phi 8$	M4	M4	5	A	1
	5.5	DB005V-41	1.2	64	420	388	—	480	448	140	$\phi 10$					
	7.5	DB007V-41	1.8	48												
	11	DB011V-41	2.4	32												
	15	DB015V-41	3.6	24	420	388	—	660	628	140	$\phi 10$	M5	M4	11	A	
	18.5	DB018V-41	3.6	18												
	22	DB022V-41	4.8	16	420	388	—	660	628	240	$\phi 10$					
	30	DB030V-41	6.0	10												
	37	DB037V-41	7.2	9	420	388	425	750	718	240	$\phi 10$	M5	M4	20	A	
	45	DB045V-41	9.6	8	420	388	425	750	718	340	$\phi 10$					
	55	DBH037-4	4.8×2	12/2	420	388	—	660	628	240	$\phi 10$					
	75	DBH045-4	6×2	10/2												

3-9 Braking Unit (for Motor output 55kW and 75kW)

Type:BU110-4

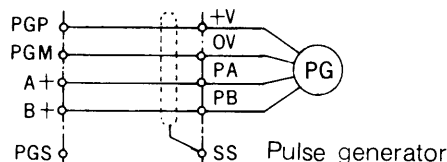


4. TRIAL RUN

4-1 Preparation for Operation

Before performing a trial run, carry out the following:

- (1) Check that the input AC satisfies the rating. (3 ϕ , 400/400V to 460V, 50/60 Hz)
- (2) Check that the input terminals and output terminals 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.

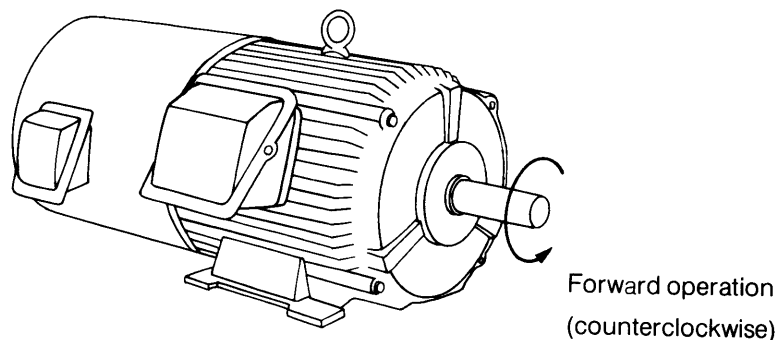


- (4) Make sure that the wiring of the main circuit and control circuit is not grounded or short circuit.
- (5) Check that no matter such as a piece of metal or electric wiring has fallen in the panel or has become attached to it.
- (6) Check the action of external sequence circuit.

4-2 Trial Run

For safety, separate the coupling or belt that connects the motor and machine so that the motor can be operated independently. If you operate the motor which 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. (The control circuit and the sequence circuit become active.) Wait a while, and check that there is no abnormality (such as heat, smoke, foreign 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 clockwise 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.



- (5) If a forward operation command and reverse operation command are input at the same time, the motor stops with regenerative braking. Please take care.
- (6) Increase the 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 5-2.
- (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."

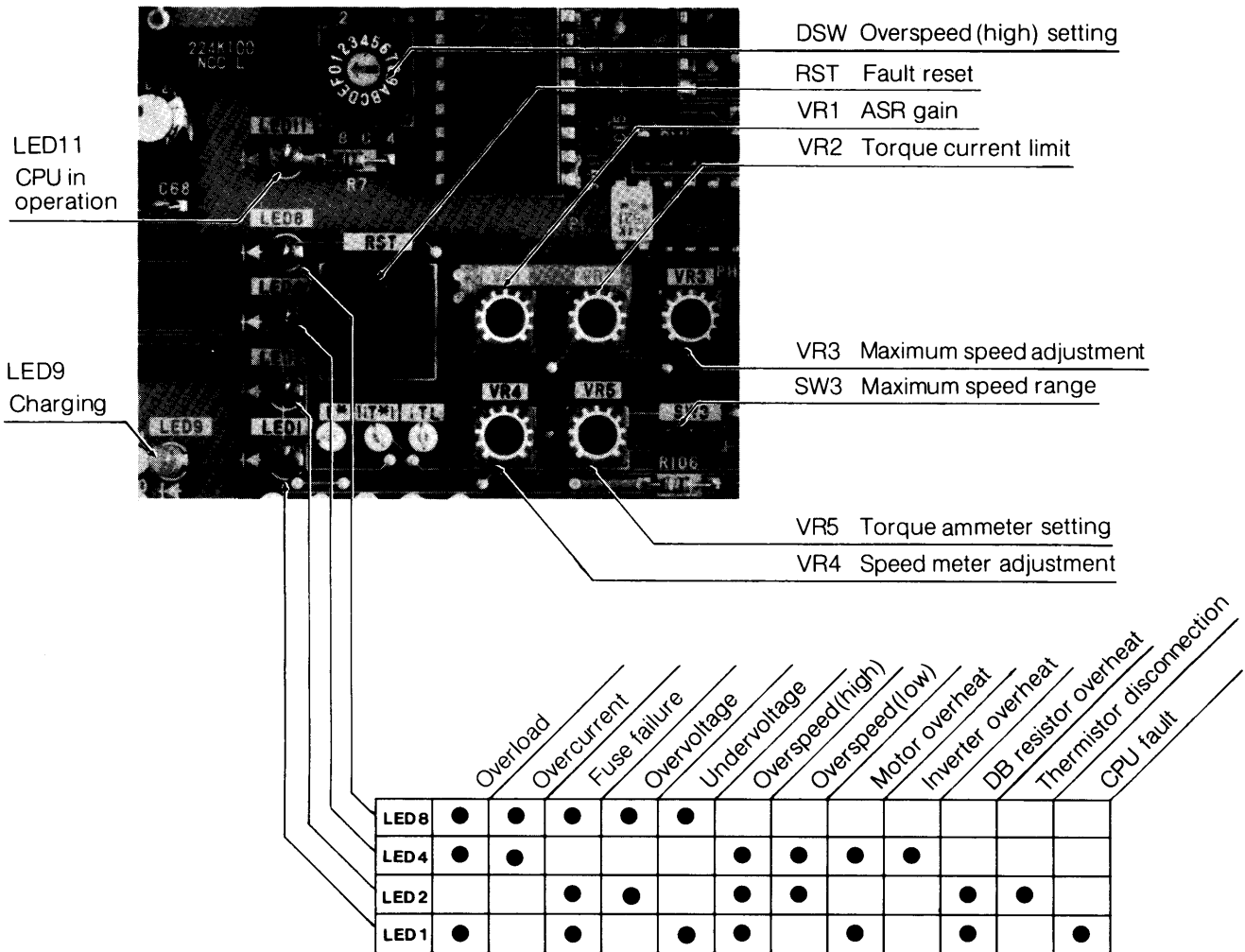
5. ADJUSTMENT AND CHECKS

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

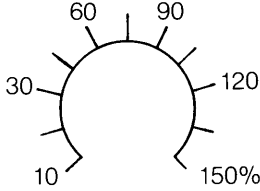
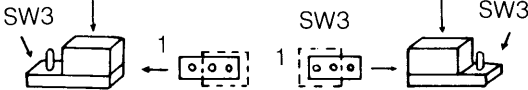
No adjustment is usually required for parts other than those printed on the unit cover. However, if adjustments are required due to a change in operational conditions, note the following.

- (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 counterclockwise 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: <div style="text-align: center; margin: 10px 0;">  </div>	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 (B) For 2300 to 3600 rpm Set the right end (factory setting). Set the strapping plug at the left end. Strapping plug Strapping plug 	VR3: Set to 1500 rpm for 10V setting SW3: Strapping plug to be set at the right end

Adjustment point symbol	Name	Adjustment procedure	Factory adjustment value												
V R 3 S W 3	Maximum speed adjustment (continued)	<p>(A) When the maximum speed of the motor is changed in the range from 1500 rpm to 2300 rpm.</p> <ol style="list-style-type: none"> 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. <p>(B) When the maximum speed of the motor is changed in the range from 2300 rpm to 3600 rpm (Note that the maximum speed is 3000rpm for 30kW, 37kW and 45kW motors and is 2400rpm for 55kW and 75kW motors.</p> <ol style="list-style-type: none"> 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. <p>Note: The motor speed can be measured by the two methods shown below:</p> <ol style="list-style-type: none"> 1) Measure the motor speed directly by using a 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 border="1" data-bbox="472 1216 1225 1435" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Motor speed</th> <th style="width: 25%;">1500 rpm</th> <th style="width: 25%;">3000 rpm</th> <th style="width: 25%;">3600 rpm</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>When the motor speed is N rpm, the pulse frequency and pulse interval are determined by the following formulas:</p> $\text{Pulse frequency } f \text{ [kHz]} = 12.8[\text{kHz}] \times \frac{N[\text{rpm}]}{1500[\text{rpm}]}$ $\text{Pulse interval } T[\mu\text{S}] = \frac{1000}{12.8} \times \frac{1500[\text{rpm}]}{N[\text{rpm}]}$	Motor speed	1500 rpm	3000 rpm	3600 rpm	Pulse frequency	12.8kHz	25.6kHz	30.7kHz	Pulse interval	78.1 μ S	39.1 μ S	32.6 μ S	
Motor speed	1500 rpm	3000 rpm	3600 rpm												
Pulse frequency	12.8kHz	25.6kHz	30.7kHz												
Pulse interval	78.1 μ S	39.1 μ S	32.6 μ S												
V R 4	Adjustment of speed meter level	<ol style="list-style-type: none"> 1. Run the motor at maximum speed. 2. Adjust so that the pointer of the speed meter indicates the full scale value. The pointer of meter increases in the clockwise direction. 	10 V \pm 2% between SM+ and SM- at maximum speed												

Adjustment point symbol	Name	Adjustment procedure	Factory adjustment value																																										
V R 5	Adjustment of torque ammeter level	<ol style="list-style-type: none"> The level between LM+ and LM- is set to $\pm 10 V \pm 5\%$ by the $\pm 150\%$ torque command at the factory. When a torque ammeter with the overscale is used, adjust the counterclockwise direction to align with that scale. 																																											
S W 3	Changeover of maximum speed range	Setting depends on the maximum speed range. See the item for the maximum speed adjustment (VR3 and SW3)																																											
D S W	Overspeed (high) setting	<ol style="list-style-type: none"> Setting depends on the maximum speed. Before the adjustment of the maximum speed, turn power off and change the notch, then turn power on again. The notch and maximum speed are listed below: 	Notch 0																																										
		<table border="1"> <thead> <tr> <th>Notch</th> <th>Maximum speed</th> <th>Notch</th> <th>Maximum speed</th> <th>Notch</th> <th>Maximum speed</th> </tr> </thead> <tbody> <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> </tbody> </table>		Notch	Maximum speed	Notch	Maximum speed	Notch	Maximum speed	0	1500~ 1580 rpm	6	2070~ 2200 rpm	C	2900~ 3060 rpm	1	1580~ 1680	7	2200~ 2310	D	3060~ 3230	2	1680~ 1770	8	2310~ 2450	E	3230~ 3420	3	1770~ 1860	9	2450~ 2590	F	3420~ 3600	4	1860~ 1970	A	2590~ 2740			5	1970~ 2070	B	2740~ 2900		
		Notch		Maximum speed	Notch	Maximum speed	Notch	Maximum speed																																					
		0		1500~ 1580 rpm	6	2070~ 2200 rpm	C	2900~ 3060 rpm																																					
		1		1580~ 1680	7	2200~ 2310	D	3060~ 3230																																					
		2		1680~ 1770	8	2310~ 2450	E	3230~ 3420																																					
		3		1770~ 1860	9	2450~ 2590	F	3420~ 3600																																					
		4		1860~ 1970	A	2590~ 2740																																							
5	1970~ 2070	B	2740~ 2900																																										
R S T	Fault reset	<ol style="list-style-type: none"> Reset the fault display. 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. If there are two or more faults, the first fault is displayed. When the RST button 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. Before resetting the fault display, always record the content of a fault. 																																											

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 occur, 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	Magnetic contactor Relay	Once a year	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Whether there is abnormality such as decoloration, foreign odor, and so on. • Whether there are any dits of metal or wiring. 	Replace defective parts after checking.
3	Unit cooling fan	Once a week	<ul style="list-style-type: none"> • Whether power is supplied to the fan and it turns powerfully. • Whether an abnormal noise is heard from the bearing part. 	Replace the fan
4	Terminals and connectors	Once a year or one year and half	<ul style="list-style-type: none"> • Whether there is looseness 	Retighten them

Remarks:

If a lot of dust is found inside the drive unit, remove it with an electric vacuum cleaner.

6-2 Fault Diagnostics

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 fault 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.

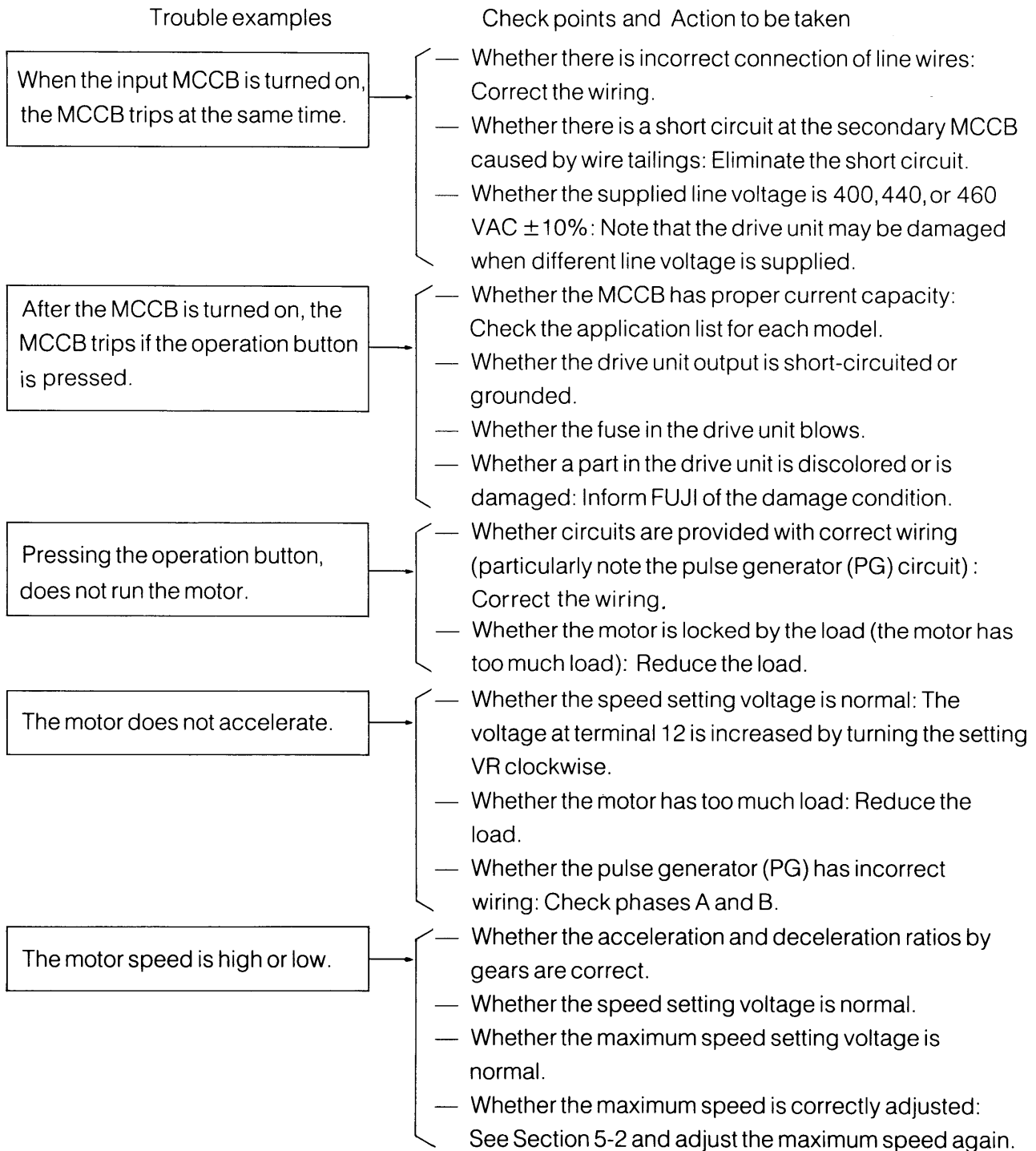
Fault display code				Contents of fault	Check point	Action to be taken
LED8	LED4	LED2	LED1			
○	○		○	Overload	Whether the motor runs at overload	Reduce the motor load.
					Whether the motor runs in the open-phase operation	Check wiring between the drive unit and the motor.
○	○			Over-current	Whether there is a short circuit between the drive and the motor.	Eliminate the short circuit.
○		○	○	Fuse failure		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 360V or less for 15 ms or more, when another motor in the same power system was started.
	○	○	○	Overspeed (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 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 the unit is 50°C or more.	When the temperature of the unit housing panel is high, cool the panel.
		○	○	DB resistor overheat	Whether the motor is accelerated or decelerated frequently	The standard specification of the braking resistor (DB resistor) is 5%ED. If the DB resistor is overheated by frequent 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 thermistor in the motor is disconnection, a backup spare thermistor built-in the motor could be used. Contact FUJI in this case.
			○	CPU fault	Whether the drive unit is installed in a location where generated excessive noise.	Install the drive unit from the noise source or eliminate the noise.

NB: Mark ○ shows lighting on condition of LEDs.

Notes:

1. When one of the protection display lamps shown above goes on and the protective function is performed, the motor stops with free running and the abnormality warning relay 30 operates. To rerun the motor, take appropriate action listed above (to get rid of 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 get rid of 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 of Trouble and Action to be Taken



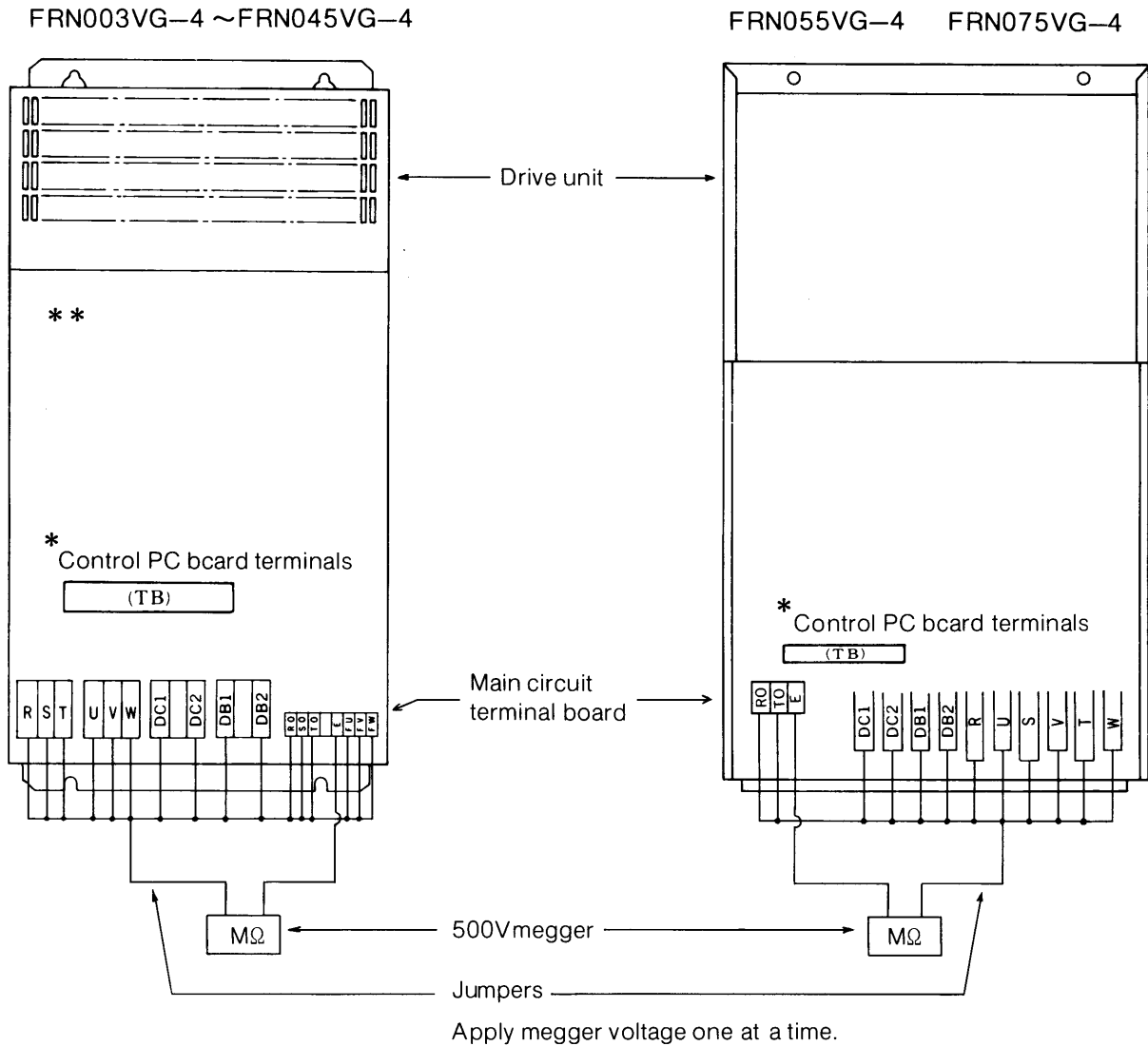
Trouble examples

Check points and Action to be taken

Unstable speed during operation.	<ul style="list-style-type: none"> — 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.	<ul style="list-style-type: none"> — 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.	<ul style="list-style-type: none"> — Whether a part in the drive unit is discolored or is damaged: Transistor or diode is probably damaged. Contact FUJI. — Whether the temperature in the panel is normal: Provide the panel with ventilation holes when the temperature in the panel is abnormal. — 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 of the MCCB other than the drive unit.
The motor does not stop when the stop button is pressed.	<ul style="list-style-type: none"> — Whether there is incorrect wiring in the external sequence circuit: Correct the 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 500VDC megger.
- Do not perform an insulation resistance test for the control circuit terminals (control PC board terminals).
- Disconnect jumpers after testing.



* All terminals of the control PC board are electronic circuits.

Do not perform an insulation resistance test on them

* * Main circuit terminal array is the case of FRN037VG-4 or FRN045VG-4.

* 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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