VARISPEED-656RC5
INSTRUCTION MANUAL

POWER REGENERATIVE UNIT (VS-656RC5)

MODEL: CIMR-R5U ☐, CIMR-R5A ☐

200V CLASS 3.7 to 37kW
400V CLASS 3.7 to 75kW

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

YASKAWA

MANUAL NO. TOE-S656-3D

PREFACE

YASKAWA's VS-656RC5 is a power regenerative unit which has both braking and regenerative functions. This instruction manual describes installation, maintenance and inspection, troubleshooting, and specifications of the VS-656RC5. Read this instruction manual thoroughly before operation.

YASKAWA ELECTRIC CORPORATION

General Precautions

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

SAFETY INFORMATION

Read this instruction manual thoroughly before installation, operation, maintenance or inspection of the VS-656RC5. In this manual, NOTES FOR SAFE OPERATION are classified as “WARNING” or “CAUTION.”

⚠ WARNING

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

⚠ CAUTION

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

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

NOTE : These are steps to be taken to insure proper operation.

NOTES FOR SAFE OPERATION

RECEIVING

⚠ CAUTION

(Ref. page)

- Do not install or operate any power regenerative unit which is damaged or has missing parts.
  Failure to observe this caution may result in personal injury or equipment damage. 12

INSTALLATION

⚠ CAUTION

(Ref. page)

- Lift the cabinet by the base. When moving the unit, never lift by the front cover or the front panel.
  Otherwise, the main unit may be dropped causing damage to the unit. 14
- Mount the power regenerative unit on nonflammable material (i.e. metal).
  Failure to observe this caution can result in a fire. 14
- When mounting units in an enclosure, install a fan or other cooling device to keep the intake air temperature below 45°C.
  Overheating may cause a fire or damage to the unit. 14

WIRING

⚠ WARNING

(Ref. page)

- Only commence wiring after verifying that the power supply is turned OFF.
  Failure to observe this warning can result in an electric shock or a fire. 21
- Wiring should be performed only by qualified personnel.
  Failure to observe this warning can result in an electric shock or a fire. 21
- Make sure to ground the ground terminal ⏚ before connecting the other terminals.
  Failure to observe this warning can result in an electric shock or a fire. 21

⚠ CAUTION

(Ref. page)

- Verify that the power regenerative unit rated voltage coincides with the AC power supply voltage.
  Failure to observe this caution can result in personal injury or a fire. 21
- Do not perform a withstand voltage test of the power regenerative unit.
  It may cause semi-conductor elements to be damaged. 21
- Connect the power coordinating reactor and the power suppressing reactor as described in this instruction manual.
  Improper connection may cause a fire. 21
- Verify that the rated voltage of the power regenerative unit coincides with the rated voltage of the power regenerative unit to be connected.
  Failure to observe this caution can result in a fire. 21
- Tighten terminal screws.
  Failure to observe this caution can result in a fire. 21

OPERATION

⚠ WARNING

(Ref. page)

- Only turn ON the input power supply after replacing the front cover or the terminal cover. Do not remove the cover while current is flowing.
  Failure to observe this warning can result in an electric shock. 34
- Never operate the digital operator or other switches when your hand is wet.
  Failure to observe this warning can result in an electric shock. 34
- Never touch the terminals while current is flowing, even if the power regenerative unit stops.
  Failure to observe this warning can result in an electric shock. 34

⚠ CAUTION

(Ref. page)

- Never touch the heatsink or input reactor since the temperature is very high.
  Failure to observe this caution can result in harmful burns to the body. 34
- All the constants of the power regenerative unit have been preset at the factory. Do not change the settings unnecessarily.
  The power regenerative unit may be damaged. 34

MAINTENANCE AND INSPECTION

⚠ WARNING

(Ref. page)

- Never touch high-voltage terminals in the power regenerative unit.
  Failure to observe this warning can result in an electric shock. 41
- Perform maintenance or inspection only after verifying that the CHARGE LED goes OFF, after the main circuit power supply is turned OFF.
  The capacitors are still charged and can be dangerous. 41
- Only authorized personnel should be permitted to perform maintenance, inspections or parts replacement.
  [Remove all metal objects (watches, bracelets, etc.) before operation.]
  (Use tools which are insulated against electric shock.)
  Failure to observe this warning can result in an electric shock. 41
- Never modify the product.
  Failure to observe this warning can result in an electric shock or personal injury and will invalidate the guarantee.

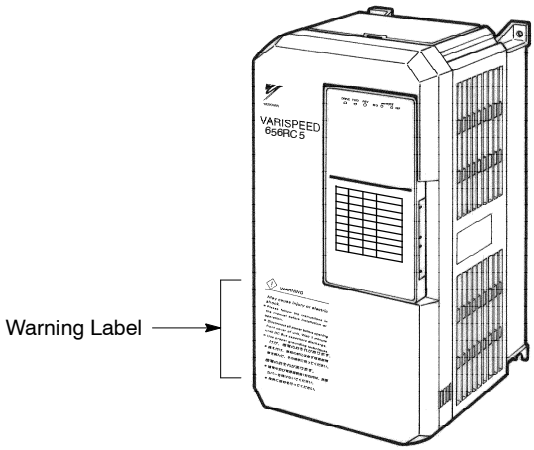
⚠ CAUTION

(Ref. page)

- The power regenerative unit employs semi-conductor elements. Do not touch the CMOS elements.
  They are easily damaged by static electricity. 41
- Do not connect or disconnect wires or connectors while power is applied to the circuit.
  Failure to observe this caution can result in personal injury. 41

WARNING LABEL

A warning label is displayed on the front cover of the power regenerative unit, as shown below. Follow these instructions when handling the power regenerative unit.



Model CIMR-R5A23P7

Warning Label

⚠ WARNING - Risk of electric shock.
• Read manual before installing. • Wait 5 minutes for capacitor discharge after disconnecting power supply. • To conform to CE requirements, make sure to ground the supply neutral.
⚠ AVERTISSEMENT - Risque de décharge électrique
• Lisez le manuel avant installation. • Attendez 5 minutes après la coupure de l' alimentation électrique afin que les condensateurs soient complètement décharges. • Assurez vous de connecter a la masse le fil du neutre afin d' être en accord avec la règlementation CE .
⚠ 危　険　　- けが・感電のおそれがあります。
・据え付け、運転の前には必ず取扱説明書をお読み下さい。 ・通電中及び電源遮断後5分以内は表面カバーを外さないでください。 ・電源の中性点を接地して下さい。(CE 対応)

CONTENTS

1 RECEIVING

⚠ CAUTION
• Do not install or operate any power regenerative unit which is damaged or has missing parts. Failure to observe this caution may result in personal injury or equipment damage.

This chapter describes how to verify the VS-656RC5 after delivery to the user.

1.1 INSPECTION CHECKPOINTS

(1) Receiving Checkpoints

Table 1 Checkpoints

Checkpoints	Description
Does the power regenerative unit model number correspond with the purchase order?	Check the model number on the nameplate on the side of the VS-656RC5. (Refer to page 13.)
Are any parts damaged?	Visually check the exterior and verify that there was no damage during transport.
Is hardware properly seated and securely tightened?	Remove the front cover of the power regenerative unit. Check all visible hardware with appropriate tools.

If any of the above checkpoints are not satisfactory, contact your YASKAWA representative.

(2) Checking the Nameplate Data

(a) Nameplate Data

Example of standard domestic model CIMR-R5U23P7

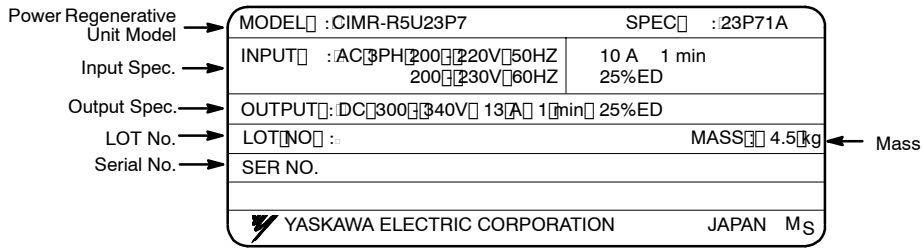


Fig.1 Nameplate Data

(b) Model Designation

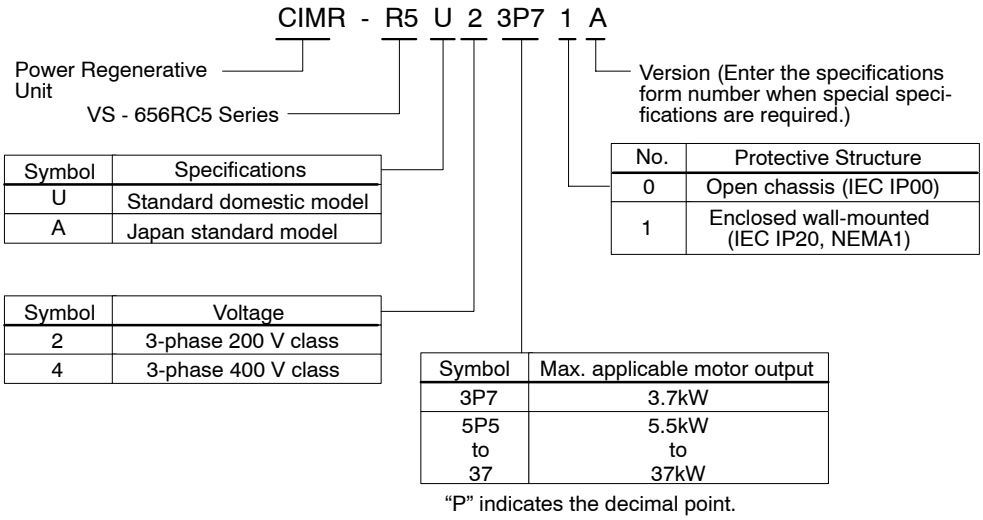


Fig.2 Model Designation

(c) Protective Structure

- Open Chassis Type (IEC IP00)
  Protected so that parts of the human body cannot reach electrically charged parts from the front when the Power regenerative unit is mounted in a control panel.

- Enclosed Wall-mounted Type (IEC IP20, NEMA 1)
  The power regenerative unit is structured so that the power regenerative unit is shielded from the exterior, and can thus be mounted to the interior wall of a standard building (not necessarily enclosed in a control panel). The protective structure conforms to the standards of NEMA 1 in the USA.

2 INSTALLATION

⚠ CAUTION
• Lift the cabinet by the base. When moving the unit, never lift by the front cover or the front panel. Otherwise, the main unit may be dropped causing damage to the unit. • Mount the power regenerative unit on nonflammable material (i.e. metal). Failure to observe this caution can result in a fire. • When mounting units in an enclosure, install a fan or other cooling device to keep the intake air temperature below 45°C. Overheating may cause a fire or damage to the unit.

This chapter describes the configuration, location and space when mounting the VS-656RC5.

2.1 CHECKING INSTALLATION SITE

(1) Installation Site

Install the power regenerative unit under the following conditions.

Type	Ambient Operating Temperature	Humidity
Enclosed wall-mounted	–10 to + 40 °C	90 % RH or less (no condensation)
Open chassis	–10 to + 45 °C	90 % RH or less (no condensation)

Protection covers are attached to the top and bottom of the power regenerative unit. Be sure to remove the protection covers before installing a 200 or 400 V Class power regenerative unit with an output of 30 kW or less in a panel.

To ensure proper performance and long operating life, follow the recommendations below when choosing a location for installing the VS-656RC5. Make sure the power regenerative unit is protected from the following conditions:

☐ Extreme cold and heat.
Use only within ambient temperature range: –10°C to +40°C
☐ Rain, moisture. (For enclosed wall-mounted type)
☐ Oil sprays, splashes
☐ Salt spray.
☐ Direct sunlight. (Avoid using outdoors.)
☐ Corrosive gases or liquids.
☐ Dust or metallic particles in the air. (For enclosed wall-mounted type)
☐ Physical shock, vibration.
☐ Magnetic noise. (Example: welding machines, power devices, etc.)
☐ High humidity.
☐ Radioactive materials.
☐ Combustibles: thinners, solvents, etc.

(2) Controlling the Ambient Temperature

To enhance the reliability of operation, the power regenerative unit should be installed in an environment free from extreme temperature increases. If the power regenerative unit is installed in an enclosed environment, such as a box, use a cooling fan or air conditioner to maintain the internal air temperature below 45°C.

(3) Protecting the Power Regenerative Unit from Foreign Matter

Place a cover over the power regenerative unit during installation to shield it from metal power produced by drilling.

Always remove the cover from the power regenerative unit after completing installation. Otherwise, ventilation will be reduced, causing the power regenerative unit to overheat.

2.2 CLEARANCES

Install the VS-656RC5 vertically and allow sufficient clearances for effective cooling as shown in Fig. 3.

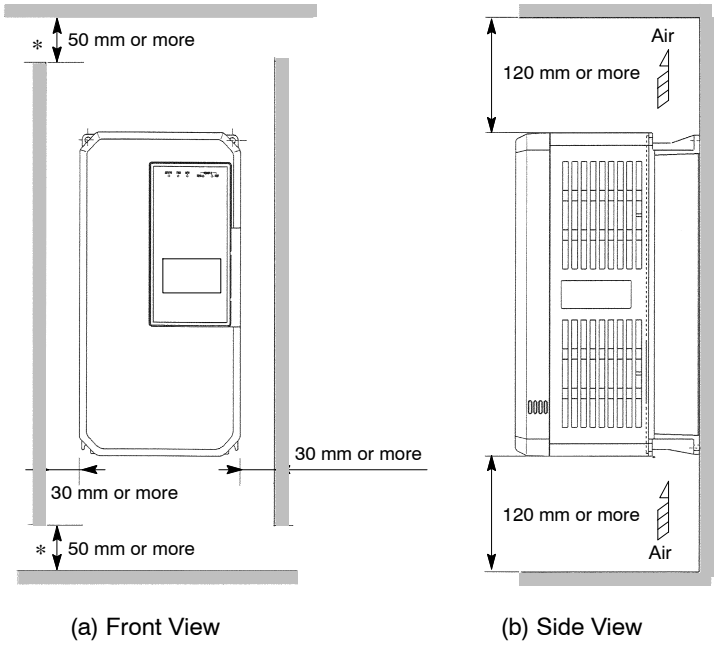


Fig.3 Clearances

NOTE

1. The clearances required at top/bottom and both sides are common in open chassis type (IP00) and enclosed wall-mounted type (NEMA 1).
2. Remove the top and bottom covers to use the open chassis type of 200 V/ 400 V 30 kW or less.
3. When installing the models of 200 V/400 V 37 kW or more equipped with eyebolts, extra spacing will be required on either side. For detailed dimensions, contact your YASKAWA representative.
4. Ensure sufficient space for the sections at the upper and lower parts marked with * in order to permit the flow of intake/exhaust air to/from the inverter.

2.3 DIMENSIONS (mm)

(1) Models of 200 V/400 V 30 kW and Lower

The following figure shows a 200 V 3.7 kW model. Use open chassis type 200 V/400 V 30 kW and lower with the top and bottom covers removed.

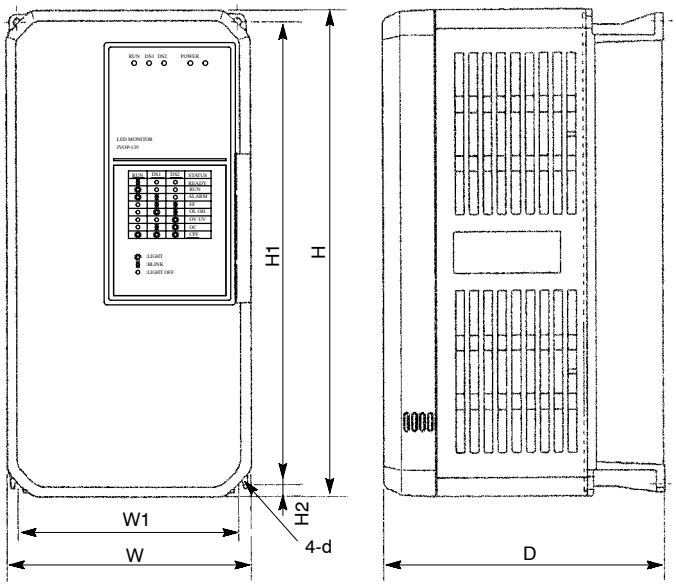


Fig.4 Dimensions of VS-656RC5

(2) Models of 200 V/400 V 37 kW and Higher

The following figure shows a 200 V 37 kW model.

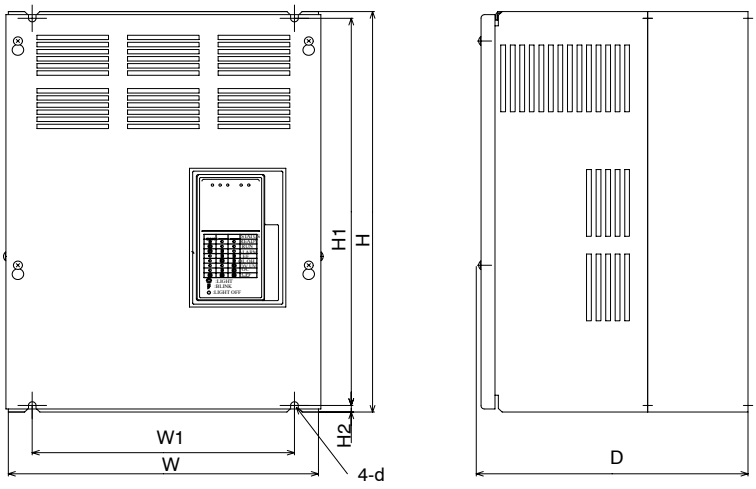


Table 2 VS-656RC5 Dimensions (mm) and Approx. mass (kg)

Voltage	VS-656RC5 CIMR-R5U□	Open Chassis Type (IP00)							Enclosed wall-mounted (IP20)							Mounting Hole d
		Dimensions (mm)			Mounting Dimension (mm)			Approx. Mass (kg)	Dimensions (mm)			Mounting Dimension mm)			Approx. Mass (kg)	
		W	H	D	W1	H1	H2		W	H	D	W1	H1	H2		
200V Class	23P7	140	280	180	126	266	7.0	4.5	140	280	180	126	266	7.0	4.5	M5
	25P5															
	27P5															
	2011	200	300	205	186	285	8.0	5.5	200	300	205	186	285	8.0	5.5	M6
	2015							6							6	
	2018	250	380	225	236	365	7.5	10	250	380	225	236	365	7.5	10	M6
	2022															
	2030							11		400				27.5	11	
	2037	325	450	285	275	435	7.5	23	330	610	285	275	435	87.5	27	M6
400V Class	43P7	140	280	180	126	266	7.0	3.5	140	280	180	126	266	7.0	3.5	M5
	45P5							4							4	
	47P5															
	4011	200	300	205	186	285	8.0	6	200	300	205	186	285	8.0	6	M6
	4015															
	4018	250	380	225	236	365	7.5	10.5	250	380	225	236	365	7.5	10.5	M6
	4022															
	4030															
	4037	325	450	285	275	435	7.5	25	330	610	285	275	435	87.5	28	M6
	4045							26							29	
	4055	325	625	285	275	610	7.5	34	330	785	285	275	610	87.5	38	M6
	4075							36		850				152.5	40	

2.4 REMOVING AND REPLACING THE FRONT COVER

To remove the front cover, first move the LED monitor/digital operator in the direction shown by arrow 1. Then squeeze the cover in the direction shown by arrows 2 on both sides and lift in the direction shown by arrow 3.

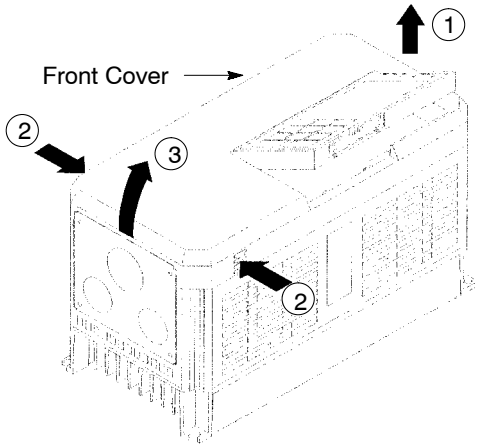


Fig.5 Removing and Replacing the Front Cover

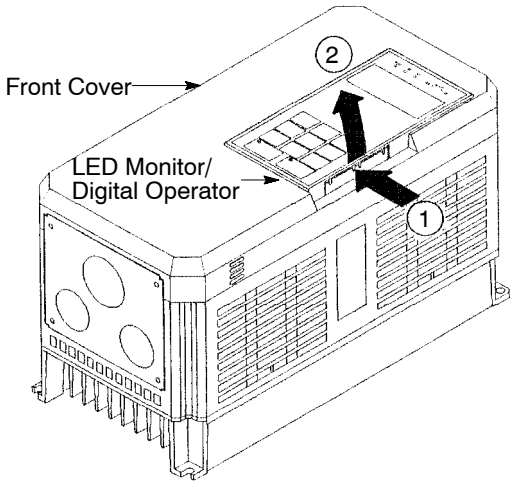
NOTE

Do not replace the front cover with the LED monitor/digital operator connected. The LED monitor/digital operator will not be connected to the power regenerative unit. Replace the front cover first and then install the LED monitor/digital operator on the cover. See Par. 2.5 for replacing the LED monitor/digital operator.

2.5 REMOVING AND REPLACING THE LED MONITOR/DIGITAL OPERATOR

Remove and replace the LED monitor/digital operator as follows.

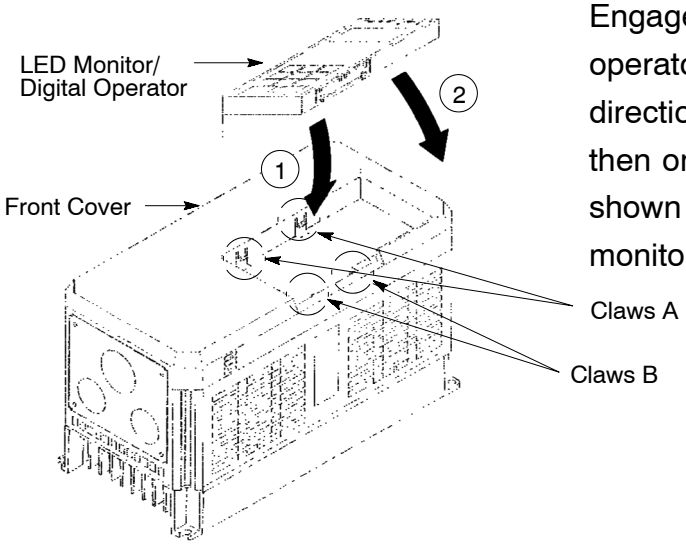
(1) Removing the LED Monitor/Digital Operator



Push the LED monitor/digital operator lever in the direction shown by arrow 1 and lift the LED monitor/digital operator in the direction shown by arrow 2 to remove the LED monitor/ digital operator from the front cover.

Fig.6 Removing the LED Monitor/Digital Operator

(2) Replacing the LED Monitor/Digital Operator



Engage the LED monitor/digital operator on claws A in the direction shown by arrow 1 and then on claws B in the direction shown by arrow 2 to lock the LED monitor/digital operator.

Fig.7 Replacing the LED Monitor/Digital Operator

NOTE

Never fit the LED monitor/digital operator in any other direction or by any other method.
The LED monitor/digital operator will not be connected to the inverter.

3 WIRING

⚠ WARNING

- Only commence wiring after verifying that the power supply is turned OFF.
  Failure to observe this warning can result in an electric shock or a fire.
- Wiring should be performed only by qualified personnel.
  Failure to observe this warning can result in an electric shock or a fire.
- Make sure to ground the ground terminal ⏚ before connecting the other terminals.
  Failure to observe this warning can result in an electric shock or a fire.

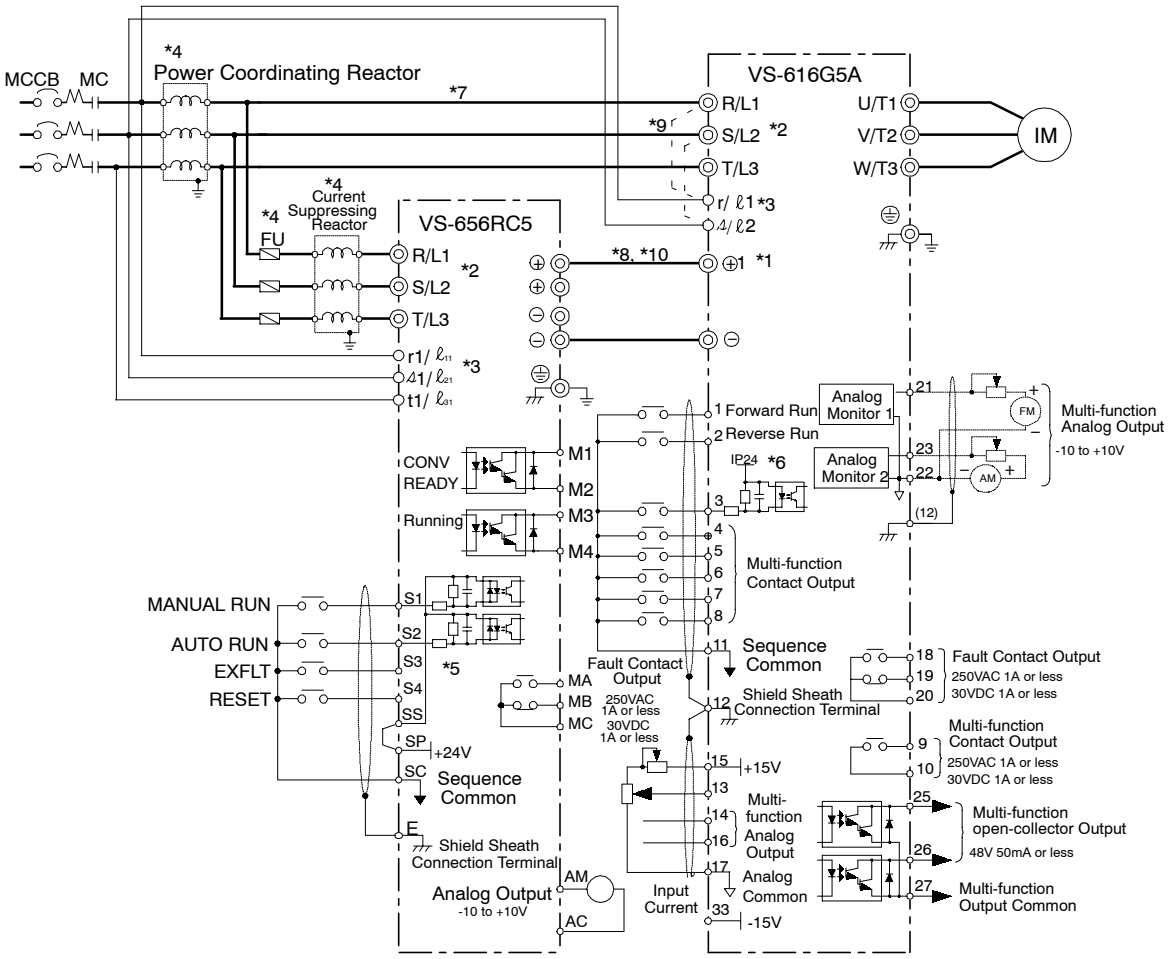
⚠ CAUTION

- Verify that the power regenerative unit rated voltage coincides with the AC power supply voltage.
  Failure to observe this caution can result in personal injury or a fire.
- Do not perform a withstand voltage test of the power regenerative unit.
  It may cause semi-conductor elements to be damaged.
- Connect the power coordinating reactor and the power suppressing reactor as described in this instruction manual.
  Improper connection may cause a fire.
- Verify that the rated voltage of the power regenerative unit coincides with the rated voltage of the power regenerative unit to be connected.
  Failure to observe this caution can result in a fire.
- Tighten terminal screws.
  Failure to observe this caution can result in a fire.

3.1 CONNECTION DIAGRAM

(1) Connection Diagram with Inverter

Fig.8 shows a diagram of a typical connection of the VS-656RC5 with the VS-616G5.



* 1 Connect to the terminal ⊕1 for 200 V class 0.4 to 22 kW, and 400 V class 0.4 to 45 kW VS-616G5 inverters. Use terminal ⊕3 for 200 V class 30 to 37 kW, and 400 V class 55 to 75 kW VS-616G5 inverters.

* 2 Connect VS-616G5 AC power supply terminals R/L1, S/L2, and T/L3 to the secondary side of the power coordinating reactor. Connect VS-656RC5 AC power supply terminals R/L1, S/L2, and T/L3 to the secondary side of the power suppressing reactor.

* 3 Connect terminals r/ℓ1, ⊿/ℓ2 of VS-616G5, and terminals r1/ℓ11, ⊿1/ℓ21, and t1/ℓ31 of VS-656RC5 to the primary side of the power coordinating reactor.

* 4 Make sure to use the specified reactor, fuse and fuse holder.

* 5 The sequence input terminal of VS-656RC5 is the same as terminal S1.

* 6 The circuit for the sequence input terminal of VS-616G5 is the same as that of terminal 3 of VS-656RC5.

* 7 The wiring distance between the power coordinating reactor and VS-616G5/VS-656RC5 should be 10 m or less.

* 8 DC bus wiring (⊕1 – ⊕, ⊖ – ⊖) between the Inverter and the power regenerative unit should be 5 m or less.

* 9 Remove the wiring of terminals r/ℓ1 and ⊿/ℓ2 since they were connected at the factory.

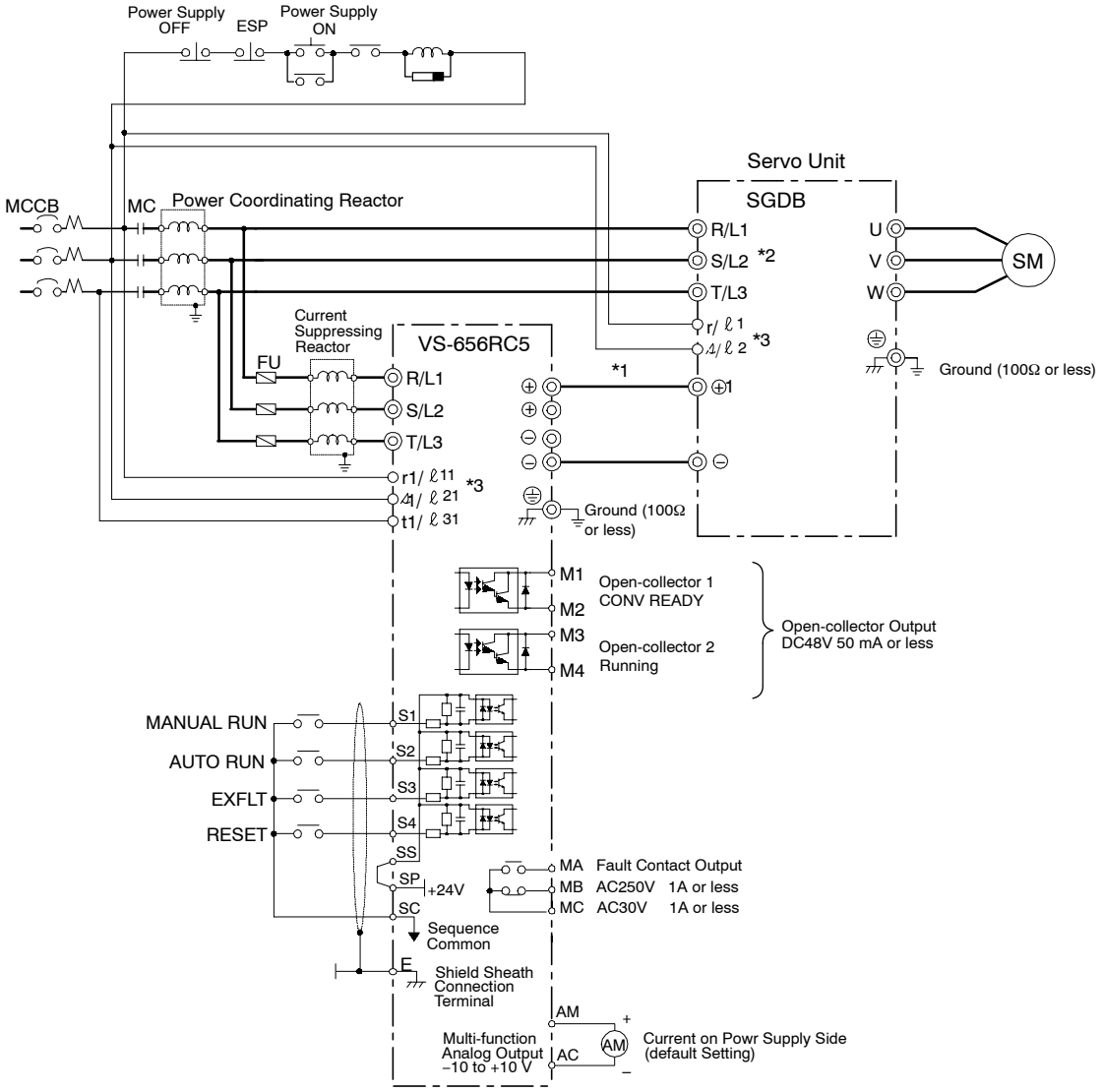
* 10 If installing a circuit breaker or a magnetic contactor on the VS-656RC5 output (DC) side to shut down the power supply in an emergency, observe the following precautions.

- Be sure to confirm that the charge lamps on the VS-656RC5 and the Inverter are not lit, and then turn on the circuit breaker or contactor. If the circuit breaker or contactor is turned on while power is supplied to the VS-656RC5 and the Inverter, an overcurrent may occur and damage the circuit breaker or contactor.
- Be sure to confirm that the circuit breaker or contactor is turned on before the power is turned on for the VS-656RC5.

Fig.8 Connection Diagram (When connecting a VS-656RC5 and a VS-616G5)

(2) Connection Diagram with Servo

Fig.9 shows a diagram of a typical connection of the VS-656RC5 with the Σ-series SGDB Servopack.



Note: 1. The Servopack SVON signal and the power regenerative converter signal, MANUAL RUN or AUTO RUN, should be turned off at the same time when the emergency stop SW (ESP) is turned off.

2. Wire the VS-656RC5 and the SGDB so that the RY relay and the main circuit power supply turn off when an alarm occurs in the Servopack or the power regenerative converter.

* 1 The DC bus wiring (⊕1 – ⊕, ⊖ – ⊖) between the Servo unit and the power regenerative unit should be 5m or less.

* 2 Connect the Servo unit's AC power supply terminals R/L1, S/L2, and T/L3 to the secondary side of the power coordinating reactor.

* 3 Connect terminals r/ℓ1, ⊿ℓ2 on the Servo unit and terminals r1/ℓ11, ⊿1/ℓ21, and t1/ℓ31 on the VS-656RC5 to the primary side of the power coordinating reactor.

Fig.9 Connection Diagram (When connecting a VS-656RC5 and Σ series SGDB Servopack)

3.2 CONNECTING MAIN AND CONTROL CIRCUITS

(1) Main Circuit Input Fuse

Connet a fuse at the primary side of the power suppressing reactor. Recommended fuses are shown in Tables 3 and 4.

Table 3 200 V Class Input Fuse

VS-656RC5			Input fuse			Fuse holder		
Model CIMR-R5U□	Rated re-generative capacity (kW) 25%ED	Rated input current (Aac) 25%ED	Model	Code No.	Amount per unit	Model	Code No.	Amount per unit
23P7	3.7	10	CR2LS-20/UL	FU000799	3	CM-1A	FU002014	1
25P5	5.5	15	CR2LS-30/UL	FU000791	3	CM-1A	FU002014	1
27P5	7.5	20	CR2LS-30/UL	FU000791	3	CM-1A	FU002014	1
2011	11	30	CR2LS-50/UL	FU000797	3	CM-1A	FU002014	1
2015	15	40	CR2LS-75/UL	FU000792	3	CM-1A	FU002014	1
2018	18	50	CR2LS-100/UL	FU002085	3	CM-1A	FU002014	1
2022	22	60	CR2LS-100/UL	FU002085	3	CM-1A	FU002014	1
2030	30	80	CR2LS-150/UL	FU002086	3	CM-2A	FU002090	1
2037	37	100	CR2LS-150/UL	FU002086	3	CM-2A	FU002090	1

Note: These fuses and fuse holders are made by FUJI ELECTRIC CO., LTD.

Table 4 400 V Class Input Fuse

VS-656RC5			Input fuse			Fuse holder		
Model CIMR-R5U□	Rated re-generative capacity (kW) 25%ED	Rated input current (Aac) 25%ED	Model	Code No.	Amount per unit	Model	Code No.	Amount per unit
43P7	3.7	5	CR6L-20/UL	FU002087	3	CMS-4	FU002091	3
45P5	5.5	7.5	CR6L-20/UL	FU002087	3	CMS-4	FU002091	3
47P5	7.5	10	CR6L-20/UL	FU002087	3	CMS-4	FU002091	3
4011	11	15	CR6L-30/UL	FU002088	3	CMS-4	FU002091	3
4015	15	20	CR6L-30/UL	FU002088	3	CMS-4	FU002091	3
4018	18	25	CR6L-50/UL	FU000935	3	CMS-4	FU002091	3
4022	22	30	CR6L-50/UL	FU000935	3	CMS-4	FU002091	3
4030	30	40	CR6L-75/UL	FU002089	3	CMS-5	FU002092	3
4037	37	50	CR6L-75/UL	FU002089	3	CMS-5	FU002092	3
4045	45	60	CR6L-100/UL	FU000927	3	CMS-5	FU002092	3
4055	55	75	CR6L-150/UL	FU000928	3	CMS-5	FU002092	3
4075	75	100	CR6L-150/UL	FU000928	3	CMS-5	FU002092	3

Note: These fuses and fuse holders are made by FUJI ELECTRIC CO., LTD.

(2) Input AC Reactor

An input 3-phase reactor corresponding to each model is necessary when operating VS-656RC5. This input AC reactor is effective against saturated current and excessive heat.

Table 5 shows the code numbers of AC reactor of each model. Check the table and use a specified AC reactor.

Table 5 AC Reactor

VS-656RC5		Power coordinating reactor			Power Suppressing Reactor		
Model CIMR-R5U□		Rated current (Arms)	Inductance (mH)	Code No.	Rated current (Arms)	Inductance (mH)	Code No.
200 V Class	23P7	20	0.53	X002491	15	0.31	X010121
	25P5	30	0.35	X002492	15	0.31	X010121
	27P5	40	0.265	X002493	20	0.15	X010122
	2011	60	0.18	X002495	40	0.1	X010123
	2015	80	0.13	X002497	40	0.1	X010123
	2018	90	0.12	X002498	50	0.06	X010124
	2022	120	0.09	X002555	60	0.05	X010125
	2030	160	0.07	X002556	80	0.04	X010126
	2037	200	0.05	X002557	100	0.03	X010127
400 V Class	43P7	10	2.2	X002500	7.5	1.2	X010128
	45P5	15	1.42	X002501	7.5	1.2	X010128
	47P5	20	1.06	X002502	10	0.6	X010129
	4011	30	0.7	X002503	15	0.4	X010130
	4015	40	0.53	X002504	25	0.3	X010131
	4018	50	0.42	X002505	25	0.3	X010131
	4022	60	0.36	X002506	30	0.2	X010132
	4030	80	0.26	X002508	40	0.15	X010133
	4037	90	0.24	X002509	50	0.12	X010134
	4045	120	0.18	X002566	60	0.1	X010135
	4055	150	0.15	X002567	75	0.08	X010136
	4075	200	0.11	X002568	100	0.06	X010137

(3) Main Circuit Surge Protector

Fig.10 shows a diagram of a typical connection of the surge protector. Recommended protectors are shown in Tables 6 and 7.

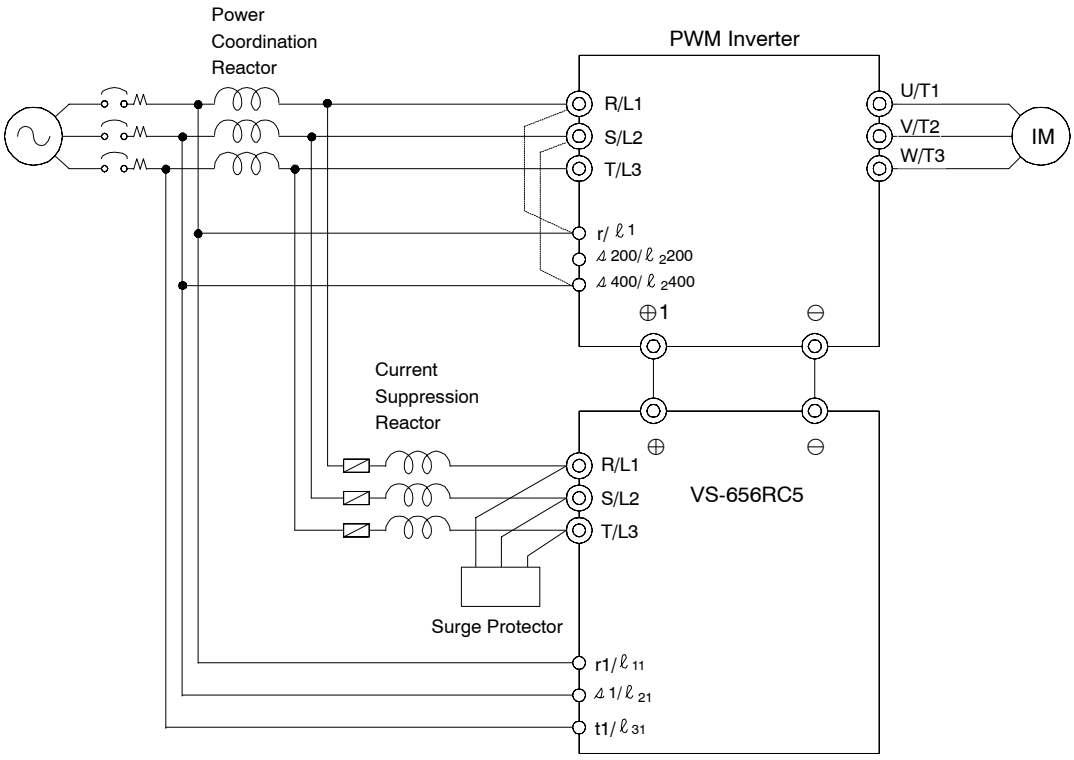


Fig.10 Connection Diagram (When connecting a surge protector)

Table 6 200 V Class Surge Protector

VS-656RC5			Surge protector			
Model CIMR-R5U□	Rated Capacity (kW) 25%ED	Rated Input Current (Aac) 25%ED	Model	Manufactured by	Code No.	Amount per unit
23P7	3.7	10	R•A • V-781BYZ-2	Okaya Electric	XX 000221	1
25P5	5.5	15	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
27P5	7.5	20	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2011	11	30	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2015	15	40	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2018	18	50	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2022	22	60	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2030	30	80	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1
2037	37	100	R • A • V-781BYZ-2	Okaya Electric	XX 000221	1

Table 7 400 V Class Surge Protector

VS-656RC5			Surge protector			
Model CIMR-R5U□	Rated Capacity (kW) 25%ED	Rated Input Current (Aac) 25%ED	Model	Manufactured by	Code No.	Amount per unit
43P7	3.7	5	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
45P5	5.5	7.5	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
47P5	7.5	10	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4011	11	15	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4015	15	20	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4018	18	25	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4022	22	30	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4030	30	40	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4037	37	50	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4045	45	60	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4055	55	75	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1
4075	75	100	R • A • V-152BYZ-2A	Okaya Electric	XX 000222	1

(4) Wiring Precautions

The external interconnection wiring must be performed with following procedures. After completing VS-656RC5 interconnections, be sure to check that the connections are correct. Never use control circuit buzzer check.

(a) Precautions on Control Circuit Wiring

- Separate control circuit wires from main circuit wires and other power cables to prevent erroneous operation caused by noise interference.
- Separate the wiring of control circuit terminals from other control terminals or main circuit wirings.
- Wiring distance should be less than 50 m.
- Insert the wire into the lower part of the terminal block and connect it tightly with a screwdriver. Wire sheath strip length must be 7 mm.

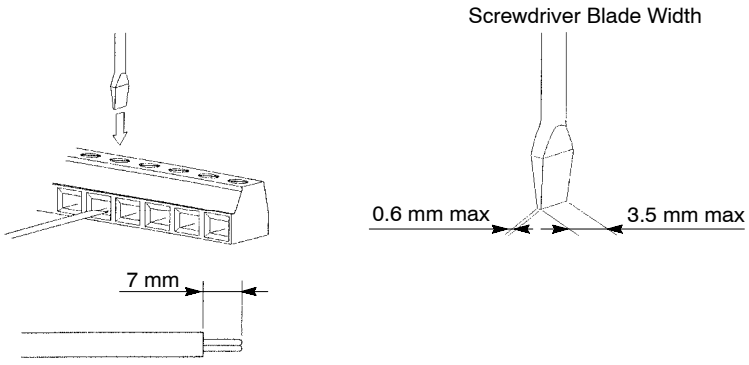


Fig.11 Control Circuit Terminal Wiring

- Use twisted shielded or twisted-pair shielded wire for the control circuit line and connect the shielded sheath to inverter terminal E. (See Fig.12)

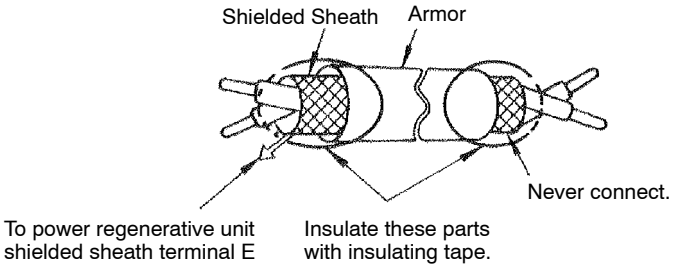


Fig.12 Shielded Wire Termination

(b) Ground Wiring

- □ Do not share the ground wire with other devices, such as welding machines or power tools. Separate the grounding cables from the wirings for power tools.
- Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire.
  Leakage current flows through the power regenerative unit. Therefore, if the distance between the ground electrode and the ground terminal is too long, potential on the ground terminal of the power regenerative unit will become unstable.
- When using more than one power regenerative unit, be careful not to loop the ground wire.

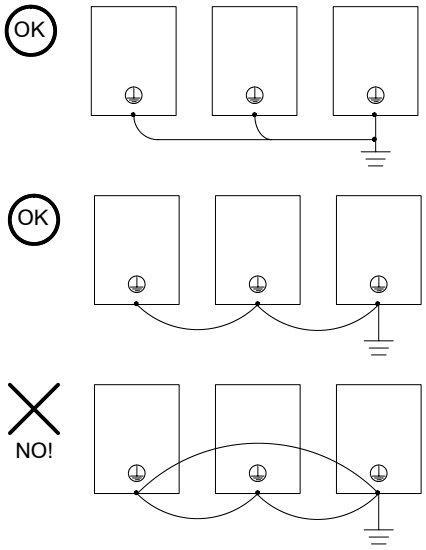


Fig.13 Ground Wiring

3.3 WIRING MAIN CIRCUIT TERMINALS

(1) Required Wire Size

Select wires to be used for wiring from Tables 8 and 9.

Table 8 200 V Class Wire Size

Circuit	VS-656RC5 CIMR-R5U□	Terminal Symbol	Terminal Screw	Wire Size*		Wire Type
				mm²	AWG	
Main	23P7	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	2 to 5.5	14 to 10	Power cable: 600 V vinyl sheathed wire or equivalent
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31				
		⏚				
	25P5	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	3.5 to 5.5	12 to 10	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31		2 to 5.5	14 to 10	
		⏚		3.5 to 5.5	12 to 10	
	27P5	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	5.5	10	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31		2 to 5.5	14 to 10	
		⏚		3.5 to 5.5	12 to 10	
	2011	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M5	8	8	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31		2 to 5.5	14 to 10	
		⏚		5.5 to 8	10 to 8	
	2015	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M5	8	8	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31		2 to 5.5	14 to 10	
		⏚		5.5 to 8	10 to 8	
	2018	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	22	4	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	2022	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	22	4	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	2030	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	30 to 38	3 to 2	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	14	6	
	2037	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	50 to 60	1 to 1/0	
		r1/ℓ11, ⍼1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	14	6	
Control	Common to all models	S1, S2, S3, S4, SS, SP, SC, M1, M2, M3, M4, MA, MB, MC, AM, AC	—	twisted wire 0.5 to 1.25 single 0.5 to 1.25	twisted wire 20 to 16 single 20 to 16	Shielded twisted-pair wires
		E (G)	M3.5	0.5 to 2	20 to 14	

Note: Cable size is selected assuming external wiring of single 3-core cables at an ambient temperature of 30°C.

* Wire size is determined by 75°C temperature-rated copper wire.

NOTE

For model number 2015, use closed-loop connectors that are recommended by JST.

Table 9 400 V Class Wire Size

Circuit	VS-656RC5 CIMR-R5U□	Terminal Symbol	Terminal Screw	Wire Size*		Wire Type
				mm²	AWG	
Main	43P7	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	2 to 5.5	14 to 10	Power cable: 600 V vinyl sheathed wire or equivalent
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31				
		⏚				
	45P5	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	2 to 5.5	14 to 10	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31				
		⏚				
	47P5	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M4	2 to 5.5	14 to 10	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31				
		⏚				
	4011	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M5	3.5 to 5.5	12 to 10	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31		**2 to 5.5**	**14 to 10**	
		⏚				
	4015	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M5	5.5	10	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31		2 to 5.5	14 to 10	
		⏚		5.5	10	
	4018	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M6	8 to 14	8 to 6	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	4022	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M6	8 to 14	8 to 6	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	4030	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M6	14	6	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	4037	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M6	14 to 22	6 to 4	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	4045	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	22 to 38	4 to 2	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	8	8	
	4055	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	38 to 60	2 to 1/0	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	14	6	
	4075	R/L1, S/L2, T/L3, ⊕1, ⊕2, ⊖1, ⊖2	M8	50 to 60	1 to 1/0	
		r1/ℓ11, ⁄1/ℓ21, t1/ℓ31	M4	2 to 5.5	14 to 10	
		⏚	M6	14	6	
Control	Common to all models	S1, S2, S3, S4, SS, SP, SC, M1, M2, M3, M4, MA, MB, MC, AM, AC	—	twisted wire 0.5 to 1.25 single 0.5 to 1.25	twisted wire 20 to 16 single 20 to 16	Shielded twisted-pair wires
		E (G)	M3.5	0.5 to 2	20 to 14	

Note: Cable size is selected assuming external wiring of single 3-core cables at an ambient temperature of 30°C.

* Wire size is determined by 75°C temperature-rated copper wire.

NOTE

For model number 4011 and 4015, use closed-loop connectors that are recommended by JST.

(2) Closed-Loop Connectors Size

Table 10 Closed Loop Connectors Sizes (JIS C 2805) (For 200 V/400 V classes)

Wire Size		Terminal Screw	Tightening Torque (N•m)	Closed Loop Connectors
mm^2	AWG			
0.5	20	M3.5 M4	0.8 to 1.0 1.2 to 1.4	1.25 to 3.5 1.25 to 4
0.75	18			
1.25	16			
2	14	M4	1.2 to 1.4	2 to 4
		M5	2.1 to 2.5	2 to 5
3.5	12	M4	1.2 to 1.4	3.5 to 4
		M5	2.1 to 2.5	3.5 to 5
5.5	10	M4	1.2 to 1.4	5.5 to 4
		M5	2.1 to 2.5	5.5 to 5
8	8	M5	2.1 to 2.5	8 to 5
		M6	3.6 to 5.1	8 to 6
14	6	M6	3.6 to 5.1	14 to 6
22	4	M8	8.2 to 10.2	22 to 8
30/38	3/2	M8	8.2 to 10.2	38 to 8
30/38	3/2	M10	18 to 23	38 to 10
50/60	1/1/0			60 to 10
80	3/0			80 to 10
100	4/0			100 to 10
100	4/0	M12	31.5 to 39.5	100 to 12
150	300			150 to 12
200	400			200 to 12

NOTE

Determine the wire size for the main circuit so that line voltage drop is within 2 % of the rated voltage. Line voltage drop is calculated as follows:
(If there is a possibility of excessive voltage drop, use a larger wire suitable to the required length.)

Line voltage drop (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}

3.4 EXTERNAL TERMINALS

(1) Main Circuit Terminal Functions

Table 11 Main Circuit Terminal Functions

Terminal Symbol		Description
R/L1 S/L2 T/L3	Power Regenerative Unit Main Circuit Input	Main circuit AC power supply terminal for the power regenerative unit.
⊕ , ⊖		Connect to the Inverter's DC power supply voltage input terminals. • Two terminals are provided for both ⊕ and ⊖.
r1/ℓ 11 s1/ℓ 21 t1/ℓ31	Power Supply Voltage Detection	Detects the phase sequence and the voltage level. • Connect to the power side of the power coordinating reactor.
	Power Input for FAN and MC	Supplies power for the cooling fan and inrush prevention MC of the power regenerative unit.

(2) Control Circuit Terminal Functions

Table 12 Control Circuit Terminal Functions

Type	No.*	Signal Input	Function	Signal Level
Sequence Input	S1	MANUAL RUN	Run when CLOSED, stops when OPEN	24 VDC 8 mA Photocoupler isolation
	S2	AUTO RUN	Auto run (regenerative operation) when CLOSED	
	S3	EXFLT	External fault when CLOSED	
	S4	RESET	Fault reset when CLOSED	
	SC	Sequence Common		
	SS	Photocoupler internal common		
	SP	Sequence +24V Power Supply		
Photocoupler Output	M1 - M2	CONV READY	Closed when power regenerative unit is READY	48 VDC 80 mA or less
	M3 - M4	RUN	CLOSE during run	
Relay Output	MA - MC MB - MC	FAULT Output (Transfer Contact)	Outputs when a fault is detected. Terminal MA-MC : Closed during fault detection Terminal MB-MC : Open during fault detection	250 VAC 1 A or less 30 VDC 1 A or less
Analog Output	AM	Input Current	5 V : 100 % of rated input current	– 10 V to + 10 VDC 2 mA or less
	AC	Analog grand		

* Indicates the terminal number of the control card.

4 OPERATION

⚠ WARNING

- Only turn ON the input power supply after replacing the front cover or the terminal cover. Do not remove the cover while current is flowing.
  Failure to observe this warning can result in an electric shock.
- Never operate the digital operator or other switches when your hand is wet.
  Failure to observe this warning can result in an electric shock.
- Never touch the terminals while current is flowing, even if the power regenerative unit stops.
  Failure to observe this warning can result in an electric shock.

⚠ CAUTION

- Never touch the heatsink or input reactor since the temperature is very high.
  Failure to observe this caution can result in harmful burns to the body.
- All the constants of the power regenerative unit have been preset at the factory. Do not change the settings unnecessarily.
  The power regenerative unit may be damaged.

4.1 CHECKPOINTS BEFORE TURNING ON THE POWER SUPPLY

Check the following before turning ON the power supply.

- Check that the power supply is of the correct voltage.
  200 V class: 200 to 230 VAC, 50/60 Hz
  400 V class: 380 to 460 VAC, 50/60 Hz
- Make sure that the power regenerative unit and the Inverter are connected correctly.
- Make sure that the phase sequence of the main circuit terminals (R/L1, S/L2, T/L3) and the power supply voltage detection terminals (r1/ℓ11, ⊿1/ℓ21, t1/ℓ31) are correct.
- Make sure that the power regenerative unit and the control device are wired correctly.
- Set the run command of the power regenerative unit and the inverter to OFF.

4.2 SETTING THE POWER SUPPLY VOLTAGE JUMPER (400 V CLASS CONVERTERS OF 37 KW OR HIGHER)

Set the power supply voltage jumper for 400 V class power regenerative unit of 37 kW or higher. Insert the jumper into the voltage connector nearest to the actual power supply voltage.

Incorrect connector setting may negatively impact the performance and credibility of the power regenerative unit.

The jumper is factory-set to 460 V when shipped. If the power supply voltage is not 460 V, use the following procedure to change the setting.

① Turn OFF the power supply switch and wait for at least five minutes before removing the front panel and setting the jumper.

② Remove the front cover.

③ Insert the jumper at the position for the voltage supplied to the power regenerative unit (see Fig.14).

④ Replace the front cover.

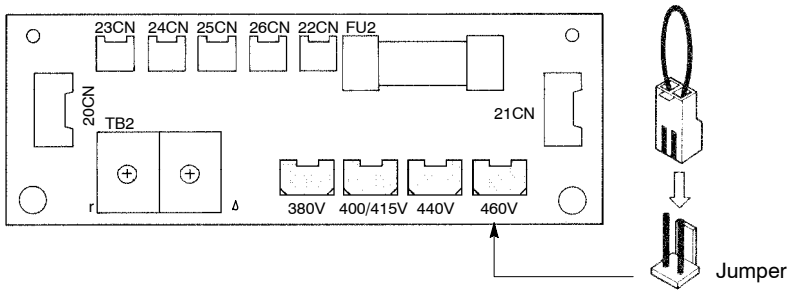


Fig.14 Setting the Power Supply Voltage (For 400 V Class Power Regenerative Unit between 37 kW and 75 kW)

4.3 CONFIRMING DISPLAY STATUS

(1) LED Monitor Display

Fig.15 shows the LED monitor of the VS-656RC5.

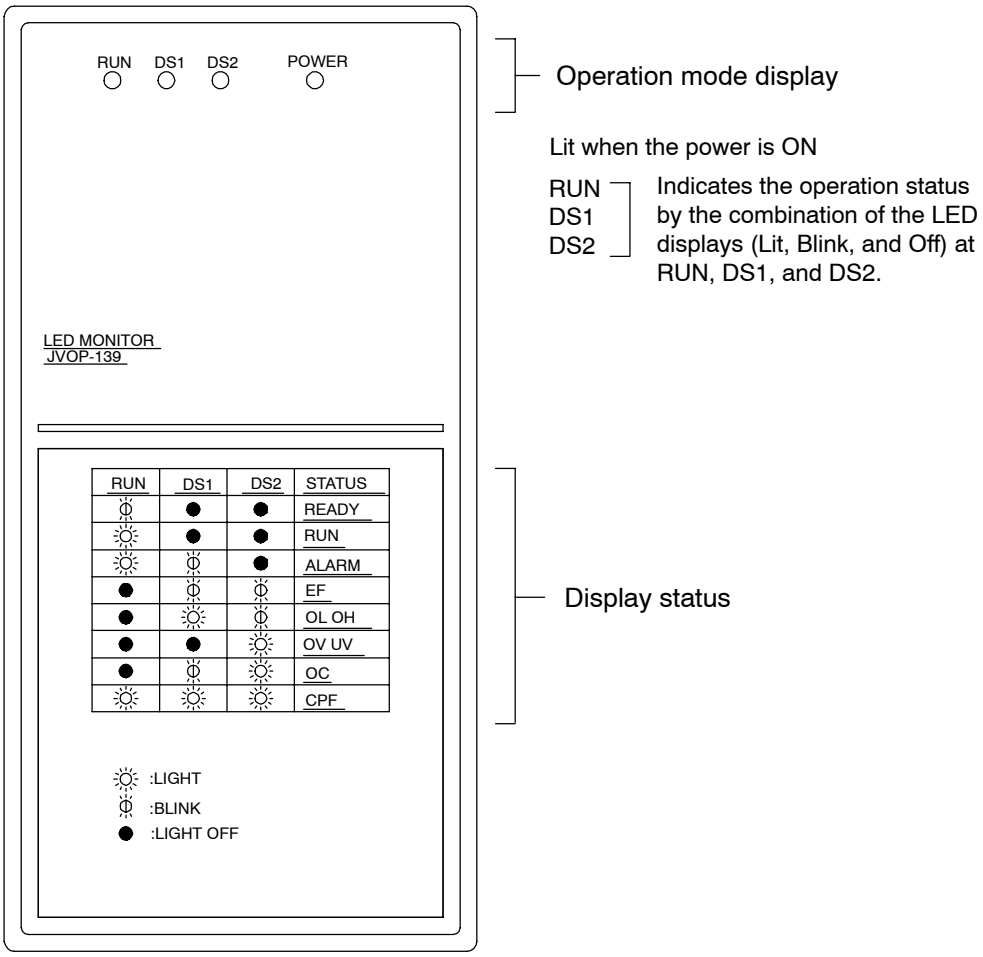
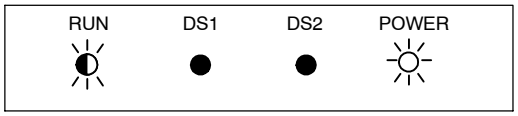


Fig.15 LED Monitor Display

(2) LED Display when the Power is ON

The following shows the LED display pattern during normal operation.

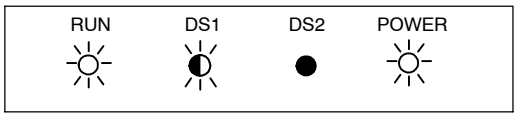
[At normal operation]



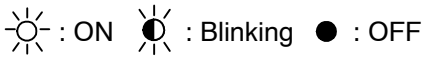
Indicates READY

The LED display pattern is different when a fault (minor fault) occurs. Below shows an example of LED display when a minor fault occurs. Refer to Chapter 6 and take appropriate countermeasures.

[At fault (monitor fault)]



Indicates a minor fault



4.4 POWER ON/OFF SEQUENCE

Refer to Fig. 16 when building a power ON/OFF sequence for the VS-656RC5.

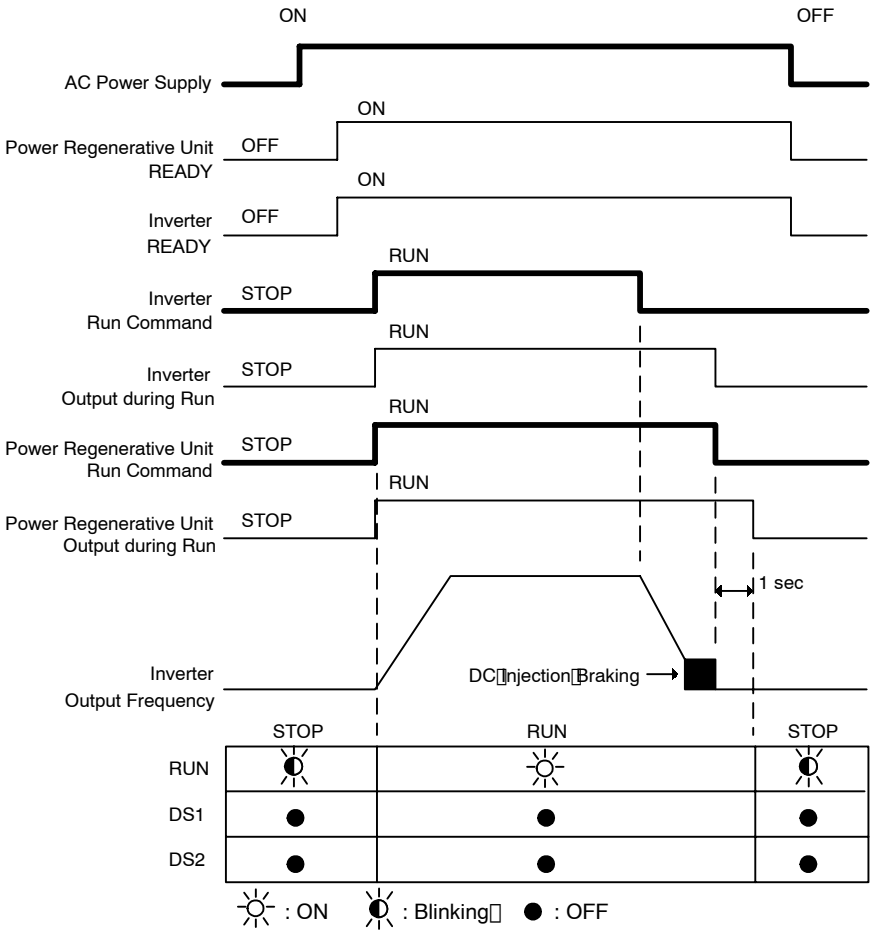


Fig.16 Power Supply ON/OFF Sequence

Check the following when using the power regenerative unit.

- Run commands of the inverter and the power regenerative unit should be turned ON after confirming that the inverter and the power regenerative unit are READY.
- Run commands of the inverter and the power regenerative unit should be turned ON at the same time.
- Never turn the run command of the power regenerative unit OFF while the inverter output during run is ON.
- Run output of the power regenerative unit turns OFF one second after the run command is turned OFF.
- Turn the power OFF after the run output of the power regenerative unit is OFF.

4.5 RUN COMMAND SELECTION

This section explains the two run command modes of the power regenerative unit. Select the mode according to the application.

(1) Auto Run

Auto run is the mode in which the power regenerative unit detects any increase/decrease of the bus voltage and performs an auto run/stop if the terminal S2-SC is “closed.”

When the DC voltage is less than the acceptable voltage set at the auto run/stop level, the motor stops after the preset time that was set at C8-20 has passed (default: 1sec).

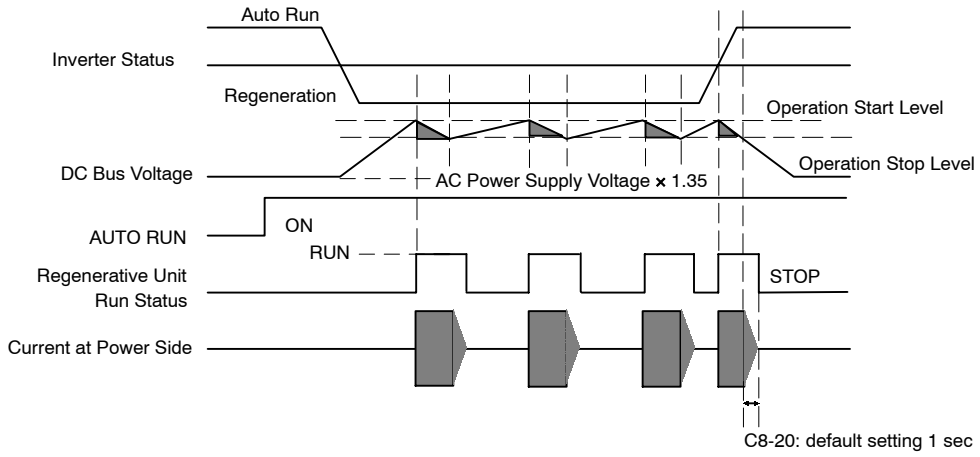


Fig.17 Timechart of the Auto Run Mode

If the motor vibrates when in AUTO RUN mode, change the mode to MANUAL RUN.

(2) Manual Run

Manual run is the mode in which the power regenerative unit starts running when the terminal S1-SC is “closed,” and stops one second after S1-SC is “open.”

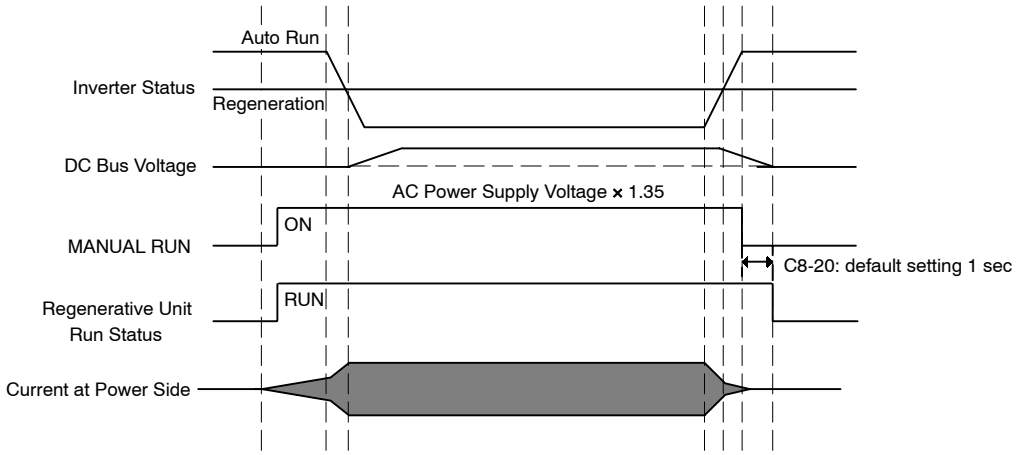


Fig.18 Timechart of the Manual Run mode

Build a sequence so that the run commands of the power regenerative unit and the inverter are turned ON at the same time.

5 MAINTENANCE AND INSPECTION

⚠ WARNING

- Never touch high-voltage terminals in the power regenerative unit.
  Failure to observe this warning can result in an electric shock.
- Perform maintenance or inspection only after verifying that the CHARGE LED goes OFF, after the main circuit power supply is turned OFF.
  The capacitors are still charged and can be dangerous.
- Only authorized personnel should be permitted to perform maintenance, inspections or parts replacement.
  [Remove all metal objects (watches, bracelets, etc.) before operation.]
  (Use tools which are insulated against electric shock.)
  Failure to observe this warning can result in an electric shock.
- Never modify the product.
  Failure to observe this warning can result in an electric shock or personal injury and will invalidate the guarantee.

⚠ CAUTION

- The power regenerative unit employs semi-conductor elements. Do not touch the CMOS elements.
  They are easily damaged by static electricity.
- Do not connect or disconnect wires or connectors while power is applied to the circuit.
  Failure to observe this caution can result in personal injury.

5.1 MAINTENANCE PERIOD

The maintenance period of the power regenerative unit is as follows.
Maintenance period: Within 18 months of shipping from the factory or within 12 months of being delivered to the final user, whichever comes first.

5.2 DAILY INSPECTION

Check the following items with the system in operation.

- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The cooling fan on the power regenerative unit should be operating normally.

5.3 PERIODIC INSPECTION

Check the following items during periodic maintenance.

Always turn OFF the power supply before beginning inspection. Confirm that the LED indicators on the front cover have all turned OFF, and then wait at least five minutes have elapsed before beginning the inspection. Be sure not to touch terminals right after the power has been turned OFF. Doing so can result in an electric shock.

Table 13 Periodic Inspections

Item	Inspection	Corrective Procedure
External terminals, mounting bolts, connectors, etc.	Are all screws and bolts tight?	Tighten loose screws and bolts firmly.
	Are connectors tight?	Reconnect the loose connectors.
Heatsink	Are the fins dirty of dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2). Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor or power regenerative unit.

5.4 PERIODIC MAINTENANCE OF PARTS

The power regenerative unit is configured of many parts, and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the power regenerative unit operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

When replacing parts, be careful not to drop any, such as screws, inside the VS-656RC5. Failure to observe this caution may result in a short-circuit and a fire.

Periodic inspection standards vary depending the installation environment and usage conditions of the power regenerative unit. The power regenerative unit's maintenance periods are noted below. Keep them as reference.

Table 14 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Braker relays	—	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

Note Usage conditions are as follows:

- Ambient temperature : Yearly average of 30°C
- Load factor : 80 % max.
- Operating rate : 12 hours max. per day

6 TROUBLESHOOTING

6.1 FAULT DETECTION

When the power regenerative unit detects a fault, the fault code is displayed on the LED monitor, the fault contact output operates.

- When a fault has occurred, refer to the following table to identify and correct the cause of the fault.
- Reset the fault after restarting the power regenerative unit by turning ON the fault reset signal or turning the main circuit power supply of and then on again.

Table 15 Fault Displays and Processing

LED				Meaning	Trouble Causes	Corrective Actions
RUN	DS1	DS2	Meaning			
●	◐	◐	EF	External Fault	An external fault was input from the contact input terminal.	• Reset the fault from the contact input terminal. • Correct the cause of the external fault.
●	☼	◐	OL	Power Regenerative Unit Input Overload Power regenerative unit input exceeded the overload capacity.	The load is too heavy.	Check the size of the load.
			OH	Heatsink Overheating The temperature of the power regenerative unit's cooling fins exceeded the factory setting.	The ambient temperature is too high.	Install a cooling unit.
					There is a heat source nearby.	Remove the heat source.
					The power regenerative unit's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
●	●	☼	UV	Main Circuit Undervoltage The main circuit DC voltage is below the undervoltage detection level. 200 V class : Approx. 190 VDC 400 V class : Approx. 380 VDC	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large.	Reset the fault after correcting its cause.
				Control Power Fault The control power supply voltage dropped.	—	• Try turning the power supply off and on. • Replace the power regenerative unit if the fault continues to occur.
				Inrush Prevention Circuit Fault A fault occurred in the inrush prevention circuit.	—	• Try turning the power supply off and on. • Replace the power regenerative unit if the fault continues to occur.

☼ : ON ◐ : Blinking ● : OFF

LED				Meaning	Trouble Causes	Corrective Actions
RUN	DS1	DS2	Meaning			
●	●	☼	UV	Input Undervoltage Input undervoltage was detected during operation. 200 V class : Approx. 150 VAC or less 400 V class : Approx 300 VAC or less Power Supply Frequency Fault Power supply frequency exceeded the power supply frequency limit (factory setting). Power Supply Phase Rotation Fault Phase rotation of the input side changed after the control power supply was turned ON.	• There is a fault to the equipment at the power side. • There is a fault to the power supply.	• Check the wiring of the equipment at the power side. • Adjust the power supply voltage.
					• The voltage detection circuit at the power side is faulty.	• Replace the control card. • Replace the power board.
			OV	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class : Approx. 400 VDC 400 V class : Approx. 800 VDC	The regenerative energy from the motor is too large.	Adjust the regenerative load.
					The power supply voltage is too high.	Decrease the voltage so it is within specifications.
					• The wiring between the voltage detection circuit at the power side (r1, ▵1, t1) and the main circuit (R, S, T) is not correct. • The wiring distance between the power regenerative unit and the AC reactor is too long.	Check the wiring.
●	◐	☼	OC	Overcurrent The input current of the power regenerative unit exceeded the overcurrent detection level. (200 % of rated current)	• A short-circuit occurred at the power regenerative output. • Power supply drop • The wiring between the voltage detection circuit at the power side (r1, ▵1, t1) and the main circuit (R, S, T) is not correct.	• Improve the power supply. • Check the wiring. • Reset the fault after correcting its cause.
☼	☼	☼	CPF	Baseblock Circuit Error EEPROM Error CPU Internal A/D Coverter Error	—	Try turning the power supply off and on.
					The control circuit is damaged.	Replace the control card.

☼ : ON ◐ : Blinking ● : OFF

6.2 MINOR FAULT DETECTION

An alarm is displayed on the LED monitor when the power generative unit detects a minor fault. Power regenerative unit automatically returns to the original status once the cause of the minor fault has been removed.

Take appropriate countermeasures according to the table below.

Table 16 Minor Fault Displays and Processing

LED Display				LED Display		Probable Causes	Corrective Actions
RUN	DS1	DS2	Meaning				
☼	◐	●	ALARM	UV	Main Circuit Undervoltage The following conditions occurred during stop. • The main circuit DC voltage was below the undervoltage detection level. • The surge current limiting contactor opened. • The control power supply is below the undervoltage detection level. • Frequency detection exceeded the allowable level. • Voltage phase rotation at the input side changed.	Refer to the UV section of the Fault Detection.	Refer to the UV section of the Fault Detection.
				OV	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level during stop. 200 V class : Approx. 400 VDC 400 V class : Approx. 800 VDC	The power supply voltage is too high.	Decrease the voltage so it is within specifications.
				OH	Heatsink Overheating The temperature of the power regenerative unit heatsink exceeded 90 % of the allowable level.	The ambient temperature is too high.	Install a cooling unit.
						There is a heat source nearby.	Remove the heat source.
						The power regenerative unit cooling fan has stopped.	Replace the cooling fan. (Contact your Yaskawa representative.)
				OL	Power Regenerative Unit Input Overload The amount of the load exceeded 80 % of the overload capacity.	The load is too heavy.	Reduce the load.
				EF	External Fault (Operation continues by the setting of the digital operator.)	An external fault was input from the contact input terminal.	• Reset the external fault from the contact input terminal. • Correct the cause of the external fault.

☼ : ON ◐ : Blinking ● : OFF

7 SPECIFICATIONS

NOTE

1. Use 1:1 with an inverter. Do not connect more than one inverter to one power regenerative unit.
2. Use the power regenerative unit whose capacity is equal to one exceeding the inverter capacity to be combined.
3. Do not use this unit with single-phase power. Use three-phase power.

Table 17 200 V Class Specifications

Model CIMR-R5U□		23P7	25P5	27P5	2011	2015	2018	2022	2030	2037
Rating	Rated Capacity kW	3.7	5.5	7.5	11	15	18.5	22	30	37
	Rated DC Current A	13	19	26	37	51	64	77	102	126
	Rated Current on Power Side A	10	15	20	30	40	50	60	80	100
	Regenerative Torque	100 % for 1 minute, 25 % ED, 80 % continuous								
Input Power Supply	Voltage Frequency	200 to 220 VAC 50 Hz, 200 to 230 VAC 60 Hz								
	Allowable Voltage Fluctuation	+10 to −15 % (Imbalance rate between phases: within 2 %)								
	Allowable Frequency Fluctuation	±3 Hz (Free phase rotation)								
Control Characteristics	Control Method	120° current conduction								
	Input Power Factor	0.9 or more (Rated current)								
	Overload Capacity	Stops in 30 seconds at approx. 150 % of rated current.								
Operation Input		External terminals								
Status Output	Fault	1C contact output								
	Running, READY Signal	Photocoupler output								
	Analog Output	Analog output: 1 point can be selected (current monitor)								
Protective Function	Instantaneous Overcurrent	Stops at approx. 200 % of the current on power side								
	Blown Fuse	Motor stops by blown fuse.								
	Overload	Stops after 30 seconds at 150 % of rated current								
	Undervoltage (DC Voltage)	Stops at approx. 190 VDC or less.								
	Undervoltage (Power Side Voltage)	Stops at approx. 150 VAC or less.								
	Overload	Stops at approx. 400 VDC or more.								
	Fin Overheat	Protected by thermister								
	Power Supply Open Phase	Stops at power supply open phase detection.								
	Power Frequency Error	Stops by fluctuation more than ± 3 Hz of rated input frequency.								
	Power Charge Indication	Indicated until main output voltage is approx. 50 V or less.								

Model CIMR-R5U□		23P7	25P5	27P5	2011	2015	2018	2022	2030	2037
Environmental Conditions	Location	Indoor (Protected from corrosive gases and dust)								
	Ambient Temperature	–10 °C to +40 °C (Enclosed wall-mounted type) –10 °C to +45 °C (Open chasis type)								
	Humidity	90 % RH or less (non-condensing)								
	Vibration	9.8 m/s^2 (1G) less than 20 Hz, up to 1.96 m/s^2 (0.2G) at 20 to 50 Hz								

* Use a power regenerative unit with larger output capacity if the imbalance rate between phases exceeds 2 %.

Imbalance rate between phases can be calculated using the following formula (Conforming to IEC1800-3).

$$\text{Imbalance rate between phases [\%]} = \frac{\text{Max. voltage - Min. voltage}}{\text{Three-phase average voltage}} \times 67$$

Table 18 400 V Class Specifications

Model CIMR-R5U□		43P7	45P5	47P5	4011	4015	4018	4022	4030	4037	4045	4055	4075
Rating	Rated Capacity kW	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
	Rated DC Current A	6	9	13	19	26	32	37	51	64	77	96	128
	Rated Current on Power Side A	5	7.5	10	15	20	25	30	40	50	60	75	100
	Regenerative Torque	100% for 1 minute, 125% ED, 80% continuous											
Input Power Supply	Voltage Frequency	380 to 460 VAC 50/60 Hz,											
	Allowable Voltage Fluctuation	+10 to –15 % (Imbalance rate between phases: within 2 %)											
	Allowable Frequency Fluctuation	±3 Hz (Free phase rotation)											
Control Characteristics	Control Method	120° current conduction											
	Input Power Factor	0.9 or more (Rated current)											
	Overload Capacity	Stops in 30 seconds at approx. 150 % of rated current.											
Operation Input		External terminals											
Status Output	Fault	1C contact output											
	Running, READY Signal	Photocoupler output											
	Analog Output	Analog output: 1 point can be selected (current monitor)											
Protective Function	Instantaneous Overcurrent	Stops at approx. 200 % of the current on power side											
	Blown Fuse	Motor stops by blown fuse.											
	Overload	Stops after 30 seconds at 150 % of rated current											
	Undervoltage (DC Voltage)	Stops at approx. 380 VDC or less.											
	Undervoltage (Power Side Voltage)	Stops at approx. 300 VAC or less.											
	Overload	Stops at approx. 800 VDC or less.											
	Fin Overheat	Protected by thermister											
	Power Supply Open Phase	Stops at power supply open phase detection.											
	Power Frequency Error	Stops by fluctuation more than ± 3 Hz of rated input frequency.											
	Power Charge Indication	Indicated until main output voltage is approx. 50 V or less.											
Environmental Conditions	Location	Indoor (Protected from corrosive gases and dust)											
	Ambient Temperature	–10 °C to +40 °C (Closed wall-mounted) –10 °C to +45 °C (Open chasis type)											
	Humidity	90 % RH or less (non-condensing)											
	Vibration	9.8 m/s^2 (1G) less than 20 Hz, up to 1.96 m/s^2 (0.2G) at 20 to 50 Hz											

* Use a power regenerative unit with larger output capacity if the imbalance rate between phases exceeds 2 %.

Imbalance rate between phases can be calculated using the following formula (Conforming to IEC1800-3).

$$\text{Imbalance rate between phases [\%]} = \frac{\text{Max. voltage - Min. voltage}}{\text{Three-phase average voltage}} \times 67$$

APPENDIX 1 OPTIONAL FUNCTIONS

1.1 USING DIGITAL OPERATOR JVOP-130

The following functions are available by using the digital operator JVOP-130.

- Starts and stops by using the RUN and STOP keys.
- Monitors the operation status of the power regenerative unit.
- Check the current fault and the fault history.
- Sets and changes constants.

1.2 MOUNTING THE DIGITAL OPERATOR

Follow the following procedure when mounting the digital operator.

① Turn the power supply OFF and wait at least five minutes.

② Remove the front cover.

③ Remove the shunt connector, SW1, from “LED” and reinsert it in “OPE.” Refer to Fig. A-1.

④ Replace the front cover.

⑤ Mount the digital operator.

Change the location of the shunt connector from “OPE” to “LED” when using a LED monitor.

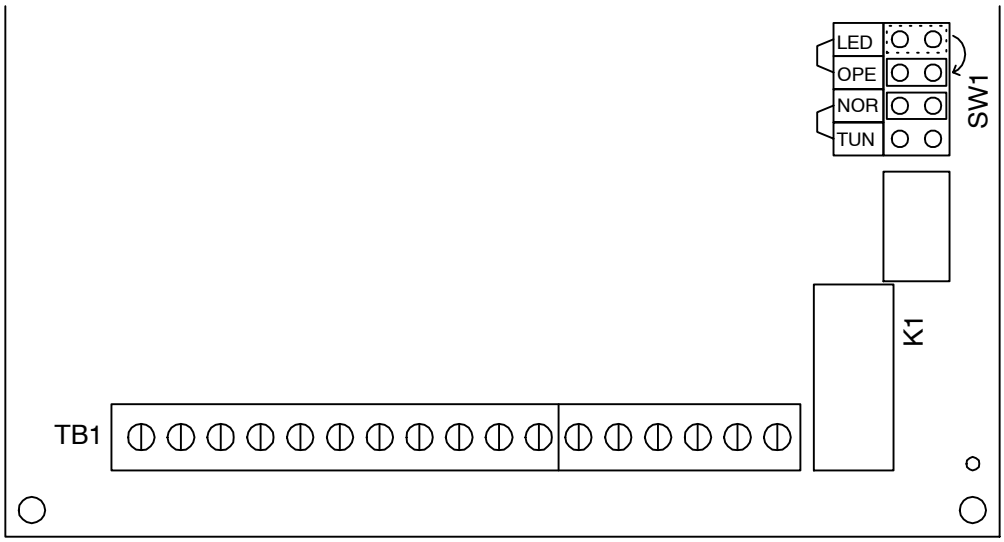


Fig. A-1 Changing the Location of the Shunt Connector

1.3 USING THE DIGITAL OPERATOR

This section describes the component names and functions of the Digital Operator. The component names and functions are shown in Fig. A-2 and Key function are described in Table A-1.

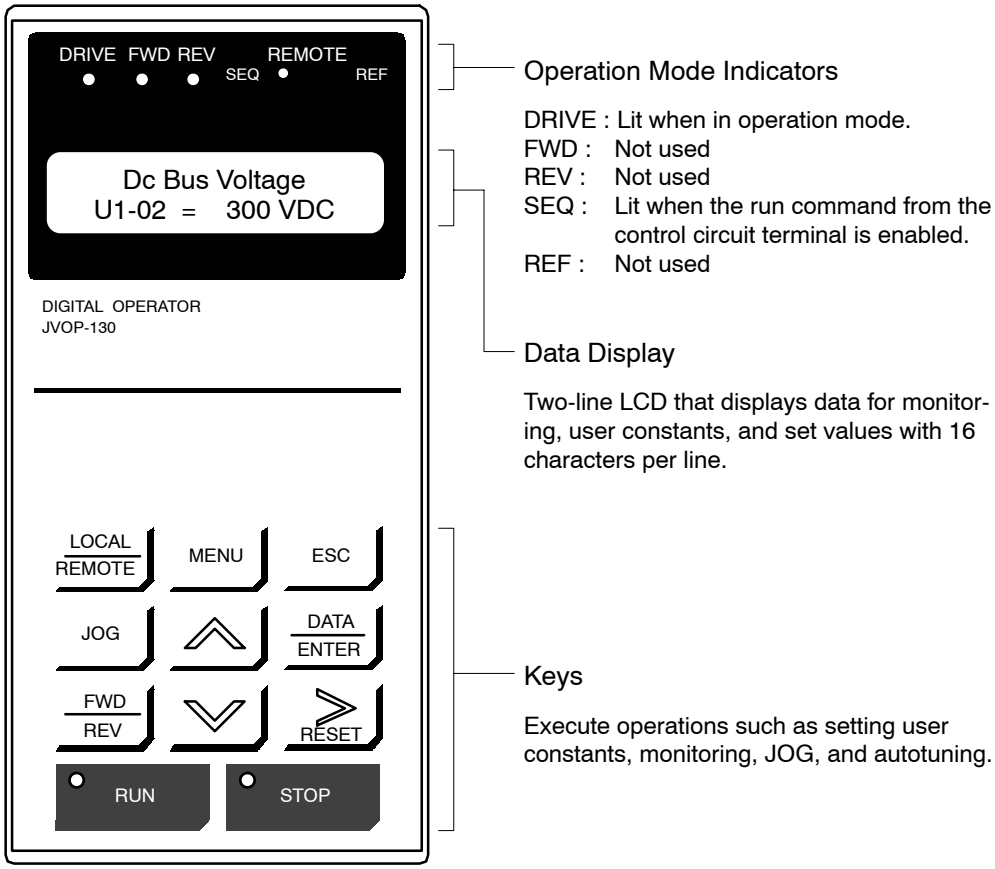
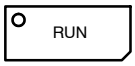
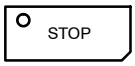


Fig. A-2 Digital Operator Component Names and Functions

Table A-1 Key Function

Key	Name	Function
	LOCAL/REMOTE Key	Switches between operation (LOCAL) via the Digital Operator and control circuit terminal (REMOTE) operation. This key can be enabled or disabled by setting a user constant (o2-01).
	MENU Key	Displays menus.
	ESC Key	Returns to the status before the DATA/ENTER Key was pressed.
	JOG Key	Not used.
	FWD/REV Key	Not used.
	RESET Key	Set the number of digits for user constant settings. Also acts as the reset Key when a fault has occurred.
	Increment Key	Selects menu items, groups, functions, and user constant names, and increments set values.
	Decrement Key	Selects menu items, groups, functions, and user constant names, and decrements set values.
	DATA/ENTER Key	Enters menu items, functions, constants, and set values after they are set.
	RUN Key	Starts the VS-656RC5 operation when the VS-656RC5 in operation with the Digital Operator.
	STOP Key	Stops VS-656RC5 operation. This Key can be enabled or disabled by setting a user constant (o2-02) when operating from the control circuit terminal.

Note: Except diagrams, keys are referred to using the key names listed in the above table.

1.4 MODES

This section describes the VS-656RC5's monitor modes, switching between modes, and accessing/setting user constants.

(1) Modes

The VS-656RC5's user constants and monitoring functions have been organized in groups called modes that make it easier to read and set user constants.

The VS-656RC5 is equipped with 4 modes, as shown in the Table A-2.

Table A-2 Modes

Mode	Primary function(s)
Operation mode	The power regenerative unit can be run in this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information, or displaying the fault history.
Initialize mode	Use this mode when selecting the language displayed on the Digital Operator, selecting the access level for reading/setting user constants, selecting the control mode, or initializing the user constants. Factory setting : English (A1-00=0)
Programming mode	Use this mode when reading/setting the user constants required for operation. The program-mode functions are subdivided into the following groups: • Apprication: Operation mode selection • Tuning: Settings for automatic operation • Option: Settings for Optional Cards • Terminal: Settings for sequential I/O and analog I/O • Protection: Settings for the motor and power regenerative unit protection function • Operator: Selects the Digital Operator's display and Key function
Modified constants mode	Use this mode to read/set user constants that have been changed from their factory set values.

(2) Switching Modes

Once the power regenerative unit has been put into operation mode by pressing the Menu Key, the Increment and Decrement Keys can be pressed to switch to other modes. Press the DATA/ENTER Key to read/set the user constants in each mode.

Press the ESC Key to return to the mode display from the user constant display.

Press the DATA/ENTER Key twice to write a constant and then press the ESC Key to return to the mode display. This is the most Basic operation, so you should remember it.

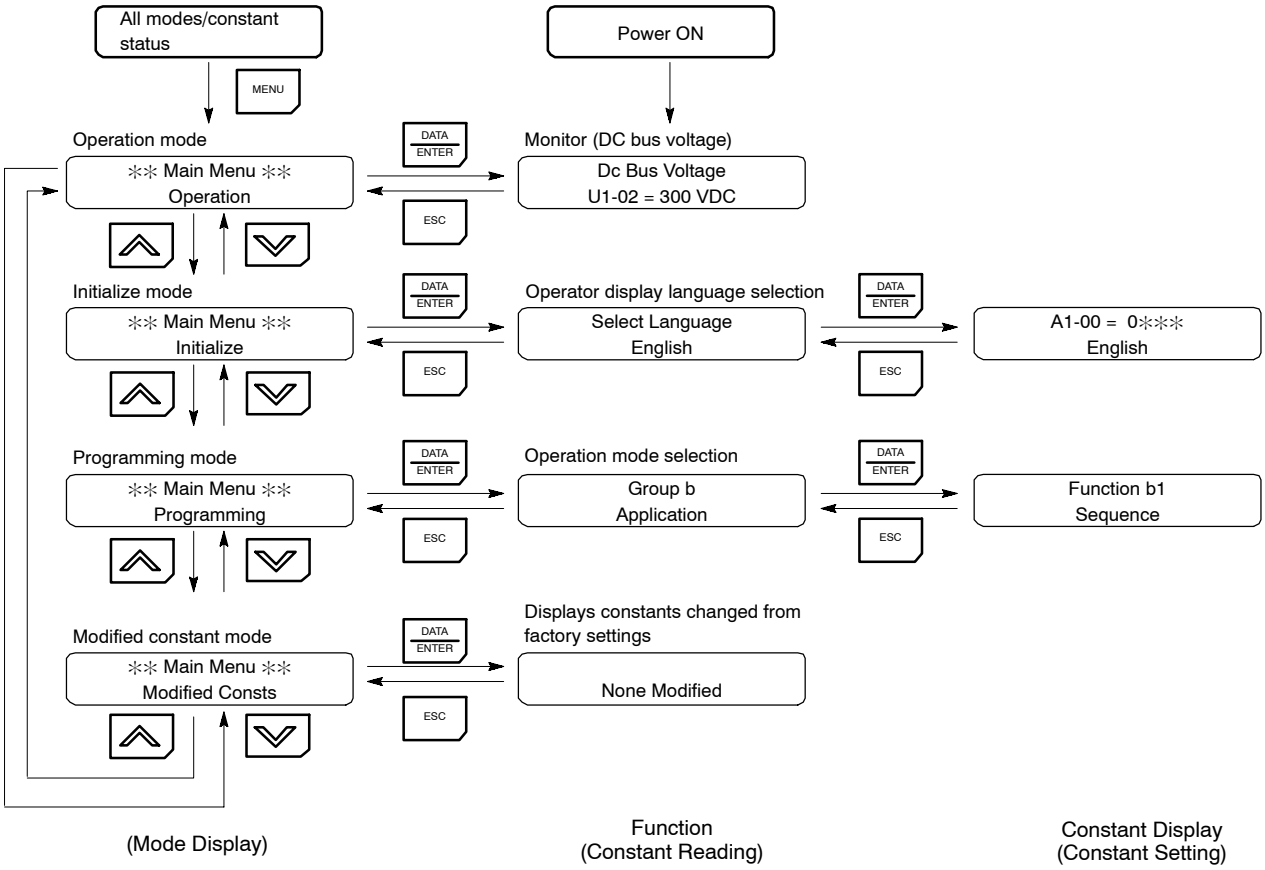


Fig. A-3 Mode Transitions

NOTE

When running the power regenerative unit after using digital operator, press the MENU Key to enter the operation mode and then press the DATA/ENTER Key from the operation mode display to bring up the monitor display. Run commands can't be received from any other display. (Monitor display in the operation mode appears when the power is turned ON.)

[Example] Setting a user constant

The group level will be displayed when the DATA/ENTER Key is pressed at the programming mode display.

Step	Key Sequence	Digital Operator Display	Remarks
1	MENU	∗∗ Main Menu ∗∗ Operation	
2	^ (Press twice.)	∗∗ Main Menu ∗∗ Programming	
3	DATA/ENTER	Group b Application	
4	DATA/ENTER	Function b1 Sequence	Changed to constant reading (function) level.
5	DATA/ENTER	Run Source Terminals	
6	DATA/ENTER	b1-02 = 1∗∗∗ Terminals	
7	^ (Press twice.)	b1-02 = 0 Operator	
8	DATA/ENTER	Entry Accepted	Writes-in the news settings.
		Run Source Operator	After a few seconds, the operator display is as shown on the left.
9	ESC	Function b1 Sequence	

The constant setting has been completed (operation mode has changed from the external terminals to the the operator).

(3) Operation Mode

Operation mode is the mode in which the power regenerative unit can be operated.

Many user constants can't be changed when the power regenerative unit is operating. Refer to Table A-3 for details.

The following monitor displays are possible in operation mode: Frequency, current, and voltage of AC power side as well as fault information and the fault history.

NOTE

When running the power regenerative unit after using digital operator, press the MENU Key to enter the operation mode and then press the DATA/ENTER Key from the operation mode display to bring up the monitor display. Run commands can't be received from any other display. (Monitor display in the operation mode appears when the power is turned ON.)

■ Operations in Operation Mode

Key operations in operation mode are shown in Fig. A-4.

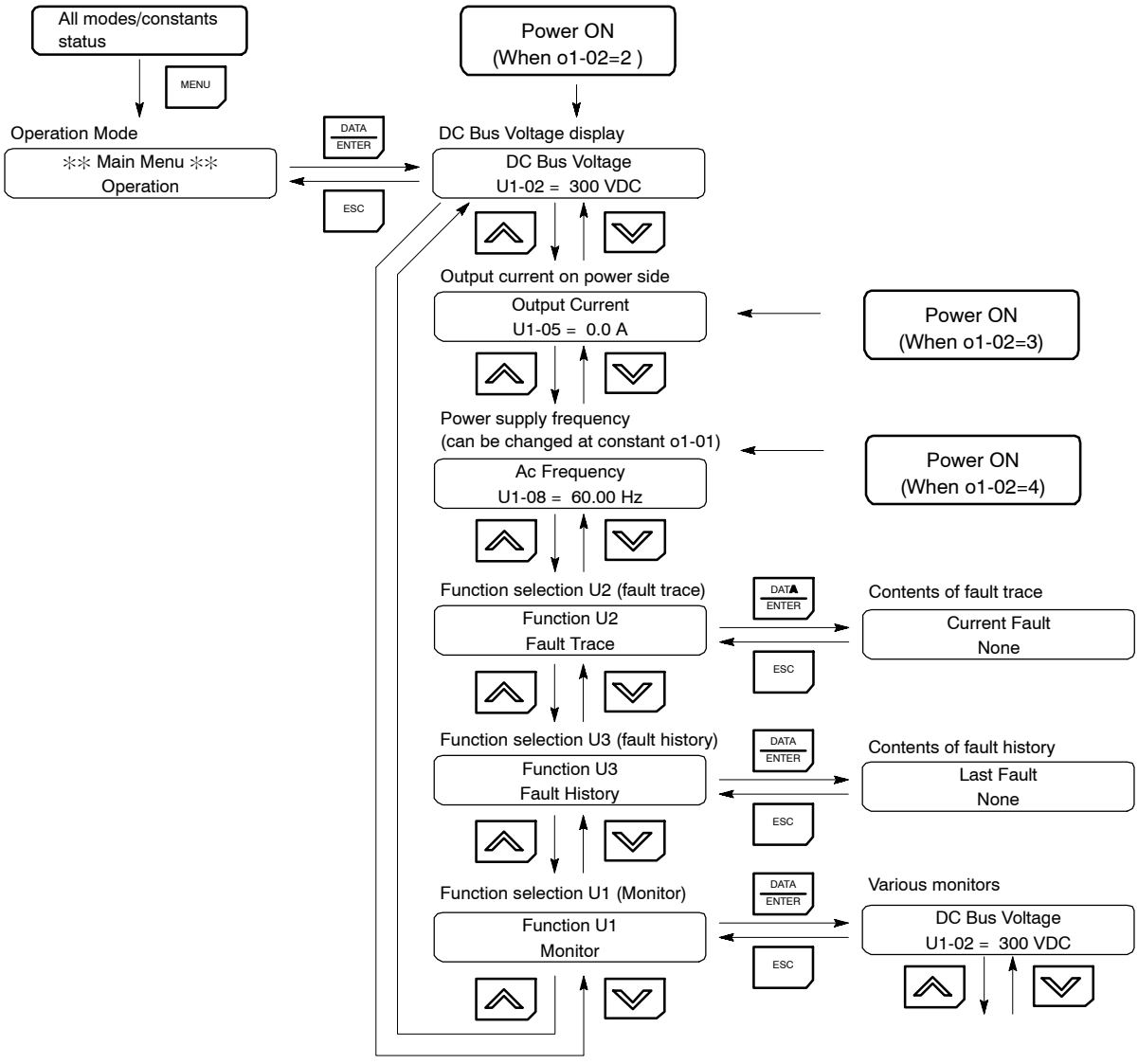


Fig. A-4 Operations in Operation Mode

APPENDIX 2 PROTECTIVE AND DIAGNOSTIC FUNCTIONS OF THE DIGITAL OPERATOR

2.1 FAULT DETECTION

When the power regenerative unit detects a fault, the fault code is displayed on the Digital Operator and the fault contact output operates.

When a fault has occurred, refer to the following table to identify and correct the cause of the fault.

Use one of the following methods to reset the fault after restarting the power regenerative unit.

- Turn ON the fault reset signal.
- Press the RESET Key on the Digital Operator.
- Turn the main circuit power supply OFF and then ON again.

Table A-3 Fault Displays and Processing

Fault Display	Meaning	Probable Causes	Corrective Actions
PUF IGBT, Fuse Failure	Fuse Blown The fuse in the main circuit is blown. The main transistor has damaged.	The output transistor has failed because of a short-circuit or overcurrent.	Replace the power regenerative unit after correcting the cause.
UV1 Dc Bus Undervolt	Main Circuit Undervoltage The main circuit DC voltage is below the undervoltage detection level (L2-05). 200 V class : Approx. 190 VDC 400 V class : Approx. 380 VDC	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose.	Reset the fault after correcting its cause.
UV2 CTR PS Undervolt	Control Power Fault The control power supply voltage dropped.	–	• Try turning the power supply off and on. • Replace the power regenerative unit if the fault continues to occur.
UV3 MC Answerback	Inrush Prevention Circuit Fault A fault occurred in the inrush prevention circuit.	–	• Try turning the power supply off and on. • Replace the power regenerative unit if the fault continues to occur.
AUv Ac Undervoltage	AC Power Undervoltage AC power undervoltage occurred during running. 200 V class : Approx. 150 VAC or less 400 V class : Approx. 300 VAC or less	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose.	Reset the fault after correcting its cause.
FdVe Power F Fault	Power Supply Frequency Fault AC power supply frequency has exceeded the setting value (F1-10).	• The power supply fluctuations occurred during running. • Power loss occurred during running.	Reset the fault after correcting its cause.
SrC Power Supply Flt.	Power Supply Fault The phase of the input power supply has changed after turning ON the control power supply.	• An open-phase occured with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose.	Reset the fault after correcting its cause.

Fault Display	Meaning	Probable Causes	Corrective Actions
OC Over Current	Overcurrent The output current of the power regenerative unit exceeded the overcurrent detection level. (200 % of rated current)	• A short-circuit occurred at the power regenerative output. • Power supply drop • Faulty wiring	Reset the fault after correcting its cause.
SC Short Circuit	IGBT Short-circuit The IGBT gate signal was short-circuited.	A short-circuit of the PWM signal occurred.	Replace the control card.
OV Dc Bus Overvolt	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class : Approx. 400 VDC 400 V class : Approx. 800 VDC	The deceleration time is too short and the regenerative energy from the motor is too large.	• Increase the deceleration time. • Check the capacity of the power regenerative unit. (Increase the capacity.)
		The power supply voltage is too high.	Decrease the voltage so it is within specifications.
OH Heatsink Overtmp	Heatsink Overheating The temperature of the power regenerative unit's cooling fins exceeded the setting in L8-02. (Stopping method can be changed by L8-03.)	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The cooling fan of the power regenerative unit has stopped.	Replace the cooling fan. (Contact our sales representative.)
OH1 Heatsink Max temp	Heatsink Overheating The temperature of the power regenerative unit's cooling fins exceeded 105°C. (Stopping method : Coast to stop)	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The cooling fan of the power regenerative unit has stopped.	Replace the cooling fan. (Contact our sales representative.)
OL Input Over Loaded	Power Regenerative Unit Input Overload Power regenerative unit input exceeded the overload capacity.	The load is too heavy.	Check the size of the load.
EF3 External Fault 3	External fault (terminal S3-SC)	An external fault was input from a multi-function input.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 External Fault 4	External fault (terminal S4-SC)		
OPR Oper Disconnect	Operator Connectin Fault The Operator was disconnected during operation started by a run command from the Operator.	–	Check the Operator connection.
ERR EEPROM R/W Err	EEPROM Write Error	–	A verification error occurred when writing EEPROM. • Try turning the power supply off and on again. • Try setting the constants again.
CPF00 COM-ERR (OP&CONV)	Control Circuit Error 1 (Operator Communications Error)	• Communications with the digital operator were not established within 5 seconds after the power was turned on. • MPU peripheral element check fault.	• Disconnect the digital operator and then connect it again. • Check the wiring of the control circuit power supply. • Replace the control card.
CPF01 COM-ERR (OP&CONV)	Control Circuit Error 2 (Operator Communications Error)	• After communications were established, there was a transmission error with the digital operator for more than 2 seconds. • MPU peripheral element check fault	• Disconnect the digital operator and then connect it again. • Check the wiring of the control circuit power supply. • Replace the control card.
CPF02 BB Circuit Err	Baseblock Circuit Error	The control circuit is damaged.	Replace the control card.
CPF03 EEPROM Err	EEPROM Error		
CPF04 Internal A/D Err	CPU Internal A/D Converter Error		

2.2 MINOR FAULT DETECTION

Minor faults are a type of the protection function that do not operate the fault contact output and are automatically returned to their original status once the cause of the minor fault has been removed.

The Digital Operator display blinks.

Take appropriate countermeasures according to the table below.

Table A-4 Minor Fault Displays and Processing

Minor Fault Display	Meaning	Probable Causes	Corrective Actions
UV Dc Bus Undervolt	Main Circuit Undervoltage The main circuit DC voltage was below the undervoltage detection level (L2-05). 200 V class : Approx. 190 VDC or less 400 V class : Approx. 380 VDC or less	See causes for AUv, FdVe, SrC, and UV3 faults.	–
OV Dc Bus Overvolt	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class : Approx. 400 VDC 400 V class : Approx. 800 VDC	The regenerative energy from the motor is too large.	Check the capacity of the power regenerative unit. (Increase the capacity.)
		The power supply voltage is too high.	Decrease the voltage so it is within specifications.
OH Heatsink Overtmp	Heatsink Overheating The temperature of the power regenerative unit's cooling fins exceeded the setting in L8-02. (Stopping method can be changed by L8-03.)	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The cooling fan of the power regenerative unit has stopped.	Replace the cooling fan. (Contact your YASKAWA representative.)
OL Input Over Loaded	Power Regenerative Unit Input Overload Power regenerative unit input exceeded the overload capacity.	The load is too heavy.	Check the size of the load.
EF3 External Fault 3	External fault (terminal S3-SC)	An external fault was input from a multi-function input.	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 External Fault 4	External fault (terminal S4-SC)		

2.3 OPERATION ERRORS

After the constants have been set, an operation error will occur if there is an invalid setting or a contradiction between two constant settings.

It won't be possible to start the power regenerative unit until the constants have been set correctly. (The minor fault output and fault contact output will not operate, either.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table A-5 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
OPE01 kVA Selection	Incorrect Power Regenerative Unit Capacity Setting	The power regenerative unit capacity setting does not match the Unit. (Contact your YASKAWA representative.)
OPE02 Limit	Constant Setting Range Error	The constant setting is outside of the valid setting range.
OPE03 Terminal	Multi-function Input Selection Error	The same setting has been selected for two or more multi-function inputs (H1-01, H1-02)

APPENDIX 3 CONSTANTS LIST

Table A-6 shows the items that can be monitored in operation mode. The output signal levels for multi-function analog outputs shown in the table are for a gain of 100.0 and a bias of 0.00.

Table A-6 Constants Monitored in Operation Mode

Function	Constant No.	Name	Function	Output Signal Level for Multi-function Analog Outputs	Min. Unit
Status Monitor	U1-02	DC bus voltage DC Bus Voltage	Monitors the DC voltage of the power regenerative unit's internal main circuit	200 V class : 400 V/10 V 400 V class : 800 V/10 V (0 to +10 V Output)	1 V
	U1-04	AC power supply voltage AC Voltage	Monitors the AC power supply voltage.	200 V class : 200 V/5 V 400 V class : 400 V/5 V (0 to +10 V Output)	1 V
	U1-05	Current at power side AC Current	Monitors the AC current at power side.	Rated current /10 V (0 to +10 V Output)	1 A
	U1-07	Power at power side AC Power	Monitors the AC power supply at power side.	Rated power /10 V (0 to +10 V Output)	1 kW
	U1-08	AC power supply frequency AC Frequency	Monitors the AC power supply frequency.	60 Hz /10 V (0 to +10 V Output)	0.01 Hz
	U1-10	Input terminal status Input Term Sts	Shows input ON/OFF status. U1-10 = 00000000 1 : MANUAL RUN (terminal S1) ON 1 : AUTO RUN (terminal S2) ON 1 : EXFLT (terminal S3) ON *1 1 : RESET (terminal S4) ON *1 1 : Not used. (always 0) *1 : Can be selected by user constant H1-01 or H1-02.	(Cannot be output)	–
	U1-11	Output terminal status Output Term Sts	Shows output ON/OFF status. U1-11 = 00000000 0 : Not used. (always 0) 1 : Multi-function output 1 (terminals M1-M2) ON *2 1 : Multi-function output 2 (terminals M3-M4) ON *2 0 : Not used. (always 0) 1 : Fault output (terminal MA/MB-MC) ON *2 : Can be selected by user constant H2-02 or H2-03.		–
	U1-12	Operation status Int Ct1 Sts 1	Power regenerative unit operating status U1-12 = 00000000 1 : Running 0 : Not used. (always 0) 1 : Reset input ON 0 : Not used. (always 0) 1 : Power regenerative unit ready 0 : Minor fault detected 1 : Major fault detected		–
	U1-13	Cumulative operation time Elapsed Time	Monitors the power regenerative unit's elapsed operating time. Can be set with user constants o2-07 or o2-08.		–
	U1-14	Software No. FLASH ID	(Manufacturer's ID number)		–

Function	Constant No.	Name	Function	Output Signal Level for Multi-function Analog Outputs	Min. Unit
Status Monitor	U1-21	Voltage deviation V Deviation	Monitors the deviation between the AC power supply voltage and the main circuit DC voltage.	200 V class : 400 V/10 V 400 V class : 800 V/10 V	1 V
	U1-28	Software No. (CPU) CPU ID	(Manufacturer's ID number)	(Cannot be output)	–
Fault Trace	U2-01	Current fault Current Fault	Information on the current fault		–
	U2-02	Last fault Last Fault	Information on the last fault		–
	U2-04	DC bus voltage at fault DC Bus Voltage	Main circuit DC voltage value when the "last fault" occurred.		1 V
	U2-06	Power supply voltage at fault AC Voltage	AC power supply voltage value when the "last fault" occurred.		1 V
	U2-07	Power side current at fault AC Current	Current value at AC power side when the "last fault" occurred.		1 A
	U2-08	Power at fault AC Power	Power at AC power side when the "last fault" occurred.		1 kW
	U2-10	Power side frequency at fault AC Frequency	Frequency at AC power side when the "last fault" occurred.		0.01 Hz
	U2-11	Input terminal status at fault Input Term Sts	Input terminal status when the "last fault" occurred. (Same format as U1-10.)		–
	U2-12	Output terminal status at fault Output Term Sts	Output terminal status when the "last fault" occurred. (Same format as U1-11.)		–
	U2-13	Operation status at fault Regen Unit Sts	Operating status when the "last fault" occurred. (Same format as U1-12.)		–
	U2-14	Cumulative operation time at fault Elapsed Time	Elapsed operating or power-on time when the "last fault" occurred.		1 H
	U2-20	Voltage deviation input at fault V Deviation	Voltage deviation when the "last fault" occurred.		1 V
Fault History	U3-01	Most recent fault Last Fault	Information on the last fault.		–
	U3-02	Second most recent fault Fault Message 2	Information on the 2nd to last fault.		–
	U3-03	Third most recent fault Fault Message 3	Information on the 3rd to last fault.		–
	U3-04	Fourth/oldest fault Fault Message 4	Information on the 4th to last fault.		–
	U3-05	Cumulative operation time at fault Elapsed Time 1	Elapsed running or power-on time when the last fault occurred.		1 H
	U3-06	Accumulated time of second fault Elapsed Time 2	Elapsed running or power-on time when the 2nd to last fault occurred.		1 H
	U3-07	Accumulated time of third fault Elapsed Time 3	Elapsed running or power-on time when the 3rd to last fault occurred.		1 H
	U3-08	Accumulated time of fourth/oldest fault Elapsed Time 4	Elapsed running or power-on time when the 4th to last fault occurred.		1 H

Table A-7 Constant List

Constant No.	Name / Display	Setting Range	Factory Setting	Change during Operation	Access Level	Description
A1-00	Language selection for operator display, / [Select Language]	0, 1	0	○	A	0 : English 1 : Japanese
A1-01	Constant access level / [Access Level]	0 to 9999	4	○	A	0 : Monitoring only 4 : Advanced (A)
A1-03	Initialize / [Init Parameters]	0000 to 9999	0000	×	A	2220:Initializes using the User Constants
A1-04	Password 1 (Input) / [Enter Password]	0000 to 9999	0	×	A	
B1-02	Operation method selection / [Run Source]	0, 1	1	×	A	0 : Digital Operator 1 : Control circuit terminals
B1-06	Read sequence input twice / [Cntl Input Scans]	0, 1	1	×	A	0 : Two scans every 500 μsec 1 : Two scans every 5 ms
C8-17	Automatic operation stop current / [Autorun Iout]	10 to 100 %	50	×	A	
C8-18	Bias voltage at operation start / [V Bias of Run]	0.0 to 50.0 V	2.0	×	A	For 400 V class power regenerative units, double the initial setting and setting range.
C8-19	Hysteresis voltage width at operation start/stop / [V Width of Stop]	0.5 to 50.0 V	3.0	×	A	For 400 V class power regenerative units, double the initial setting and setting range.
C8-20	Min. operating time / [Minimum Run Time]	0.0 to 600.0 sec	1.0	×	A	
F1-10	Excessive frequency deviation detection level / [FDEV DetectLevel]	1.0 to 10.0 Hz	3.0	×	A	
F1-11	Excessive frequency deviation detection delay time / [FDEV Detect Time]	0.0 to 255.0 sec	70.0	×	A	
H1-01	Multi-function input (terminal S3) / [Terminal S3 Sel]	0 to 2F	24	○	A	24 : External fault (NO contact, stop) Refer to Table A-8.
H1-02	Mlti-function input (terminal S4) / [Terminal S4 Sel]	0 to 2F	14	○	A	14 : Fault reset Refer to Table A-8.
H2-02	Multi-function input (terminal M1-M2) / [Terminal M1 Sel]	0 to 20	6	○	A	6 : Regenerative unit ready Refer to Table A-9.
H2-03	Multi-function input (terminal M3-M4) / [Terminal M3 Sel]	0 to 20	0	○	A	0 : During Run Refer to Table A-9.
H4-01	Multi-function AO (terminal AM-AC) / [Terminal AM Sel]	0 to 21	5	○	A	0 : Not used 2 : DC bus voltage (U1-02) 4 : Power supply voltage (U1-04) 5 : Current at power side (U1-05) 7 : Power at power side (U1-07) 8 : Power supply frequency (U1-08) 21 : Voltage deviation input (U1-21) Refer to Table A-10.
H4-02	Gain (terminal AM-AC) / [Terminal AM Gain]	0.00 to 2.50	0.50	○	A	
H4-03	Bias (terminal AM-AC) / [Terminal AM Bias]	–10.0 to +10.0 %	0.0	○	A	
H4-07	Analog output signal polarity selection / [AO Level Select]	0, 1	1	○	A	0 : Without sign 1 : With sign

Constant No.	Name Display	Setting Range	Factory Setting	Change during Operation	Access Level	Description
L2-01	Momentary power loss detection [PwrL Selection]	0 to 2	0	×	A	0 : Fault 1 : Operation continues within power loss ridethrough time 2 : Operation continues if control power supply is hold. Note : Even if L2-01 is set to 1 or 2, the power regenerative unit may detect a fault if momentary power loss occurs during regeneration.
L2-02	Momentary power loss ridethru time [PwrL Ridethru t]	0.0 to 2.0	2.0	×	A	
L2-05	Undervoltage detection level [PUV Det Level]	150 to 210 V	190	×	A	For 400 V class power regenerative units, double the initial setting and setting range.
L5-01	Number of auto restart attempts [Num of Restarts]	0 to 10	0	×	A	
L5-02	Auto restart operation selection [Restart Sel]	0, 1	0	×	A	0 : Not output (Fault contact is not activated.) 1 : Output (Fault contact is activated.)
L8-02	Overheat pre-alarm level [OH Pre-Alarm Lvl]	50 to 110 deg	95	×	A	
L8-03	Operation selection after overheat pre-alarm [OH Pre-Alarm Sel]	1, 3	3	×	A	1 : Stop 3 : Continue operation
L8-07	Power supply open-phase protection selection [Ph Loss In Sel]	0, 1	0	×	A	0 : Disabled 1 : Enabled
o1-01	Monitor selection [User Monitor Sel]	4 to 8	8	○	A	4 : Power supply voltage (U1-04) 7 : Power at power side (U1-07) 8 : Power supply frequency (U1-08)
o1-02	Monitor selection after power up [Power-On Monitor]	2 to 4	2	○	A	2 : DC bus voltage (U1-02) 3 : Current at power side (U1-05) 4 : The monitor item set for o1-01
o2-01	LOCAL/REMOTE key enable/disable [Local/Remote Key]	0, 1	1	×	A	0 : Disabled 1 : Enabled
o2-02	STOP key during remote operation [Oper STOP Key]	0, 1	0	×	A	0 : Enabled during run command from the digital operator 1 : Enabled
o2-04	kVA selection [Regen Unit Model]	00 to FF	＊	×	A	Varies depending on power regenerative unit capacity.
o2-06	Operation selection when digital operator is desconnected [Oper Detection]	0, 1	0	×	A	0 : Operation continues even if the digital operator is disconnected. 1 : Fault is detected at digital operator disconnection
o2-07	Cumulative operation time setting [Elapsed Time Set]	0 to 65535H	–	×	A	
o2-08	Cumulative operation time selection [Elapsed Time Run]	0, 1	0	×	A	0 : Cumulative time when the regenerative unit is on. 1 : Cumulative regenerative unit run time.

Table A-8 Multi-function Input Functions

Setting Value	Function (H1-01, 02)	Remarks
8	External baseblock (NO contact) [Ext BaseBlk N.O.]	
9	External baseblock (NC contact) [Ext BaseBlk N.C.]	
F	Not used [Term Not Used]	
14	Fault reset [Fault Reset]	
24	External fault [External Fault]	24 : NO input, Normally detected, stop
24-2F		

Table A-9 Multi-function Output Functions

Settig value	Function (H2-02, 03)	Remarks
0	During run [During RUN 1]	
6	Regenerative unit ready [Regen Unit Ready]	
7	During DC bus undervoltage (UV) detection [DC Bus Undervolt]	
8	During baseblock [BaseBlk 1]	
A	During MCON [Mc On]	
E	Fault [Fault]	
F	Not used [Not Used]	
10	Alarm [Minor Fault]	
11	Fault reset command active [Reset Cmd Active]	
1E	Restart enabled [Restart Enabled]	
1F	Overload (OL1) pre-alarm [Overload (OL1)]	80 % of the OL1
20	Overheat pre-alarm [OH Prealarm]	

Table A-10 Multi-function Analog Output Functions

Setting value	Function (H4-01)	Output signal level	Remarks
0	Not used [Not Used]		
2	DC bus voltage [DC Bus Voltage]	200 V class : 400 V/10 V 400 V class : 800 V/10 V	
4	Power supply voltage [AC Voltage]	200 V class : 200 V/5 V 400 V class : 400 V/5 V (0 to +10 V output)	
5	Current at power side [AC Current]	Rated current /10 V	
7	Power at power side [AC Power]	Rated power /10 V	
8	Power supply frequency [AC Frequency]	60 Hz/10 V	
21	Voltage deviation input [V Deviation]	200 V class : 400 V/10 V 400 V class : 800 V/10 V	

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INSTRUCTION MANUAL

IRUMA BUSINESS CENTER (SOLUTION CENTER)
480, Kamifujisawa, Iruma, Saitama 358-8555, Japan
Phone 81-4-2962-5696 Fax 81-4-2962-6138

YASKAWA ELECTRIC AMERICA, INC.
2121 Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone 1-847-887-7000 Fax 1-847-887-7370

YASKAWA ELÉTRICO DO BRASIL COMÉRCIO LTD.A.
Avenida Fagundes Filho, 620 Bairro Saude-Sao Pãulo-SP, Brazil CEP: 04304-000
Phone 55-11-5071-2552 Fax 55-11-5581-8795

YASKAWA ELECTRIC EUROPE GmbH
Am Kronberger Hang 2, 65824 Schwalbach, Germany
Phone 49-6196-569-300 Fax 49-6196-569-312

YASKAWA ELECTRIC UK LTD.
1 Hunt Hill Orchardton Woods Cumbernauld, G68 9LF, United Kingdom
Phone 44-1236-735000 Fax 44-1236-458182

YASKAWA ELECTRIC KOREA CORPORATION
7F, Doore Bldg. 24, Yeoido-dong, Youngdungpo-Ku, Seoul 150-877, Korea
Phone 82-2-784-7844 Fax 82-2-784-8495

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.
151 Lorong Chuan, #04-01, New Tech Park 556741, Singapore
Phone 65-6282-3003 Fax 65-6289-3003

YASKAWA ELECTRIC (SHANGHAI) CO., LTD.
No.18 Xizang Zhong Road. Room 1702-1707, Harbour Ring Plaza Shanghai 200001, China
Phone 86-21-5385-2200 Fax 86-21-5385-3299

YASKAWA ELECTRIC (SHANGHAI) CO., LTD. BEIJING OFFICE
Room 1011A, Tower W3 Oriental Plaza, No.1 East Chang An Ave.,
Dong Cheng District, Beijing 100738, China
Phone 86-10-8518-4086 Fax 86-10-8518-4082

YASKAWA ELECTRIC TAIWAN CORPORATION
9F, 16, Nanking E. Rd., Sec. 3, Taipei, Taiwan
Phone 886-2-2502-5003 Fax 886-2-2505-1280

YASKAWA ELECTRIC CORPORATION

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