YASKAWA

POWER REGENERATION FUNCTION BUILT-IN TYPE
HIGH PERFORMANCE ALL-DIGITAL GENERAL-PURPOSE INVERTER

Varispeed-616R3

INSTRUCTION MANUAL

MODEL : CIMR-R3A ☐☐☐☐☐

200 V CLASS 3.7 to 37 kW (5 to 69 kVA)
400 V CLASS 7.5 to 45 kW (12.6 to 85 kVA)

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

YASKAWA

MANUAL NO. TOE-S616-7B

PREFACE

YASKAWA's Varispeed-616R3 series (hereafter VS-616R3) is a general-purpose inverter with power regeneration function and also, a heavy duty inverter. This instruction manual describes installation, operation, maintenance, inspection, and troubleshooting of the VS-616R3. 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.

NOTES FOR SAFE OPERATION

Read this instruction manual thoroughly before installation, operation, maintenance or inspection of the VS-616R3. 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 somesituations. In either case, follow these important notes.

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

1 RECEIVING

⚠ CAUTION

2 INSTALLATION

⚠ CAUTION

(Ref. page)

- Lift the cabinet by the base. When moving the unit, never lift by the front cover.
  Otherwise, the main unit may be dropped causing personal injury, or equipment damages. 16
- Mount the inverter on nonflammable material (i. e. metal).
  Failure to observe this caution can result in a fire. 16
- 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. 16

3 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 electrical shock or a fire. 22
- Wiring should be performed only by qualified personnel.
  Failure to observe this warning can result in an electrical shock or a fire. 22
- When wiring the emergency stop circuit, check the wiring thoroughly before operation.
  Failure to observe this warning can result in personal injury. 22
- Make sure to ground the ground terminal ⏚ .
  (Ground resistance :
  200 V class : 100 Ω or less, 400 V class : 10 Ω or less)
  Failure to observe this warning can result in an electrical shock or a fire. 22

3 WIRING (Cont'd)

⚠ CAUTION

(Ref. page)

- Verify that the inverter rated voltage coincides with the AC power supply voltage. (For example, controller power supply voltage for 400 V class inverter is single phase 200 V.)
  Failure to observe this caution can result in personal injury or a fire. 22
- Do not perform a withstand voltage test of the inverter.
  It may cause semi-conductor elements to be damaged. 22
- Tighten terminal screws to the specified tightening torque.
  Failure to observe this caution can result in malfunctions, equipment damages, or a fire. 22
- Never connect the AC main circuit power supply to output terminals U, V and W.
  The inverter will be damaged and invalidate the guarantee. 22

4 OPERATION

⚠ WARNING

(Ref. page)

- Only turn ON the input power supply after replacing the front cover. Do not remove the cover while current is flowing.
  Failure to observe this warning can result in an electrical shock. 40, 59, 93, 100
- Do not touch the operator with wet hand.
  Failure to ovserve this warning can result in an electrical shock. 40, 59, 93, 100

⚠ WARNING

(Ref. page)

- Do not touch inverter terminals during power "ON" even when the motor is stopping.
  Failure to observe this warning can result in an electrical shock. ····· 40, 59, 93, 100
- Do not open or close the circuit breaker (MCCB) in the internal of inverter during power "ON" since this circuit breaker is for the protection of the main circuit breaker.
  Failure to observe this warning can result in an electrical shock. ····· 40, 59, 93, 100
- Since the stop button can be disabled by a function setting, install a separate emergency stop switch.
  Failure to observe this warning can result in personal injury. ··· 40, 59, 93, 100

⚠ CAUTION

(Ref. page)

- Never touch the heatsink or discharging resistor since the temperature is very high.
  Failure to observe this caution can result in harmful burns to the body. ····· 40, 59, 93, 100
- Since it is easy to change operation speed from low to high speed, verify the safe working range of the motor and machine before operation.
  Failure to observe this caution can result in personal injury and machine damage. ····· 40, 59, 93, 100
- Install a holding brake separately if necessary.
  Failure to observe this caution can result in personal injury.··· 40, 59, 93, 100
- Do not check signals during operation.
  The machine or the inverter may be damaged. ····· 40, 59, 93, 100
- All the constants of the inverter have been preset at the factory. Do not change the settings unnecessarily.
  The inverter may be damaged. ····· 40, 59, 93, 100

5 MAINTENANCE AND INSPECTION

⚠ WARNING

(Ref. page)

- Never touch high-voltage terminals in the inverter.
  Failure to observe this warning can result in an electrical shock. 108
- 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.
  Failure to observe this warning can result in an electrical shock. 108
- 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 electrical shock.)
  Failure to observe this warning can result in an electrical shock. 108

⚠ CAUTION

(Ref. page)

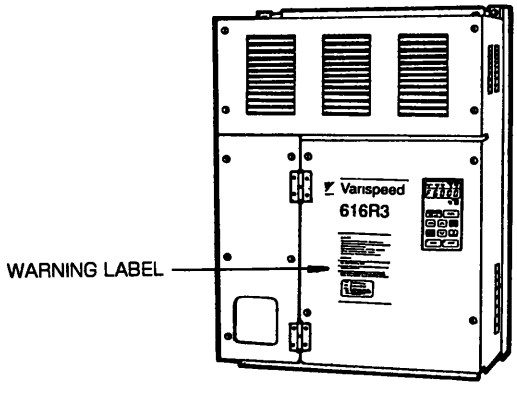
- The control PC board employs CMOS ICs. Do not touch the CMOS elements.
  They are easily damaged by static electricity. 108
- Do not connect or disconnect wires or connectors while power is applied to the circuit.
  Failure to observe this caution can result in an electrical shock, personal injury, or equipment damage. 108

6 OTHERS

⚠WARNING

- Never modify the product.
  Failure to observe this warning can result in an electrical shock or personal injury and will invalidate the guarantee.

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



Model CIMR-R3A2030

Warning Label

⚠WARNING

May cause injury or electric shock.

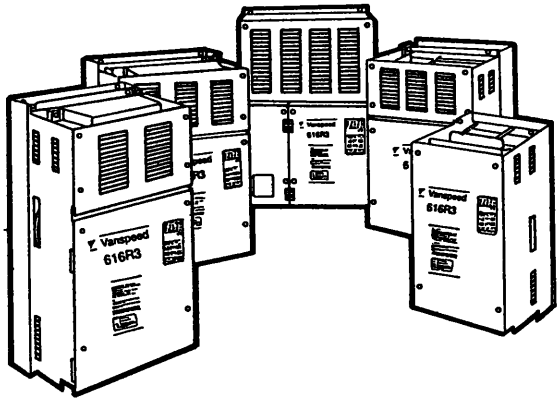
- Please follow the instructions in the manual before installation or operation.
- Disconnect all power before opening front cover of unit. Wait 3 minute until DC Bus capacitors discharge.
- Use proper grounding techniques.

CONTENTS

Page

1. FEATURES AND SPECIFICATIONS

The VS-616R3 is a general-purpose inverter with power regenerative function, and also a heavy-duty inverter to show its full performance over a wide operation range.



1.1 FEATURES

(1) High-efficiency and Energy-Saving Drives Realized

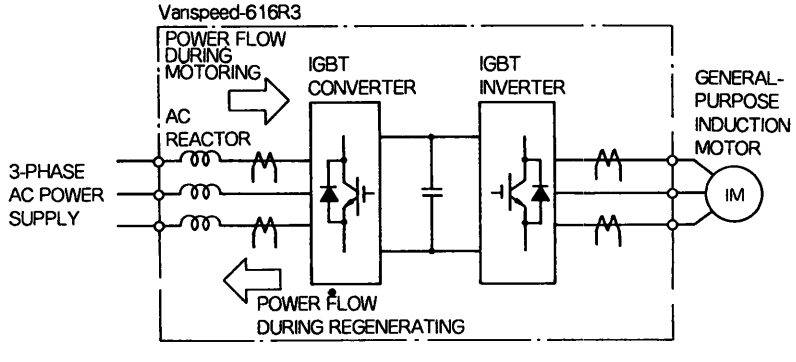
- Load energy is regenerated to the power supply with excellent efficiency.
- AC reactor for power factor improvement is built-in.

(2) Optimum for Cranes or Heavy-inertial Loads

- Smooth and powerful operation enabled by 32-bit DSP high-speed vector calculation and IGBT high-speed switching.
- Accel/decel time and S-curve time change, output frequency hold or multi-step speed (10 steps) operation is available.
- Motor torque monitoring function assures torque at start and stop. (Crane exclusive-use sequence is built-in.)
- Minus energy of the load is regenerated to the power supply.

(3) Simplified Control Panel Design and Space Saving Enabled

- Braking resistor or braking unit does not have to be added.
- Motoring operation and regeneration have the same continuous capacity and overload capacity.



1.2 STANDARD SPECIFICATONS

Item	Model CIMR-R3A□□□	200 V Class									400 V Class							
	Voltage Class	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037	47P5	4011	4015	4018	4022	4030	4037	4045
Max. Applicable Motor Capacity *	HP (kW)	5 (3 7)	7.5 (5.5)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)	50 (37)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)	50 (37)	60 (45)
Output (for Motoring and Regenerating)	Output Capacity kVA	5.0	8.5	12.6	17.1	25 2	34	42	50	69	12.6	17.1	25.1	34	42	50	69	85
	Rated Current A	13.2	22 2	33.0	45.0	66.1	90.1	111 1	132 1	130.2	16.5	22 5	33.0	45.0	55.6	66.1	90.1	111 0
	Overload Capacity	150% for one minute of rated output current																
	Max. Output Voltage V	3-phase 200/208/220/230 V (for input voltage)									3-phase 380/400/415/440/460 V (for input voltage)							
	Rated Output Frequency	50/60 Hz (Up to 400 Hz available in constant setting)																
Power† Supply	Voltage/Frequency #	3-phase 200/208/220 V 50 Hz 200/208/220/230 V 60 Hz									3-phase 380/400/415/440/460 V 50/60 Hz‡							
	Allowable Voltage Fluctuation	±10%																
	Allowable Frequency Fluctuation	±5%																
Control Characteristics	Control Method	Sine wave PWM (with power regenerative function and vector-calculated torque boost function)																
	Frequency Control Range	0 1 to 400 Hz																
	Frequency Accuracy (Temperature Variation)	Digital command : 0 01% +14 to 104°F (−10 to 40°C), Analog command : 0 1% 77±50°F (25°C ±10°C)																
	Frequency Setting Resolution	Digital operator reference . 0 01 Hz when less than 100 Hz, 0 1 Hz when 100 Hz or more; Analog reference : 0.06 Hz/60 Hz																
	Output Frequency Resolution	0.01 Hz (1/30,000)																
	Frequency Setting Signal	0 to +10 VDC (50 kΩ)																
	Accel/Decel Time	0 1 to 6000.0 sec (Acceleration, deceleration, S-curve time setting independently)																
	Conversion Efficiency	Approx. 95%																
	Voltage/Frequency Characteristics	Arbitrary program V/f pattern setting enabled																
	Operation Sequence	Either general-purpose sequence or crane exclusive-use sequence can be selected.																
Protective Functions	Inverter Protection	Overcurrent, overvoltage, overload, MCCB trip, stall prevention, cooling fin overheat, etc.																
	Motor Protection	Electronic thermal overload, overtorque detection, etc.																
	System Protection	Output open-phase, power supply voltage fault, power supply frequency fault, etc.																
Environmental Conditions	Location	Indoor (free from corrosive gases of dust)																
	Ambient Temperature	14.0 to 107°F (−10 to 45°C) (no freezing)																
	Storage Temperature **	−4 to 140°F (−20 to +60°C)																
	Humidity	90% RH and below (non-condensing)																
	Vibration Acceleration	Allowed up to 9.8 m/s²(1G) at vibration frequency less than 20 Hz, 2 m/s² (0.2 G) at 20 to 50 Hz																

* 4-pole standard motor

** Short-term temperature during transportion.

*** When a reverse power relay is installed to the power receiving equipment, contact your YASKAWA representative.

† If a generator is used as a power supply, inquire its capacity

‡ 400 V class needs a transformer (CPT-006275) for control power supply.

\# Single-phase power supply cannot be used

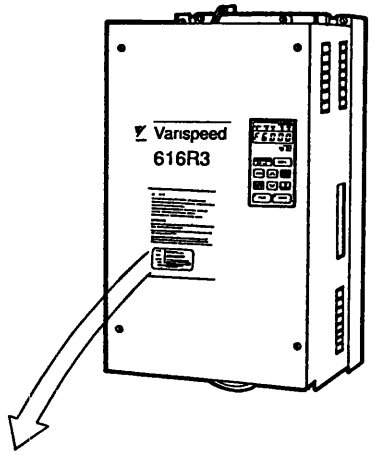
2. HARDWARE

2.1 RECEIVING

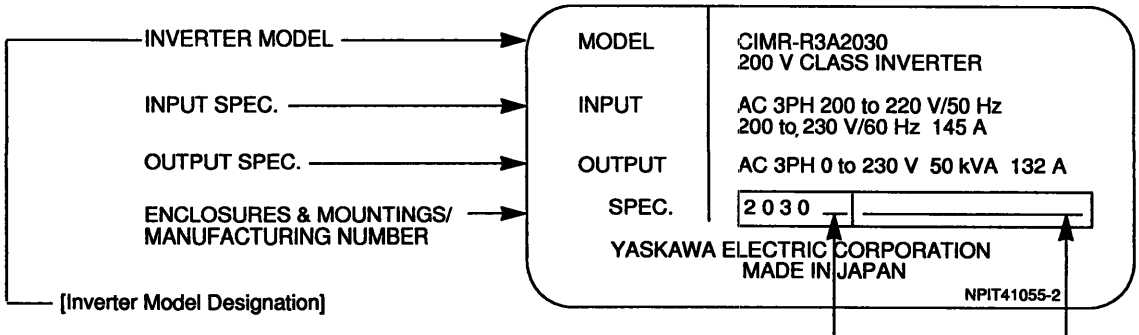
This VS-616R3 has been put through demanding tests at the factory before shipment. After unpacking, check the followings.

- Verify the received product with the purchase order sheet (invoice) and/or packing slip.
- Transit damage.

If any part of VS-616R3 is damaged or lost, immediately notify the shipper.



NAME PLATE DATA (In case of 200 V class, 30 kW)

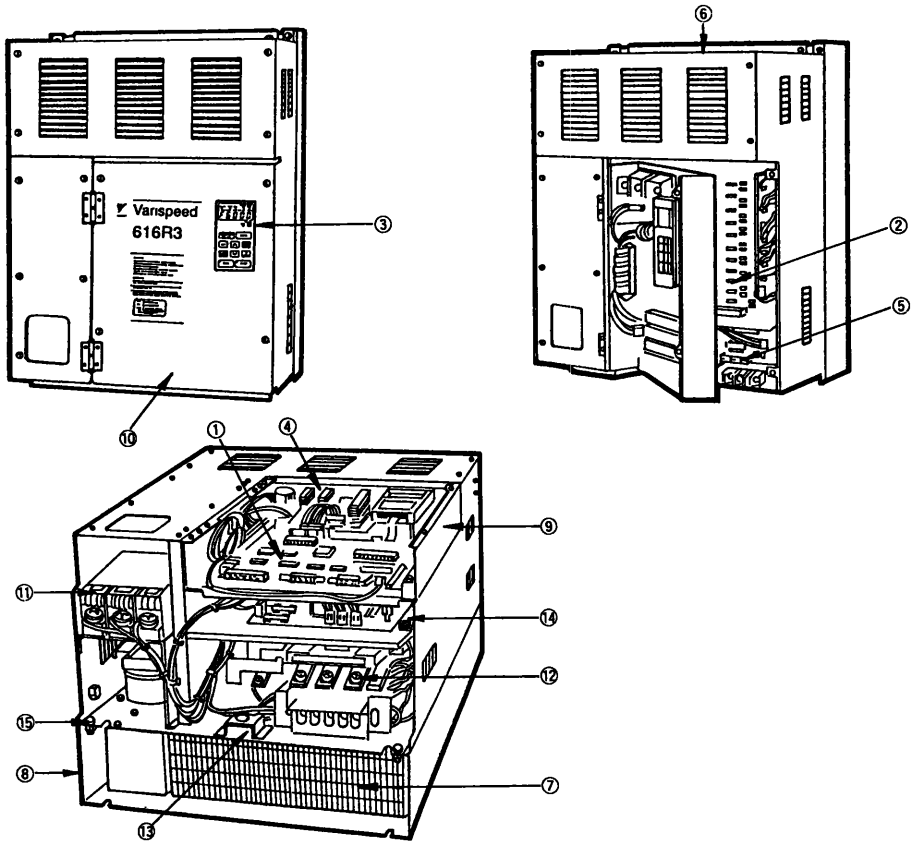


CIMR - R3 A 2 0 3 0

- Inverter
- R3 Series
- Specifications
  A : Standard
- Voltage
  2 : 200 V Class
  4 : 400 V Class
- Applicable Maximum Motor Output
  3P7 : 3.7 kW
  to
  037 : 37 kW

["P" indicates a decimal point.]

2.2 NAMES AND FUNCTIONS OF INVERTER PARTS



① Controller : Consists of electronic circuits including the inverter-controller CPU.
② Gate driver : Receives signals from the controller and drives the insulated gate bipolar transistor (IGBT) of the main circuit.
③ Digital operator : Monitors operation status, and is used for display and setting of constants.
④ DC power supply (Control power supply) : Supplies control power to the controller and the pulse generator.
⑤ Power supply interface : Consisting of control power fuses, serves as the input circuit of control power.
⑥ Fan box : Contains a fan for cooling the heat sink.
⑦ Heat sink : This is the cooling medium for the main circuit IGBT.
⑧ Air passage panel : This panel is used for mounting the inverter, and also serves as an air passage.
⑨ PC board mounting frame : Bears the controller and the DC power supply.
⑩ Face plate : Protects the controller and other PC boards while improving the appearance.
⑪ Input terminals (R, S, T) and MCCB : Receives commercial power, named R, S, and T as well as functions as MCCB to protect main circuit (Digital operator indicates "Cb" when MCCB is tripped.)
⑫ Output terminals : Connect to motors and electromagnetic contactors U, V, and W.
⑬ Ground terminal : Grounds the inverter, named E.
⑭ Charge lamp : Indicates charges stored in the electrolytic capacitor in the main circuit. Do not touch the inverter main circuit until this lamp is extinguished.
⑮ Air passage panel fastening screws : Remove these four screws to remove the air passage panel.

Fig. 2.1 Construction of Inverter (VS-616R3)

2.3 INSTALLATION

2.3.1 Transportation

- Never move, lift or handle the VS-616R3 cabinet by the front cover.
- Lift the cabinet by the bottom.
- Do not drop the inverter.

2.3.2 Location

Location of the equipment is important to achieve proper performance and normal operating life. The VS-616R3 units should be installed in areas where the following conditions exist.

- Protected from rain or moisture.
- Protected from direct sunlight.
- Protected from corrosive gases or liquids.
- Free from airborne dust or metallic particles.
- Free from vibration.
- Free from magnetic noise (e.g. welding machines, power units)
- Ambient temperature : 14.0 to +113° F, -10 to +45℃
- Free from combustible materials, gases, etc.

CAUTION

When mounting units in a common enclosure, install a cooling fan or some other means to cool the air entering the inverter below 113° F(45 ℃).

2.3.3 Mounting Space

Install VS-616R3 vertically and allow sufficient space for effective cooling as shown in Fig. 2.2.

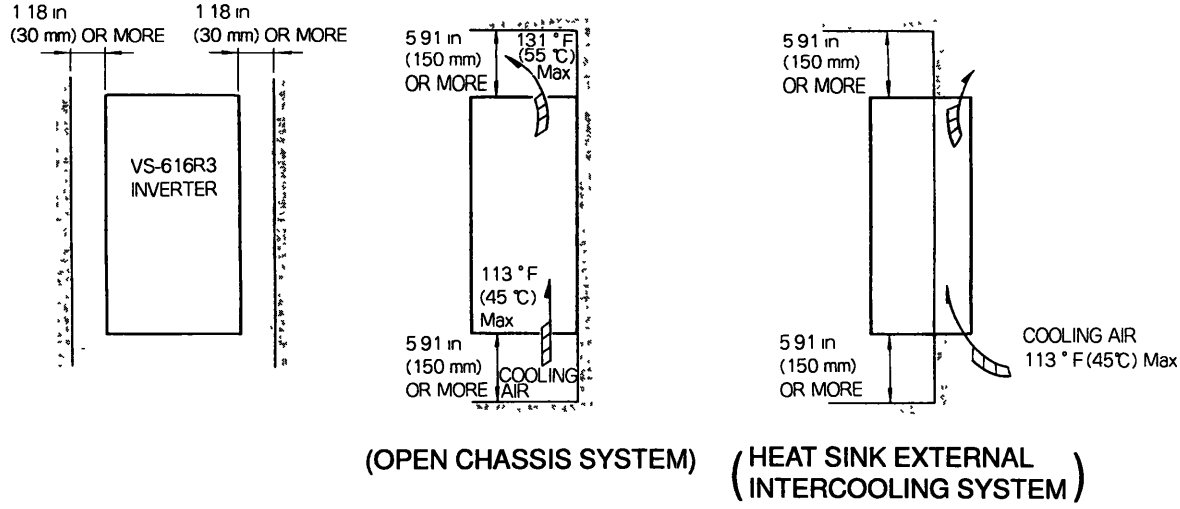


Fig. 2.2 Mounting Spaces

Inverter Unit Heat Production (200 V class)

Model CIMR-R3A		23P7	25P5	27P5	2011	2015	2018	2022	2030	2037
Capacity (kVA)		5.0	8.5	12.6	17.1	25.2	34	42	50	69
Rated Current (A)		13.2	22.2	33.0	45.6	66.1	90.1	111.1	132.1	180.2
Heat Production (W)	Cooling Fin	101	203	301	361	571	717	1037	1072	1206
	Unit Internal	131	112	161	182	218	280	328	344	394
	Total Heat Production	232	315	462	546	789	1027	1365	1416	1600
Fin Cooling Method		Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling

Inverter Unit Heat Production (400 V class)

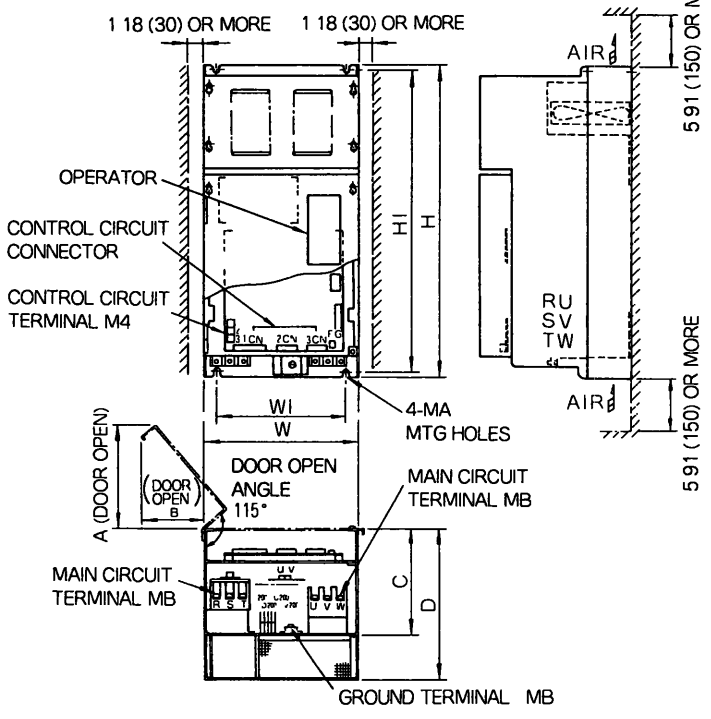
Model CIMR-R3A		47P5	4011	4015	4018	4022	4030	4037	4045
Inverter Capacity (kVA)		12.6	17.1	25.1	34	42	50	69	85
Rated Output Current (A)		16.5	22.5	33.0	45.0	55.6	66.1	90.1	111.0
Heat Production (W)	Cooling Fin	291	354	556	732	1017	1052	1186	1560
	Unit Internal	177	198	238	300	353	369	416	485
	Total Heat Production	468	552	791	1032	1370	1421	1605	2045
Fin Cooling Method		Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling	Fan cooling

2.3.4 Dimensions in inch (mm)

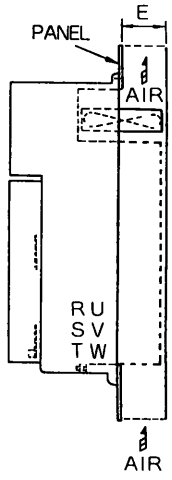
VS-616R3 has two mounting means ; open chassis type and heat sink external intercooling type. To use an external heat sink, see (3).

(1) 200 V Class

• Open Chassis Type



• Heat Sink External Intercooling Type



in inch (mm)

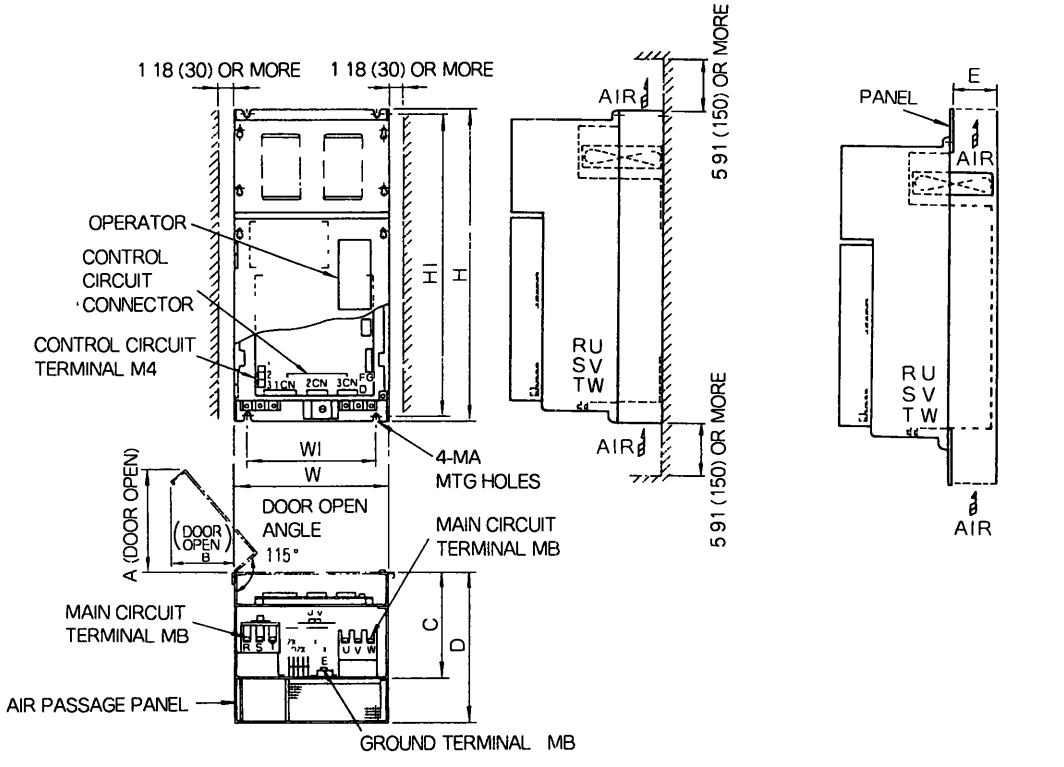
Model CIMR-R3A□□□	W	H	D	WI	HI	A	B	C	MA	MB	Approx. Weight lb (kg)
23P7	9.84 (250)	18 50 (470)	11 26 (286)	7.87 (200)	17 91 (455)	10.04 (255)	8 27 (210)	8.66 (220)	M6	M5	55 (25)
25P5											57.2 (26)
27P5			12 05 (306)								59 4 (27)
2011	11 8 (300)	23.62 (600)	11 57 (294)	9.84 (250)	22.83 (580)	11 94 (303)	10 94 (278)	8 15 (207)	M8	M8	79.2 (36)
2015											85.8 (39)
2018	14 17 (360)		13 7 (348)	11 8 (300)		14 25 (362)	13 98 (355)	9 45 (240)			105 6 (48)
2022	16 54 (420)			14.57 (370)		11 50 (292)	6 30 (160)				129 8 (59)
2030	18.50 (470)	27 56 (700)	14 49 (368)	13 78 (350)	26.77 (680)	12 08 (307)	4 80 (122)				156.2 (71)
2037											158 4 (72)

Fig. 2.3 Dimensions of 200 V Class Inverter Series

(2) 400 V Class

• Open Chassis Type

• Heat Sink External Intercooling Type



In inch (mm)

Model CIMR-R3A□□□	W	H	D	WI	HI	A	B	C	MA	MB	Approx Weight lb (kg)
47P5	9.84 (250)	18 5 (470)	12.05 (306)	7.87 (200)	17.91 (455)	10 04 (255)	8 27 (210)	8 66 (220)	M6	M5	59 4 (27)
4011	11 8 (300)	23 62 (600)	11 57 (294)	9 84 (250)	22 83 (580)	11 94 (303)	10 94 (278)	8 15 (207)	M8	M8	79.2 (36)
4015											85 5 (39)
4018	14 17 (360)		13 70 (348)	11 8 (300)		14 25 (362)	13.98 (355)	9.45 (240)			105 6 (48)
4022	16.54 (420)			14 57 (370)		11.50 (292)	6.30 (160)				121 2 (55)
4030	18 50 (470)	27 56 (700)	13 78 (350)	13.78 (350)	26 77 (680)	12 08 (307)	4.80 (122)				156 2 (71)
4037											158 4 (72)
4045			13.70 (348)			12.05 (306)					154 0 (70)

Fig. 2.4 Dimensions of 400 V Class Inverter Series

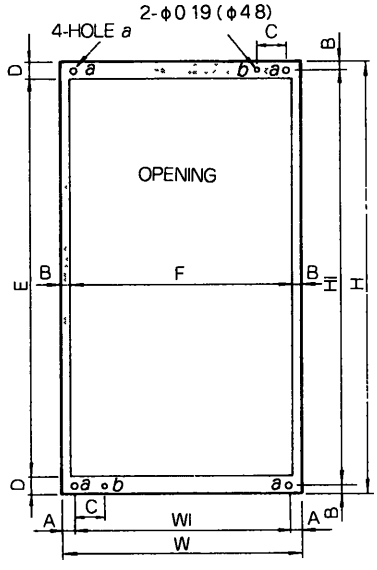
2.3.4 Dimensions in inch (mm) (Cont'd)

(3) To Use an External Heat Sink

(a) Drilling in the Panel

Cut out the panel as shown in Fig. 2.5. (below)

Line the hatched area with packing to prevent entry of dust.



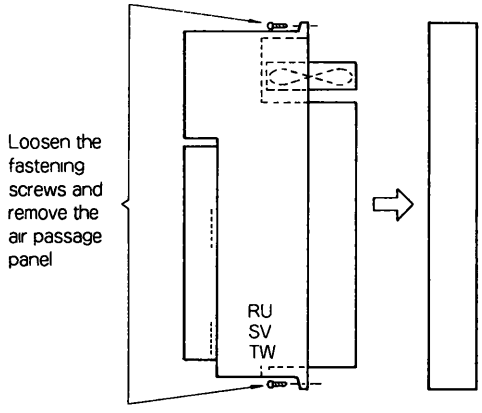
In inch (mm)

Model CIMR-□□□R3 \ Size	W	WI	H	HI	A	B	C	D	E	F	Hole a
23P7 25P5 27P5	9 84 (250)	8 86 (225)	18 50 (470)	17 91 (455)	0 19 (12 5)	0 30 (7 5)	1 18 (30)	0 59 (15)	17 32 (440)	9 21 (234)	φ0 28 (φ7)
2011 2015	11 8 (300)	10 83 (275)	23 62 (600)	22.83 (580)	0 49 (12 5)	0 39 (10)	1 18 (30)	0 79 (20)	22 01 (560)	11 8 (284)	φ0 39 (φ10)
2018	14 17 (360)	13 19 (335)	23 62 (600)	22 83 (580)	0 49 (12 5)	0 39 (10)	1 38 (35)	0 79 (20)	22 04 (560)	13 54 (344)	φ0 39 (φ10)
2022	16 54 (420)	15 55 (395)	23.62 (600)	22 83 (580)	0 49 (12 5)	0 39 (10)	1 18 (30)	0 79 (20)	22 01 (560)	15 91 (404)	φ0 39 (φ10)
2030 2037	18 50 (470)	13 78 (350) 16 54 (420)	27 56 (700)	26 77 (680)	0 98 (25)	0 39 (10)	0 69 (17 5)	0 79 (20)	25 98 (660)	17 87 (454)	φ0 39 (φ10)
47P5	9 84 (250)	8 86 (225)	18 50 (470)	17 91 (455)	0 49 (12 5)	0 29 (7 5)	1 18 (30)	0 59 (15)	17.32 (440)	9 21 (234)	φ0 28 (φ7)
4011 4015	11 8 (300)	10 83 (275)	23 62 (600)	22 83 (580)	0 49 (12 5)	0 39 (10)	1 18 (30)	0 79 (20)	22 04 (560)	11 18 (284)	φ0 39 (φ10)
4018	14 17 (360)	13 19 (335)	23 62 (600)	22 83 (580)	0 49 (12 5)	0 39 (10)	1 38 (35)	0 79 (20)	22 04 (560)	13 54 (341)	φ0 39 (φ10)
4022	16 54 (420)	15 55 (395)	23 62 (600)	22 83 (580)	0 49 (12 5)	0 39 (10)	1 18 (30)	0 79 (20)	22 04 (560)	15 91 (101)	φ0 39 (φ10)
4030 4037 4045	18 50 (470)	16 54 (420) 13.78 (350)	27 56 (700)	26 77 (680)	0 98 (25) 2 36 (60)	0 39 (10)	0 69 (17 5)	0 79 (20)	25 98 (660)	17 87 (151)	φ0 39 (φ10)

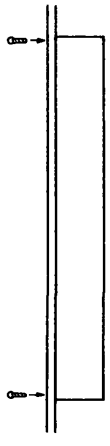
Fig. 2.5 Panel Drilling Dimensions

(b) Installation

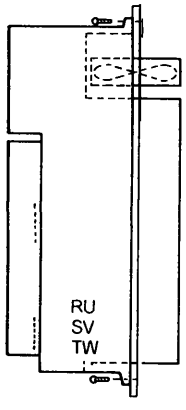
① Loosen the four fastening screws on the corners of the inverter and remove the air passage panel. Also loosen the two fastening screws at position *b* in Fig. 2.5.



② Fasten the air passage panel to the control panel with the two fastening screws at positon *b* in Fig. 2.5.



③ Mount the inverter in the hole, and fasten with the four fastening screws.



2.4 WIRING

The following shows a connection diagram of the main circuit and control circuit. Connection 1CN to 3CN for control signal are option.

2.4.1 Standard Connection Diagram

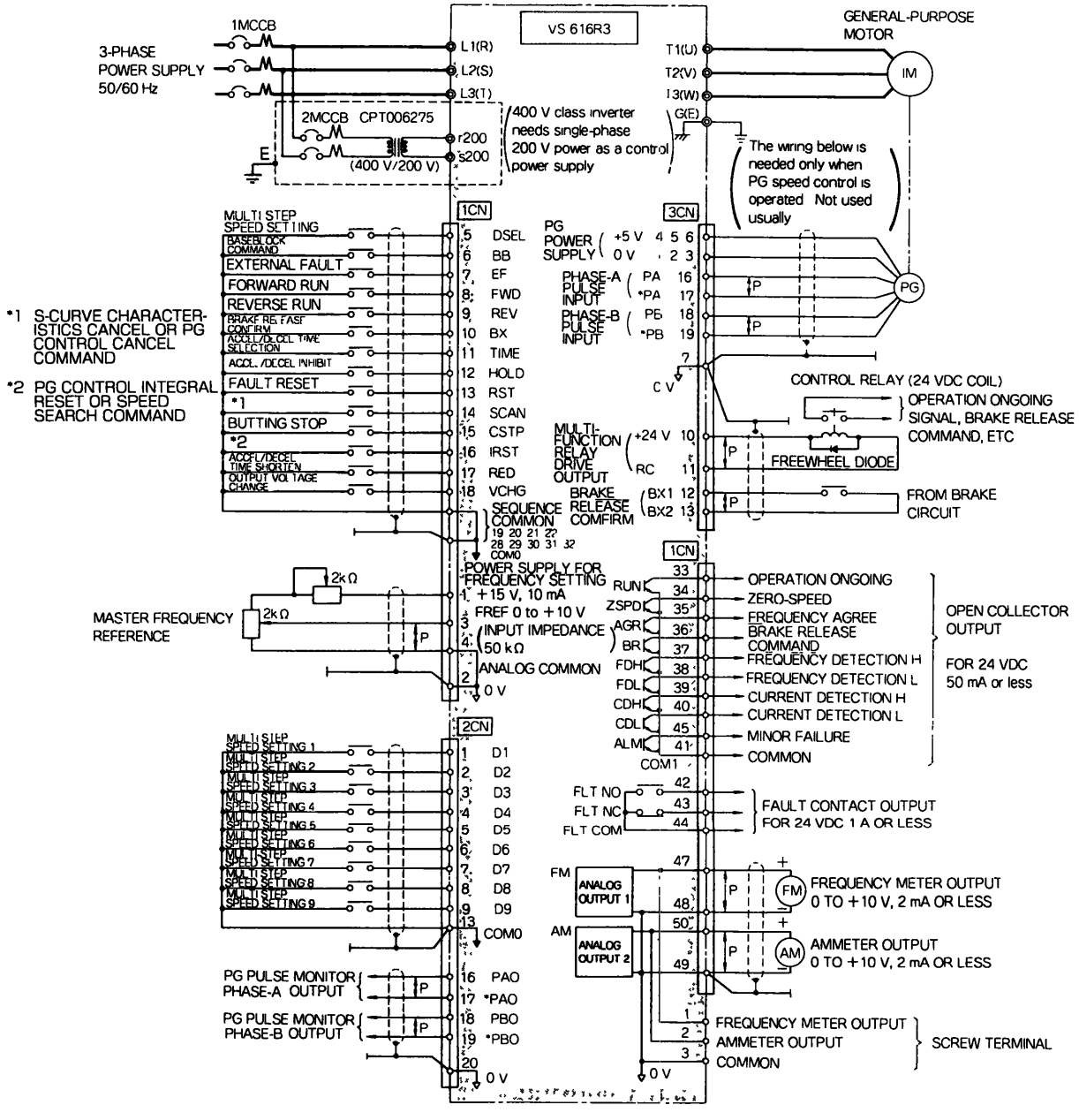


Fig. 2.6 Standard Connection Diagram

Notes :

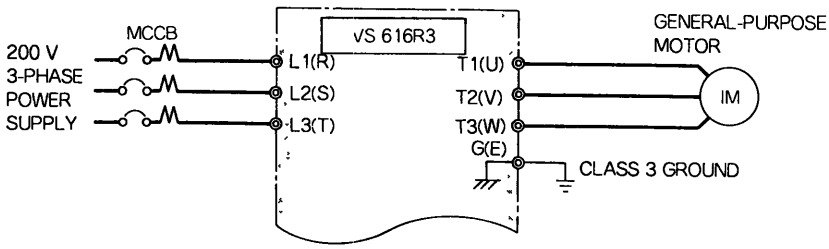
1.  *indicates shielded leads and*  *twisted-pair shielded leads.*
2. ◎ *indicates terminals for main circuit and* ○ *terminals for control circuit.*
3. *The following is needed as connectors for control circuit.*
   1CN : MR-50LFG (50-pin)
   2CN : MR-20LMG (20-pin) } *Made by Honda Tsushin Co., Ltd.*
   3CN : MR-20LFG (20-pin)
4. *Be sure to use 24 VDC power supply for open collector output and fault contact output (1CN-33 to -45).*
5. *Multi-function relay drive output (3CN-10 and -11) can be connected with only control relay (24 VDC coil). Ex : MY-2, 24 V coil (Made by OMRON Corporation), etc.*
6. *If a pulse generator (PG) is to be used, select a line-driver type complying with RS-244-A specifications. For details, see Par. 2.4.3-(6).*
7. *Use shielded wire for all the wiring. Wire common (COM0 or 0V) for each connector individually avoiding to connect multiple connectors to one common since the wirings are more subject to noise.*

2.4.2 Main Circuit

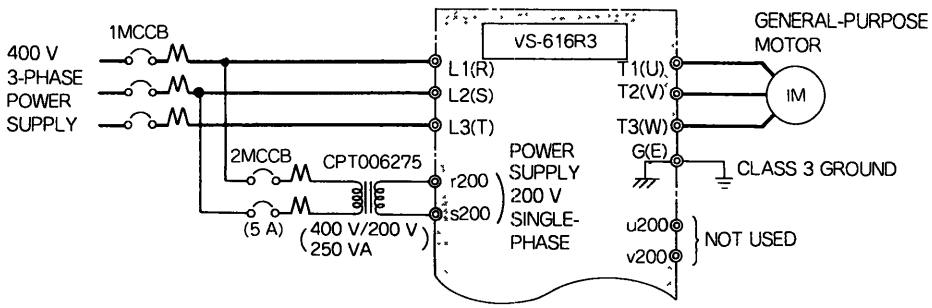
(1) Main Circuit Wiring

For a 200 V class inverter, prepare a 200 V three-phase power supply. For a 400 V class inverter, prepare a 400 V three-phase power supply and a 200 V single-phase power supply (for control).

(200 V Class)



(400 V Class)



Notes :

1. ***Terminals u200 and v200 are not used. Do not connect to anything.***
2. ***The control and main circuit power supplies must be turned ON and OFF at the same time.***

Fig. 2.7 Main Circuit Wiring

(2) Main Circuit Terminals

Table 2 1 Main Circuit Terminals

Terminal Symbol	Function
L1 (R)	For main circuit power supply input 3-phase
L2 (S)	
L3 (T)	
r200	For control power supply input of 400 V class inverter (200 V, single-phase)
s200	
T1 (U)	For motor connection 3-phase
T2 (V)	
T3 (W)	
G (E)	For grounding (class 3 ground ground resistance 100Ω or less)

Note · *Do not connect control wiring to t200 terminals installed to 400 V 37 kW or more*

(3) Molded-case Circuit Breaker (MCCB) and Power Supply Magnetic Contactor (MC)

Be sure to connect MCCBs between power supply and VS-616R3 input terminals L1 (R), L2 (S), L3 (T). Recommended MCCBs are listed in Table 2.2.

When a ground fault interrupter is used, select the one with no influence for high frequency, or setting current should be 200 mA or over and operating time, 0.1 sec or over to prevent malfunction.

(Exmaple)

- Mitsubishi Electric NV series (manufactured in 1988 and after)
- Fuji Electric EG, SG series (manufactured in 1984 and after)

For a 400 V class inverter, also connect a magnetic circuit breaker (NF-30, 5 A) for protecting the control power supply and transformer. (This is not necessary for 200 V class inverters.)

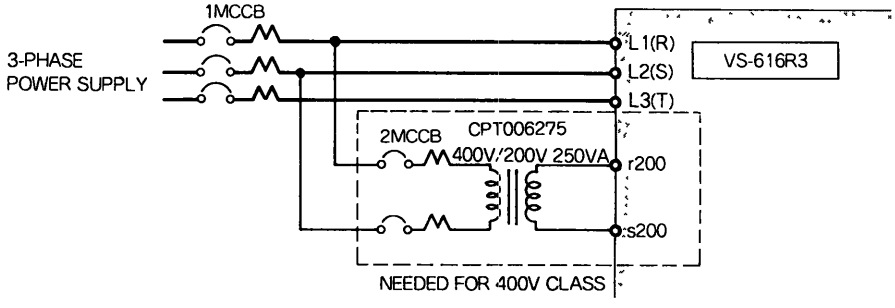


Fig. 2.8 Wiring Diagram of Molded-case Breakers

Table 2 2 Molded-case Circuit Breakers and Magnetic Contactors

200 V Class

VS-616R3	Model CIMR-	R3A23P7	R3A25P5	R3A27P5	R3A2011	R3A2015	R3A2018	R3A2022	R3A2030	R3A2037
	Capacity kVA	5.0	8.5	12.6	17 1	25 2	34	42	50	69
	Rated Output Current A	13 2	22.2	33.0	45.0	66.1	90.1	111 1	132 1	180.2
Mitsubishi Electric Molded-case Circuit Breakers Model and Rated Current A		NF30 , 30 A	NF50 ; 50 A	NF100 ; 60 A	NF100 ; 100 A	NF100 ; 100 A	NF225 , 150 A	NF225 ; 150 A	NF225 ; 225 A	NF225 ; 225 A
YASKAWA Magnetic Contactors Model		HI-20E	HI-30E	HI-50E	HI-50E	HI-80E	HI-100E	HI-100E	HI-100E	HI-200E

400 V Class

VS-616R3	Model CIMR-	R3A47P5	R3A4011	R3A4015	R3A4018	R3A4022	R3A4030	R3A4037	R3A4045
	Capacity kVA	12 6	17 1	25 1	34	42	50	69	85
	Rated Output Current A	16 5	22 5	33 0	45.0	55 6	66 1	90 1	111.0
Mitsubishi Electric Molded-case Circuit Breakers Model and Rated Current A		NF30 , 30 A	NF50 , 50 A	NF100 , 60 A	NF100 , 75 A	NF100 , 100 A	NF100 , 100 A	NF225 , 150 A	NF225, 150 A
YASKAWA Magnetic Contactors Model		HI-20E	HI-30E	HI-50E	HI-50E	HI-50E	HI-80E	HI-100E	HI-100E

2.4.2 Main Circuit (Cont'd)

(4) Surge Suppressor

For the surge suppressors should be connected to the coils of relays, magnetic contactors, magnetic valves, or magnetic relays. Otherwise, high surge voltage may be produced when the circuit is closed or opened, resulting in malfunction and damage to equipment. Select type from Table 2.3.

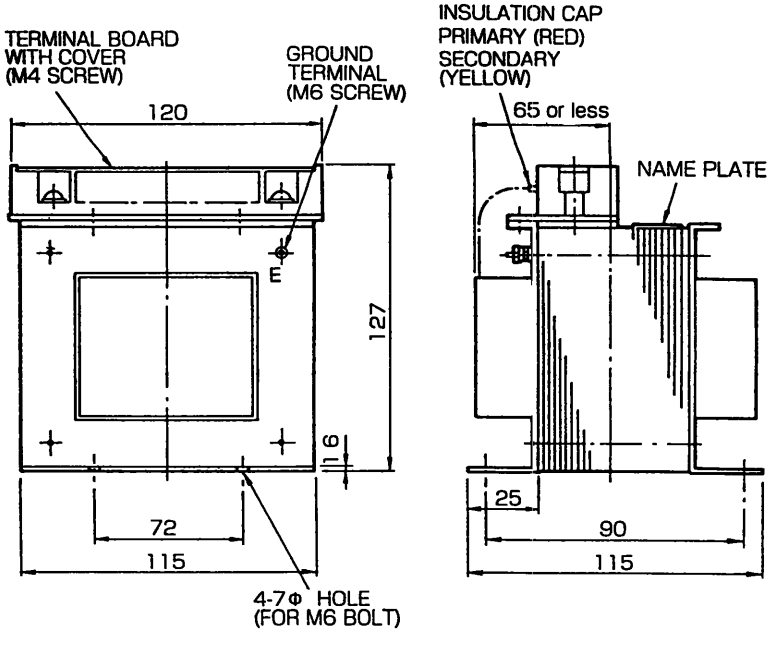
Table 2 3 Surge Suppressors

Coils of Magnetic Contactor and Control Relay		Surge Suppressor*		
		Model	Specifications	YASKAWA Code No.
200 to 230 V	Large-size Magnetic Contactors	DCR2-50A22E	250 VAC 0.5 μF +200Ω	C002417
	Control Relay MY-2, -3 (OMRON) HH-22, -23 (Fuji) MM-2, -4 (OMRON)	DCR2-10A25C	250 VAC 0.1 μF +100Ω	C002482
380 to 460 V Units		DCR2-50D100B	1000 VDC 0.5 μF +220Ω	C002630

* Made by MARCON Electronics.

(5) Transformer for Control Power Source

Control power source transformer is necessary for 400 V class inverter. Connect transformer CPT-006275, whose outside dimension is shown below, following Fig. 2.8 (Wiring Diagram of Molded-case Breakers).



Outside Dimension of Control Power Source Transformer (CPT-006275)

(6) Wire and Terminal Screw Sizes

The wire sizes and types are shown in Tables 2.4 and 2.5. Refer to Table 2.6 for the placement of the closed-loop connectors.

Table 2.4 Wire Size (200 V Class)

Circuit	VS-616R3 Model	Inverter Capacity kVA	Terminal Symbol	Terminal Screw	Wire Size mm²	Wire Type
Main	CIMR-R3A23P7	5.0	ⓇⓈⓉⓊⓋⓌ	M5	3.5 to 5.5	Power cable, 600 V vinyl sheathed wire or equivalent
			ⓔ		2 to 5.5	
	CIMR-R3A25P5	8.5	ⓇⓈⓉⓊⓋⓌ	M5	5.5 to 8	
			ⓔ		2 to 5.5	
	CIMR-R3A27P5	12.6	ⓇⓈⓉⓊⓋⓌ	M5	5.5 to 8	
			ⓔ		2 to 5.5	
	CIMR-R3A2011	17.1	ⓇⓈⓉⓊⓋⓌ	M8	8 to 14	
			ⓔ		2 to 5.5	
	CIMR-R3A2015	25.2	ⓇⓈⓉⓊⓋⓌ	M8	8 to 22	
			ⓔ		2 to 5.5	
	CIMR-R3A2018	34	ⓇⓈⓉⓊⓋⓌ	M8	22 to 38	
			ⓔ		2 to 5.5	
	CIMR-R3A2022	42	ⓇⓈⓉⓊⓋⓌ	M8	22 to 38	
			ⓔ		2 to 5.5	
	CIMR-R3A2030	50	ⓇⓈⓉⓊⓋⓌ	M8	38 to 100	
			ⓔ		2 to 5.5	
	CIMR-R3A2037	69	ⓇⓈⓉⓊⓋⓌ	M8	38 to 100	
			ⓔ		2 to 5.5	
Control	Common to all models		1CN	MR-50LFG*		Twisted-pair shielded leads
			2CN	MR-20LMG*		
			3CN	MR-20LFG*		

* Made by Honda Tsushin Co., Ltd.

IMPORTANT

Wire size should be determined considering voltage drop. Voltage drop is obtained by the following equation : select the size so that voltage drop will be less than 2% the normal rated voltage.

$$\text{Phase-to-phase voltage drop (V)} = \sqrt{3} \times \text{wire resistance } (\Omega/\text{km}) \times \text{wiring distance (m)} \times \text{current (A)} \times 10^{-3}$$

2.4.2 Main Circuit (Cont'd)

Table 2 5 Wire Size (400 V Class)

Circuit	VS-616R3 Model	Inverter Capacity kVA	Terminal Symbol	Terminal Screw	Wire Size mm²	Wire Type
Main	CIMR-R3A47P5	12.6	ⓇⓈⓉⓊⓋⓌ	M5	3 5 to 5.5	Power cable . 600 V vinyl sheathed wire or equivalent
			Ⓔ		2 to 5 5	
			r200 s200	M4	0 5 to 2	
	CIMR-R3A4011	17 1	ⓇⓈⓉⓊⓋⓌ	M8	5 5 to 8	
			Ⓔ		2 to 5.5	
			r200 s200	M4	0.5 to 2	
	CIMR-R3A4015	25 1	ⓇⓈⓉⓊⓋⓌ	M8	5 5 to 8	
			Ⓔ		2 to 5.5	
			r200 s200	M4	0 5 to 2	
	CIMR-R3A4018	34	ⓇⓈⓉⓊⓋⓌ	M8	8 to 14	
			Ⓔ		2 to 5 5	
			r200 s200	M4	0.5 to 2	
	CIMR-R3A4022	42	ⓇⓈⓉⓊⓋⓌ	M8	8 to 14	
			Ⓔ		2 to 5 5	
			r200 s200	M4	0.5 to 2	
	CIMR-R3A4030	50	ⓇⓈⓉⓊⓋⓌ	M8	22 to 38	
			Ⓔ		2 to 5.5	
			r200 s200	M4	0 5 to 2	
	CIMR-R3A4037	69	ⓇⓈⓉⓊⓋⓌ	M8	22 to 38	
			Ⓔ		2 to 5 5	
			r200 s200		0.5 to 2	
	CIMR-R3A4045	85	ⓇⓈⓉⓊⓋⓌ	M8	22 to 38	
			Ⓔ		2 to 5.5	
			r200 s200	M4	0.5 to 2	
Control	Common to all models		1CN	MR-50LFG*		Twisted-pair shielded leads
			2CN	MR-20LMG*		
			3CN	MR-20LFG*		

* Made by Honda Tsushin Co , Ltd

Table 2.6 Closed-loop Connectors

Wire Size		Terminal Screw	Closed-loop Connectors
AWG	mm²		
20	0.5	M3 5 M4	1.25-3.5 1 25-4
18	0.75		
16	1.25		
14	2	M4	2-4
		M5	2-5
12	3.5	M4	3.5-4
		M5	3 5-5
10	5.5	M4	5 5-4
		M5	5.5-5
8	8	M5	8-5
		M6	8-6
6	14	M6	14-6
4	22	M8	22-8
2	38	M8	38-8
2	38	M10	38-10
1/0	60		60-10
3/0	80		80-10
4/0	100		100-10

(7) Main Circuit Wiring

(a) Main circuit input/output

① Phase rotation of input terminals L1 (R), L2 (S), L3 (T) is available in either direction, clockwise and counterclockwise.

② When inverter output terminals T1 (U), T2 (V), and T3 (W) are connected to motor terminals T1 (U), T2 (V), and T3 (W), respectively, motor rotates counterclockwise, viewed from opposite drive end, upon forward operation command. To reverse the rotation interchange any two of motor leads.

③ Never connect AC main circuit power supply to output terminals T1 (U), T2 (V), and T3 (W). Otherwise the inverter may be damaged.

④ Care should be taken to prevent contact of wiring leads with VS-616R3, cabinet, for short-circuit may result.

⑤ When a noise filter is needed for the output side of VS-616R3, connect L-noise filter. Never connect phase advancing capacitor, LC- or RC-noise filter.

⑥ Be sure to fasten the main circuit terminals with screws.

⑦ To prevent an erroneous operation, be sure to separate the main circuit wiring from the control lines of inverter and peripheral equipments.

2.4.2 Main Circuit (Cont'd)

(b) Grounding

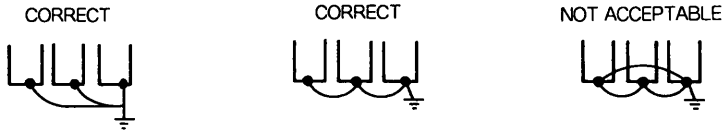
Ground the casing of the VS-616R3 using ground terminal G (E).

① Ground resistance should be 100 Ω or less.

② Never ground VS-616R3 in common with welding machines, motors, and other large-current electrical equipment, or ground pole. Run the ground lead in a separate conduit from leads for large-current electrical equipment.

③ Use the ground leads which comply with AWG standards and make the length as short as possible.

④ Where several VS-616R3 units are used side by side, all the units should preferably be grounded directly to the ground poles. However, connecting all the ground terminals of VS-616R3 in parallel, and ground only one of VS-616R3 to the ground pole is also permissible (Fig.2.9). However, do not form a loop with the ground leads.



(a) (b) (c)

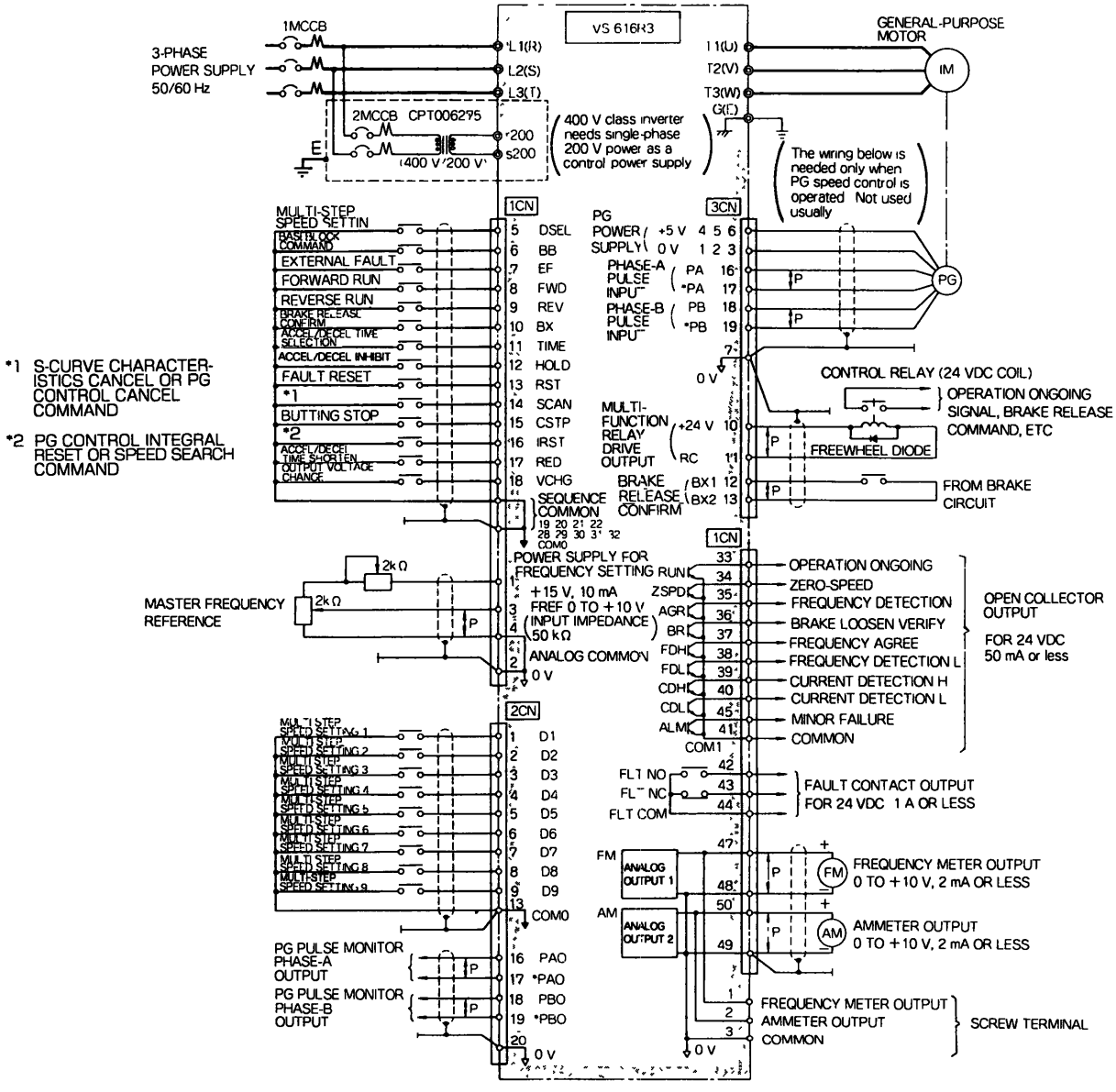
Fig. 2.9 Grounding of Three VS-616R3 Units

2.4.3 Control Circuit

(1) Wiring of the Control Circuit

A connector (option) is used to input and output control signals.

The signal voltage must be 24 VDC or lower. Fig. 2.10 shows the connector pins and the corresponding input and output signal names. Screw terminals can be used by using the screw terminal conversion option. For details, see Appendix 1.2.



Notes :

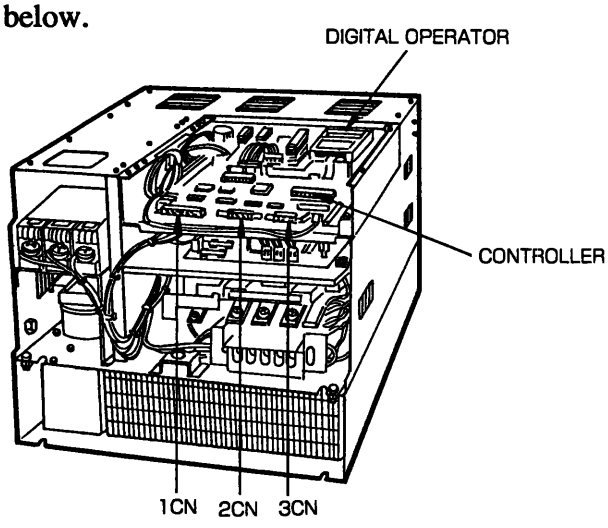
1. *indicates shielded leads and twisted-pair shielded leads.*
2. *◎ indicates terminals for main circuit and ○ indicates terminals for control circuit.*
3. *The following is needed as connectors for control circuit.*
   1CN : MR-50LFG (50-pin)
   2CN : MR-20LMG (20-pin) } *Made by Honda Tsushin Co., Ltd.*
   3CN : MR-20LFG (20-pin)
4. *Be sure to use 24 VDC power supply for open collector output and fault contact output (1CN-33 to -45).*
5. *Multi-function relay drive output (3CN-10 and -11) can be connected with only control relay (24 VDC coil). Ex : MY-2, 24 V coil (Made by OMRON Corporation), etc.*
6. *If a pulse generator (PG) is to be used, select a line-driver type complying with RS-244-A specifications. For details, see Par. 2.4.3-(6).*
7. *Use shielded wire for all the wiring. Wire common (COM0 or 0V) for each connector individually avoiding to connect multiple connectors to one common since the wirings are more subject to noise.*

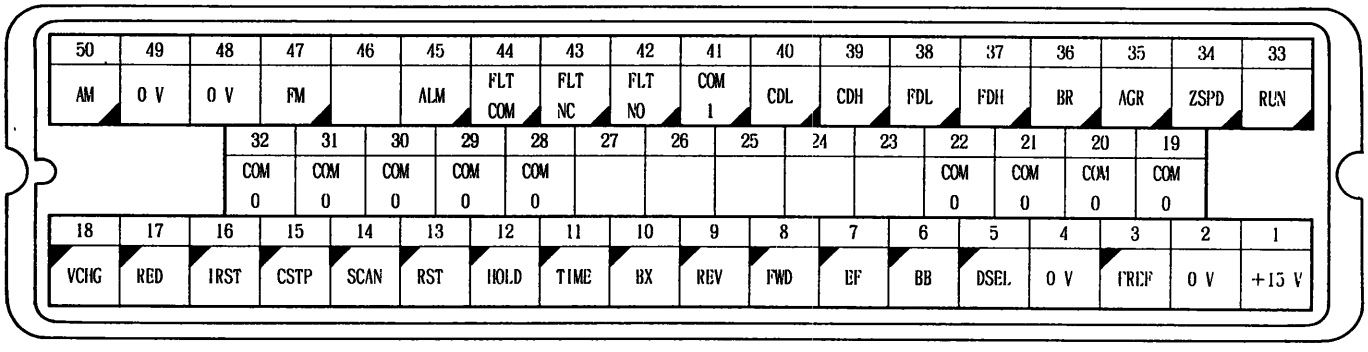
Fig. 2.10 Wiring of Control Circuit

2.4.3 Control Circuit (Cont'd)

(2) Pin Arrays of Control Signal Connectors

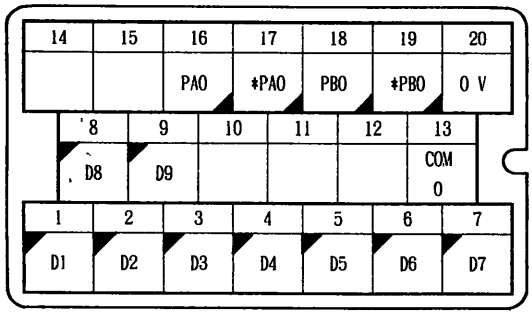
Fig. 2.11 shows the pin arrays of the connectors to the board viewed from below.





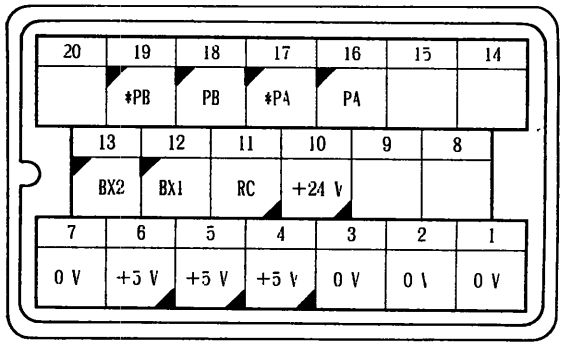
Connectors to the Board : MR-50RMAG
Connectors to the Cable · MR-50LF(G)

(a) Controller 1CN



Connectors to the Board : MR-20RFAG
Connectors to the Cable : MR-20LM(G)

(b) Controller 2CN



Connectors to the Board : MR-20RMAG
Connectors to the Cable : MR-20LF(G)

(c) Controller 3CN

Notes :

1. ☐marks input signals to the inverter. ☐marks output signals from the inverter.
2. 2CN and 3CN signals marked with * are inverted signals.
3. Brank pins are not used. Do not connect anything.

Fig. 2.11 Pin Arrays of Connectors

(3) Connectors

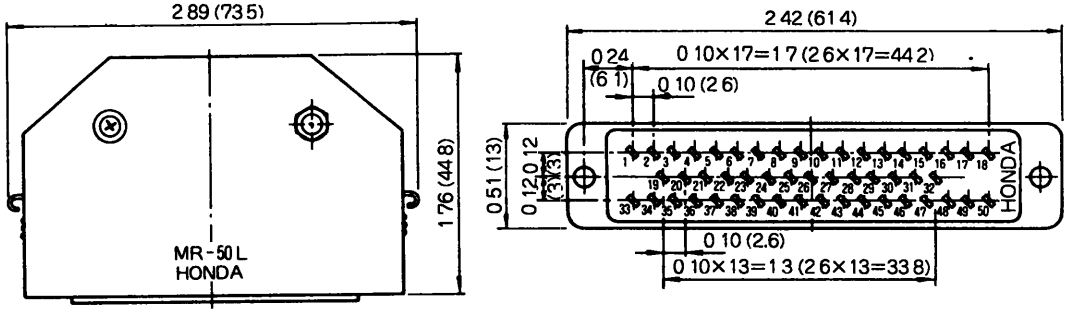
Fig. 2.12 shows the specifications, type, and dimensional diagram of the connectors. For information about the screw terminal conversion option, see Appendix 1.2.

(a) Specifications (Soldered type) ····· Manufactured by Honda Tsushin

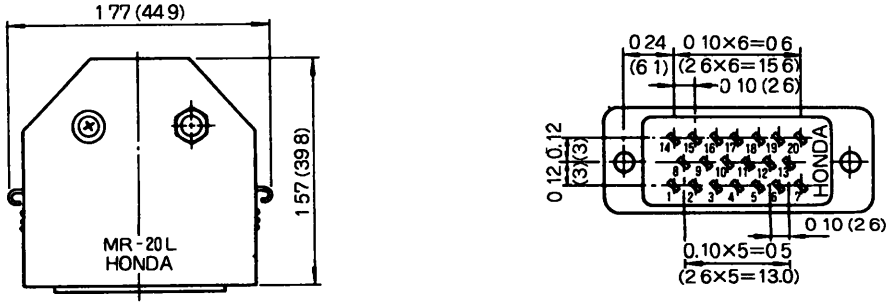
- Threshold current : 0.5 mA
- Contact material : Brass (male pin), phosphor bronze (female pin)
- Surface treatment : Precoated with nickel and goldplated on the surface (marked by "G" at the end of the type name)
- Insulator material : Diallyl phthalate resin
- Case material : ABS resin

(b) Dimensions in inches (mm)

① MR-50LFG (50 pins) ····· For 1CN



② MR-20LMG (20 pins) ····· For 2CN



③ MR-20LFG (20 pins) ····· For 3CN

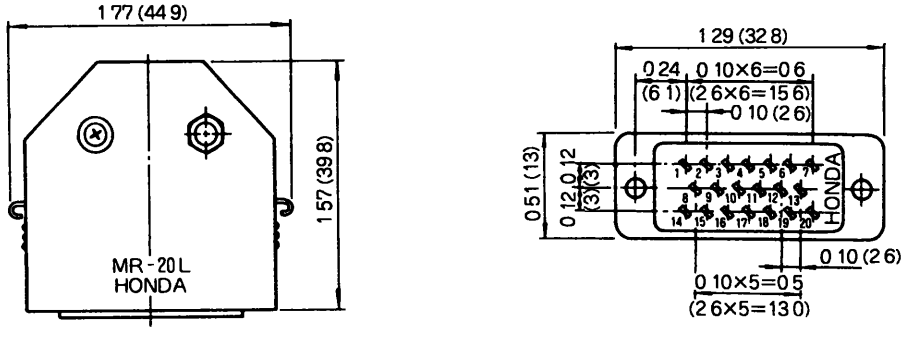


Fig. 2.12 Dimension Diagram

2.4.3 Control Circuit (Cont'd)

(4) Control Signals

Table 2.7 Control Signals (1CN)

Classification	Terminal No	Symbol	Name	Description	Signal Level	Constants	Page
Analog Input Signal	1	+15 V	Frequency Setup Power Supply	Frequency setup −15 V power supply	+15 V load power supply 10 mA or lower	Sn-04	66, 76
	2	0 V	Analog Common	Shielded wire connection	—		
	3	FREF	Frequency Reference	0 V to +10 V/0 Hz to maximum output frequency	0 V to +10 V (input impedance 50kΩ)		
	4	0 V	Analog Common	Command common	—		
Sequence Input Signal	5	DSEL	Multi-speed Command Enable	OFF : Analog frequency reference (1CN-3) or frequency reference from the digital operator is used. ON : Multi-speed commands (2CN-1 to -9) are used	24VDC current in. ON state is 5 mA	An-01 to -09 Sn-01 -05	68
	6	BB	External Base Block	OFF . Inverter is operable ON : Inverter output is shut down		Sn-05	77
	7	EF	External Fault	ON : Inverter output is shut down and fault contact output is output. Operation is impossible		Sn-08	80
	8	FWD	Forward Operation	OFF : Stop ON · Forward operation (Effective only after the inverter is charged)		Sn-01	66, 76
	9	REV	Reverse Operation	OFF Stop ON . Reverse operation (Effective only after the inverter is charged.)		Sn-04	66, 76
	10	BX	Brake Release Check	OFF Brake close is checked ON : Brake release is checked (Exclusively for cranes)		Sn-03 Cn-70 to -80	41 49 78
	11	TIME	Accel/decel Time Selection	OFF : Accel/decel will be according to settings in bn-01 to -03 ON : Accel/decel will be according to settings in bn-04 to -06		bn-01 to -06 bn-12	70
	12	HOLD	Accel/decel Prohibit	OFF : Accel/decel is enabled. ON : Accel/decel is disabled. (Preset output will be retained)			
	13	RST	Fault Reset	ON : Fault reset (Invalid when FWD or REV is ON.)			
	14	SCAN	S-curve Characteristics Cancel	OFF : S-curve characteristic (bn-03,-06) is valid. ON : S-curve characteristic is invalid (S-curve time is 0.0 s) When Sn-10 fourth digit = 1, PG control cancel is commanded. (Able for P-ROM No. NSN618015 and after) OFF : PG control functions (Closed loop) ON : PG control does not function (Open loop)		bn-03, -06	70
	15	CSTP	Butting Stop	ON : Perform butting stop operation at stopping (Exclusive to cranes)		Sn-03 Cn-70 to -80	39, 75 78
	16	IRST	PG Control Integration Reset	OFF . PI operation for PG control ON · P operation for PG control (Valid only when PG is used) When Sn-10 second digit = 1, speed search is commanded (Able for P-ROM NO NSN618012 and after)		Sn-11 Cn-43 to -52	39 81 92

* For additional functions by P−ROM number version-up, see APPENDIX A5

Table 2 7 Control Signals (1CN) (Cont'd)

Classification	Terminal No	Symbol	Name	Description	Signal Level	Constants	Page
Sequence Input Signal	17	RED	Accel/decel Time Reduction	OFF Accel/decel will be according to settings in bn-01 to -06 ON . Accel/decel will be speeded up by a factor of bn-12	24VDC current in, ON state is 5 mA	bn-01 to -06 bn-12	70
	18	VCHG	Output Voltage Change	OFF . Output voltage complies to set values in Cn-02 to 08 ON Output voltage is changed by a factor of bn-13.		Cn-02 to -08 bn-13	73 74 83
	19 to 22 28 to 32	COM 0	Sequence Input Common	For sequence input signal common and shielded wire connection			
Sequence Output Signal	33	RUN	Operation Ongoing	ON Operation is ongoing	Open collector outputs, exclusive to 24 VDC circuit, load current must be 50 mA or lower	Sn-13	83
	34	ZSPD	Zero Speed	ON Zero speed is being applied (The inverter output is lower than the set value in Cn-07, or the inverter is stopped)		Sn-13 Cn-07	83
	35	AGR	Frequency Agreed	ON Actual and commanded frequencies agree (Commanded value − (Cn-23) ≦ Output frequency ≦ Commanded value + (Cn-23))		Sn-13 Cn-23	83 87
	36	BR	Brake Release Command	OFF . Brake is closed (Exclusive to cranes) ON Brake is released		Sn-03 -13 Cn-70 to -80	41, 49 79, 83
	37	FDH	Frequency Detection H	ON · Output frequency ≧ Cn-21 (at hysteresis of Cn-23)		Sn-13 Cn-21, -23	83 87
	38	FDL	Frequency Detection L	ON Output frequency ≦ Cn-22 (at hysteresis of Cn-23)		Sn-13 Cn-22, -23	83 87
	39	CDH	Current Detection H	ON Output current ≧ Cn-24 (detected for time Cn-26)		Sn-13 Cn-24, -26	83 88
	40	CDL	Current Detection L	ON Output current ≦ Cn-25 (detected for time Cn-26)		Sn-13 Cn-25, -26	83 88
	45	ALM	Minor Failure	ON . Minor failure has occurred (Automatically reset when the failure condition clears)		Sn-7, -8 Sn-11	79 ~
	41	COM 1	Sequence Output Common	For sequence output signal common			
Fault Contact Output	42	FLT NO	Fault Contact Output	Between 42 and 44 is closed at fault Between 43 and 44 is opened at fault	Fault contact outputs, exclusive to 24 VDC circuit, load current must be 1 A or lower	Sn-6 to -9 Sn-11	78 81
	43	FLT NC					
	44	FLT COM					
Analog Output Signal	47	FM	Frequency Meter Output	0 V to +10 V/0 Hz to maximum output frequency	0 V to +10 V, load current must be 2 mA or lower	bn-14	75
	48	0 V	Analog Common	For frequency meter common	—		
	50	AM	Ammeter Output	0 V to +10 V/0% to 200% of inverter rated current	0 V to - 10 V, load current must be 2 mA or lower	bn-15	75
	49	0 V	Analog Common	For ammeter common and shielded wire connection	—		

* For additional functions by P-ROM number version-up see APPENDIX A5

2.4.3 Control Circuit (Cont'd)

Table 2.8 Control Signals (2CN)

Classification	Terminal No.	Symbol	Name	Description	Signal Level	Constants	Page
Sequence Input Signal	1	D1	Multi-step Speed 1	Frequency command is selected from An-01 to -09 according to a combination of input multi-speed commands.	24VDC current in, ON state is 5 mA	An-01 to -09 Sn-04, 05	68
	2	D2	Multi-step Speed 2				
	3	D3	Multi-step Speed 3				
	4	D4	Multi-step Speed 4				
	5	D5	Multi-step Speed 5				
	6	D6	Multi-step Speed 6				
	7	D7	Multi-step Speed 7				
	8	D8	Multi-step Speed 8				
	9	D9	Multi-step Speed 9				
	13	COM 0	Sequence Input Common	Sequence input signal common and shielded wire connection			
PG Pulse Monitor Signal	16	PAO	PG Pulse Monitor Output Phase-A	Phase-A pulse monitor output when PG is used	Line-driver complying with RS-422A specifications	Sn-11 Cn-43, -52	39 81 92
	17	*PAO					
	18	PBO	PG Pulse Monitor Output Phase-B	Phase-B pulse monitor output when PG is used			
	19	*PBO					
	20	0 V	Analog Common	For shielded wire connection	—		

Table 2 9 Control Signals (3CN)

Classification	Terminal No.	Symbol	Name	Description	Signal Level	Constants	Page
PG Pulse Input Signal	4, 5, 6	+5 V	+5 V Power Supply for PG	+5 V power supply for PG	+5 V, load current must be 300 mA or lower	Sn-11 Cn-43, -52	39 81 92
	1, 2, 3	0 V	Common for PG Power Supply				
	16	PA	PG Pulse Input Phase-A	Phase-A pulse input when PG is used	Line-receiver complying with RS-422A specifications		
	17	* PA					
	18	PB	PG Pulse Input Phase-B	Phase-B pulse input when PG is used			
	19	* PB					
	7	0 V	Analog Common	For shielded wire connection	—		
Relay Drive Output	10	+24 V	+24 V Power Supply for Relay Drive	Multifunction relay drive outputs [One of sequence outputs (1CN-33 to -40) can be output via a separate relay.]	For driving control mini-relay (MY-2, 24 VDC coil made by OMRON, or equivalent)	Sn-13	83
	11	RC	Relay Drive Signal				
Relay Contact Input	12	BX 1	Brake Release Check Signal	For checking brake release, exclusive to cranes. (The same signal as 1CN-10 ORed with 1CN-10 internally.)	Rleay contact inputs (MY-2 made by OMRON, or equivalent)	Sn-03, -13 Cn-70 to -80	41 52 79
	13	BX 2					

2.4.3 Control Circuit (Cont'd)

(5) Notes on Wiring the Control Circuit

- Separate the control signal cable from the power feeders to prevent malfunctioning.
- Use a shielded wire and carefully terminate the cable ends.

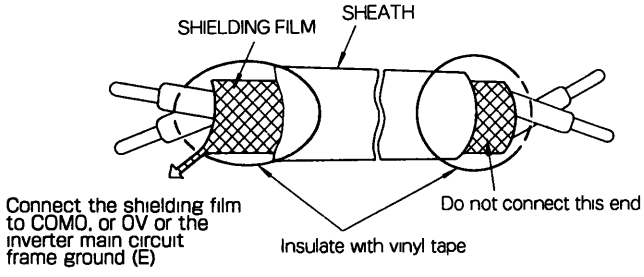


Fig. 2.13 Termination of Shielded Wire

- Wire common line (COM0 or 0V) for every using connecter.
- The control signal cable must be 50 m or shorter.
- If a contact input signal is to be driven by a transistor, use one having 50 V and 50 mA or greater rating. Also suppress circuit leak current so as to make it 100 μ A or lower when the signal is OFF.
- If open collector outputs and/or fault contact outputs are to be used, apply 24 V power. If inductive load (such as relay coils) is to be driven, make sure to insert freewheeling diodes.

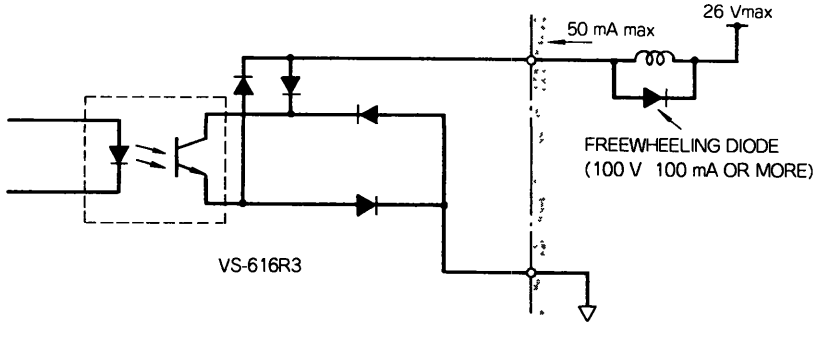


Fig. 2.14 Example of Connecting Freewheeling Diodes

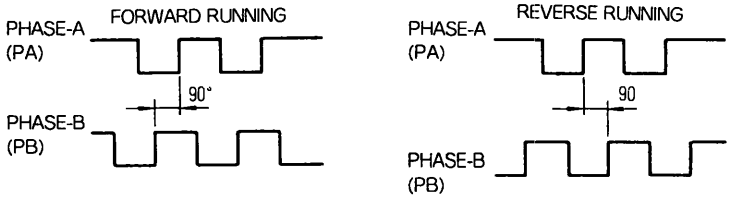
- If multifunctional relay drive outputs are to be used, use control mini-relays (MY-2 manufactured by OMRON Corporation, or equivalent 24 V coils). Be sure to connect freewheeling diodes with their polarities in the proper direction.
- Forward and reverse rotation signals (1CN-8 and -9) take effect after the internal capacitors of the inverter are charged. (If the signals are set ON before power is turned ON, they will have no effect.) Wait about two seconds after turning ON power, then turn ON the forward (or reverse) rotation signal.

(6) Specifications and Wiring when PG Signal is Used

(a) PG Specifications

① Signal Form 90° phase difference, two-phase pulse (Phase-A, -B)

② Output phase

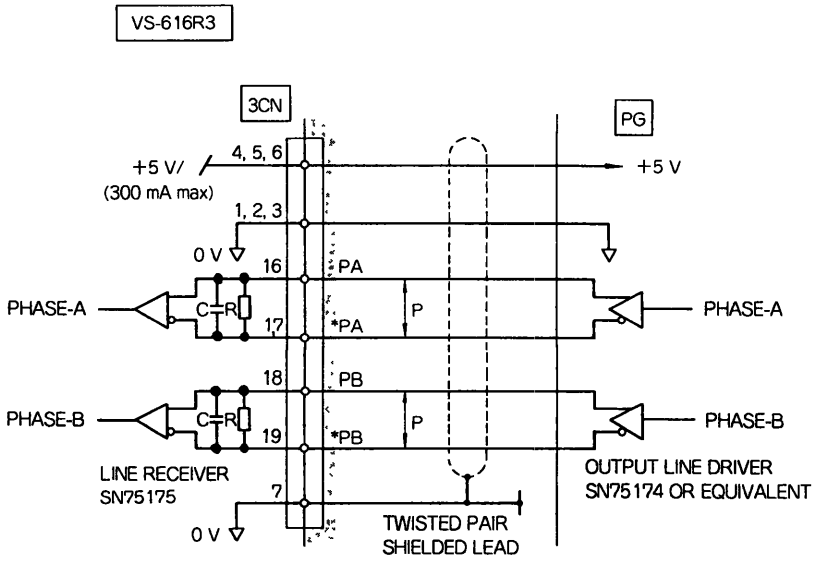


③ PG frequency range 50 to 32767 Hz
(Possible to 100 kHz at most when On-04 first digit = 1 displayed at Sn-03 = 1010 ··· Able for P-ROM No. NSN618015 and after.)
2 to 1092 PULSE/REV at rated speed 1800 r/min
2 to 1310 PULSE/REV at rated speed 1500 r/min

④ PG output circuit Adapted to RS-422-A, line driver

⑤ Power supply for PG +5 V, 300mA max.

(b) Wiring



Notes :

1. *Wiring length of the PG cable should be 20 m or less.*
2. *PG side connectors : prepared by customer*
3. *Use the pulse monitor output (2CN-16 to -19) in accordance with the wiring diagram above.*
   (VS-616R3 side is SN75174 output. R=51 to 200 Ω, C =47 to 220 pF)

Fig. 2.15 Wiring Diagram of PG Signal Circuit

3. BASIC OPERATION SEQUENCE

3.1 OUTLINE AND USE OF FUNCTIONS

VS-616R3 supports two operation sequences as standard. Select either sequence for your purpose. Outline of the functions and their applications are explained below. Determine which is better for your machines.

(1) General-purpose Sequence

Using this sequence, the inverter can be operated or stopped, and its frequency can be modified by just inputting frequency reference and (FWD or REV) operation command, in the same way as using general-purpose inverters available on the market.

[Applications] Winding machines, centrifuges, and testing instruments

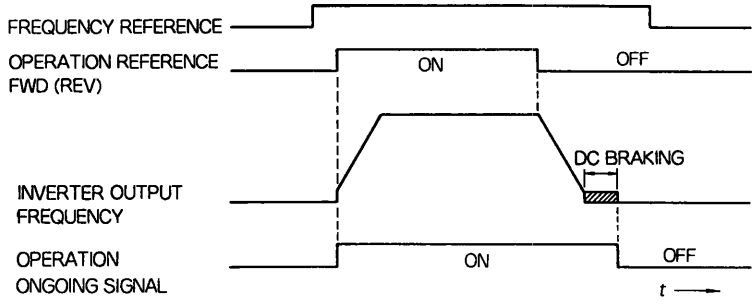


Fig. 3.1 General-use Sequence

(2) Crane Exclusive-use Sequence

At starting and stopping, the inverter operates the locking brake while monitoring generated torque, making it easy to stabilize motor torque to prevent starting failure and slip at stopping. Also, butting stop function is supported for easy positioning.

Some wiring work between the inverter and the holding brake circuit is required to use the crane exclusive-use sequence.

[Applications] Cranes in general, unmanned truck movement

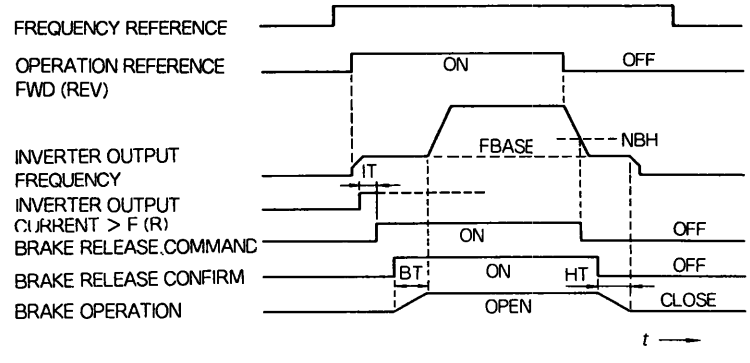


Fig. 3.2 Crane Exclusive-use Sequence

3.2 SELECTING METHOD

To select operation sequences, set up data for system constant Sn-03 as explained below and initialize constants.

- To select general-purpose sequence :

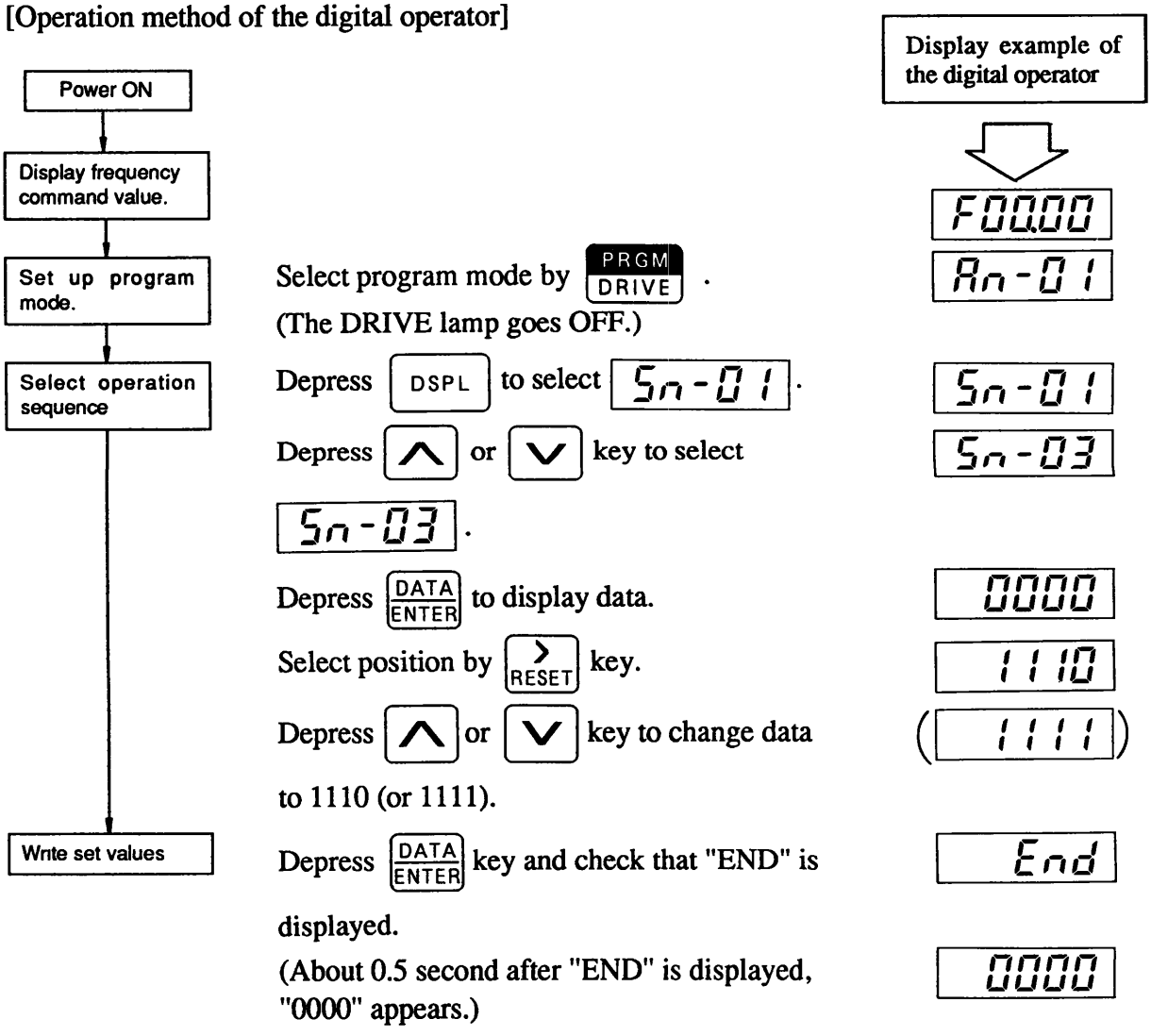
  Set "1110" for Sn-03, and depress [DATA ENTER] key. The operation sequence and constants are initialized to general-purpose settings. General-purpose sequence is preset at the factory.

- To select crane exclusive-use sequence :

  Set "1111" for Sn-03, and depress [DATA ENTER] key. The operation sequence and constants are initialized to crane settings.

After selecting either operation sequence, set up individual constants as needed. After the initialization, all constants other than system constants Sn-01 and -02 are automatically set to the initial values for the selected operation sequence. Troubles may arise from careless initialization. If some settings have been modified already, write them down before initializing constants so that they can be restored.

[Operation method of the digital operator]



The above procedure completes selection of operation sequence.

3.3 INITIAL VALUES OF CONSTANTS

The following shows the initial values of when each sequence is selected. The initial value of the constants Sn-06, Sn-13, Cn-12, and Cn-70 to -80 differ in general-purpose sequence or in crane exclusive-use sequence.

3.3.1 An-□□ : Frequency References

Table 3 1 Initial Value of Frequency References An-□□

No	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
01	Frequency Reference 1	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0 00 Hz
02	Frequency Reference 2	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz
03	Frequency Reference 3	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz
04	Frequency Reference 4	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0 00 Hz
05	Frequency Reference 5	0.01 Hz	0.00 to 400.00 Hz	0 00 Hz	0 00 Hz
06	Frequency Reference 6	0 01 Hz	0 00 to 400.00 Hz	0.00 Hz	0 00 Hz
07	Frequency Reference 7	0 01 Hz	0.00 to 400 00 Hz	0.00 Hz	0 00 Hz
08	Frequency Reference 8	0 01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz
09	Inching Frequency Reference	0.01 Hz	0 00 to 400.00 Hz	6 00 Hz	6.00 Hz

3.3.2 bn-□□ : Constants Modifiable during Operation

Table 3 2 Initial Value of Constants Modifiable bn-□□

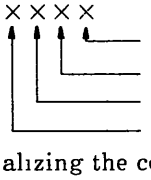
No.	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
01	Acceleration Time 1	0 1 s	0.1 to 6000 0 s	10.0 s	10.0 s
02	Deceleration Time 1	0.1 s	0.1 to 6000.0 s	10.0 s	10.0 s
03	S-curve Characteristic Time 1	0.1 s	0 0 to 2.0 s	0.2 s	0 2 s
04	Acceleration Time 2	0.1 s	0.1 to 6000.0 s	10.0 s	10.0 s
05	Deceleration Time 2	0.1 s	0.1 to 6000.0 s	10.0 s	10.0 s
06	S-curve Characteristic Time 2	0.1 s	0 0 to 2.0 s	0 2 s	0.2 s
07	Frequency Reference Gain	0.1%	0 to 1000.0%	100.0%	100.0%
08	Frequency Reference Bias	1 %	−100 to 100%	0%	0%
09	Torque Compensation Gain	0.1	0.0 to 2.0	1 0	1.0
10	Motor Rated Slip	0.1%	0 0 to 10.0%	0.0%	0.0%
11	Monitor No. after Power ON	1	1 to 3	1	1
12	Acceleration/Deceleration Time Reduction Gain	0.01	0.01 to 1.00	1.00	1 00
13	Output Voltage Change Gain	0.01	0.80 to 1.20	1.00	1.00
14	Output Gain of Frequency Meter	0.01	0.00 to 2.55	1.00	1.00
15	Output Gain of Ammeter	0.01	0 01 to 2.55	0.50	0.50

3.3.3 Sn-□□ : System Constants

Table 3 3 Initial Values of System Constants Sn-□□

No.	Name	Description	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
01	Inverter Capacity Selection	Selection of inverter capacity (Usually, no modification is necessary.)	—	—
02	V/f Pattern	Selection of voltage-frequency pattern (Only 0F or FF is possible) (When FF is selected, output voltage limit function is disabled.)	0F	0F
03	Operator Status	0000 : An, bn, Sn, and Cn can be set up and referred to. 0101 : An can be set up and referred to ; bn, Cn, and Sn can be referred to. 1010 : An, bn, Sn, Cn and On can be set up and referred to. 1110 : Initialization of constants (for general-purpose sequence) 1111 : Initialization of constants (for crane exclusive-use sequence)	0000	0000
04	Operation Signal Selection 1	Digit 1: Setting Value : 0 — External pin 1CN-3 is used for master frequency reference. Setting Value : 1 — An-01 is used for master frequency reference. Digit 2: 0 — External pin is used to run and stop; 1 — Digital operator is used to run and stop Digit 3: 0 — Deceleration stop; 1 — Coasting to a stop Digit 4: —	0011	0011
05	Operation Signal Selection 2	1: 0 — STOP key on the digital operator is enabled.; 1 — STOP key on the digital operator is disabled. 2: 0 — Reverse rotation is possible.; 1 — Reverse rotation is impossible. 3: 0 — External BB is input to contact *a*.; 1 — External BB is input to contact *b*. 4: 0 — Multi-speed control using combination of contact inputs; 1 — Multi-speed control by specifying one speed by one contact input	0000	0000
06	Protection Characteristic Selection 1 (crane functions)	1: 0 — General-purpose sequence is applied.; 1 — Crane exclusive-use sequence is applied. 2: 0 — No SEs are checked for.; 1 — SEs are checked for. 3: 0 — Missing phase in output is not checked for.; 1 — Missing phase in output is checked for. 4: 0 — With automatic clear of display of updated fault history.; 1 — Without automatic clear of display of updated fault history.	0000	0111
07	Protection Characteristic Selection 2 (excess torque detection)	1: 0 — Excess torque is not checked for.; 1 — Excess torque is detected if current detection H is ON. 2: 0 — Excess torque is always checked for.; 1 — Excess torque is checked for only when actual and command speed agree 3, 4: Stop method when excess torque is detected — 00 Deceleration stop (bn-02) (Major failure); 01 Coasting to a stop (Major failure); 10 Deceleration stop (bn-05) (Minor failure); 11 Operation continued (Minor failure)	0100	0100

Note : *Digit in Sn-04 to -12 (From right to left)*



* By initializing the constants with operator status Sn-03 = 1110 or 1111 Sn-03 data returns automatically to 0000

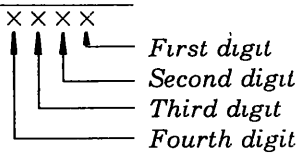
3.3.3 Sn-□□ : System Constants (Cont'd)

Table 3 3 Initial Values of System Constants Sn-□□ (Cont'd)

No	Name	Description			Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
		Digit	Setting Value : 0	Setting Value : 1		
08	Protection Characteristic Selection 3 (external fault)	1	Contact *a* input	Contact *b* input	0100	0100
		2	Always checked	Checked on y during operation		
		3	Stop method when external fault is detected { 00 Deceleration stop (bn-02); 01 Coasting to a stop; 10 Deceleration stop (bn-05) } Major failure; { 11 : Operation continued } Minor failure			
		4				
09	Protection Characteristic Selection 4 (Motor protection)	1	Electronics thermal motor protection is enabled.	Electronics thermal motor protection is disabled.	0000	0000
		2	Standard motor characteristics	Exclusive motor characteristics		
		3	Protection time constant is set for 8 minutes.	Protection time constant is set for 5 minutes.		
		4	—	—		
10	Slip Compensation	1	Slip compensation is enabled only when actual and command speed agree.	Slip compensation is enabled in all modes	0000	0000
		2	—	—		
		3	—	—		
		4	—	—		
11	PG Speed Control	1	No PG speed control is used. (Open loop)	PG speed control is used. (Closed loop)	0100	0100
		2	Integration is applied only when actual and commanded speeds agree.	Integration is applied in all modes.		
		3	When PG open, OS, or DEV is detected { 00 · Deceleration stop (bn-02); 01 Coasting to a stop; 10 · Deceleration stop (bn-05) } Major failure; { 11 · Operation continued } Minor failure			
		4				
12	Stall Prevention Selection	1	Stall prevention is used during acceleration.	Stall prevention is not used during acceleration.	0000	0000
		2	Stall prevention is used during deceleration.	Stall prevention is not used during deceleration		
		3	Stall prevention is used during operation.	Stall prevention is not used during operation.		
		4	If stall prevention event occurs during operation, decelerate at bn-02	If stall prevention event occurs during operation, decelerate at bn-05		
13	Relay Drive Output	Select an output item from 3CN-10 or -11.			00	03

Notes

1 Digit in Sn-04 to -12



2 Relay drive output function selection (Sn-13)

Setting Value	Name	Description
00	Operation Ongoing	ON Operation ongoing
01	Zero Speed	ON . Zero speed is being applied. (The inverter output is lower than the set value in Cn-07, or the inverter is stopped)
02	Frequency Agreed	ON Actual and command output frequencies agree. (Commanded value − (Cn-23) ≦ output frequency ≦ commanded value + (Cn-23))
03	Brake Release Command	OFF : Brake is closed ON · Brake is released (Exclusive to cranes)
04	Frequency Detection H	ON · Output frequency ≧ Cn-21 (at hysteresis of Cn-23.)
05	Frequency Detection L	ON Output frequency is ≦ Cn-22 (at hysteresis of Cn-23)
06	Current Detection H	ON : Output current ≧ Cn-24 (detected for time Cn-26)
07	Current Detection L	ON · Output current ≦ Cn-25 (detected for time Cn-26)

3 Sn-10 second digit and third digit is valid for P-ROM No. NSN618012 and after.

4. Sn-09 fourth digit and Sn-10 fourth digit is valid for P-ROM No NSN618015 and after

5 For additional functions by P-ROM number version-up, see Appendix A5.

3.3.4 Cn-□□: Control Constants

Table 3 4 Initial Values of Control Constants Cn-□□

No	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
01	Input Voltage	0.1 V	180.0 to 255 0 V	200 0 V*	200.0 V*
02	Maximum Frequency	0.1 Hz	50 0 to 400.0 Hz	60.0 Hz	60 0 Hz
03	Maximum Voltage	0 1 V	0 0 to 255.0 V	200.0 V*	200 0 V*
04	Maximum Voltage Frequency	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz
05	Medium Output Frequency	0.1 Hz	0 0 to 400.0 Hz	3.0 Hz	3.0 Hz
06	Medium Output Frequency Voltage	0 1 V	0.0 to 255.0 V	15.0 V*	15.0 V*
07	Minimum Output Frequency	0.1 Hz	0.0 to 400.0 Hz	1.5 Hz	1.5 Hz
08	Minimum Output Frequency Voltage	0.1 V	0 0 to 255.0 V	10 0 V*	10.0 V*
09	Motor Rated Current	0 1 A	10 to 200% of inverter rated current	**	**
10	DC Braking Start Frequency	0.1 Hz	0.0 to 10.0 Hz	1.5 Hz	1.5 Hz
11	DC Braking Current	1%	0 to 100%	50%	50%
12	DC Braking Time at Stop	0.1 s	0.0 to 10.0 s	0.5 s	0.0 s
13	DC Braking Time at Start	0.1 s	0.0 to 10 0 s	0.0 s	0.0 s
14	Frequency Reference Upper Limit	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz
15	Not used	—	—	—	—
16	Prohibited Frequency 1	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0 0 Hz
17	Prohibited Frequency 2	0.1 Hz	0.0 to 400.0 Hz	0 0 Hz	0.0 Hz
18	Prohibited Frequency 3	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz
19	Prohibited Frequency Range	0.1 Hz	0.0 to 25.5 Hz	1.0 Hz	1.0 Hz
20	Operator Display Mode	1	0 to 39999	0	0
21	Frequency Detection H Level	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz
22	Frequency Detection L Level	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz
23	Frequency Agree Detection Width	0.1 Hz	0 0 to 25.5 Hz	2.0 Hz	2.0 Hz
24	Current Detection H Level	1%	5 to 200%	160%	160%
25	Current Detection L Level	1%	5 to 200%	5%	5%
26	Current Detection Time	0.1 s	0 0 to 25.5 s	0 1 s	0.1 s
27	Start Level for Stall Prevention during Accel/Decel	1%	30 to 200%	150%	150%
28	HOLD Level for Stall Prevention during Accel/Decel	1%	30 to 200%	170%	170%
29	Limiter for Stall Prevention during Accel/Decel	1%	30 to 200%	50%	50%
30	Activation Level for Stall Prevention during Operation	1%	30 to 200%	160%	160%

* For 400 V class inverters, the range of setting and initial value are doubled

** The initial value depends on the inverter kVA selection (Sn-01).

Table 3 4 Initial Values of Control Constants Cn-[ ] (Cont'd)

	No.	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected
	31	Motor Phase to Phase Resistance	0 001Ω	0 to 65.535Ω	**	**
	32	Torque Compensation Iron Loss	1 W	0 to 65535 W	**	**
	33	Torque Compensation Limiter	1 V	0 to 50 V	50 V *	50 V *
	34	Torque Compensation Response Time Constant	0 1 s	0 0 to 1.0 s	0 3 s	0 3 s
	35	Motor No-load Current	1%	0 to 99%	30%	30%
	36	Slip Compensation Response Time Constant	0.1 s	0.0 to 25.5 s	0.5 s	0.5 s
	37	Voltage Recovery Time	0 1 s	0 1 to 2 0 s	0.3 s	0.3 s
	38	Minimum Base Block Time	0.1 s	0 1 to 2.0 s		
	39	Not used	—	—	— **	— **
	40	Not used	—	—	—	—
	41	Not used	—	—	—	—
	42	Not used	—	—	—	—
PG Control Exclusive-use Functions	43	PG Pulse Number	0.1 P/R	0.0 to 3000.0 P/R	0.0 P/R	0.0 P/R
	44	No. of Motor Poles	2 P	2 to 32 P	4 pole	4 pole
	45	ASR Gain 1	0 01	0.00 to 2 55	0 00	0 00
	46	ASR Time Constant 1	0 1 s	0.1 to 10.0 s	1.0 s	1.0 s
	47	ASR Gain 2	0.01	0.00 to 2.55	0.20	0.20
	48	ASR Time Constant 2	0.1 s	0.1 to 10.0 s	1.0 s	1.0 s
	49	ASR Limiter (positive side)	0.1%	0 0 to 10.0%	5.0%	5 0%
	50	ASR Limiter (negative side)	0.1%	0 0 to 10.0%	5.0%	5.0%
	51	Speed Deviation Excess Detection Level	1%	1 to 50%	10%	10%
	52	Overspeed Detection Level	1%	1 to 120%	110%	110%
	53 to 69	Not used	—	—	—	—
Cranes Exclusive-use Functions	70	Brake Release Frequency (FBASE)	0.1 Hz	0 0 to 10.0 Hz	0 0 Hz	3.0 Hz
	71	Forward Rotation Brake Release Current (IF)	1%	0 to 150%	0%	50%
	72	Reverse Rotation Brake Release Current (IR)	1%	0 to 150%	0%	50%
	73	Brake Release Current Detection Time (IT)	0.1 s	0.0 to 1.0 s	0.0 s	0.1 s
	74	Speed Increase Timing (BT)	0.1 s	0.0 to 2.0 s	0.0 s	0.3 s
	75	Brake Holding Speed (NBH)	0.1 Hz	0.0 to 50.0 Hz	0.0 Hz	6.0 Hz
	76	Slip Prevention Hold Time (HT)	0.1 s	0.0 to 2.0 s	0.0 s	0.3 s
	77	Creep Speed (NCR)	0.1 Hz	0.0 to 20.0 Hz	0.0 Hz	6.0 Hz
	78	Forward Butting Stop Detection Current (IFOT)	1%	0 to 150%	0%	50%
	79	Reverse Butting Stop Detection Current (IROT)	1%	0 to 150%	0%	50%
	80	Butting Stop Detection Time (TIOT)	0.1 s	0.0 to 2.0 s	0.0 s	0.3 s

* For 400 V class inverters, the range of setting and initial value are doubled.

** The initial value depends on the inverter kVA selection (Sn-01).

*** Function of Cn-39 to 41 is valid for P-ROM No. NSN618012 and after.

Note : *Functions No 70 to 80 are exclusive to cranes*

3.4 HOW TO USE

3.4.1 General-purpose Sequence

Using general-purpose sequence, the inverter can be operated or stopped, and its frequency can be modified by just inputting frequency reference and operation command, in the same way as using general-purpose inverters available on the market.

Minimum connection and constant settings for operation and the timing chart under these conditions are shown below.

(1) Example of Connection (Full connections can be quite complex. Therefore, detailed connections are not shown.)

(a) Operation by the digital operator (Operation with system constant Sn-04 set to 0011)

Frequency setting and operation/stop are commanded by keys on the digital operator.

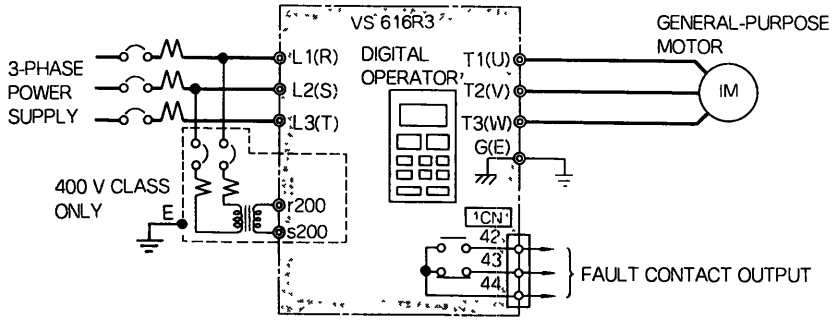


Fig. 3.3 Operation by Digital Operator

(b) Operation with external pin signals (Operation with system constant Sn-04 set to 0000)

Operation is carried out according to the frequency reference signal and forward (or reverse) operation signal from external pins.

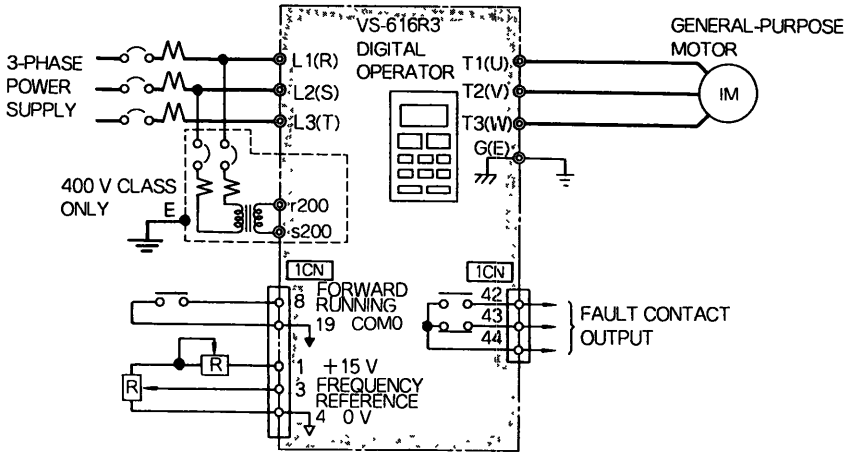


Fig. 3.4 Operation with External Pin Signals

(2) Time Chart of Operation and Stop

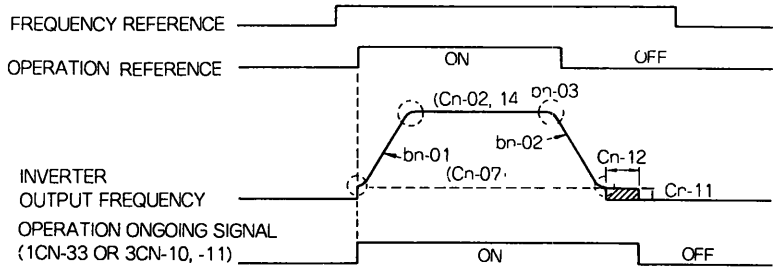


Fig. 3.5 Time Chart of Operation/Stop

(Initial values of major constants)

- Acceleration time 1 (bn-01) : 10.0 s
- Deceleration time 1 (bn-02) : 10.0 s
- S-curve time 1 (bn-03) : 0.2 s
- Maximum frequency (Cn-02) : 60.0 Hz
- Frequency reference upper limit (Cn-14) : 60.0 Hz
- Minimum output frequency (Cn-07) : 1.5 Hz
- DC braking current (Cn-11) : 50% (of inverter rated current)
- DC braking time at stop (Cn-12) : 0.5 s

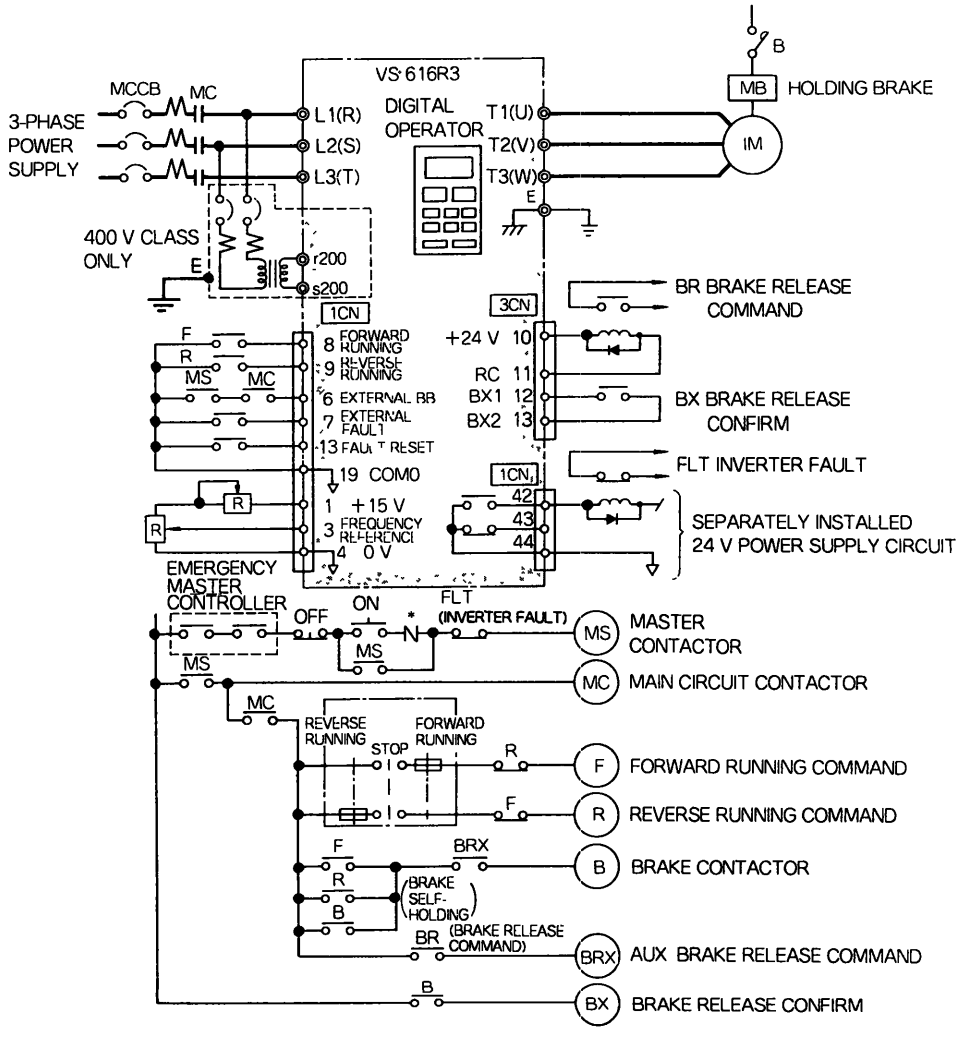
3.4.2 Crane Exclusive-use Sequence

If crane exclusive-use sequence is selected, the inverter, at starting and stopping, operates the holding brake while monitoring generated torque, making it easy to stabilize motor torque to prevent starting failure and slip at stop.

3.4.2 Crane Exclusive-use Sequence (Cont'd)

Minimum connection and constant settings for operation and the timing chart under these conditions are shown below.

(1) Example of Connection (Full connections can be quite complex. Therefore, detailed connections are not shown.)



(Settings of major inverter constants)

- Initialization of constants Sn-03=1111 : Initialize for crane sequence.
- Operation signal selection Sn-04 =0000 : Run according to external pin signals.
- Operation signal selection Sn-05 =0100 : External BB is input to contact *b* (base block clear when ON).
- Excess torque detection Sn-07=0101 : If motor current is excessive, assume an excess torque fault and stop operation.
  Cn-24=140% to 150% : Set up excess torque detection level.
  Cn-26=3 s to 5 s : Set up excess torque detection time.

(For protection against holding brake failure and overload to the machine)

Notes :

1. *Brake release command can be output from 1CN-36 (open collector output). Signals are output simultaneously to 3CN-10, -11 and 1CN-36.*
2. *Brake release check can be input from 1CN-10 (sequence input). Signals from 3CN-12 and -13 and 1CN-10 are ORed internally..*
3. *Set Sn-04 to ××0× (RUN stop by external pin signal). If ××1× (RUN stop by digital operator) is set up, the inverter does not release the brake.*

Fig. 3.6 Example of Wiring Sequence for Crane

(2) Timing Chart of Operation and Stop

NOTE

Set Sn-04 to ××0× (operation and stop by external pin signal). If ××1× (operation and stop by the digital operator) is set up, the inverter does not release the brake.

(a) Normal operation and stop

Receiving frequency and operation reference, the inverter performs a sequence of operation described below. This prevents the load motor from rotating in the direction opposite to the command, just as you do when you are starting your car on an incline.

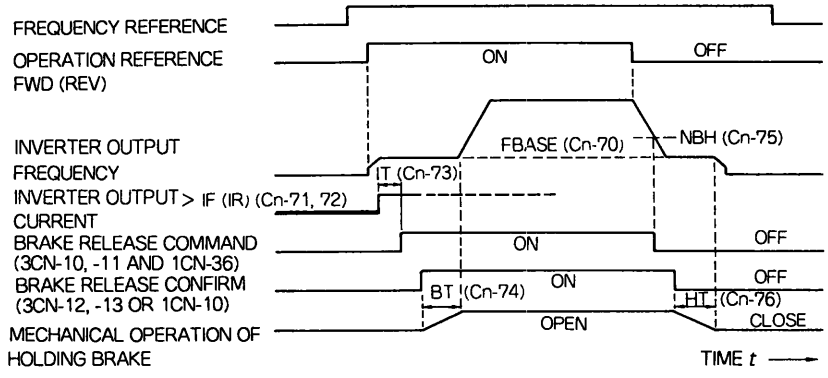


Fig. 3.7 Time Chart of Normal Operation and Start

(At starting)

① When an operation reference (either forward or reverse rotation) is turned ON, the inverter increases output freuquency to a set value in FBASE (Cn-70) while holding the brake being applied.

② Detecting that inverter output current of a set amount for IF (Cn-71) (or IR (Cn-72)) has flowed for a specified time for IT (Cn-73), the inverter turns ON the brake release command (3CN-10, -11, and 1CN-36).

③ After the brake release check (3CN-11, -13, or 1CN-10) comes ON, output frequency of the inverter is tied to FBASE for time BT (Cn-74), then it is accelerated to the target value.

(At stopping)

④ When operation reference is turned OFF, the inverter decreases output frequency at a set deceleration rate.

⑤ Detecting that output frequency has reduced to NBH (Cn-75), the inverter turns OFF the brake release command (3CN-10, -11, and 1CN-36).

⑥ Detecting the brake release check (3CN-12, -13, or 1CN-10) has gone OFF, the inverter outputs FBASE frequency for HT time (Cn-76), then stops.

NOTES

1. *If frequency reference value is lower than FBASE, the inverter continues to output FBASE frequency even after releasing the brake.*
2. *After an operation reference is turned OFF, if another operation reference in the opposite direction is input during deceleration, stop sequence from ④ to ⑥ applies the brake, then sequence from ① to ③ starts rotation in the opposite direction.*

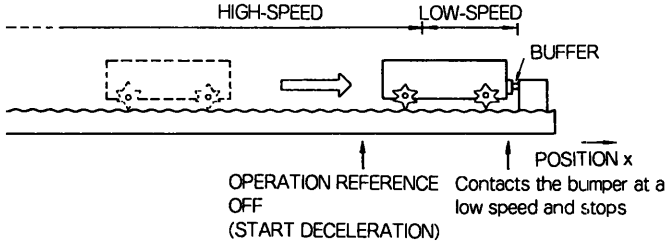
3.4.2 Crane Exclusive-use Sequence (Cont'd)

(Initial values of major constants)

- Crane function (Sn-06) =0111 : Use crane exclusive-use sequence and protection function.
- Relay drive output (Sn-13) =03 : Output brake release command.
- DC brake time at stopping (Cn-12)=0.0 s : No DC braking.
- Brake release frequency FBASE (Cn-70)=3.0 Hz
- Forward brake release current IF (Cn-71)=50% (of the inverter rated current)
- Reverse brake release current IR (Cn-72)=50% (of the inverter rated current)
- Brake release current detection time IT (Cn-73)=0.1 s
- Speed increase timing BT (Cn-74)=0.3 s
- Brake holding speed NBH (Cn-75)=6.0 s
- Slip prevention hold time HT (Cn-76)=0.3 s

(b) Butting stop

Butting stop function enables easy positioning for conveyor lines.



Note : *The inverter detects stop position by monitoring the motor locking current produced by contact. Do not use this function for a machine in which wheels idle upon contact, since there will be no locking current.*

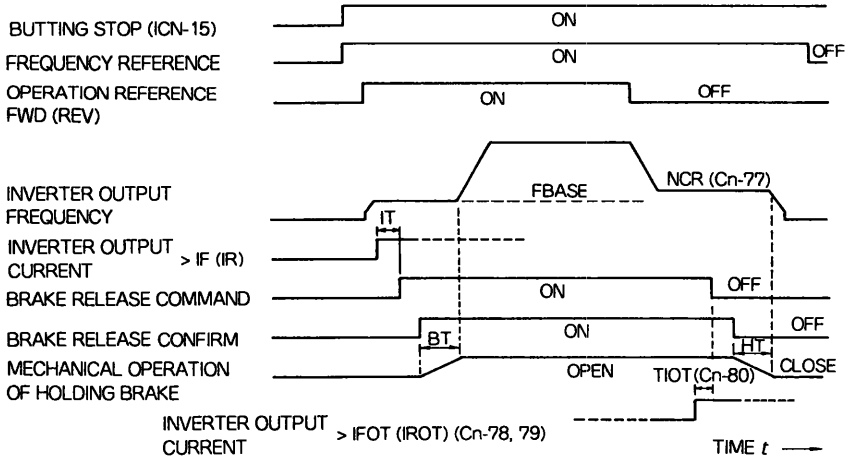


Fig. 3.8 Time Chart of Butting Stop

(At starting)
Starting sequence is similar to that of normal operation described in (a). Only the stopping sequence is different.
(At stopping)
If the (forward or reverse) operation reference is turned OFF while butting stop command (1CN-15) is ON, butting stop sequence described below is carried out.

① When the operation reference is turned OFF, the inverter decreases output frequency to NCR (Cn-77) at a set deceleration rate, and continues operation.
② When the load hits the bumper, locking current flows to the motor. Detecting that this locking current is higher than IFOT (Cn-78) (or IROT (Cn-79) for reverse rotation) and has continued for time TIOT (Cn-80), the inverter turns OFF the brake release command (3CN-10, -11, and 1CN-36).
③ Detecting the brake release check (3CN-12, -13, or 1CN-10) has gone OFF, the inverter outputs NCR frequency for HT time (Cn-76), then stops.

NOTES

1. If IFOT (IROT), or TIOT is set up inappropriately, the inverter may stop before bumping, or may continue to run at the NCR speed. For datails, see calculation of constants in (4).
2. If the butting stop command (1CN-15) is turned OFF before the sequence has been completed, the inverter stops by the stop sequence of (a), described above.

(Initial values of major constants)

- Creep speed NCR (Cn-77)=6.0 Hz
- Forward butting stop detection current IFOT (Cn-78)=50% (of the inverter rated current)
- Reverse butting stop detection current IROT (Cn-79)=50% (of the inverter rated current)
- Butting stop detection time TIOT (Cn-80) =0.3 s

3.4.2 Crane Exclusive-use Sequence (Cont'd)

(3) Supervising Function

If an error occurs during operation in the crane exclusive-use sequence, the inverter issues a sequence error, stops output, applies the brake, and outputs signal to the fault contact.

Table 3 5 Sequence Errors

Display on the Digital Operator	Description	Detection Time	Cause	Action to be Taken
SE 1	Both forward and reverse operation commands are ON.	Instantaneous	External operation sequence error	Check the sequence circuit.
SE 2	One second has elapsed after (forward or reverse) operation command was input but brake release command remains OFF	1 sec (Possible to change by order constant On-16)	• No motor is connected. • The set value of IF (or IR) is too high. • Motor current is low.	• Check the motor circuit. • Review the set value of IF (or IR)
SE 3	One second has elapsed after brake release command is output but the brake release check remains OFF.	1 sec (Possible to change by order constant On-17)	• Brake circuit sequence error • Response (scan) delay of the sequence circuit	Check the sequence circuit
SE 4	Brake release check goes OFF while the inverter holds brake release command ON.	Note 6 0 3 sec	Imperfect contact or break in wire in a relay, contactor, or brake	Check relays, contactors, the brake and the whole wiring.
SE 5	In cases where brake release check does not go OFF 1.0 second after brake release command is turned ON to stop the machine	1 sec	Imperfect contact or break in wire in a relay, contactor, or brake	Check relays, contactors, the brake and the whole wiring.
SE 6	Butting stop is selected, and ten seconds have passed with running at the NCR speed but brake release command remains ON	10 sec (Possible to change by order constant On-18)	• The motor is not locked • Motor current is low. • The set value of IFOT (or IROT) is too high	• Check the motor circuit. • Review the set value of IFOT (or IROT).

Notes

1. *To check the inverter with no motor connected, disconnect the holding brake circuit from the inverter, temporarily set IF (IR) or IFOT (IROT) to 0%, and set Sn-06 to ××01 (No SE detection)*
2. *If system constant Sn-06 is set to ××01 (No SE detection), no sequence error except SE2 is detected*
3. *If system constant Sn-06 is set to ××0 (Operation in general-purpose sequence), no sequence error is detected at all, and the inverter performs general-purpose sequence*
4. *Another protective function for cranes is detection for missing phase in output After operation is started, if any phase of inverter output current falls short of 5% (of inverter rated current) continuously for 0.2 second or longer, it is recognized as lost-phase output If this occurs, the inverter stops output, applies the brake, and outputs a signal to the fault contacts*
   At the same time, the digital operator displays LF
   No missing phase is detected if no motor is connected or system constant Sn-06 is set to ×0××.
5. *Among the sequence abnormals, following's detection time can be changed by order constant (Order constant is displayed by setting system constant Sn-03 = 1010)*
   SE2 . Can be changed by On-16 Setting range 1 0 to 2 0 second
   SE3 : Can be changed by On-17 Setting range 1 0 to 2 0 second
   SE6 · Can be changed by On-18 Setting range 1 0 to 25 5 second
   Do not change order constants other than these. Fail to observe this may result in inverter abnormality.
6. *SE4 detection time for P-ROM No NSN618015 and before is instantaneous*
   (Detection time for P-ROM No NSN618016 and after is 0 3 sec)

(4) Calculation of Constants

(a) Brake release frequency FBASE (Cn-70)

Set motor rated slip frequency plus about 1.0 Hz. For example, if the motor rated slip frequency is 2.0 Hz, set 3.0 Hz for Cn-70.

- A low value may result in no current flow in the motor at starting and lead to sequence error SE2.
- A high value may cause torque shock at starting.

(b) Brake release current IF (Cn-71), IR (Cn-72)

IF (Cn-71) = (IM × KF × 100)/IINV

IR (Cn-72) = (IM × KR × 100)/IINV

Where,

IM : Motor rated current

IINV : Inverter rated current

For a wind-up load, set KF or KR to about 1.0.

For a running load, set KF or KR to about 0.5.

(If the load factor of forward rotation differs from that of reverse rotation, vary KF from KR accordingly.)

- A low value, especially with a wind-up load, may cause slip at starting.
- A high value may result in sequence error SE2 or friction to the brake.

(c) Brake release current detection time IT (Cn-73)

Usually, set about 0.1 s to 0.3 s. If response of the machine is slow, set 0.0 s.

(d) Speed increase timing BT (Cn-74), slip prevention hold time HT (Cn-76)

BT (Cn-74) = Mechanical delay before the brake is closed

HT (Cn-76) = Mechanical delay before the brake is closed + 0.1 s (For a running load, HT = 0.1 s)

(e) Brake holding speed NBH (Cn-75)

Usually, set FBASE frequency + 3 Hz to 4 Hz.

If you wish to be precise, calculate as follows.

$$\text{NBH} = \frac{\text{(Mechanical delay before the brake is closed)}}{\text{(Setup deceleration time)}} \times \text{(Maximum frequency)}$$

(f) Butting stop creep speed NCR (Cn-77)

Set a higher value than FBASE.

(g) Butting stop detection current IFOT (Cn-78), IROT (Cn-79)

Set a higher current value than that during running at the NCR speed, as a percentage of the inverter rated current. Usually, 50 % to 100 % is appropriate.

- At a low value, the inverter may stop before bumping.
- At a high value, the inverter may continue to run at the NCR speed.

(h) Butting stop detection time TIOT (Cn-80)

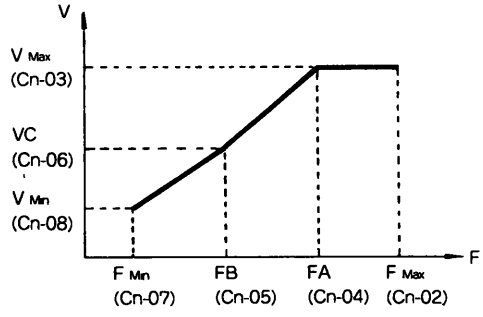
Usually, set 0.2 s to 0.3 s. At a low value, the inverter may stop before bumping.

3.4.2 Crane Exclusive-use Sequence (Cont'd)

(i) V/f setting Cn-02 to Cn-08, torque compensation gain bn-09

① Use motor data to calculate the minimum frequency, minimum voltage, and output current to obtain necessary motor torque (150% torque for wind-up load, 100 % torque for running load) to sustain the load, then set voltage-frequency data.

F Max (Cn-02) = maximum frequency
V Max (Cn-03) = motor rated voltage
FA (Cn-04) = motor rated frequency
FB (Cn-05) = minimum frequency to obtain necessary torque
VC (Cn-06) = minimum voltage to obtain necessary torque
F Min (Cn-07) = about 1.5 Hz
V Min (Cn-08) = (VMax − VC)/(FA − FB) × (FMin − FA) + V Max
KT (bn-09) = 0.0



② If accurate motor data cannot be obtained, set as follows.

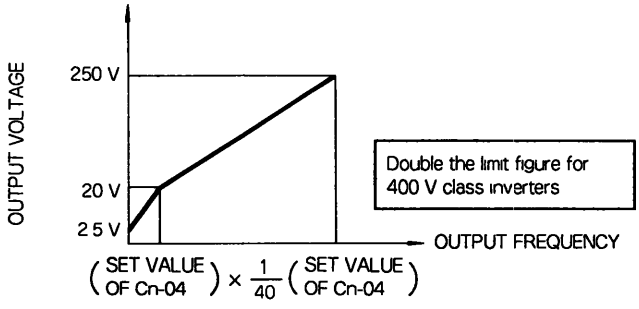
- Cn-02 to -08 : Use the initial values. bn-09 = 1.0 (initial value)
- If sequence error SE2 or slip occurs at starting, increase VC and VMin until there such trouble is eliminated.

  VC (Cn-06) = initial value + *(5 to 10) V
  V Min (Cn-08) = initial value + *(5 to 10) V

  * Double the figures for 400 V class inverters.

NOTES

1. *Raising VC or VMin over the above limits, overexcitation may occur with the motor under a light load.*
2. *Inverter output voltage restriction*
   Output voltage of the inverter is restricted as shown below so as to prevent starting failure and inverter overload trip caused by motor overexcitation.



If application of high voltage at low frequency is required to obtain necessary starting torque, as with high-resistance motors or the long motor cables, set FF for system constant Sn-02. In this way, the output voltage restriction function is disabled. Set appropriate V/f value for control constants Cn-02 to Cn-08.

For general-purpose motors or inverter specialized motors, unnecessary to change the initial value of Sn-02. Sufficient starting torque is guaranteed without modification.

3.4.2 Crane Exclusive-use Sequence (Cont'd)

(5) Check Points

If any trouble occurs during test operation, check the following points.

Table 3.6 Test Operation Check Points

Trouble	Cause	Action to be Taken
Sequence errors SE to SE6 occur.	External sequence or constant setting error	See explanation on supervising functions in (3)
Crane-specialized sequence or butting stop sequence is not worked out.	• Not initialized for crane exclusive-use sequence • Sn-04 is set to ××1×.	• Initialize constants for crane exclusive-use sequence according Par 3.2 • Modify Sn-04 to ××0×.
The system remains inactive although operation command has been input.	External base block signal is not cleared (when the signal is input to contact *b*).	Input signal to external base block pin 1CN-6. Otherwise, do not use the external base block signal
Stop positions are widely scattered depending on the load factor.	Deceleration time deviations because of deceleration stall prevention function	Deceleration time extended for stall prevention function is not activated.
The motor stops during operation at FBASE speed.	Excess motor slip or FBASE setting error	Increase FBASE.
Suspended load falls.	V/f is set low	Increase V/f.
Slip down occurs at starting	V/f is set low.	Increase V/f.
	Brake release currents IF and IR are set low.	Increase IF and IR.
Slip occurs at stopping.	Slip stop hold time HT is set short.	Extend HT.
Brake friction occurs at starting	V/f is set high.	Decrease V/f.
	Brake release currents IF and IR are set high.	Decrease IF and IR.
Brake friction occurs at stopping	Slip-down stop hold time HT is set long.	Shorten HT
	Brake holding speed NBH is set long.	Shorten NBH.
Speed decreases during acceleration, or acceleration stall prevention is activated and acceleration fails	Speed increase timing BT is set high	Decrease BT.
	Acceleration time is set shorten.	Extend acceleration time. Decrease stall prevention setting.
Butting stop is selected but the inverter stops before bumping	Butting stop detection currents IFOT and IROT are set low	Increase IFOT and IROT.
	Butting stop detection time TIOT is set short.	Extend TIOT
Butting stop is selected but the inverter continues to operate at creep speed NCR	Butting stop detection currents IFOT and IROT are set high.	Decrease IFOT and IROT
	There is no rise of motor current at bumping.	Vary V/f Check mechanical frictions (such as wheel slippage)

Note · *Special care is required to use two inverters in synchronization or to switch and operate two or more motors by a single inverter Consult your YASKAWA representative in advance.*

4. LIST OF CONSTANTS AND FUNCTIONS

4.1 LIST OF CONSTANTS

4.1.1 An-□□ : Frequency References

Table 4 1 Frequency References An-□□

No	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
01	Frequency Reference 1	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz		66 68 76
02	Frequency Reference 2	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz		
03	Frequency Reference 3	0.01 Hz	0.00 to 400.00 Hz	0 00 Hz	0.00 Hz		
04	Frequency Reference 4	0.01 Hz	0.00 to 400 00 Hz	0.00 Hz	0 00 Hz		
05	Frequency Reference 5	0.01 Hz	0 00 to 400 00 IIz	0 00 Hz	0.00 Hz		
06	Frequency Reference 6	0 01 Hz	0 00 to 400.00 Hz	0.00 Hz	0 00 Hz		
07	Frequency Reference 7	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz		
08	Frequency Reference 8	0.01 Hz	0.00 to 400.00 Hz	0.00 Hz	0.00 Hz		
09	Inching Frequency Reference	0.01 Hz	0.00 to 400.00 Hz	6.00 Hz	6.00 Hz		

4.1.2 bn-□□ : Constants Modifiable during Operation

Table 4 2 Modifiable Constants bn-□□

No	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
01	Acceleration Time 1	0.1 s	0 1 to 6000.0 s	10.0 s	10.0 s		70
02	Deceleration Time 1	0 1 s	0.1 to 6000 0 s	10.0 s	10 0 s		70
03	S-curve Time 1	0 1 s	0.0 to 2.0 s	0.2 s	0.2 s		70
04	Acceleration Time 2	0.1 s	0 1 to 6000.0 s	10.0 s	10.0 s		70
05	Deceleration Time 2	0.1 s	0.1 to 6000.0 s	10 0 s	10.0 s		70
06	S-curve Time 2	0.1 s	0.0 to 2.0 s	0 2 s	0 2 s		70
07	Frequency Reference Gain	0 1%	0 to 1000.0%	100.0%	100.0%		72
08	Frequency Reference Bias	1 %	−100 to 100%	0%	0%		72
09	Torque Compensation Gain	0.1	0.0 to 2 0	1.0	1.0		73. 82 91
10	Motor Rated Slip	0.1%	0.0 to 10 0%	0.0%	0.0%		73
11	Monitor No. after Power ON	1	1 to 3	1	1		74
12	Accel/Decel Time Reduction Gain	0.01	0.01 to 1.00	1.00	1.00		70
13	Output Voltage Change Gain	0.01	0.80 to 1.20	1.00	1.00		73 74 82. 91
14	Output Gain of Frequency Meter	0 01	0.00 to 2.55	1 00	1.00		75
15	Output Gain of Ammeter	0 01	0.01 to 2.55	0.50	0 50		75

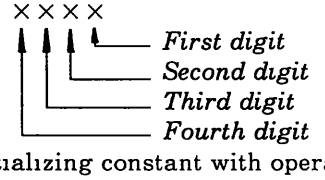
4.1.3 Sn-□□ : System Constants

Table 4.3 System Constants Sn-□□

No	Name	Description	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
01	Inverter Capacity Selection	Selection of inverter capacity (Usually, no modification is necessary.)	—	—		89
02	V/f Pattern	Selection of voltage-frequency pattern (Only 0F or FF is possible.) (When FF is selected, output voltage limit function is disabled.)	0F	0F		56 83
03	Operator Status	0000 : An, bn, Sn, and Cn can be set and referred to. 0101 : An can be set and referred to ; bn, Cn, and Sn can be referred to. 1010 : An, bn, Sn, Cn and On can be set and referred to. 1110 : Initialization of constants (for general-purpose sequence) 1111 : Initialization of constants (for crane exclusive-use sequence)	0000	0000		41 66 75
04	Operation Signal Selection 1	Digit 1 : Setting Value : 0 — External pin 1CN-3 is used for master frequency reference; Setting Value 1 — An-01 is used for master frequency reference Digit 2 : 0 — External pin is used to run and stop.; 1 — Digital operator is used to run and stop Digit 3 : 0 — Deceleration stop; 1 — Coasting to a stop Digit 4 : 0 — —; 1 — —	0011	0011		66 75
05	Operation Signal Selection 2	Digit 1 : 0 — STOP key on the digital operator is enabled.; 1 — STOP key on the digital operator is disabled. Digit 2 : 0 — Reverse rotation is possible.; 1 — Reverse rotation is impossible. Digit 3 : 0 — External BB is input to contact *a*.; 1 — External BB is input to contact *b*. Digit 4 : 0 — Multi-speed control using combination of contact inputs; 1 — Multi-speed control by specifying one speed by one contact input	0000	0000		68 77
06	Protection Characteristic Selection 1 (crane exclusive-use functions)	Digit 1 : 0 — General-purpose sequence is applied; 1 — Crane exclusive-use sequence is applied Digit 2 : 0 — No SEs are checked for; 1 — SEs are checked for. Digit 3 : 0 — Missing phase in output is not checked for.; 1 — Missing phase in output is checked for. Digit 4 : 0 — With automatic clear of display of updated fault history.; 1 — Without automatic clear of display of updated fault history.	0000	0111		41 49 78
07	Protection Characteristic Selection 2 (excess torque detection)	Digit 1 : 0 — Excess torque is not checked for.; 1 — Excess torque is detected if current detection H is ON Digit 2 : 0 — Excess torque is always checked for.; 1 — Excess torque is checked for only when actual and commanded speed coincide. Digit 3 : Stop method when excess torque is detected — 00 Deceleration stop (bn-02); 01 Coasting to a stop; 10 Deceleration stop (bn-05); 11 Operation continued Digit 4 : Stop method when excess torque is detected — 00 Deceleration stop (bn-02); 01 Coasting to a stop; 10 Deceleration stop (bn-05); 11 Operation continued	0100	0100		79 88

Major failure / Minor failure

Note : *Digit in Sn-04 to -12 (From right to left)*



* By initializing constant with operator status Sn-03 = 1110 or 1111, Sn-03 data returns automatically to 0000.

4

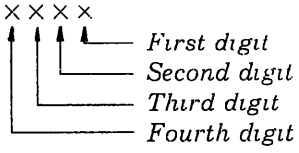
4.1.3 Sn-□□ : System Constants (Cont'd)

Table 4 3 System Constants Sn-[... (Cont'd)

No	Name	Description			Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
08	Protection Characteristic Selection 3 (external fault)	Digit	Setting Vaule 0	Setting Vaule 1	0100	0100		80 109
		1	Contact *a* input	Contact *b* input				
		2	Always checked	Checked only during operation				
		3 4	Stop method when external fault is detected: 00 · Deceleration stop (bn-02) (Major failure); 01 . Coasting to a stop; 10 · Deceleration stop (bn-05) (Minor failure); 11 Operation continued					
09	Protection Characteristic Selection 4 (Motor protection)	1	Electronics thermal motor protection is enabled.	Electronics thermal motor protection is disabled	0000	0000		65 81 83 107
		2	Standard motor characteristics	Exclusive motor characteristics				
		3	Protection time constant is set for 8 minutes	Protection time constant is set for 5 minutes				
		4	—	—				
10	Slip Compensation	1	Slip compensation is enabled only when actual and commanded speed agree	Slip compensation is enabled in all modes	0000	0000		73
		2	—	—				
		3	—	—				
		4	—	—				
11	PG Speed Control	1	No PG speed control is used. (Open loop)	PG speed control is used (Closed loop)	0100	0100		39 81 107
		2	Integration is applied only when actual and commanded speeds agree.	Integration is applied in all modes				
		3 4	When PG break, OS. or DEV is detected: 00 . Deceleration stop (bn-02) (Major failure); 01 · Coasting to a stop; 10 Deceleration stop (bn-05) (Minor failure); 11 : Operation continued					
12	Stall Prevention Selection	1	Stall prevention is used during acceleration.	Stall prevention is not used during acceleration	0000	0000		91
		2	Stall prevention is used during deceleration	Stall prevention is not used during deceleration				
		3	Stall prevention is used during operation	Stall prevention is not used during operation				
		4	If stall prevention function occurs during operation, decelerate at bn-02.	If stall prevention function occurs during operation, decelerate at bn-05.				
13	Relay Drive Output	Select an output item from 3CN-10 and -11			00	03		41 83

Notes

1. *Digit in Sn-04 to -12 (From right to left)*



2. *Relay drive output function selection (Sn-13)*

Setting Value	Name	Description
00	Operation Ongoing	ON Operation ongoing
01	Zero Speed	ON Zero speed is being applied (The inverter output is lower than the set value in Cn-07, or the inverter is stopped)
02	Frequency Agreed	ON Actual and command output frequencies agree (Commanded value − (Cn-23) ≦ Output frequency ≦ Commanded value + (Cn-23))
03	Brake Release Command	OFF Brake is closed ON Brake is released (Exclusive to cranes.)
04	Frequency Detection H	ON : Output frequency ≧ Cn-21 (at hysteresis of Cn-23)
05	Frequency Detection L	ON · Output frequency ≦ Cn-22 (at hysteresis of Cn-23.)
06	Current Detection H	ON · Output current ≧ Cn-24 (detected for time Cn-26)
07	Current Detection L	ON . Output current ≦ Cn-25 (detected for time Cn-26.)

3. *Sn-10 second digit and third digit is valid for P-ROM No. NSN618012 and after*
4. *Sn-09 fourth digit and Sn-10 fourth digit is valid for P-ROM No NSN618015 and after*
5. *For additional functions by P-ROM No version-up, see Appendix A5*

4.1.4 Cn-□□ : Control Constants

Table 4.4 Control Constants Cn-□□

No	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
01	Input Voltage	0.1 V	180.0 to 255.0 V	200.0 V*	200.0 V*		66 83
02	Maximum Frequency	0.1 Hz	50.0 to 400.0 Hz	60.0 Hz	60.0 Hz		
03	Maximum Voltage	0.1 V	0.0 to 255.0 V	200.0 V*	200.0 V*		
04	Maximum Voltage Frequency	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz		
05	Medium Output Frequency	0.1 Hz	0.0 to 400.0 Hz	3.0 Hz	3.0 Hz		66 73 83
06	Medium Output Frequency Voltage	0.1 V	0.0 to 255.0 V	15.0 V*	15.0 V*		
07	Minimum Output Frequency	0.1 Hz	0.0 to 400.0 Hz	1.5 Hz	1.5 Hz		
08	Minimum Output Frequency Voltage	0.1 V	0.0 to 255.0 V	10.0 V*	10.0 V*		
09	Motor Rated Current	0.1 A	10 to 200% of inverter rated current	**	**		66 73 81, 84
10	DC Braking Start Frequency	0.1 Hz	0.0 to 10.0 Hz	1.5 Hz	1.5 Hz		84
11	DC Braking Current	1%	0 to 100%	50%	50%		84
12	DC Braking Time at Stop	0.1 s	0.0 to 10.0 s	0.5 s	0.0 s		49 84
13	DC Braking Time at Start	0.1 s	0.0 to 10.0 s	0.0 s	0.0 s		85
14	Frequency Reference Upper Limit	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz		85 86
15	Not used	—	—	—	—		
16	Prohibited Frequency 1	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz		
17	Prohibited Frequency 2	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz		85
18	Prohibited Frequency 3	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz		
19	Prohibited Frequency Range	0.1 Hz	0.0 to 25.5 Hz	1.0 Hz	1.0 Hz		
20	Operator Display Mode	1	0 to 39999	0	0		86
21	Frequency Detection H Level	0.1 Hz	0.0 to 400.0 Hz	60.0 Hz	60.0 Hz		
22	Frequency Detection L Level	0.1 Hz	0.0 to 400.0 Hz	0.0 Hz	0.0 Hz		86
23	Frequency Agree Detection Width	0.1 Hz	0.0 to 25.5 Hz	2.0 Hz	2.0 Hz		87
24	Current Detection H Level	1%	5 to 200%	160%	160%		
25	Current Detection L Level	1%	5 to 200%	5%	5%		86
26	Current Detection Time	0.1 s	0.0 to 25.5 s	0.1 s	0.1 s		88
27	Start Level for Stall Prevention during Accel/Decel	1%	30 to 200%	150%	150%		
28	HOLD Level for Stall Prevention during Accel/Decel	1%	30 to 200%	170%	170%		90
29	Limiter for Stall Prevention during Accel/Decel	1%	30 to 200%	50%	50%		
30	Activation Level for Stall Prevention during Operation	1%	30 to 200%	160%	160%		91

* For 400 V class inverters, the range of setting and initial value are doubled.

** The initial value depends on the inverter kVA selection (Sn-01).

Table 4 4 Control Constants Cn-[illegible] (Cont'd)

	No.	Name	Unit	Setting Range	Initial Value when General-purpose Sequence is Selected	Initial Value when Crane Exclusive-use Sequence is Selected	Setting Value by Customer	Page
	31	Motor Phase to Phase Resistance	0.001Ω	0 to 65 535Ω	**	**		
	32	Torque Compensation Iron Loss	1 W	0 to 65535 W	**	**		73
	33	Torque Compensation Limiter	1 V	0 to 50 V	50 V*	50 V*		92
	34	Torque Compensation Response Time Constant	0 1 s	0 0 to 1 0 s	0 3 s	0.3 s		
	35	Motor No-load Current	1%	0 to 99%	30%	30%		
	36	Slip Compensation Response Time Constant	0 1 s	0 0 to 25.5 s	0 5 s	0.5 s		73
	37	Voltage Recovery Time	0.1 s	0 1 to 2.0 s	0 6 s	0.6 s		92
	38	Minimum Base-Block Time	0.1 s	0 1 to 2 0 s	**	**		
	39	Speed Search Function Level	1%	0 to 200%	80%	80%		
	40	Speed Search Time	0 1 s	0 to 25.5 s	2 0 s	2.0 s		
	41	V/f during Speed Search	1%	0 to 100%	30%	30%		
	42	Not used	—	—	—	—		
PG Control Exclusive-use Functions	43	PG Pulse Number	0.1 P/R	0 0 to 3000 0 P/R	0 0 P/R	0 0 P/R		
	44	Motor No. of Palses	2 P	2 to 32 P	4 pole	4 pole		
	45	ASR Gain 1	0 01	0 00 to 2.55	0 00	0 00		
	46	ASR Time Constant 1	0 1 s	0 1 to 10.0 s	1 0 s	1 0 s		39
	47	ASR Gain 2	0.01	0.00 to 2.55	0 20	0.20		81
	48	ASR Time Constant 2	0 1 s	0.1 to 10.0 s	1 0 s	1.0 s		92
	49	ASR Limiter (positive side)	0 1%	0 0 to 10 0%	5 0%	5 0%		109
	50	ASR Limiter (negative side)	0 1%	0 0 to 10 0%	5 0%	5.0%		
	51	Speed Deviation Excess Detection Level	1%	1 to 50%	10%	10%		
	52	Overspeed Detection Level	1%	1 to 120%	110%	110%		
	53 to 69	Not used	—	—	—	—		
Cranes Exclusive-use Functions	70	Brake Release Frequency (FBASE)	0.1 Hz	0 0 to 10.0 Hz	0.0 Hz	3 0 Hz		
	71	Forward Rotation Brake Release Current (IF)	1%	0 to 150%	0%	50%		
	72	Reverse Rotation Brake Release Current (IR)	1%	0 to 150%	0%	50%		
	73	Brake Release Current Detection Time (IT)	0.1 s	0.0 to 1.0 s	0.0 s	0.1 s		
	74	Speed Increase Timing (BT)	0.1 s	0 0 to 2.0 s	0 0 s	0 3 s		41
	75	Brake Holding Speed (NBH)	0 1 Hz	0 0 to 50 0 Hz	0 0 Hz	6 0 Hz		49
	76	Slip Prevention Hold Time (HT)	0.1 s	0 0 to 2 0 s	0 0 s	0.3 s		78
	77	Creep Speed (NCR)	0.1 Hz	0.0 to 20 0 Hz	0.0 Hz	6 0 Hz		92
	78	Forward Butting Stop Detection Current (IFOT)	1%	0 to 150%	0%	50%		
	79	Reverse Butting Stop Detection Current (IROT)	1%	0 to 150%	0%	50%		
	80	Butting Stop Detection Time (TIOT)	0.1 s	0.0 to 2.0 s	0 0 s	0 3 s		

* For 400 V class inverters, the range of setting and initial value are doubled

** The initial value depends on the inverter kVA selection (Sn-01)

Notes · *(1) Functions No. 70 to 80 are exclusive to cranes*

(2) Functions of Cn-39 to 41 are valid for P-ROM No. NSN618012 and after.

4.2 MINIMUM SETTINGS BEFORE OPERATION

Be sure to set the following constants before starting operation.
For operation method of the digital operator, see Par. 5. (Basic operations are similar to those of VS-616G3.)

(1) Operator Status (Sn-03) : Initial value = 0000
Select operation sequence according to Par. 3.2. General-purpose sequence is preset at the factory.

(2) Frequency Reference (An-01) : Initial value = 0.00 Hz
To use digital operator frequency reference, set a frequency value in An-01. If analog command is to be used, no value needs to be set.

(3) Acceleration Time 1 (bn-01), Deceleration Time 1 (bn-02) :
Initial value=10.0 s
Set time for varying speeds from 0 to the rated frequency and vice versa.

(4) Operation Signal Selection 1 (Sn-04) : Initial value=0011
(Digit : from right to left)

If 0 is set in the first digit : Analog signal input to 1CN-3 is used to control operation frequency.

If 1 is set in the first digit : Frequency reference of An-1 is used to control operation frequency.

If 0 is set in the second digit : Operation is started and stopped according to signals from pins 1CN-8 and -9.

If 1 is set in the second digit : Operation is started and stopped according to key operations on the digital operator.

NOTE
To use crane exclusive-use sequence, set 0 for the second position and use external pin signals (1CN-8 and -9) to start and stop operation.

(5) Protective Characteristic Selection 4 (Sn-9) : Initial value=0000
(Digit : from right to left)

If 0 is set in the second digit : Use standard (general-purpose) motor.

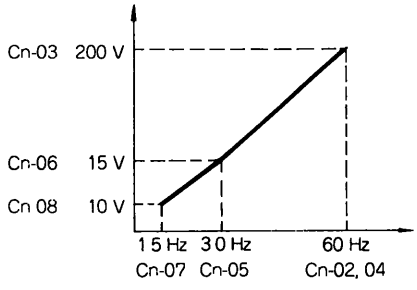
If 1 is set in the second digit : Use exclusive motor (specialized for inverter).

(6) Input Voltage (Cn-01) : Initial value=200 V (for 200 V class inverters) or 400 V (for 400 V class inverters)
Set the nominal voltage of the main circuit power supply connected to the inverter.

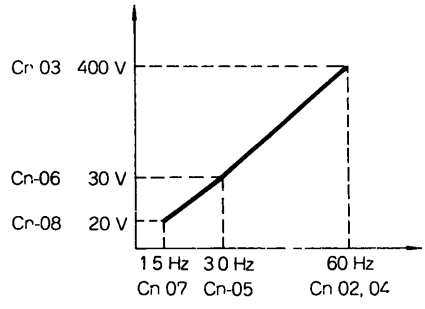
(7) V/f Setting (Cn-02 to -08)

Initial values are determined as shown below.

(200 V class)



(400 V class)



Cn-02, 04 : Set up the motor rated frequency.

Cn-03 : Set up the motor rated voltage.

Cn-06, 08 : Adjust depending on the motor rated voltage.

$$\text{Value to be set for Cn-06 (or -08)} = \text{Initial value of Cn-06 (or -08)} \times \frac{\text{Motor rated voltage}}{\text{Initial value of Cn-03}}$$

NOTE

To operate in crane exclusive-use sequence, set constants according to Par. 3.4.2. (4).

(8) Motor Rated Current (Cn-09)

Set the motor rated current.

4.3 FUNCTIONS

In the explanation below, related constants are enclosed in parentheses whereas related pins are in brackets.

For additional functions by software (P-ROM No.) version-up, see APPENDIX A5.

4.3.1 Basic Functions

(1) Frequency Reference Selection (An-01 to -09, Sn-04, -05) [1CN-3, -5, 2CN-1 to -9]

- If multi-speed command enable signal (1CN-5) is OFF, the signal selected by the first digit of Sn-04 takes effect.

  If 0 is set in the first digit of Sn-04 : Analog signal input from 1CN-3 specifies operation frequency.

  If 1 is set in the first digit of Sn-04 : Frequency reference An-01 specifies operation frequency.

- If multi-speed command enable signal (1CN-5) is ON, multi-speed operation is available as shown below.

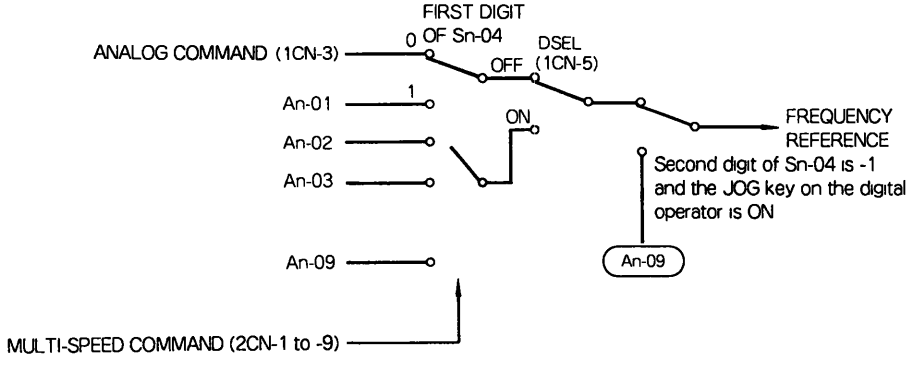


Fig. 4.1 Multi-speed Operation Block Diagram

Table 4 5 Contact Combination Method (used when the fourth digit of Sn-05 is 0)

Digital Command DSEL (1CN-5)	Sn-04 First Digit	Inching Command 2CN-4	Multi-speed Command 3 2CN-3	Multi-speed Command 2 2CN-2	Multi-speed Command 1 2CN-1	Effective Command	Constant
OFF	0	—	—	—	—	Analog reference	1CN-3
OFF	1	—	—	—	—	Frequency reference 1	An-01
ON	—	OFF	OFF	OFF	OFF	Frequency reference 1	An-01
ON	—	OFF	OFF	OFF	ON	Frequency reference 2	An-02
ON	—	OFF	OFF	ON	OFF	Frequency reference 3	An-03
ON	—	OFF	OFF	ON	ON	Frequency reference 4	An-04
ON	—	OFF	ON	OFF	OFF	Frequency reference 5	An-05
ON	—	OFF	ON	OFF	ON	Frequency reference 6	An-06
ON	—	OFF	ON	ON	OFF	Frequency reference 7	An-07
ON	—	OFF	ON	ON	ON	Frequency reference 8	An-08
ON	—	ON	—	—	—	Frequency reference 9	An-09

Notes :

1. The commands after 2CN-5 are ineffective

2 Inching command (2CN-4) has priority over multi-speed command 1 to 3 (2CN-1 to -3).

3. Digit in Sn-04 to -12 (From right to left)

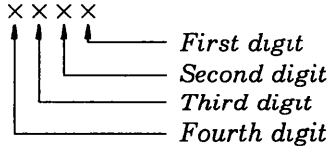


Table 4 6 Contact per Speed Method (used when the fourth digit of Sn-05 is 1)

Digital Command DSEL (1CN-5)	Sn-04 First Digit	Multi-speed Command 2CN-1 to -9	Effective Command	Constant
OFF	0	—	Analog reference	1CN-3
OFF	1	—	Frequency reference 1	An-01
ON	—	All OFF	Command 0	—
ON	—	2CN-1 is ON	Frequency reference 1	An-01
ON	—	2CN-2 is ON	Frequency reference 2	An-02
ON	—	2CN-3 is ON	Frequency reference 3	An-03
ON	—	2CN-4 is ON	Frequency reference 4	An-04
ON	—	2CN-5 is ON	Frequency reference 5	An-05
ON	—	2CN-6 is ON	Frequency reference 6	An-06
ON	—	2CN-7 is ON	Frequency reference 7	An-07
ON	—	2CN-8 is ON	Frequency reference 8	An-08
ON	—	2CN-9 is ON	Frequency reference 9	An-09

Notes :

1. *If two or more multi-speed commands (2CN-1 to -9) are ON, the lowest position those selected takes priority. For the priority of the JOG key on the digital operator, see the block diagram.*
2. *Commands 2CN-10 and beyond are not used.*

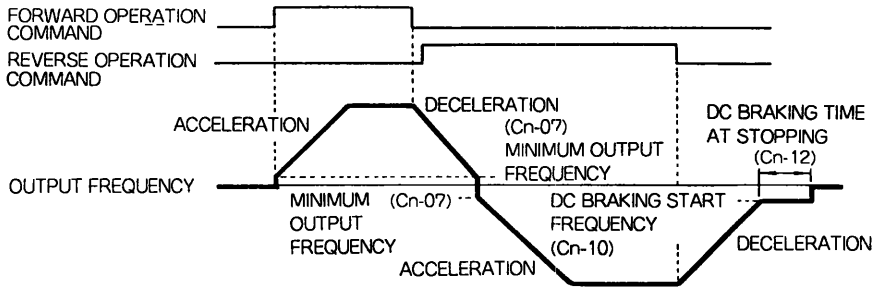
(2) Accel/decel Time, S-curve Time (bn-01 to -06, -12) [1CN-11, -14, -17]

Usually, accel/decel time and S-curve time set by bn-01 to -03 are used. (For the accel/decel time, set the time duration that goes into varying output frequency from 0% to 100% and vice versa.)

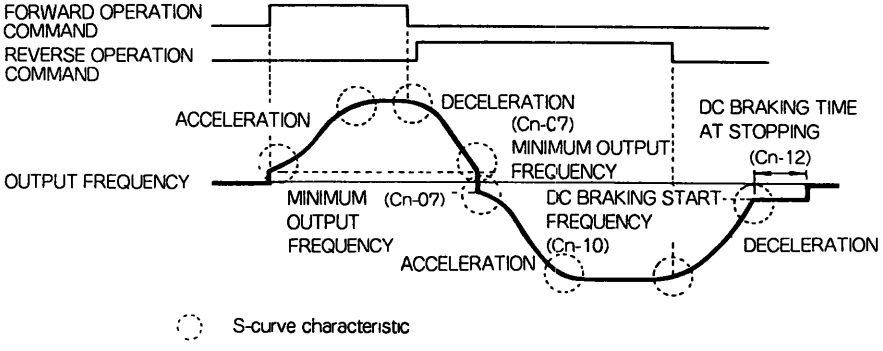
When signal is input to 1CN-11, -14, and/or 17, the three time durations are set up as shown in the table.

Table 4.7 Setup Time by Signal Input

Terminal Signal	Effective Setting		
	Accel Time	Decel Time	S-curve Time
1CN-11, 14, 17 are all OFF	bn-01	bn-02	bn-03
1CN-11 (Accel/Decel Time Selection) is ON	bn-04	bn-05	bn-06
1CN-14 (S-curve Characteristic Cancel) is ON	bn-01 or bn-04	bn-02 or bn-05	Without S-curve characteristic (0.0 second)
1CN-17 (Accel/Decel Time Reduce) is ON	(bn-01 or bn-04) ×bn-12	(bn-02 or bn-05) ×bn-12	(bn-03, -06 or 0.0 second) ×bn-12



(a) S-curve Characteristic not Used

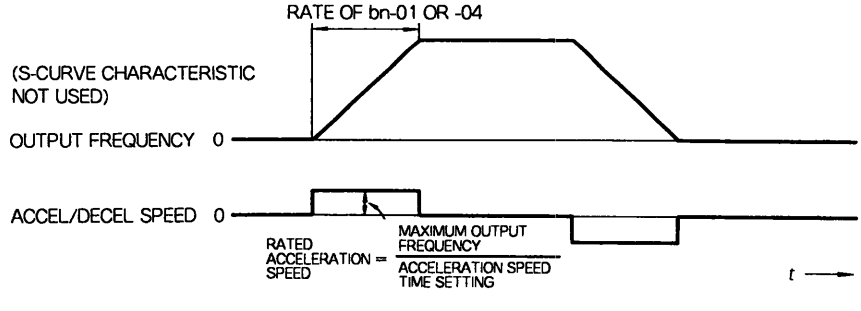


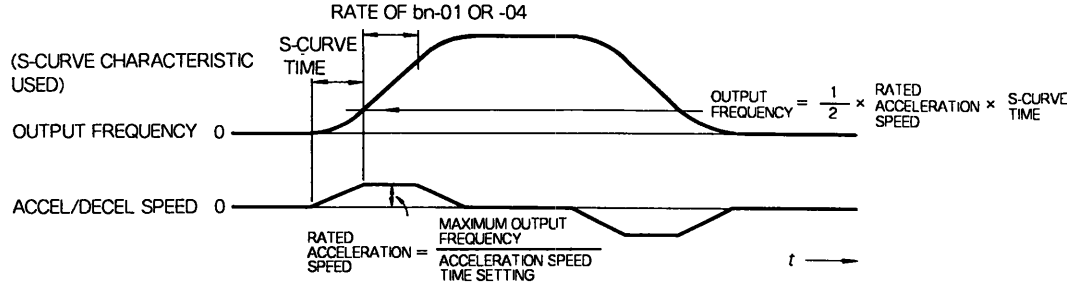
(b) S-curve Characteristic Used

Fig. 4.2 Time Chart of Switching Forward and Reverse Rotations by Deceleration Time

NOTES

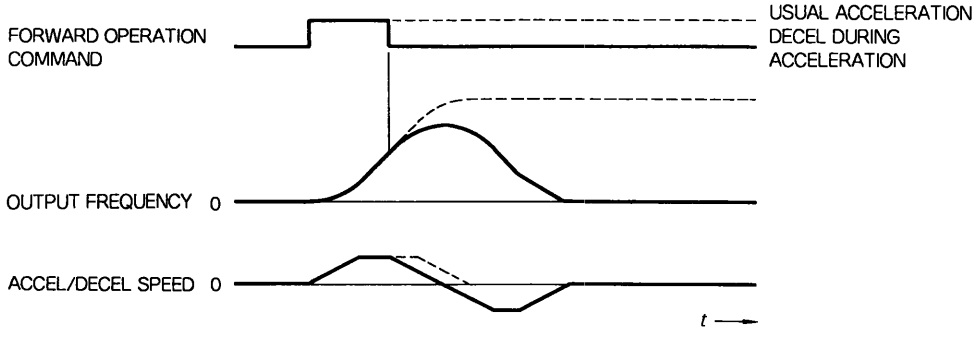
1. *S-curve characteristic time is the time duration for increasing accel/decel rate from 0 to a setup value. When S-curve characteristic is used, actual accel/decel time is extended by the S-curve characteristic time rather than the time set in bn-01, -02, -04, and -05.*





NOTES

2. If deceleration is commanded before acceleration is completed, S-curve operation is carried out as if acceleration has been completed, then deceleration is started. If the delay needs to be eliminated, vary deceleration time by 1CN-11 or cancel S-curve characteristic by 1CN-14.



(3) Frequency Reference Gain and Bias (bn-07, -08) [1CN-3]

(a) Frequency reference gain (bn-07)

Set the input level at frequency reference voltage of 10 V, in units of 0.1 %. Fig. 4.3 shows an example of setting.

(b) Frequency reference bias (bn-08)

Set the input level at frequency reference voltage of 0 V in units of 0.1 %.

(Ex.)

(1) bn-07 = 50.0

(2) a : bn-08 = 10.0

b : bn-08 = −10.0

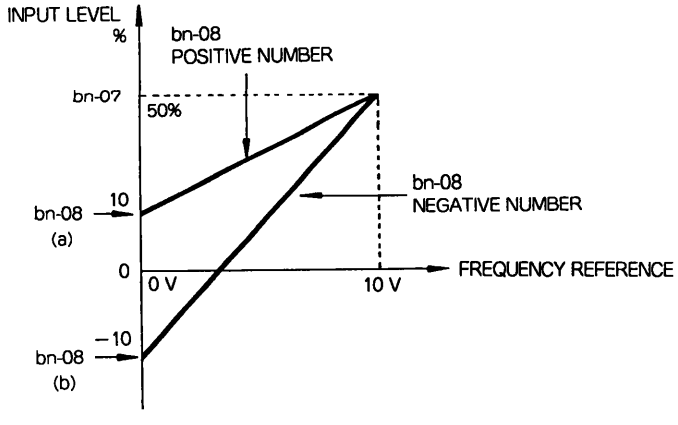


Fig. 4.3 Input level Setting

(4) Torque Compensation (bn-09, Cn-31 to -34)

The torque boost function compensates for insufficient torque in the low-speed area caused by voltage drop in cables and the motor.

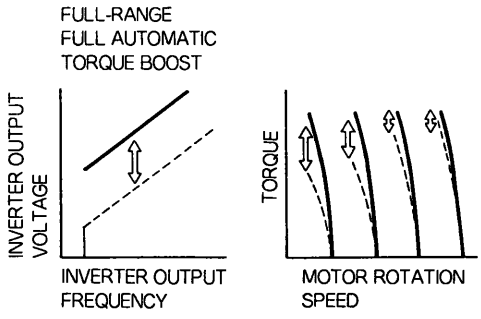


Fig. 4.4 Full-range Full-automatic Torque Boost

Standard settings of bn-09, Cn-31 to -34 need no modification to gain sufficient torque. Modification is required only under the following conditions. (For crane exclusive-use sequence, adjust according to (4) in Par. 3.4.2.)

- If torque is insufficient : Vary torque compensation gain (bn-09) between 1.0 and 1.5.
- If torque is sufficient but motor current under light load is excessive : Vary torque compensation gain (bn-09) between 0.0 and 1.0.
- If the inverter capacity is greater than the motor capacity by two degrees or more : Modify Cn-31 and -32 to fit for the motor. (See explanation on Sn-01.)

NOTE

Motor torque can also be varied by modifying V/f setting (Cn-06, -08). However, increasing Cn-06 or -08 too much may cause motor current increase (overexcitation) even under a light load.

(5) Slip Compensation (bn-10, Sn-10, Cn-9, -35, -36)

Motor speed variation due to load fluctuations can be reduced without a speed detector (PG or TG). Execute slip compensation by setting the following constants. Use of slip compensation is not selected by the initial settings (bn-10=0.0%).

- Motor rated slip (bn-10) : Set motor rated slip as a percentage of the rated synchronization rotation number.
- Motor rated current (Cn-09) : Set motor rated current in units 0.1 ampere.
- Motor no-load current (Cn-35) : Set the current at no-load to the motor as a percentage of the motor rated current (Cn-09).
- Slip compensation response time constant (Cn-36) : Adjust response time from 0.5 to 2.0 seconds.
- Slip compensation operation mode (Sn-10)

  If 0 is set in the first digit : Slip compensation is executed only when the actual and commanded speeds coincide ; in other words, during operation at a constant speed.

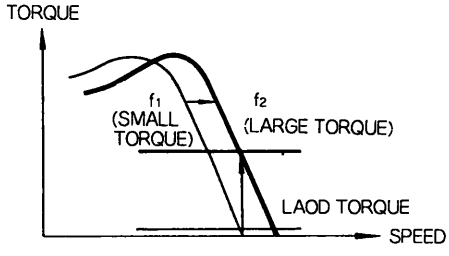
  If 1 is set in the first digit : Slip compensation is executed in all operation modes including acceleration and deceleration.

(Control operation)

If output current exceeds the motor no-load current, output frequency is corrected based on the following calculation :

Frequency compensation ($f_1 \rightarrow f_2$) reduces speed variation caused by load fluctuations.

$$\text{Output Frequency Compensation} = \frac{\text{Motor rated slip}}{\text{(Motor rated current} - \text{no-load current)}} \times \text{(Output current} - \text{no-load current)}$$



NOTES

1. *Slip compensation is not executed when output frequency drops to the minimum output frequency or lower.*
2. *Compensation is added while the motor is in monitoring mode : substracted while regenerative mode.*
3. *This function is automatically disabled when PG speed control is used.*
4. *For particular applications such as cranes, where speed fluctuations may be violent, sufficient characteristics are not necessarily desirable be obtained.*

(6) Monitor Number after Power ON (bn-11)

Set a monitor item to be displayed first on the digital operator after power is turned ON.

If 01 is set in bn-11 : Frequency reference
If 02 is set in bn-11 : Output frequency
If 03 is set in bn-11 : Output current

(7) Inverter Output Voltage Change (bn-13) [1CN-18]

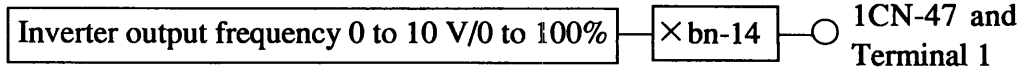
Usually, output voltage is determined by V/f characteristic set by Cn-02 to -08 and bn-09 ; however, different characteristics appear when output voltage change signal [1CN-18] is input.

Use this setting to adjust motor torque and prevent overexcitation suitable for the mode of operation.

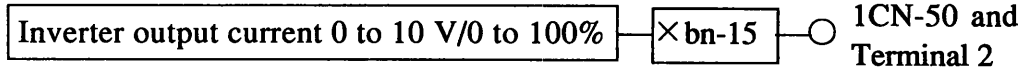
If 1CN-18 is OFF : Inverter output voltage is determined by Cn-02 to -08, bn-09, and Cn-31 to -34.

If 1CN-18 is ON : Inverter output voltage is determined by multiplying the value in Cn-02 to -08, bn-09, and Cn-31 to -34 by the value of bn-13.

(8) Calibration of Frequency Meter and Ammeter (bn-14, -15)
[1CN-47 to -50, screw terminals 1 to 3]



Output gains of the frequency meter and ammeter are shown below.



Initial value of bn-14 : 1.00 (0 to 10 V/0 to 100% output frequency)

NOTE
Use a frequency meter and ammeter of a full-scale of 1 mA (at 3 V to 10 V), and adjust monitor voltage by bn-14 and -15.
(Examples)
- *1 mA full-scale (3 V, 3 kΩ of internal impedance)*
- *1 mA ful-scale (10 V, 10 kΩ of internal impedance)*

Initial value of bn-15 : 0.50 (0 to 10 V/0 to 200% output frequency)

(9) Operator Status (Sn-03)
Operator status has the following two functions :

(a) Restriction on setting of and reference to constants (key locking)
If 0000 is set : An, bn, Sn, and Cn can be set and referred to.
If 0101 is set : An can be set and referred to. bn, Cn, and Sn can be referred to.

(b) Initialization of constants (For details, see Pars. 3.1 and 3.2.)
If 1110 is set and DATA ENTER key is depressed : Constants are initialized for general-purpose sequence.
If 1111 is set and DATA ENTER key is depressed : Constants are initialized for crane exclusive-use sequence.

NOTE
After initializing constants, value in Sn-03 is automatically reset to 0000 within about 0.5 seconds.

(10) Operation Signal Selection 1 (Sn-04) [1CN-3, 8, 9, and others]

(a) First digit (Frequency reference selection) (Digit : from right to left)

If 0 is set in the first digit : Analog signal input to 1CN-3 is used to control operation frequency.

If 1 is set in the first digit: Frequency reference of An-1 is used to control operation frequency.

NOTE

For multi-speed operation, see (1).

(b) Second digit (Operation reference selection)

If 0 is set in the second digit : Operation is started and stopped according to signals from external pins 1CN-8 and -9.

If 1 is set in the second digit : Operation is started and stopped accordingly when [RUN] and [STOP] keys on the digital operator are depressed.

NOTES

1. *Forward and reverse rotation signals (1CN-8 and -9) take effect only after the internal capacitors of the inverter are charged. (If the signals are set ON before power ON, they will have no effect.) Wait about two seconds after turning power ON, then turn ON the forward (or reverse) rotation signal.*
2. *To use crane exclusive-use sequence, set 0 in the second digit and use external pin signals (from 1CN-8 and -9) to start/stop.*

(c) Third Digit (Stop method selection)

If 0 is set in the third digit : After operation reference is turned OFF, speed is reduced according to set deceleration time, then output is stopped.

If 1 is set in the third digit : After operation reference is turned OFF, output is immediately stopped so that the motor is released free. (In crane exclusive-use sequence, holding brake is applied simultaneously as output is stopped.)

(Example of general-purpose sequence operation)

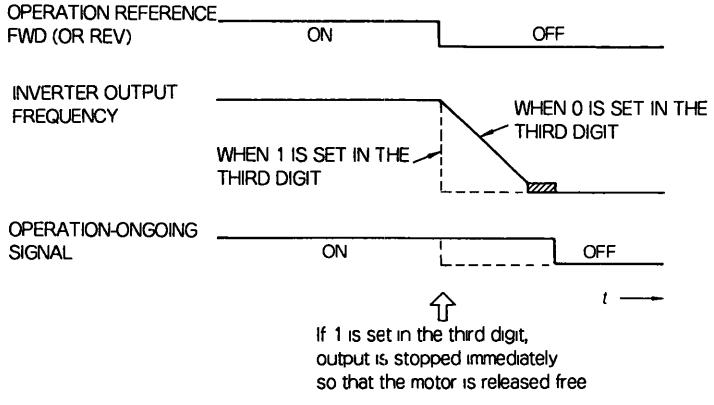


Fig. 4.5 Selection of Stop Method

(11) Operation Signal Selection 2 (Sn-05) [1CN-5, 6, 9, and others]

(a) First digit (STOP key on the digital operator) (Digit : from right to left)

If 0 is set in the first digit : STOP key on the digital operator is valid even during operation by operation signal from external pins.

When STOP key is depressed, operation is stopped according to the setting of the third digit of Sn-04.

After operation is stopped by STOP key, make sure to turn OFF the external pin operation signal.

If 1 is set in the first digit : STOP key on the digital operator is disregarded during operation by operation signal from external pins.

(b) Second digit (Reverse rotation prohibition)

If 0 is set in the second digit : Reverse signal from the external pin or the digital operator is accepted.

If 1 is set in the second digit : Reverse signal from the external pin or the digital operator is disregarded.

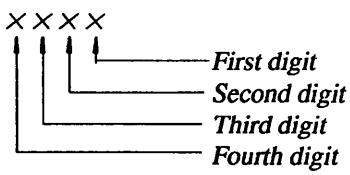
(c) Third digit (External base block signal)

If 0 is set in the third digit : External base block signal (1CN-6) is input to contact *a* (base block when ON).

If 1 is set in the third digit : External base block signal (1CN-6) is input to contact *b* (base block when OFF).

NOTES

1. *If external base block signal is input during operation, display of " bb " blinks on the digital operator and inverter output is stopped. When the external base block signal is cleared, operation is restarted at the frequency reference at that time. (Also see explanation on Cn-37 and -38.)*
2. *If external base block signal is input during the deceleration to stops, display of " bb " blinks on the digital operator, inverter output is stopped. Simultaneously, output frequency is forcibly set to 0 Hz. (This sequence is similar to coasting to a stop.)*
3. *Digit in Sn-04 to -12 (From right to left)*



(d) Fourth digit (multi-speed method) (For details, see (1).)

If 0 is set in the fourth digit : A combination of contact inputs is used to determine speed.

If 1 is set in the fourth digit : Each contact input specifies one particular speed.

(12) Protection Characteristic Selection 1 (Crane function) (Sn-06, -13, Cn-12, -70 to -80, and others) [1CN-10, -36, 3CN-10 to -13, and others]

(Sn-06)

(a) First digit (Operation sequence selection) (For details, see Par. 3.)
(Digit : from right to left)
If 0 is set in the first digit : Operation is started and stopped in general-purpose sequence.
If 1 is set in the first digit : Operation is started and stopped in crane exclusive-use sequence.

(b) Second digit (Crane supervising function)
If 0 is set in the second digit : Only SE2 is checked for duringoperation in crane exclusive-use sequence.
If 1 is set in the second digit : All sequence errors from SE1 to SE6 are checked for during operation in crane exclusive-use sequence.

(c) Third digit (Output missing phase check function)
If 0 is set in the third digit : Output missing phase check function is invalid.
If 1 is set in the third digit : Output missing phase check function is valid.

After operation is started, if any phase of inverter output current falls short of 5% of inverter rated current continuously for 0.2 second or longer, it is recognized as lost-phase output. If this occurs, the inverter stops output, closes the brake (if crane exclusive-use sequence is used), and outputs a signal to the fault contacts.
At the same time, the digital operator displays LF . No missing phase is detected if no motor is connected.

(d) Fourth digit (abnormal history automatic clear) (See Par. 5.2.)
If 0 is set in the fourth digit : If power is turned OFF when an inverter error has occurred, the inverter keeps the error type in memory and will display error history when power is turned ON the next time. Turning OFF power when the inverter is in normal condition does not clear the error history.
If 1 is set in the fourth digit : If power is turned OFF when an inverter error has occurred, the inverter keeps the error type in memory and will display error history when power is turned ON next time. Turning OFF power when the inverter is in normal condition does not clear the error history.
Turning OFF power when another error has occurred updates the error history. To clear error display, reset the fourth digit to 0 and turn OFF power, or initialize constants for Sn-03.

(13) Protective Characteristic Selection 2 (Current detection and excess torque detection) (Sn-07, -13, Cn-24 to -26) [1CN-39, -40, 3CN-10, -11]

(Sn-07)

(a) First digit (Excess torque detection selection)

If 0 is set in the first digit : Excess torque is not checked for.

If 1 is set in the first digit : Excess torque is checked for. Excess torque is detected when current detection H is ON. If excess torque is detected," oL3 " is on the digital operator. Stop mode at excess torque is determined by the third and fourth digits.

(b) Second digit (Excess torque detection mode selection)

If 0 is set in the second digit : Excess torque is always checked for unless the motor stops or DC brake is applied.

If 1 is set in the second digit : Excess torque is checked for only when the actual and commanded speeds coincide (that is, when the motor is operating at a consant rotation value.).

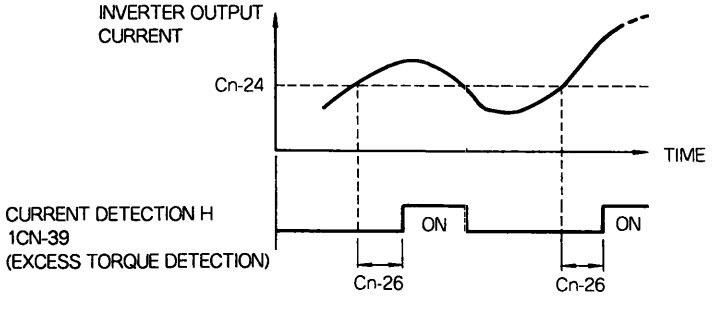


Fig. 4.6 Excess Torque Detection

(c) Third and fourth digits (Selection of stop method at excess torque)

00 : Deceleration stop by bn-02 rate
01 : Coasting to a stop
} Output to fault contacts (1CN-42 to -44) (major failure)

10 : Deceleration stop by bn-05 rate
11 : Operation continued
} Output only to minor failure contact (1CN-45) (minor failure, automatically recovered)

(14) Protection Characteristic Selection 3 (External fault) (Sn-08) [1CN-7]

(a) First digit (External error detection level selection)
(Digit : from right to left)

If 0 is set in the first digit : External fault signal (1CN-7) is input to contact *a*. (ON for presence of external fault)

If 1 is set in the first digit : External fault signal (1CN-7) is input to contact *b*. (OFF for presence of external fault)

(b) Second digit (External fault detection mode selection)

If 0 is set in the second digit : External failure signal is always acceped.

If 1 is set in the second digit : External failure signal is accepted only during operation, provided that no base block signal is input.

(c) Third and fourth digits (Selection of stop method at external fault)

00 : Deceleration stop by bn-02 rate
01 : Coasting to a stop
10 : Deceleration stop by bn-05 rate
} Output to fault contacts (Major failure)

11 : Operation continued
} Output only to minor failure contact (Minor failure, automatically recovered)

(15) Protective Characteristic Selection 4 (Motor protection) (Sn-09, Cn-09)

(Sn-09)

(a) First digit (Use of motor protection) (Digit : from right to left)

If 0 is set in the first digit : Electronics thermal function protects the motor.

If 1 is set in the first digit : Electronics thermal function does not protect the motor.

(b) Second digit (Protective characteristic selection)

If 0 is set in the second digit : Motor overload protection is based on the overload characteristic of standard (general-purpose) motors.

If 1 is set in the second digit : Motor overload protection is based on the overload characteristic of inverter-specialized motors.

(c) Third digit (Protective time constant selection)

If 0 is set in the third digit : Protective time constant is about eight minutes (at motor current of about 150%).

If 1 is set in the third digit : Protective time constant is about five minutes (at motor current of about 150%).

(16) PG Speed Control Selection (Sn-11, Cn-43 to -52) [3CN-1 to -6, -16 to -19, 2CN-16 to -19]

(Sn-11)

(a) First digit (Use of PG speed control)

If 0 is set in the first digit : No PG speed control (Motor slip compensation using PG signal) is performed.

If 1 is set in the first digit : PG speed control (Motor slip compensation using PG signal) is performed.
Slip compensation function using motor current (see explanation in (5)) is disabled.

(b) Second digit (Integration operation selection)

If 0 is set in the second digit : Integration is carried out only when the actual and commanded speed coincide.

If 1 is set in the second digit : Integration is carried out through operation.

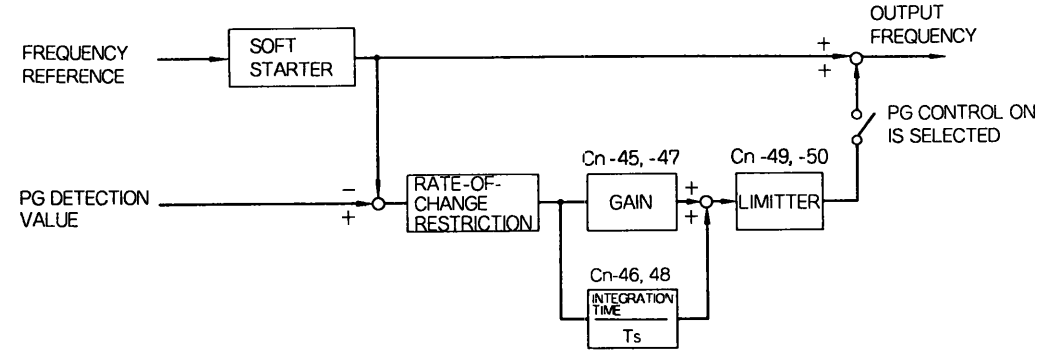
(c) Third and fourth digits (Selection of stop method at fault)

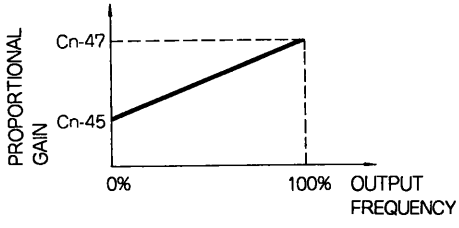
00 : Deceleration stop by bn-02 rate
01 : Coasting to a stop
10 : Deceleration stop by bn-05 rate
} Output to fault contacts (Major failure)

11 : Operation continued
} Output only to minor failure contact (Minor failure, automatically recovered)

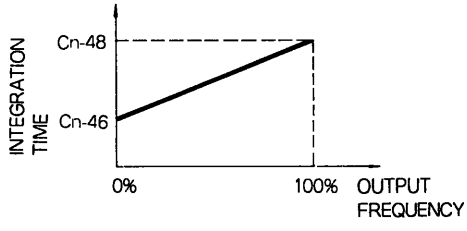
4.3.1 Basic Functions (Cont'd)

(Control block diagram)





Relationship between Output Frequency and Proportional Gain



Relationship between Output Frequency and Integration Time

NOTES

1. *Integration value is reset when mode is selected by the second digit of Sn-11, when the inverter stops, or when integration reset signal (1CN-16) is input.*
2. *PG signal wire-open, overspeed, or excess deviation is detected when it continues for more than one second.*
3. *When PG control is used, proportional signal of motor rotation number is output to 1CN-47 and screw terminal 1 (frequency output).*
4. *Zero speed and frequency agree are detected using output values from the soft starter.*

(17) Multifunction Relay Drive Output Item Selection (Sn-13) [3CN-10, -11]
Select an item to be output from multifunction relay drive output (3CN-10, -11) from the following table and set it for Sn-13. The initial value for general-purpose sequence is 00 (operation ongoing) ; for crane exclusive-use sequence, 03 (brake release command).

Table 4 8 Multifunction Relay Drive Output Items

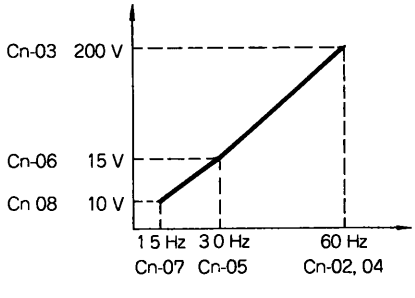
Setting Value	Name	Description
00	Operation Ongoing	ON . Operation is ongoing.
01	Zero Speed	ON : Zero speed (Inverter output is lower than Cn-07, or the inverter remains inactive.)
02	Frequency Agree	ON · Actual and command frequencies agreed. (Command value−Cn-23 ≦ output frequency ≦ commanded value + Cn-23)
03	Brake Release Command	OFF Brake is closed. ON : Bake is released (Exclusive to cranes)
04	Frequency Detection H	ON . Output frequency ≧ Cn-21 (at hysteresis of Cn-23.)
05	Frequency Detection L	ON : Output frequency is ≦ Cn-22 (at hysteresis of Cn-23)
06	Current Detection H	ON . Output current ≧ Cn-24 (detected for time Cn-26.)
07	Current Detection L	ON : Output current ≦ Cn-25 (detectec for time Cn-26.)

(18) Inverter Input Voltage Setting (Cn-01)
Set up the nominal voltage of the main circuit power supply connected to the inverter.

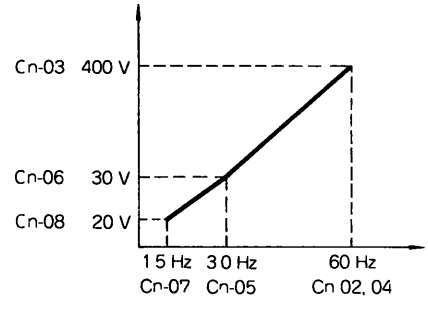
(19) V/f Setting (Cn-02 to -08)
Initial values are setup in the inverter as shown below. Adjust to fit the motor voltage and frequency.

Initial Value

(200 V Class)



(400 V Class)

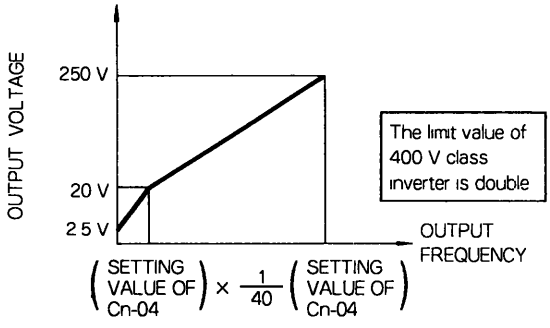


Cn-02, -04 : Set the motor rated frequency.
Cn-03 : Set the motor rated voltage.
Cn-06, -08 : Adjust depending on the motor rated voltage.

$$\text{Value to be set for Cn-06 or -08} = \text{Initial value of Cn-06 or -08} \times \frac{\text{Motor rated voltage}}{\text{Initial value of Cn-03}}$$

NOTES

1. *To operate in crane exclusive-use sequence, set constants according to (4) in Par. 3.4.2.*
2. *To increase rated rotation number of a general-purpose or inverter-specialized motor, set Cn-03 to -08 as specified above, then adjust Cn-02 and Cn-14 (frequency reference upper limit). To set rated rotation number lower than that of the motor, set V/f setting as specified above, then modify using frequency reference signal.*
3. *Motor torque is approximately proportional to $(\frac{V}{f})^2$. Varying V/f ratio excessively at low speed may result in insufficient torque or overcurrent (overexcitation) under light load. Adjust V/f ratio monitoring the motor current.*
4. *Inverter output voltage restriction*
   Output voltage of the inverter is restricted as shown below so as to prevent starting failure and inverter overload trip caused by motor overexcitation.



If application of high voltage at low frequency is required to obtain necessary starting torque, as with high-resistance motors or the long motor cables, set FF for system constant Sn-02. By doing so, the output voltage restriction function is disabled. Set appropriate V/f value for control constants Cn-02 to -08.

For general-purpose motors or inverter-specialized motors, leave the initial value of Sn-02 unchanged (0F). Sufficient starting torque is guaranteed without modification.

(20) Motor Rated Current (Cn-09)

Set the motor rated current. This value is used as reference for electronic thermal motor protection and slip compensation.

(21) DC Brake (Cn-10 to -13)

(a) DC brake starting frequency (Cn-10)

Set the frequency at which DC braking is to be started for deceleration stop, in units of 0.1 Hz. If the set value is lower than the minimum output frequency (Cn-07), DC braking is started at the minimum output frequency.

(b) DC braking current (Cn-11)

Set DC braking current as a percentage of the inverter rated current, in increments of 1%.

(c) DC braking time at stop (Cn-12)

Set the time during which DC braking is to be applied to stop, in units of 0.1 second. If 0 is set, DC brake is not applied and inverter output is stopped at the DC braking starting timing.

(d) DC braking time at start (Cn-13)

Set the time during which DC braking is to be applied at starting, in units of 0.1 second. If 0 is set, DC brake is not applied and acceleration is started from the minimum output frequency.

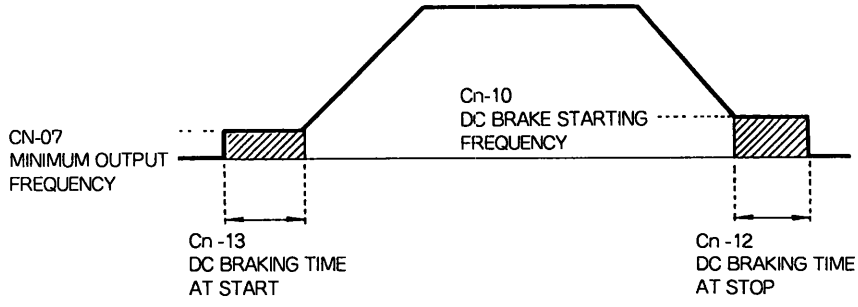


Fig. 4.7 DC Brake

(22) Frequency Reference Upper Limit (Cn-14, Cn-02)

Set the upper limit for frequency reference in units of 0.1 Hz. If a high frequency reference is commanded by the signal, it is limited to the set value for Cn-14. To increase motor rated rotation value, increase Cn-14 and Cn-02.

(23) Frequency Jump (Cn-16 to -19)

(a) Prohibited frequencies 1 to 3 (Cn-16 to -18)

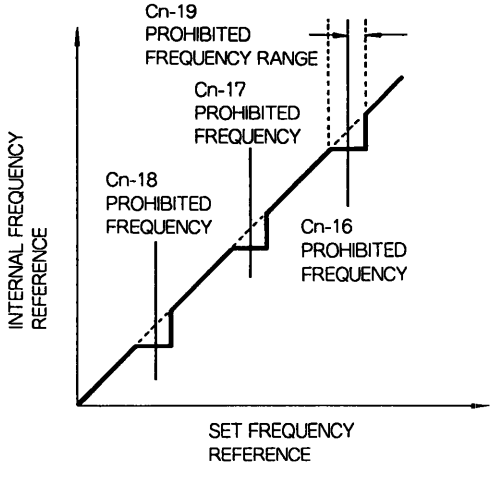
Set prohibited frequencies 1 to 3 as follows in units of 0.1 Hz. If 0.0 Hz is set, this function is disabled.

Cn-18 (prohibited frequency 3) ≦ Cn-17 (prohibited frequency 2) ≦Cn-16 (prohibited frequency 1)

(b) Prohibited frequency range (Cn-19)

Set up prohibited frequency range in units of 0.1 Hz. The prohibited frequency range is determined as follows.

Cn-16 to -18 − Cn-19 ≦ Prohibited frequency range ≦ Cn-16 to -18 + Cn-19



Note : Although constant-speed operation is prohibited in the prohibited range of frequency, output frequency is smoothly accelerated and decelerated even in this range.

Fig. 4.8 Frequency Jump

4.3.1 Basic Functions (Cont'd)

(24) Operator Display Mode (Cn-20)

Setting increments for frequency references 1 to 8 and inching frequency reference are determined as follows by operator display mode (Cn-20).

Table 4 9 Operator Display Mode (Cn-20)

Cn-20	Frequency Setting Mode	
	An- Constant	Display Mode after Power ON*
0	An-01 to -09 · Set in units of 0 01 Hz	
1	An-01 to -09 : Set in units of 0 01%	
2 to 39	Set in units of r/min. (0 to 39999) r/min. = 120 × frequency reference [Hz]/Cn-20 (Set motor pole number for Cn-20.)	
40 to 39999	The position of the decimal point is determined by the fifth digit of Cn-20 If 0 is set in the fifth digit · Display will be ×××× If 1 is set in the fifth digit : Display will be ××× × If 2 is set in the fifth digit · Display will be ×× ×× If 3 is set in the fifth digit : Display will be × ××× Set value of 100% frequency is represented by the fourth to first digit of Cn-20 (Examples) 1. To specify 200.0 for 100% speed, set 12000 for Cn-20. 2. To specify 65.00 for 100% speed, set 26500 for Cn-20	

Cn-20	Frequency Monitor Mode	
	An- and Un- Constants	Display Mode after Power ON*
0	An-01 to -09 : Displayed in units of 0 01 Hz	
1	An-01 to -09 : Displayed in units of 0.01%	
2 to 39	Displayed in units of r/min. (0 to 39999) r/min. = 120 × frequency reference [Hz]/Cn-20 (Cn-20 is the motor pole number.)	
40 to 39999	Monitored frequency is calculated compared to the standard set in Cn-20, and is displayed to the same precision as that set in Cn-20. (Examples) 1 If 12000 is set for Cn-20, 100% speed is displayed as 200.0 ; 60% speed as 120.0. 2. If 26500 is set for Cn-20, 60% speed is displayed as 39.00.	

* Monitored frequency is displayed as F×××× . Set ×××× with four significant numbers
If 99.99 or a lower number is set, numbers are displayed to the hundredth digit.
If 100.0 or higher number is set, numbers are displayed to the tenth digit

(25) Frequency Match, Frequency Detection H and L (Cn-21 to -23, Sn-13) [1CN-35, -37, -38, 3CN-10, -11]

(a) Frequency detection H level (Cn-21)

Set frequency detection H level in units of 0.1 Hz for Cn-21. If output frequency reaches to Cn-21 or greater, open collector signal 1CN-37 is turned ON. At the same time, if Sn-13 is 04, multifunction relay drive outputs 3CN-10 and -11 are turned ON.

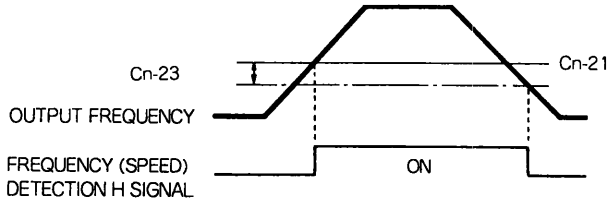


Fig. 4.9 Frequency Detection H Level

(b) Frequency detection level (Cn-22)

Set frequency detection L level in units of 0.1 Hz for Cn-22. If output frequency reaches to Cn-22 or lower, open collector signal 1CN-38 is turned ON. At the same time, if Sn-13 is 05, multifunction relay drive outputs 3CN-10 and -11 are turned ON.

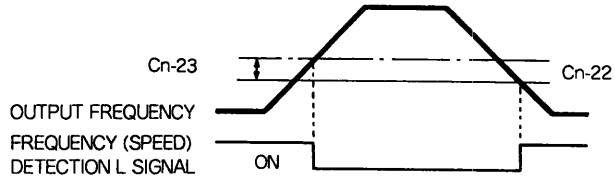


Fig. 4.10 Frequency Detection L Level

(c) Frequency agree detection width (Cn-23)

Set frequency agree detection width in units of 0.1 Hz for Cn-23. If output frequency is within the detection width, open collector signal 1CN-35 is turned ON. At the same time, if Sn-13 is 02, multifunction relay drive outputs 3CN-10 and -11 are turned ON. Value of Cn-23 is also used as hysteresis for frequency detection H and L levels.

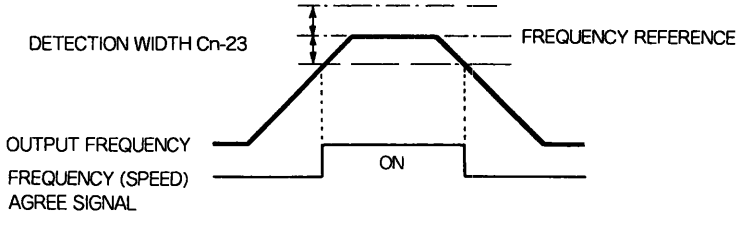


Fig. 4.11 Frequency Agree Detection Width

4.3.1 Basic Functions (Cont'd)

(26) Current Match, Current Detection H and L (Cn-24 to -26, Sn-07, 13) [1CN-39, -40, 3CN-10, -11]

(a) Current detecton H level (Cn-24)

Set current detection H level as a percentage of the inverter rated current in increments of 1% for Cn-24. If output current reaches Cn-24 level or greater, open collector signal 1CN-39 is turned ON. At the same time, if Sn-13 is 06, multifunction relay drive outputs 3CN-10 and -11 are turned ON.

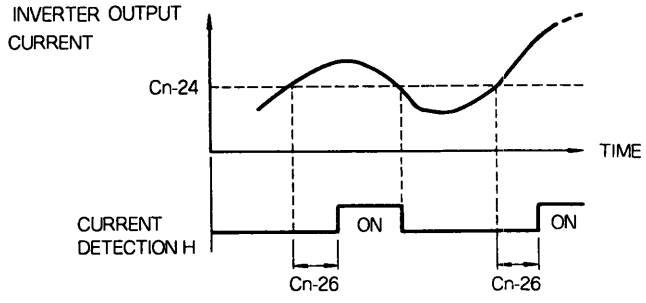


Fig. 4.12 Current Detection H Level

Current detection H signal can be used also for overtorque detection (Sn-07).

(b) Current detection L level (Cn-25)

Set current detection L level as a percentage of the inverter rated current in increments of 1% for Cn-25. If output current reaches Cn-25 level or lower, open collector signal 1CN-40 is turned ON. At the same time, if Sn-13 is 07, multifunction relay drive outputs 3CN-10 and -11 are turned ON.

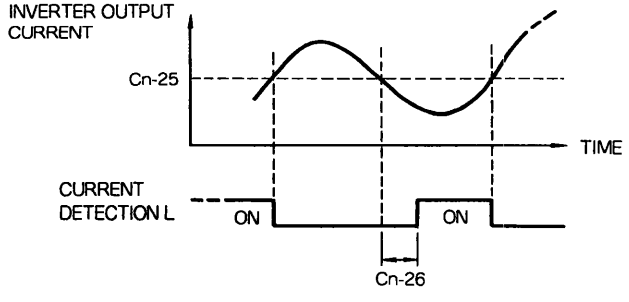


Fig. 4.13 Current Detection L Level

(c) Current detection time (Cn-26)

Set current detection time in 0.1 seconds.

4.3.2 Application Functions

(1) Inverter Capacity Selection (Sn-01)

Inverter capacity is preset at the factory. Careless modification may result in inverter fault.

When replacing the control board with a spare, refer to Table 4.10 and modify Sn-01.

Setting for Sn-01 affects initial values of control constants Cn listed in Table 4.10.

Table 4.10 Inverter Capacity Selection (200 V Class)

Name \ Sn-01		04	05	06	07	08	09	0A	0B	0C
Inverter Capacity	—	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037
Inverter Rated Current	—	13.2 A	22.2 A	33.0 A	45.0 A	66.1 A	90.1 A	111.1 A	132.1 A	180.2 A
Motor Rated Current	Cn-09	14.1 A	19.6 A	26 6 A	39.7 A	53.0 A	65.8 A	77.2 A	105.0 A	131.0 A
Motor Phase to Phase Resistance	Cn-31	0.837Ω	0.434Ω	0.241Ω	0 250Ω	0.149Ω	0.110Ω	0.086Ω	0.067Ω	0.045Ω
Torque Compensation Iron Loss	Cn-32	112 W	172 W	262 W	245 W	272 W	505 W	538 W	699 W	823 W
Minimum Base Block Time	Cn-38	0.5 s	0.7 s	0.7 s	0.7 s	0.7 s	1.0 s	1.0 s	1.0 s	1.0 s

Table 4.11 Inverter Capacity Selection (400 V Class)

Name \ Sn-01		26	27	28	29	2A	2B	2C	2D
Inverter Capacity	—	47P5	4011	4015	4018	4022	4030	4037	4045
Inverter Rated Current	—	16.5 A	22.5 A	33.0 A	45.0 A	55 6 A	66.1 A	90.1 A	111 1 A
Motor Rated Current	Cn-09	13.3 A	19.9 A	26.5 A	32 9 A	38 6 A	52.3 A	65.6 A	79.7 A
Motor Phase to Phase Resistance	Cn-31	0.964Ω	1.001Ω	0.597Ω	0.439Ω	0.344Ω	0.292Ω	0.178Ω	0.140Ω
Torque Compensation Iron Loss	Cn-32	263 W	385 W	440 W	508 W	586 W	750 W	925 W	1125 W
Minimum Base Block Time	Cn-38	0 7 s	0.7 s	0 7 s	1 0 s	1.0 s	1.0 s	1.0 s	1.0 s

[Control board replacement procedure]

① Replace the control board with a spare.

② Set inverter capacity data to Sn-01.

③ Select operation sequence according to operator status Sn-03. (Constants are initialized when 1110 or 1111 is set for Sn-03.)

④ Set 1010 for Sn-03 to make it possible to display order constants On.

⑤ Select order constant On-26 (regenerative reference voltage detection) to display.

⑥ Confirm that farthest left position is blinking and depress DATA ENTER key. (On-26 data are automatically turned.)

⑦ Set 0000 for Sn-03 to make it impossible to display order constants On.

⑧ Set up necessary values for constants An, bn, Cn, and Sn.

(2) Accel/Decel Stall Prevention (Cn-27 to -29, Sn-12)

Accel/decel stall prevention function increases accel/decel rate automatically depending on the load status being accelerated or decelerated (by monitoring inverter output current) to prevent the motor from running away. Stall prevention level in constant-output area (area over the motor rated frequency) is reduced as follows according to motor torque.

If the inverter capacity differs greatly from the motor capacity (two degrees or more) or to further suppress motor torque under acceleration or deceleration, modify Cn-27 to -29. Usually, however, no modification is required.

(a) Accel/decel stall prevention starting level (Cn-27)

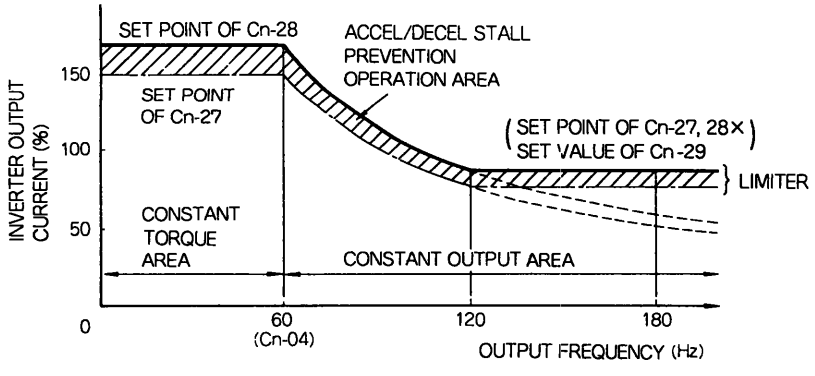
Set the starting level of accel/decel stall prevention as a percentage of the inverter rated current in increments of 1% for Cn-27.

(b) Accel/decel stall prevention holding level (Cn-28)

Set the holding level of accel/decel stall prevention (the level at which acceleration or deceleration is stopped) as a percentage of the inverter rated current in increments of 1% for Cn-28.

(c) Accel/decel stall prevention limiter (Cn-29)

Set the accel/decel stall prevention limiter that operates in constant-output area as a percentage of Cn-27 and -28 in increments of 1% for Cn-29.



NOTES :

1. *If regenerative load is applied to the motor during acceleration, or if motoring load is applied during deceleration, stall prevention function is not activated but accel/decel is executed at the rate set in bn-01 to -06, and -12.*
2. *If 1 is set in the first digit of Sn-12, acceleration is executed at the set rate without performing stall prevention. If 1 is set in the second digit of Sn-12, deceleration is executed at the set rate without performing stall prevention.*

Fig. 4.14 Accel/Decel Stall Prevention

(3) Stall Prevention during Operation (Cn-30, Sn-12)

Set the operation stall prevention activation level as a percentage of the inverter rated current in increments of 1%.

Operation stall prevention is activated as follows. When actual and commanded speeds agree, if output current exceeds the value of Cn-30 (operation stall prevention activation level) by 100 ms or greater, deceleration is started. Deceleration continues while the output current is above the set value of Cn-30. When the output current drops to that value or lower, acceleration is started again. Deceleration time set by the fourth digit of Sn-12 is used.

NOTES :

1. *Even when operation stall prevention has been activated, accel/decel stall prevention can function.*
2. *If regenerative load is applied when actual and commanded speeds agree, operation stall prevention is not activated.*
3. *Deceleration time during operation stall prevention can be selected by the fourth digit of Sn-12. Select either bn-02 or bn-05 depending on the load status and motor rotation speed.*
4. *If 1 is set for the third digit of Sn-12, operation stall prevention does not function.*

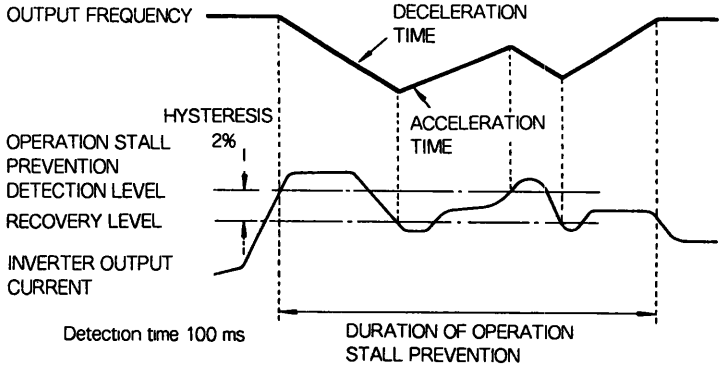


Fig. 4.15 Operation Stall Prevention

(4) Torque Compensation (Cn-31 to -34)

(a) Motor phase to phase resistance (Cn-31), torque compensation iron loss (Cn-32)

If torque compensation is insufficient because the inverter capacity exceeds the motor capacity by two degrees, refer to explanation on Sn-01 and adjust Cn-31 and Cn-32 to fit the motor capacity.

(b) Torque compensation limiter (Cn-33)

Increase of torque compensation gain (bn-09) may cause motor overcurrent at abrupt variation in load. If this occurs, reduce torque compensation gain or limit the compensation voltage by torque compensation limiter Cn-33.

Cn-33 adjustment range :
For 200 V class inverters : 10 V to 20 V
For 400 V class inverters : 20 V to 40 V

(c) Torque compensation response time constant (Cn-34)

Adjust torque compensation response timing.

Cn-34 adjustment range : 0.1 s to 1.0 s

(5) Voltage Recovery Time, Minimum Base Block Time (Cn-37, -38) [1CN-6]

Set the minimum base block time when external base block signal 1CN-6 is turned ON or OFF in Cn-37. Set the recovery rate (time to recover from 0 V to the rated voltage) in Cn-38. Usually, no modification is necessary.

(6) PG ASR Limiter, PG Fault (Cn-49 to -52)

(a) PG ASR limiter (Cn-49, -50)

Set the ASR positive correction limiter value in Cn-49 ; negative in Cn-50. Adjust if correction is insufficient or excessive.

(b) Speed deviation excess detection level (Cn-51)

Set the level at which speed deviation excess is to be detected as a percentage of the maximum frequency in increments of 1%.

(c) Overspeed detection level (Cn-52)

Set the level at which overspeed is to be detected as a percentage of the maximum frequency in increments of 1%.

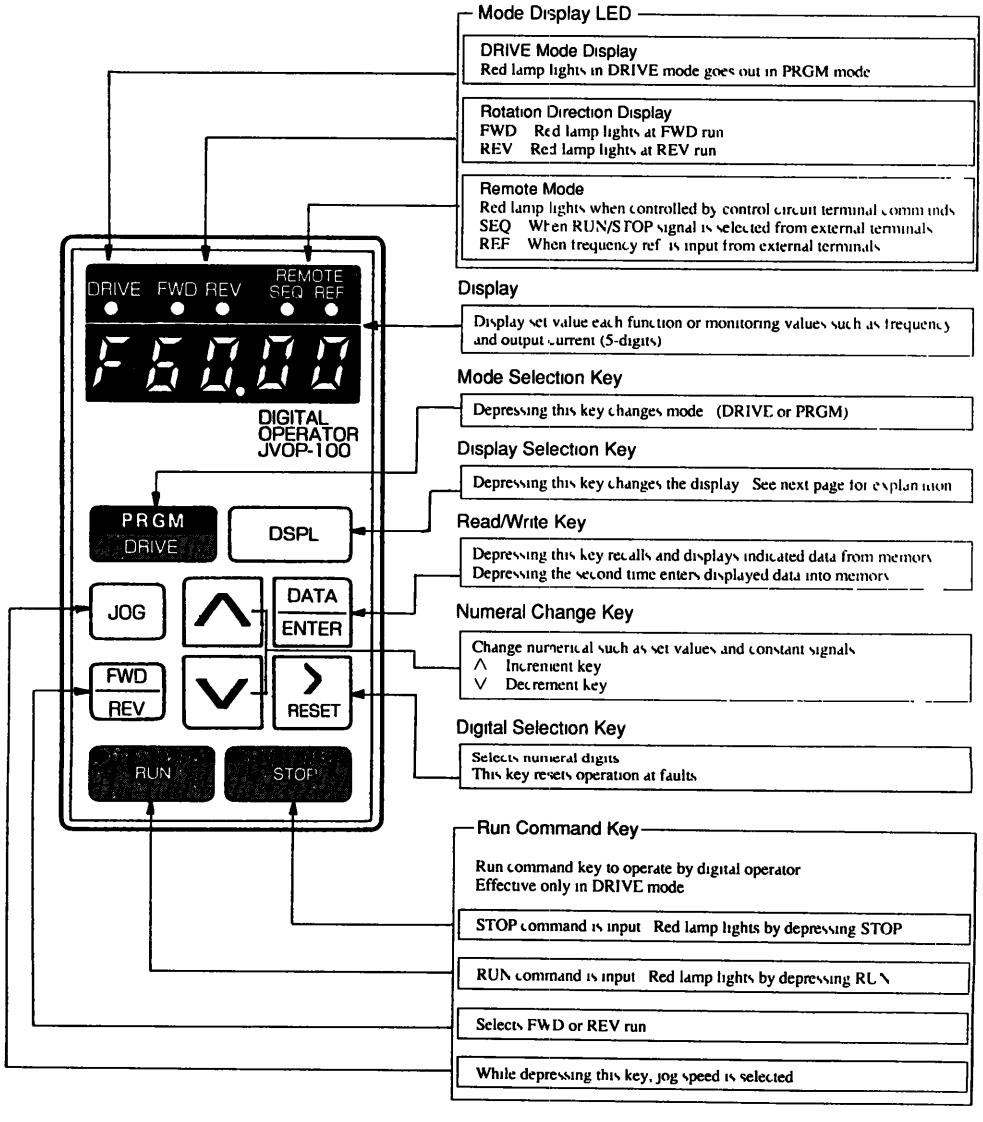
(7) Crane-specialized Constants (Cn-70 to -80)

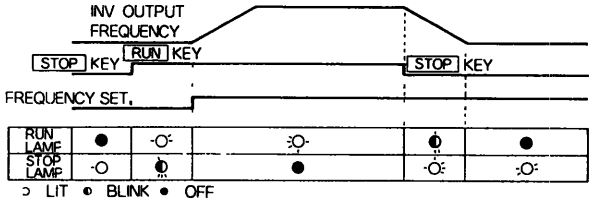
For these constants, see Par. 3.4.2, "Crane Exclusive-use Sequence."

5. USE OF DIGITAL OPERATOR AND MONITORING

5.1 DIGITAL OPERATOR

Digital operator has DRIVE mode and PRGM mode. Selecting DRIVE mode enables the inverter to operate. PRGM mode enables the programs to be written-in. DRIVE and PRGM modes can be switched by PRGM/DRIVE key only when stopped.

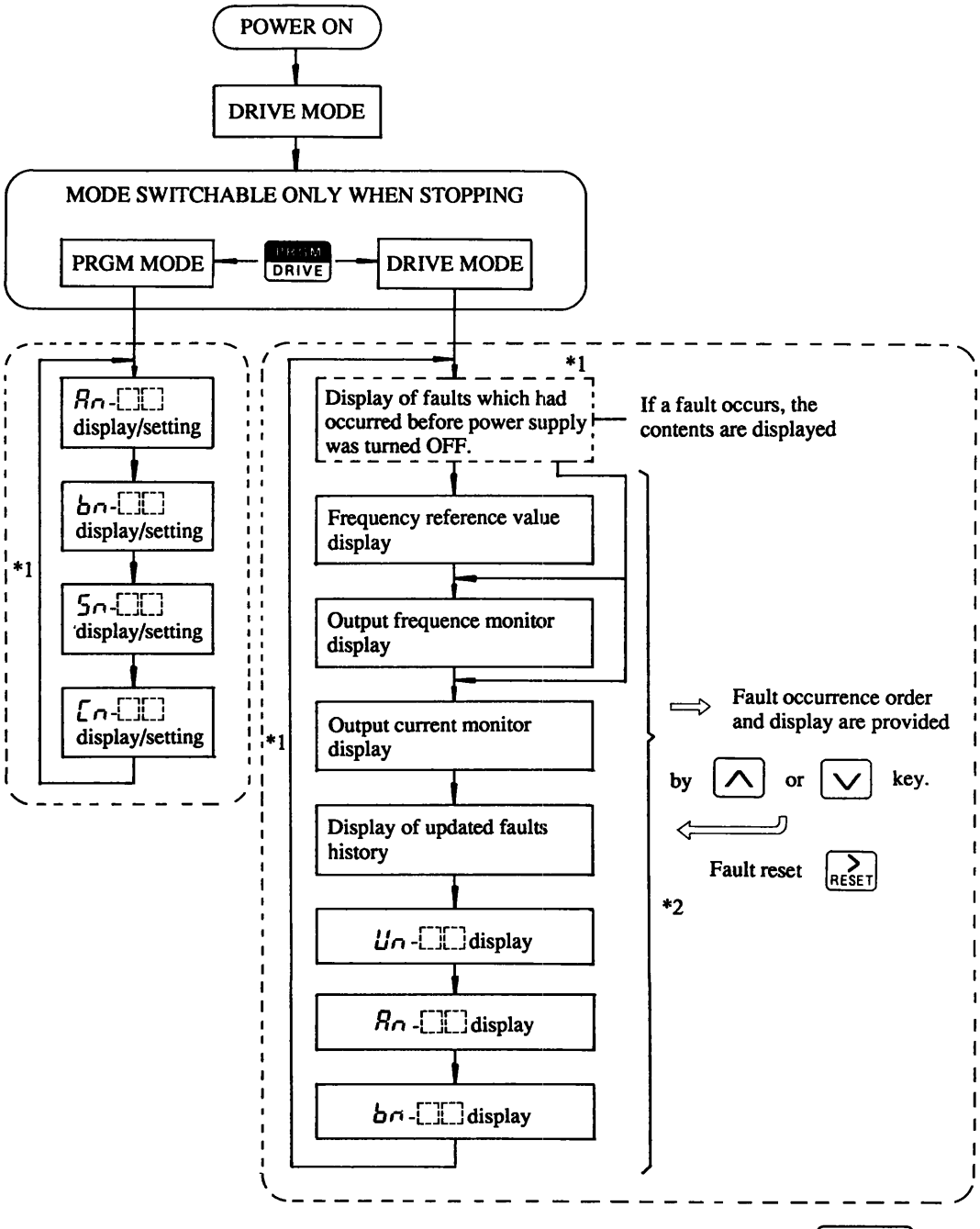




* RUN or STOP lamp changes in accordance with the operations.

Fig. 5.1

5.2 DISPLAY IN DRIVE MODE AND PROGRAM (PRGM) MODE



*1 The constant group to be displayed is changed each time display selection key DSPL is depressed.

*2 Updated faults history are displayed. Even if the power supply is turned OFF at fault occurrence, the constants are stored so that they are displayed after the power supply is turned ON again. (When no fault occurred, fault display of the previous operation is skipped.) For details, see Par. 4.3.1 (12).

Fig. 5.2

5.3 GROUPS OF CONSTANTS

Constants of VS-616R3 are classified as follows :

- An-□□ : Frequency reference setting
- bn-□□ : Constant group able to be changed during running
- Cn-□□ : Constant, among control constant groups, related to operation characteristics change
- Sn-□□ : Constant, among system constant groups, to be used for function selection

The ability to set or read the different groups of constants is determined by Sn-03 as shown below.

Table 5 1 Groups of Constants

Sn-03	DRIVE Mode		PRGM Mode		Remarks
	Setting	Reading	Setting	Reading	
0000	An, bn	Sn, Cn	An, bn, Sn, Cn	···	Factory setting
0101	An	bn, Sn, Cn	An	bn, Sn, Cn	*

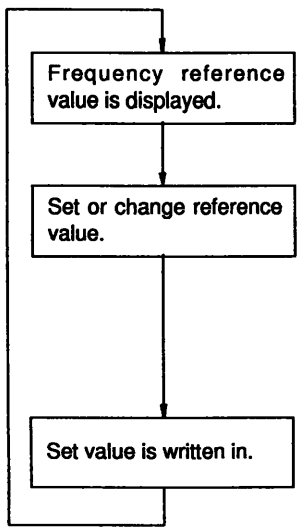
* It is recommended that Sn-03 is set to 0101 and reading mode is entered after test run adjustment

Note : *To read the Sn or Cn while in the DRIVE mode, depress the* RESET *and* DSPL *keys simultaneously.*

5.4 BASIC PROCEDURE OF SETTING AND MODIFYNG CONSTANTS

5.4.1 Setting and Modifying Frequency Command Values

The following shows an example where frequency reference value is set at 15 Hz.



[Operation]

Select by DSPL key.

Set 1 by ∧ key.

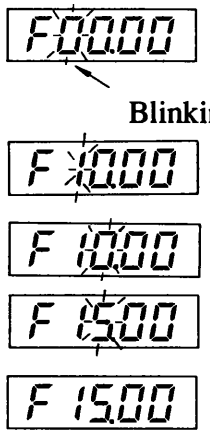
Select a digit by RESET key.

Set 5 by ∧ key.

Depress DATA ENTER key.

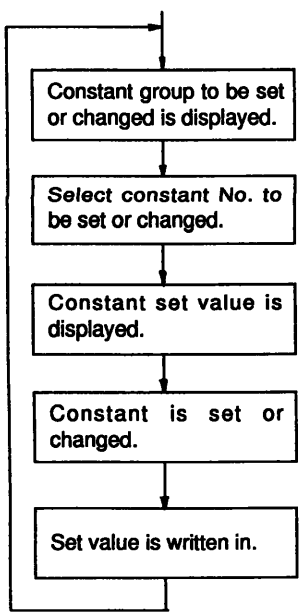
(Stops blinking for 2 seconds.)

[Digital Operator Display]



5.4.2 Modifying Constants and Selecting Functions

- The following shows an example where jog frequency (An-09) value is changed from 6 to 10 Hz.
- The other constants are changed in the same way as shown above.
- When changing Cn-□□ and Sn-□□ constants, program mode must be selected.



Select An-01 with DSPL key.

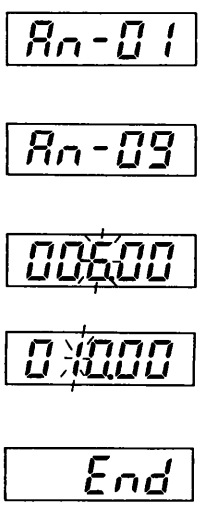
Change the value with ∧ or ∨ key.

Depress DATA ENTER key.

Change the value with RESET, ∧ or ∨ key.

Depress DATA ENTER key and check that End is displayed.

(End is displayed for 0.5 second.)

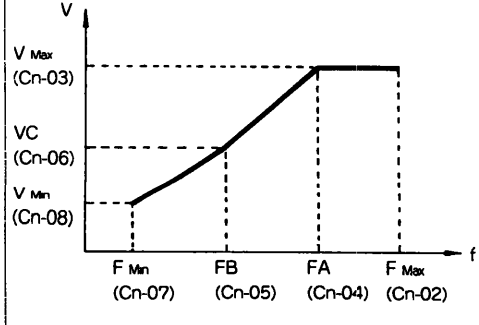


Note : *Check that* End *is displayed for each constant setting. Constants cannot be changed simultaneously.*

5.5 OPERATION ERRORS " oPE□□ "

Digital operator displays faults if the consant setting failure oPE is detected. The fault contact output of the inverter is not output. The oPE is checked when power is applied or PRGM is changed to DRIVE mode. On the other hand, if the following "conditions" occur at power ON or changing PRGM into DRIVE, it becomes oPE .

Table 5.2 Operation Errors

Display	Fault	Conditions	Example
oPE01	kVA Constant Setting Fault (Sn-01)	When incorrect data from inverter kVA data is set for Sn-01.	When "OA" (200 V, 22 kW) is set for 23P7 (200 V, 3.7 kW) and so on, the regular data is "04."
oPE02	Constant Setting Range Fault	When "out of setting range" constant is set	
oPE03	Speed Search Setting Fault	Speed search command is set at a elevator sequence Sn-10 = ××1×	
oPE04	Number of Pulses Setting Range Fault	When "out of PG frequency range" number of pulses is set	
oPE10	V/f Data Set Fault (Cn-02 to -08)	When Cn-02 to -08 do not satisfy the following conditions • $F_{Max} \geqq FA > FB \geqq F_{Min}$ (Cn-02) (Cn-04) (Cn-05) (Cn-07)  	Cn-02 = 50 Cn-04 = 60 Cn-05 = 3 Cn-07 = 1 5
Err	Constant Write-in Fault	The constant is not written in correctly to NV-RAM (Only at initialization)	

Notes :

1. *Blinking indication " bb " is not an operation error The " bb " blinks when inverter output breaking (base block) is operated by external base block signal (1CN-6).*
2. *When On-04 first digit = 1, oPE04 dtection is not executed*
3. *oPE03 is displayed only for the software P-ROM No. NSN618012 and after.*

5.6 Un- : MONITOR DISPLAY

Display Un-□□ in DRIVE mode. Depess [∧] or [∨] to select number of Un : Then, depress [DATA/ENTER] to monitor the next data. To return to Un- □□ display, depress [DSPL] key.

Table 5 3 Monitor Display

Un-□□	Item	Unit	Display
01	Frequency reference	Hz	60.00 【60.00 (Hz)】
02	Output frequency	Hz	60.00 【60.00 (Hz)】
03	Output current	A	12.5A 【12.5 A】
04	Output voltage reference	VAC	200V 【200 V】
05	DC bus voltage	VDC	Pn270 【PN 270 V】
06	Motor output power * (± display)	kW	-12.5 【−12.5 (kW)】
07	Input terminals condition 1*	—	C 1CN-6 BB, 1CN-7 EF, 1CN-8 FWD, 1CN-9 REV, 1CN-10 BX, 1CN-11 TIME, 1CN-12 HOLD, 1CN-13 RST
08	Input terminals condition 2*	—	C 1CN-14 SCAN, 1CN-15 CSTP, 1CN-16 IRST, 1CN-17 RED, 1CN-18 VCHG, 1CN-5 DSEL, 3CN-12, 13 BX2, MC answer back
09	Output terminals condition 1*	—	0 1CN-33 RUN, 1CN-34 ZSPD, 1CN-35 AGR, 1CN-36 BR1, 1CN-37 FDH, 1CN-38 FDL, 1CN-39 CDH, 1CN-40 CDL

Table 5.3 Monitor Display (Cont'd)

Un-[ ]	Item	Unit	Display
10	Output terminal condition 2 **	—	0 1 ← 3CN10-11 BR2
11	Digital operator LED check	—	8. 8. 8. 8. 8. 【All segment lights】
12	P-ROM number	—	1 8 0 1 1 【NSN618011】
13	Speed feedback †	%	1 0 0. 0 【100.0 (%)】
14	Slip compensation †	%	1 0. 0 【10.0 (%)】
15	Panel interior temperature ‡	℃	3 0. 0 【30.0℃】
16	Heat sink temperature ‡	℃	4 0. 0 【40.0℃】
17	External A/D conversion value #	—	
18	Phase U A/D conversion value #	—	
19	Phase W A/D conversion value #	—	

* Motor output power monitor (Un-06) is displayed unsigned during motoring ; with a minus sign during regeneration.

** I/O pin monitors (Un-07 to -10) light when the corresponding I/O pin signals are ON ; goes OFF when they are OFF. However, input signal 1CN-6 (BB) and 1CN-7 (EF) are ON, " bb " and " EF " are displayed respectively, taking precedence over monitor display.

† Speed feedback (Un-13) is effective only when PG speed control is used Slip compensation monitor (Un-14) is effective when PG speed control or slip compensation is used.

‡ Panel interior temperature (Un-15) indicates inverter intake air temperature, which approximates panel temperature. Heat sink monitor (Un-16) indicates temperature of the heat sink on which the main circuit transistor is mounted.

A/D conversion values (Un-17 to -19) are for fine adjustment of the inverter. Usually, these are not used.

6. METHOD AND CHECK POINTS OF TEST OPERATION

6.1 CHECK BEFORE TEST OPERATION

After completing installation and wiring, check the folowing.

- Check for connection errors. Especially, make sure that no power supply is connected to output pins T1 (U), T2 (V), and T3 (W).
- Check for cable chips which can cause short-circuits.
- Check for loose screws and pins. Check termination of cables. Check load status.
- Before test operation, disconnect the coupling or belt between the motor and the load machine so that the motor can be operated alone for safety. Take special care for safety when operating the motor connected to the load machine. Especially, with cranes, prepare emergency stop measures in case of motor starting failure or stall (fall).
- Check for correct grounding of wires.
- Check if operation command has been input inadvertently.
  Make sure that no operation command is input before turning ON power to the inverter.

6.2 SETTING BEFORE TEST OPERATION

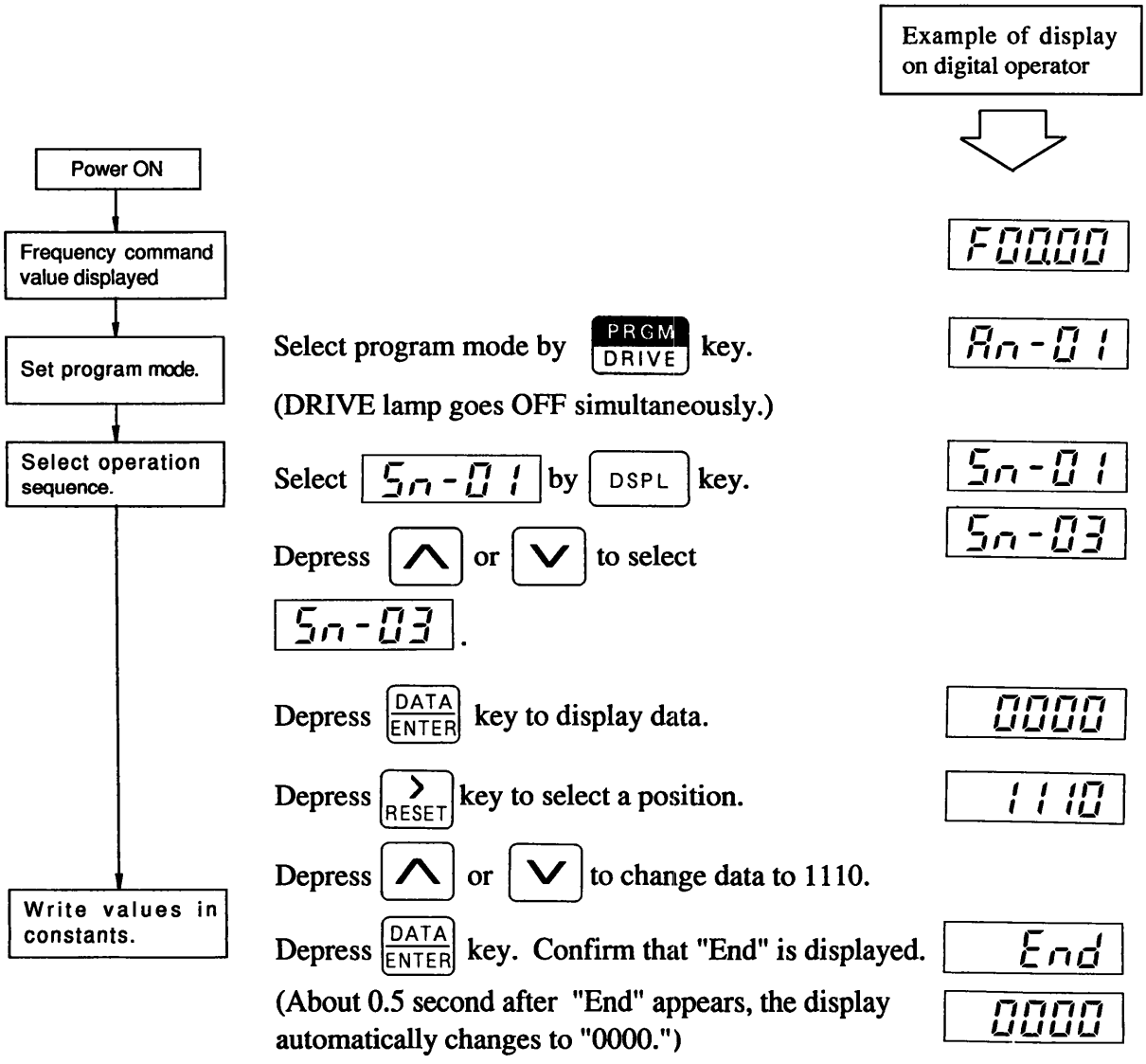
6.2.1 Selecting Operation Sequence

VS-616R3 supports the following two operation sequences, one of which can be used by initializing constants.

- Set 1110 for system constant Sn-03 and depress DATA/ENTER key to operate in general-purpose sequence. (Equivalent to standard type of VS-616G3)
- Set 1111 for system constant Sn-03 and depress DATA/ENTER key to operate in crane exclusive-use sequence. (Equivalent to VS-616G3 with crane software)

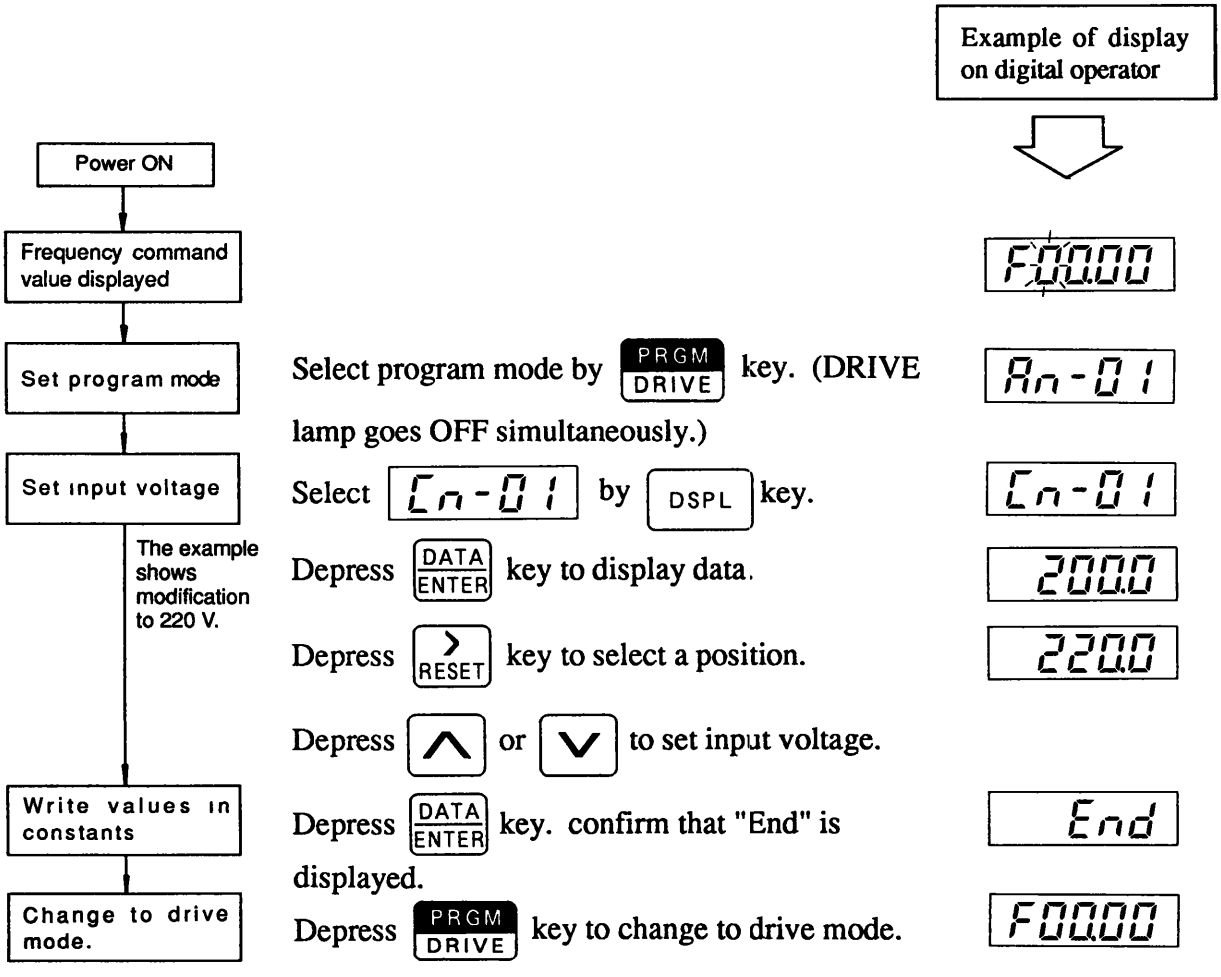
Procedure to select general-purpose sequence is shown below. To select crane exclusive-use sequence, refer to Par. 2 and Par. 3 and select by similar procedure.

Note that initializing constants resets all the constants except system constants Sn-01 and -02 to initial values. Never initialize inadvertently.



6.2.2 Setting Input Voltage

Set to power voltage to be applied. At the factory, 200 V class inverters are preset for 200 V ; 400 V class inverters for 400 V.



6.3 METHOD OF TEST OPERATION

Method of test operation using general-purpose sequence without connecting load machine to the motor is explained below. For operation connecting with load machine or use of crane exclusive-use, read Par. 2 and Par. 3 carefully and insure safe operation.

6.3.1 Operation with the Digital Operator

(Operable with System Constant Sn-04 : 0011)

(1) Connection

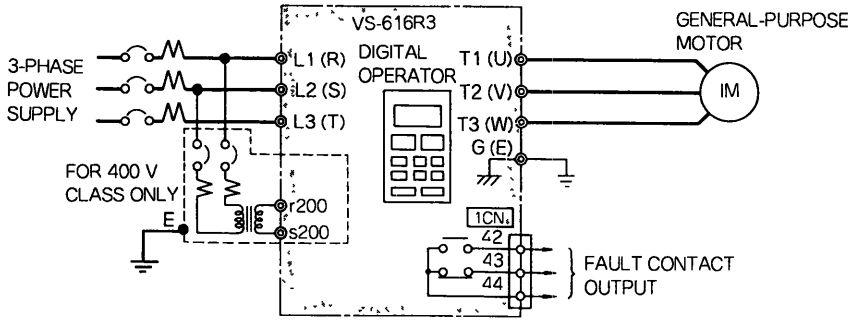
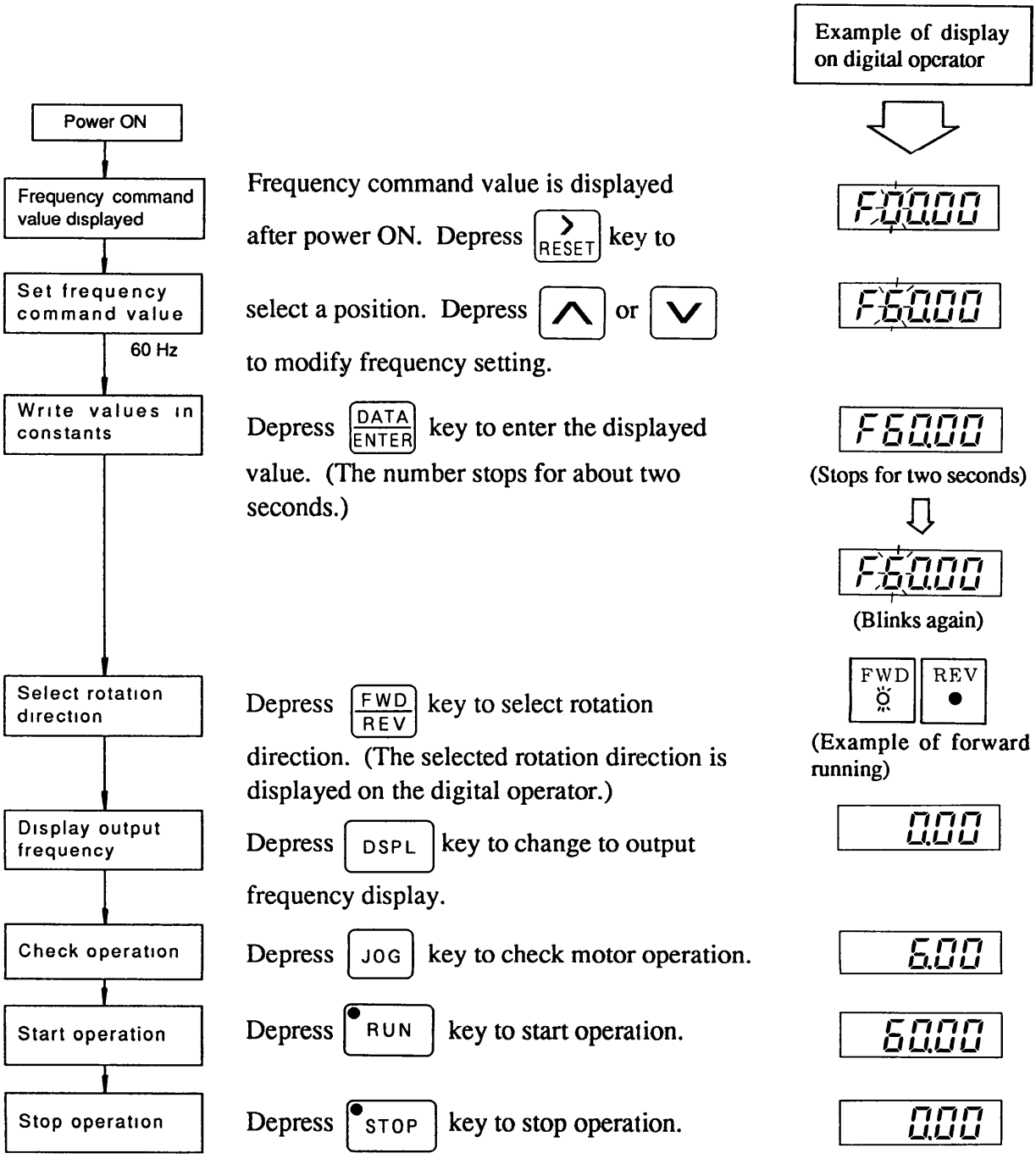


Fig. 6.1 Operation with the Digital Operator

(2) Operation


Example of display on digital operator
Power ON
Frequency command value displayed
Set frequency command value
60 Hz
Write values in constants
Select rotation direction
Display output frequency
Check operation
Start operation
Stop operation
Frequency command value is displayed after power ON. Depress RESET key to select a position. Depress ∧ or ∨ to modify frequency setting.
Depress DATA ENTER key to enter the displayed value. (The number stops for about two seconds.)
(Stops for two seconds)
(Blinks again)
Depress FWD REV key to select rotation direction. (The selected rotation direction is displayed on the digital operator.)
FWD
REV
(Example of forward running)
Depress DSPL key to change to output frequency display.
Depress JOG key to check motor operation.
Depress RUN key to start operation.
Depress STOP key to stop operation.

6.3.2 Operation using External Terminal Signals
(Operable with System Constant Sn-04 = 0000)

(1) Connection

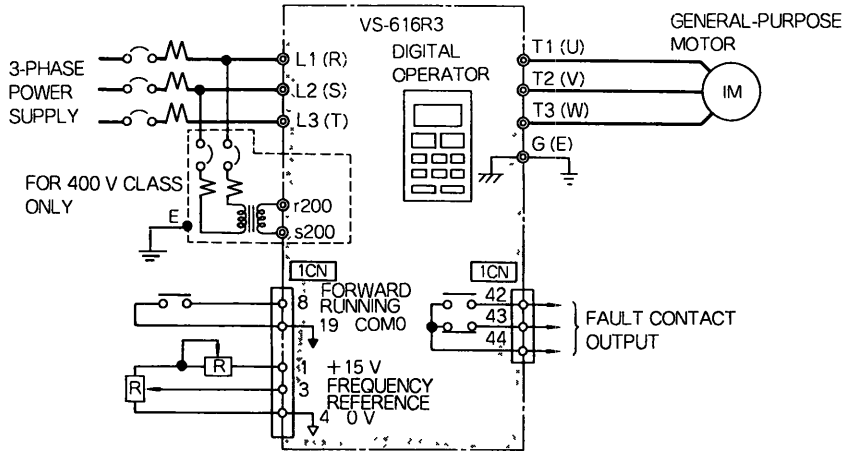
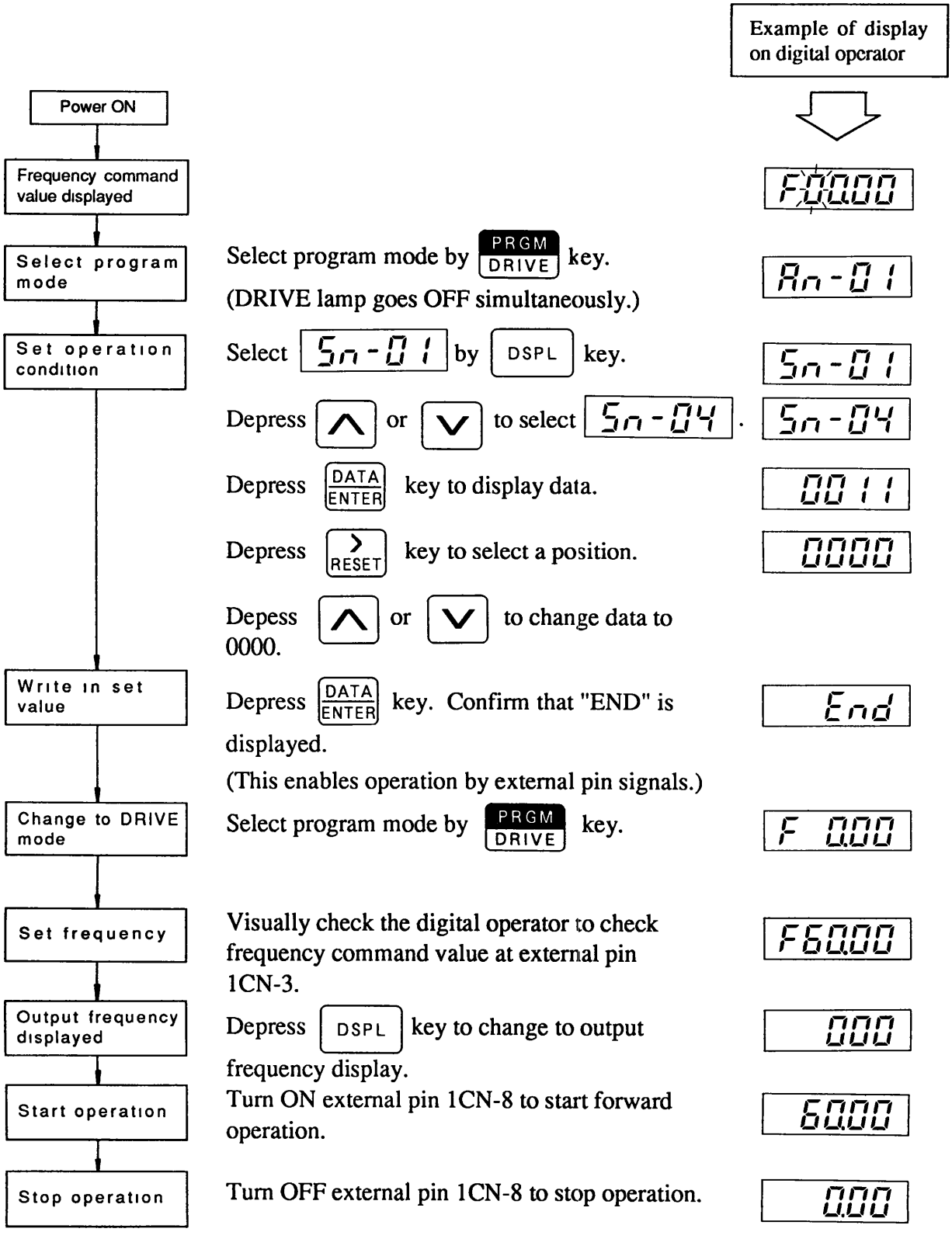


Fig. 6.2 Operation with External Signals

(2) Operation


Example of display on digital operator
Power ON
Frequency command value displayed
Select program mode
Set operation condition
Write in set value
Change to DRIVE mode
Set frequency
Output frequency displayed
Start operation
Stop operation
Select program mode by PRGM DRIVE key. (DRIVE lamp goes OFF simultaneously.)
Select Sn-01 by DSPL key.
Depress ^ or v to select Sn-04.
Depress DATA ENTER key to display data.
Depress > RESET key to select a position.
Depess ^ or v to change data to 0000.
Depress DATA ENTER key. Confirm that "END" is displayed.
(This enables operation by external pin signals.)
Select program mode by PRGM DRIVE key.
Visually check the digital operator to check frequency command value at external pin 1CN-3.
Depress DSPL key to change to output frequency display.
Turn ON external pin 1CN-8 to start forward operation.
Turn OFF external pin 1CN-8 to stop operation.
F 0.00
An-01
Sn-01
Sn-04
0011
0000
End
F 0.00
F 60.00
0.00
60.00
0.00

6.4 CHECK POINTS AT TEST OPERATION

Check points at test operation are listed below. If there is anything wrong, check connection and load status again.

- Is the motor rotating smoothly ?
- Is the motor rotation direction proper ?
- Is the motor free from abnormal vibration and noise ?
- Are acceleration and deceleration smooth ?
- Does the current match the load ?
- Is the status display LED or digital operator display normal ?

WARNING

1. *If forward and reverse operation signals are turned ON simultaneously, the motor is not started. If these signals are turned ON simultaneously during operation, the motor stops in the method selected by the third digit of constant Sn-04. (Deceleration stop is selected at the factory.)*
2. *If an fault occurs during acceleration or deceleration and the motor coasts to a stops, verify that the motor has stopped, then check the following.*
   For details, see Par. 7.1, "FAULT DISPLAY AND ACTION TO BE TAKEN."
   - *Check if load is too heavy.*
   - *Check if accel/decel time is insufficient for the load.*
3. *To reset fault, use fault reset input signal (or depress* [RESET] *key on the digital operator) or turn OFF power.*
4. *If a electromagnetic contactor for the main circuit power supply is used to start and stop sequence operations, place one hour or longer interval between each repetition (or, between each power ON to the inverter).*

7. FAULT HANDLING, MAINTENANCE AND CHECK

7.1 FAULT DISPLAY AND ACTION TO BE TAKEN

As Table 7.1 shows, the faults that the VS-616R3 detects are classified into troubles and alarms. If a problem occurs, the fault contact is output and the unit coasts to a stop. When an alarm is issued, the digital operator indicates the alarm for warning.

Table 7.1 Fault Display and Details

Indication	Fault Display	Description	Detection Level & Detection Time	Corrective Action
Uu 1	Main circuit under voltage	Voltage drop or missing phase in the main circuit power supply	150 VAC *2 or less, 16/20 msec *1	• Check the power supply and related equipment and connections • Increase power voltage and power capacity
Uu 2	Control circuit under voltage	Voltage in the control circuit power supply dropped	Corresponding to 150 VAC *2 or less, 300 msec	
Uu 3	MC reply error	The MC contactor does not establish the main circuit.	ON/OFF, 960 msec	
Uu 4	Power frequency error	Power frequency fluctuated.	±5% 50/60 msec *1	
Uu 5	Initial charge error	Main circuit capacitors are not charged.	60 VAC *2 Deviation 5 sec	
Uu 6	Initial AC input error	Synchronizing power signal has been lost.	Open phase 1 sec	
Uu 7	Initial AC frequency error	Power frequency cannot be discriminated	Open phase 1 sec	
oC1	Converter overcurrent	Converter current exceeded OC level	Approx 200% or more, Instantaneous	Check connections Reduce regenerative power
oC2	Inverter overcurrent	Inverter current exceeded OC level.	Approx 200% or more. Instantaneous	Check the motor winding and check for proper grounding Reduce load.
oU	Overvoltage	Main circuit DC voltage exceeded OV lever	Approx *2 400 VDC, or more Instantaneous	Extend accel/decel time
Cb	Molded-case circuit breaker trip	The main circuit molded-case circuit breaker has tripped	OFF, Instantaneous	Check for short-circuits and grounding in load and power equipment
oH1	Controller overheat	The inverter heat dissipation fin overheated	Approx 90°C, Instantaneous	• Reduce load • Cool inverter intake air. Improve ventilation
oH2	Panel interior temperature rise	Inverter ambient temperature rose too high.	60°C, Instantaneous	
oH3	Thermistor disconnection	There is a break in wire in thermistor	Disconnection, Instantaneous	Check the thermistor circuit.

*1 Detection time differs depending on the power source frequency 50 Hz or 60 Hz.

*2 Detection level is multiplied by two for 400 V class inverter.

Table 7.1 Fault Display and Details (Cont'd)

Indication	Fault Display	Description	Detection Level & Detection Time	Corrective Action
oL1	Motor overload	The motor is overloaded	150%, Approx. 8 minutes	• Reduce load factor of the motor and load machine. • Extend accel/decel time • Review V/f, torque compensation, and excess torque constants.
oL2	Inverter overload	The inverter is over-loaded.	150%, Approx. 1 minutes	
oL3	Excess torque detected	Inverter output currnet exceeded the set value.	Depends on Cn-24, 26 setting	
oL4	Converter over-load	The converter is over-loaded	150%, Approx. 1 minutes	
EF	External fault	External fault signal was input.	ON/OFF, Instant-aneous	Check external fault input signal.
SE 1	Sequence error 1	Sequence error occurred during operation in crane mode.	ON/OFF, Instant-aneous	See Par. 3 4.2, "Crane Exclusive-use Sequence", and take necessary corrective action.
SE 2	Sequence error 2	Sequence error occurred during operation in crane mode.	ON/OFF Depends on On-16	
SE 3	Sequence error 3	Sequence error occurred during operation in crane mode.	ON/OFF, Depends on On-17	
SE 4	Sequence error 4	Sequence error occurred during operation in crane mode .	ON/OFF, 0 3 sec *3	
SE 5	Sequence error 5	Sequence error occurred during operation in crane mode.	ON/OFF, 1 sec	
SE 6	Sequence error 6	Sequence error occurred during operation in crane mode.	ON/OFF, Depends on On-18	
LF	Output open phase	There is missing phase in inverter output.	Depends on On-14, 15 setting	Check inverter output connections and the motor winding.
PGo	PG disconnection	There is a disconnection in the PG signal wire	Disconnection, 1 sec	Check PG connections and PG-related constants Cn-43 to -52
oS	Overspeed	Overspeed was observed.	Depends on Cn-52 setting, 1 sec	
dEv	Excess deviation	Excess deviation was observed	Depends on Cn-51 setting, 1 sec	
CPF00	Control circuit hardware fault	Inverter fault	Error indication, Instant-aneous	Replace control PC board
CPF01	Control circuit memory fault			
CPF02	Control circuit I/O fault			
CPF03	Control circuit NVRAM fault			
CPF04	Control circuit data fault			
CPF05	Control circuit A/D converter fault			

*3 : S4 detection time for P-ROM No NSN618015 and before is instantaneous (0.3 sec for P-ROM No NSN618016 and after)

7.2 ALARM DISPLAY AND CORRECTIVE ACTION TO BE TAKEN

If a minor error or inappropriate setting for a constant is found, the inverter displays it as an alarm. Alarms are to be handled in the same way as faults. Investigate the cause and take necessary corrective action.

Table 7 2 Alarm Display and Details

Indication	Alarm Display	Description	Corrective Action
Uu 1	Main circuit voltage drop	Voltage dropped or phase was lost in the main circuit power supply while the inverter was inactive.	• Check the power supply and related equipment and connections • Increase power voltage and power capacity.
Uu 4	Power frequency fault	Power frequency fluctuated while the inverter was inactive.	
oH1	Controller overheat	The inverter heat dissipation fin overheated	• Reduce load. • Cool inverter intake air • Improve ventilation
oH2	Panel interior temperature rise	Inverter ambient temperature rose too high	
oL3	Excess torque detected	Inverter output current exceeded the set value.	Reduce load. Check V/f and accel/decel time.
EF	External fault	External fault signal was input	Check external fault input signal.
PGo	PG disconnection	There is a disconnection in PG signal wire	Check PG connections and PG-related constants Cn-43 to -52
oS	Overspeed	Overspeed was observed	
dEu	Excess deviation	Excess deviation was observed	
oPE01	kVA constant setting error	Value of kVA (Sn-01) is not proper.	Check constants.
oPE02	Constant setting range error	setting ranges of An, bn, Cn, Sn, or On are not proper.	
oPE03	Speed search setting error	Speed search command is set at a elevator sequence Sn−10 = ××1×	
oPE04	PG constant setting error	Values of PG-related constant are not proper.	
oPE10	V/f data setting error	Values of Cn-02 to -08 are not proper.	
Err	Constant write-in error		Initialize the constant by Sn-03. (2 or 3 times)

Notes :

1. When On-04 first digit = 1, oPE04 detection is not executed.

2. oPE03 is displayed only for software P-ROM No. NSN618012 and after.

7.3 MAINTENANCE AND CHECK

7.3.1 Periodic Check

VS-616R3 requires very few routine checks. It will function longer if it is kept clean, cool and dry, while observing the precautions listed in "Location." Check for tightness of electrical connections, discoloration or other signs of overheating. Use Table 7.3 as your inspection guide. Before servicing, turn OFF AC main circuit power and be sure that CHARGE lamp is OFF.

Table 7.3 Periodical Inspection

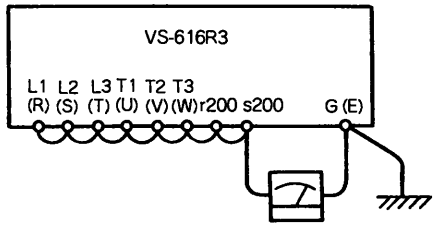
Component	Check	Corrective Action
External Terminals Unit Mounting Bolts, Connectors, etc.	Loose screws	Tighten
	Loose connectors	Tighten
Cooling Fins	Build-up of dust and dirt	Blow with dry compressed air of 39.2 × 10^4 to 58.8 × 10^4 Pa (57 to 85 psi) pressure.
Printed Circuit Board	Accumulation of conductive dust or oil.	Blow with dry compressed air of 39 2 × 10^4 to 58.8 × 10^4 Pa (57 to 85 psi.) pressure. If dust and oil cannot be removed, replace the board
Cooling Fan	For abnormal noise and vibration. Whether the cummulative operation time exceeds 20,000 hours or not	Replace the cooling fan.
Power Elements	Accumulation of dust and dirt	Blow with dry compressed air of 39.2 × 10^4 to 58.8 × 10^4 Pa (57 to 85 psi.) pressure.
Smoothing Capacitor	Discoloration or odor	Replace the capacitor or inverter unit.

7.3.2 Megger Test

Carry out insulation resistance test (megger test) for the main circuit using a (500 V) megger as explained below.

(1) Remove wiring from the pins of the inverter main and control circuits. Check insulation resistance between the main circuit pins and the ground (Grounding pin G (E)).

(2) Normal indication is 1 MΩ or greater.



Note : *Do not perform megger test on control circuit pins.*

Fig. 7.1 Megger Test

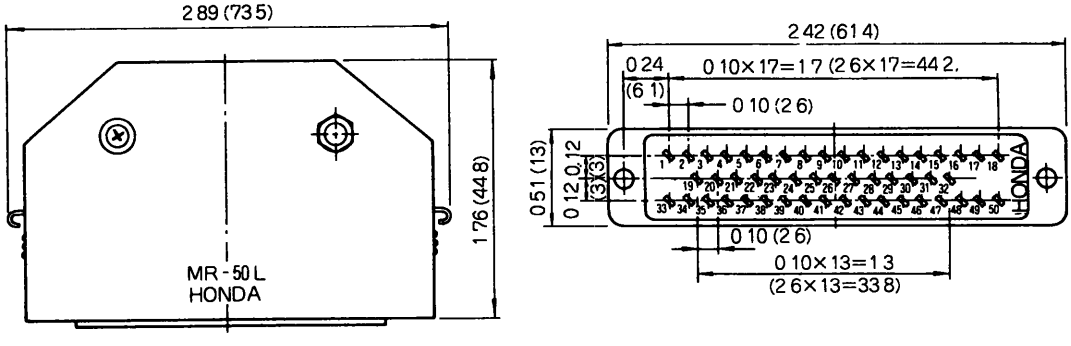
[APPENDIX]
A1. OPTION

A1.1 CONNECTORS

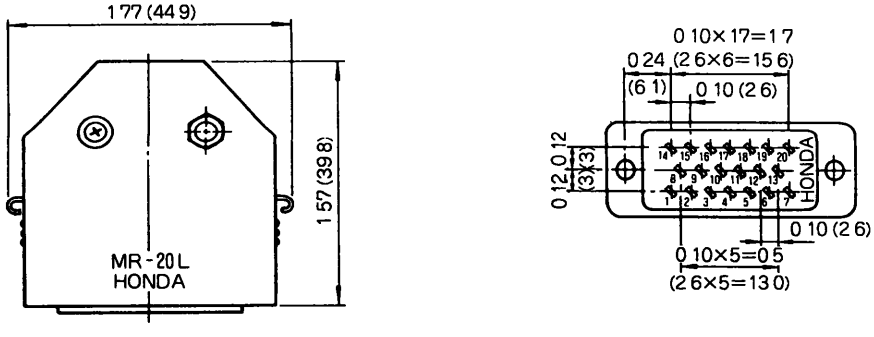
(a) Connector specifications (soldered type) manufactured by Honda Tsushin Kogyo Co., Ltd.
- Threshold current : 0.5 mA
- Contact material : Brass (male pin), phosphor bronze (female pin)
- Surface treatment : Precoated with nickel and gold-plated on the surface (marked by "G" at the end of the type name)
- Insulator material : Diallyl phthalate resin
- Case material : ABS resin

(b) Dimensions in inches (mm)

① MR-50LFG (50 pins) ····· For 1CN



② MR-20LMG (20 pins) ····· For 2CN



③ MR-20LFG (20 pins) ····· For 3CN

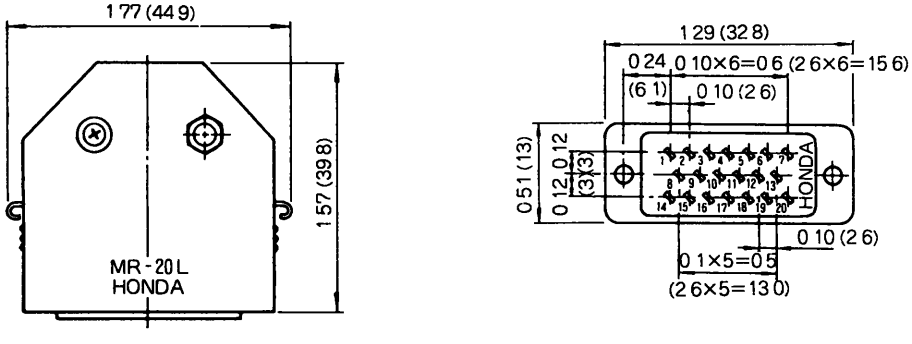
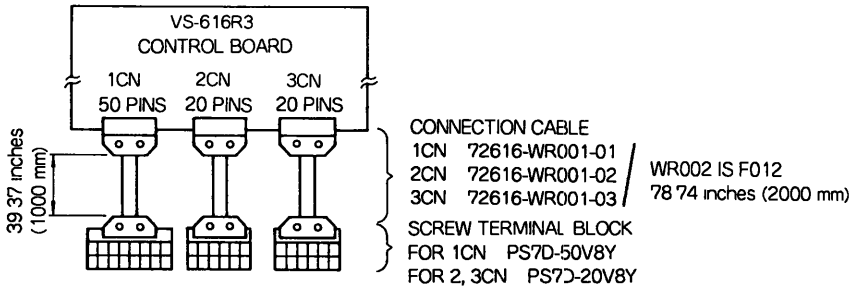


Fig. A1 Dimension Diagram

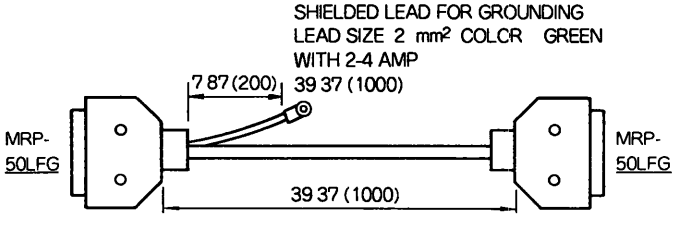
A1.2 SCREW TERMINAL BLOCK AND RELAY CABLES

Use this option to replace the connector with screw terminals. Do not apply higher voltage than 24 VDC to the screw terminals.

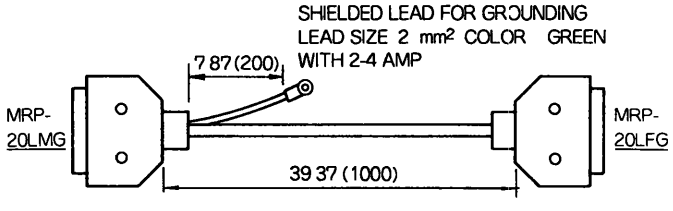


(1) Connection Cable in inches (mm)

<For 1CN> Code No. : 72616-WR001-01



<For 2CN> Code No. : 72616-WR001-02



<For 3CN> Code No. : 72616-WR001-03

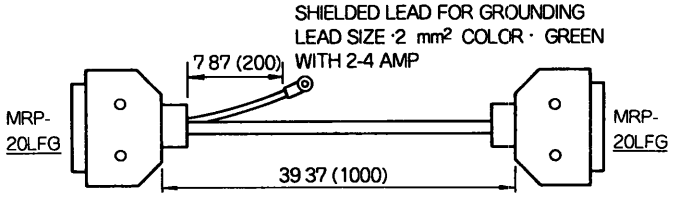


Fig. A2 Connection Cables

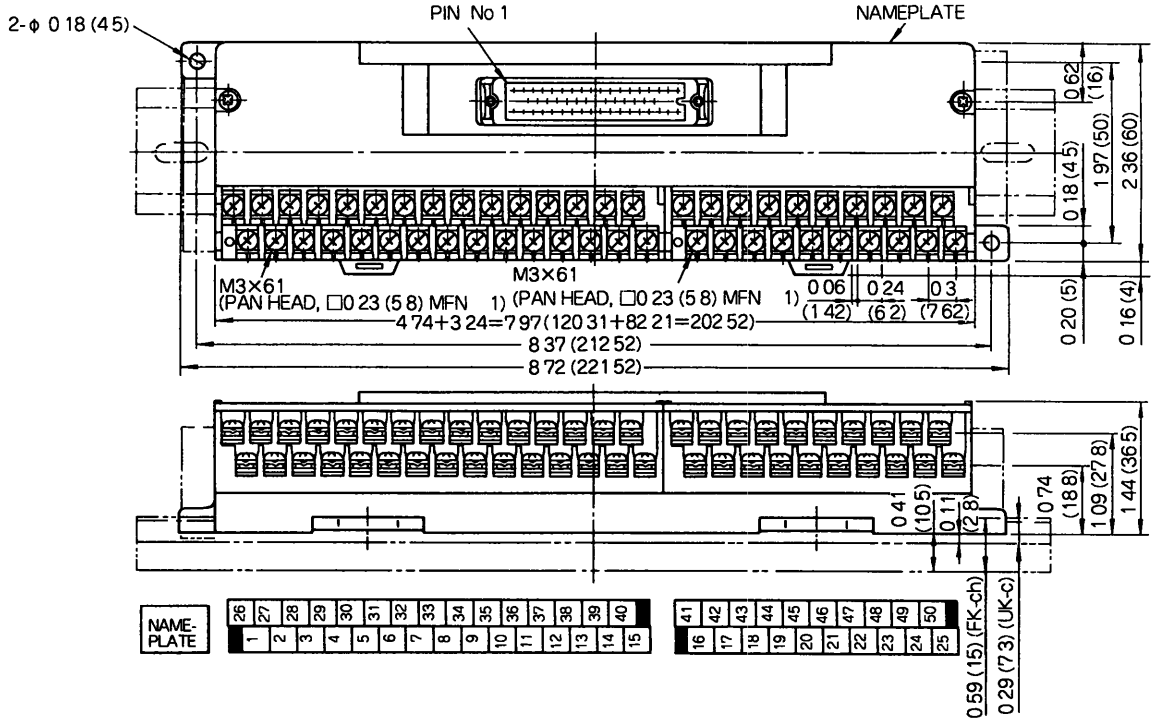
A

A1.2 SCREW TERMINAL BLOCK AND RELAY CABLES (Cont'd)

(2) Screw Terminal Block

Standard terminal block screws are 0.12 inches (3 mm) long. Also available are 3.5 mm. Contact your YASKAWA representative.

<For 1CN> Model : PS7D-50V8Y



<For 2, 3CN> Model : PS7D-20V8Y

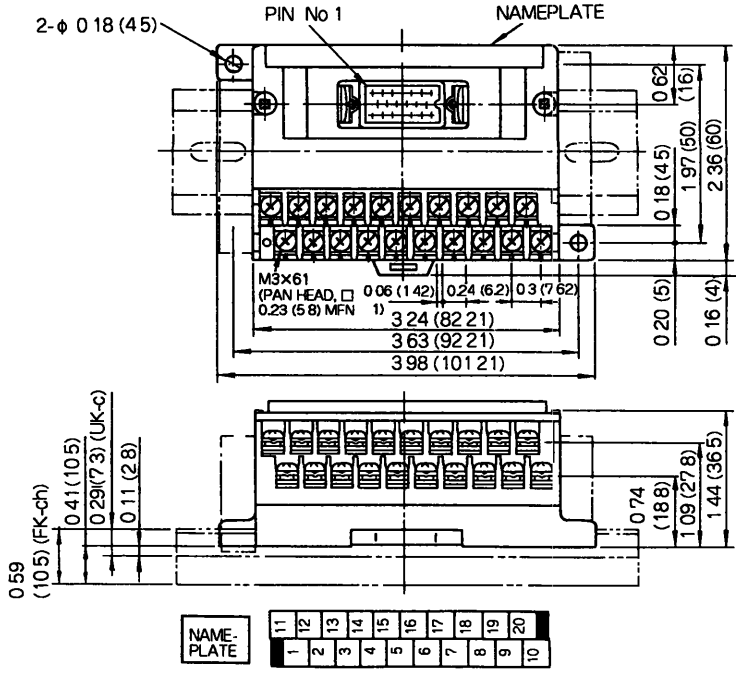


Fig. A3 Screw Terminal Block

A1.3 OTHER OPTION UNITS

Table A1 Other Option Unit

Name	Model (Code No)	Function	Installing Position	Document No	Remarks
Digital Monitor	JVOP-101 (73041-0911X)	Permits display of frequency and current by digital monitor and indication of a faults Not equipped with key pads for RUN/ STOP operation and setting a constant so that it can be safely used at the site.	On the inverter front cover	TOE-C730-50 4	
Operator/ Monitor Adapter	JVOP-109 (73041-0919O)	This removable adapter panel can be used on the inverter cover with an extension cable when the digital operator or digital monitor needs to be removed from the inverter cover.	On the inverter front cover	TOE-C736-50.11	
Adaper Panel Exclusive Use Extension Cable	3 3 ft (1 m) cable (72616-W3001-01) 9.9 ft (3 m) cable (72616-W3003-01)	Used for remote operation of digital operator/monitor using adapter panel (JVOP-109) The cable is available in 3.3 ft (1 m) and 9.9 ft (3 m) lengths.	On the inverter front cover	TOE-C736-50 11	
Exclusive Extension Cable for Digital Operator or Monitor	3.3 ft (1 m) cable (72616-W3001) 9.9 ft (3 m) cable (72616-W3003)	This extension cable is used when the digital operator or digital monitor is used after removing from the inverter front cover. The cable is available in 3.3 ft (1 m) and 9.9 ft (3 m) lengths. The package of the extension cable includes a simple blind panel. Depending on the application, the use of the operator/ monitor adapter JVOP-109 is recommended	On the inverter front cover (Blind panel)	TOE-C736-50.10	

A

A1.4 PERIPHERAL EQUIPMENT

Table A2 Peripheral Equipment

Name	Type	Application
Speedometer	DCF-6A	
• Speed Controller • Speedometer Calibrating Resistor • Speed Controller Potentiometer	—	These parts are prepared separately to enable operation from more than one position.
AC Reactor	UZBA-□	Add to the internal AC reactor of the VS-616R3, if necessary, to improve power factor of the power supply or to suppress harmonic current
Noise Filter	HF, LF	This filter suppresses transmission of high-frequency noise from the inverter to the power supply, reducing radio noise If the inverter is used in a weak electric field, a noise filter on the input side is effective to prevent interference to radios and TVs.
VS System Module	JGSM-□	Optimum system configuration is available by selecting necessary VS system modules to fit the auto-suppression system.
Molded-case Circuit Breaker	NF□	The power supply must be equipped with this breaker for protection of inverter wiring.
Magnetic Contactor	HI-□E	This contactor turns power to the inverter ON and OFF.
Surge Suppressor	DCR2-□□□	This component suppressor surge current produced when magnetic contactors or control relays are opened and closed. All magnetic contactors and relays around the inverter must contain one.
Output Voltmeter	SCF-12NH	This voltmeter is exclusive to the PWM inverter.
Isolator	DGP□□□	This component insulates inverter I/O signals, effectively reducing induction noise.

A2. SPARE PARTS

The quantity of each major component of VS-616R3 needed is shown in Appendix Table 3, 4. For purchase of spare parts, contact your YASKAWA representative.

Table A3 Code No. of Major Component (200 V Class)

Type of VS-616R3	CIMR-R3A [ ]								
	23P7	25P5	27P5	2011	2015	2018	2022	2030	2037
Controller	ETC62001X-S80XX *								
	1								
Digital Operator	CDR000070								
	1								
Gate Driver	ETC62021X					ETC62022X		ETC62023X	ETC62024X
	1					1		1	1
Power Supply Interface	ETP62001X								ETP62003X
	1								1
Control Power Supply	AVR000379								
	1								
Control Fuse	FU000592								
	2								
Cooling Fan	FAN000130			FAN000111					
	1			1			2		
Transistor Module	STR 000476	STR 000494	STR 000450	STR 000451	STR 000452	STR 000471	STR 000453	STR 000495	STR 000504
	6	6	6	6	6	6	12	12	12
Electrolytic Capacitor	C 003460		C 003497	C 003402	C 003458	C 003402		C 003458	C 003536
	2		2	2	2	4		4	4
Magnetic Contactor	MC 003253			MC 003254	MC 003255	MC 003259		MC 003256	MC 003257
	1			1	1	1		1	1
Molded-case Circuit Breaker	MCB 199790	MCB 199720	MCB 199730	MCB 199740	MCB 199750	MCB 199760		MCB 199800	MCB 199840
	1	1	1	1	1	1		1	1

(Upper box : Parts code No. ; Lower box . Necessary q'ty)

* • Specify "exclusive controller for VS-616R3, with soft-ware S80XX" when ordering.
• The customer may have used controllers with the code number of ETC62052X-S80XX, depending on the time of manufacture of the system These types of controllers are compatible with the forenamed controllers

A

A2. SPARE PARTS (Cont'd)

Table A4 Code No of Major Component (400 V Class)

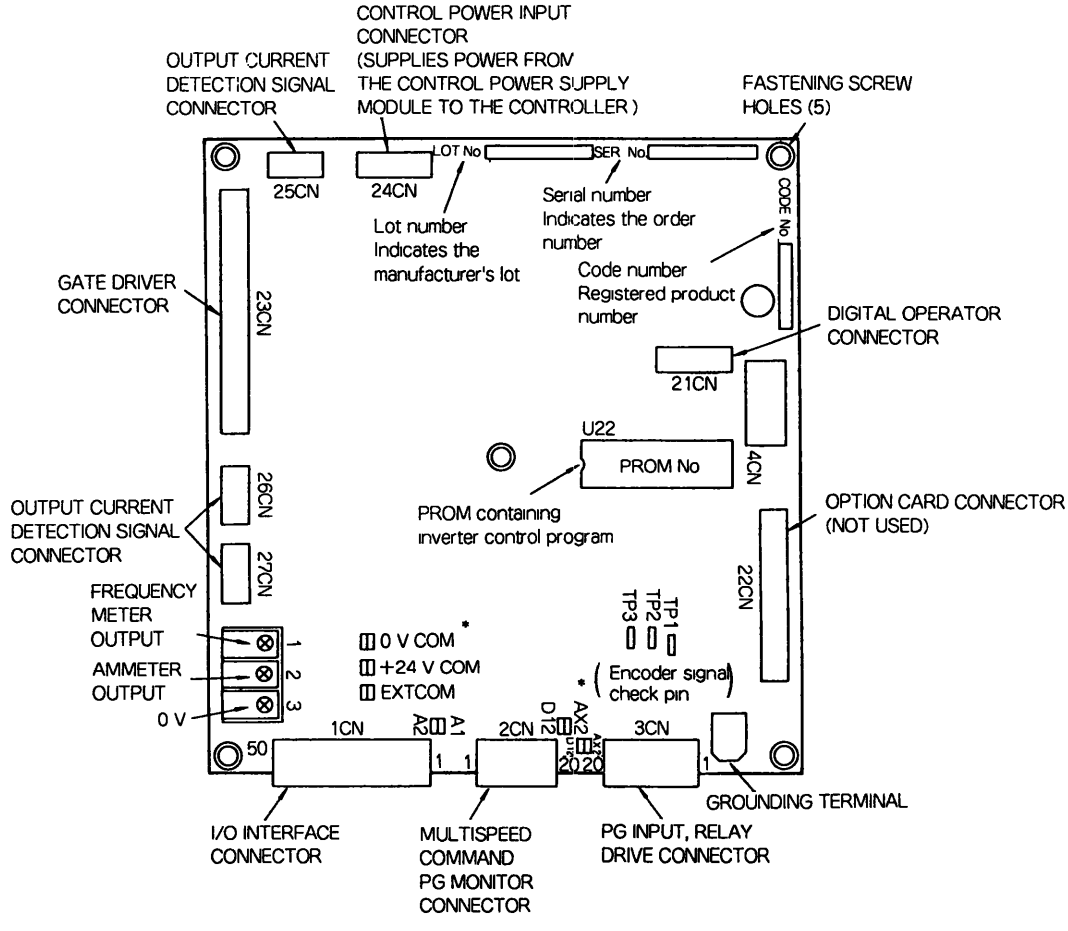
Type of VS-616R3	CIMR-R3A □□□□							
	47P5	4011	4015	4018	4022	4030	4037	4045
Controller	ETC62001X-S80XX*							
	1							
Digital Operator	CDR000070							
	1							
Gate Driver	ETC62026X			ETC62028X	ETC62027X			
	1							
Power Supply Interface	ETP62002X						ETP62004X	
	1							
Control Power Supply	AVR000379							
	1							
Control Fuse	FU000592							
	2							
Cooling Fan	FAN000130	FAN000131		FAN000111	FAN000131			
	1				2			
Transistor Module	STR 000462	STR 000430	STR 000354	STR 001069	STR 001013		STR 001014	STR 001014
	6				12			
Electrolytic Capacitior	C 003497	C 003402	C 003458	C 003402		C 003458	C 003536	C 003458
	2			4				6
Magnetic Contactor	MC 003397	MC 003253		MC 003254		MC 003255	MC 003259	MC 005006
	1							
Molded-case Circuit Breaker	MCB 199790	MCB 199720	MCB 199730	MCB 199740		MCB 199750	MCB 199760	MCB 199760
	1							

(Upper box : Parts code No. ; Lower box : Necessary q'ty)

* • Specify "exclusive controller for VS-616G3, with soft-ware S80XX" when ordering.
• The customer may have used controllers with the code number of ETC62502X-S80XX, depending on the time of manufacture of the system. These types of controllers are compatible with the forenamed controllers

A3. PC BOARDS

A3.1 CONTROL BOARD



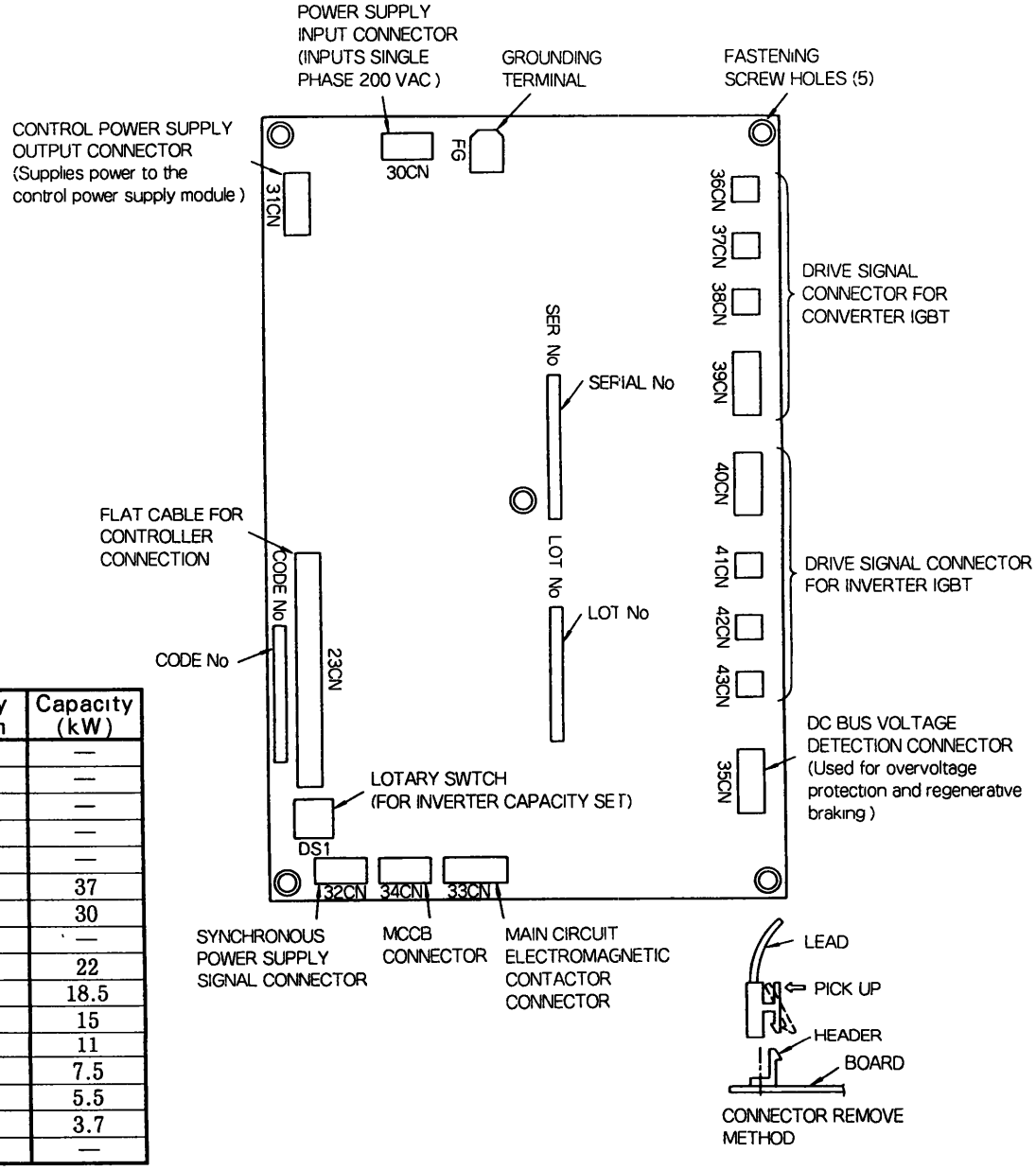
* Selectable connectors on the board are set as follows. Do not change them unless there is a good reason for doing so. 0 V COM, A2, D12, D12. To replace the control board with a spare, set the selectable connections as above.

Note : *To replace the control board, observe the following steps.*

(1) Replace the control board with the spare.
(2) Set inverter capacity data to Sn-01.
(3) Select operation sequence according to operator status Sn-03. (Constants are initialized when 1110 or 1111 is set for Sn-03.)
(4) Set 1010 for Sn-03 to make it possible to display order constants On.
(5) Select order constant On-26 (regenerative reference voltage detection) to display those data.
(6) Confirm that the farthest left position is blinking and depress DATA ENTER *key.*
(On-26 data are automatically tuned.)
(7) Set 0000 for Sn-03 to make it impossible to display order constants On.
(8) Set necessary values for constants An, bn, Cn, and Sn.

Fig. A4 Control Board

A3.2 GATE DRIVE BOARD



Lotary Switch	Capacity (kW)
0	—
1	—
2	—
3	—
4	—
5	37
6	30
7	—
8	22
9	18.5
A	15
B	11
C	7.5
D	5.5
E	3.7
F	—

Note : *When replacing the gate drive board with a spare, set the rotary switches to fit the inverter capacity.*

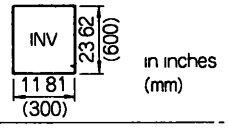
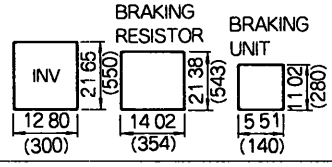
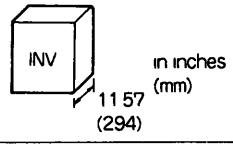
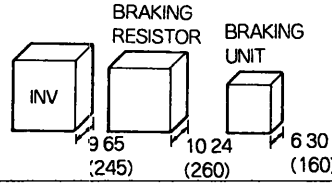
Fig. A5 Gate Drive Board

A4. COMPARISON OF FUNCTIONS AND PERFORMANCE OF VS-616R3 AND VS-616G3

Table A5 Comparison of Functions and Performance of VS-616R3 and VS-616G3

Item		Type: VS-616R3	VS-616G3	Remarks
Output Characteristics	Inverter Capacity Range	200 V class . 3.7 kW to 37 kW 400 V class : 7.5 kW to 45 kW	200 V class : 0.4 kW to 75 kW 400 V class : 0.4 kW to 300 kW 575 V class · 3.7 kW to 160 kW	
	Rated Current	Depends on motor capacity.		
	Overload Capacity	About 150 %, 1 minute		
	Maximum Output Voltage	Depends on input voltage		
	Rated Output Frequency	50 Hz/60 Hz (applicable up to 400 Hz by setting constants)		
Power Supply	Voltage and Frequency	• 200 V class . Three-phase, 200 V/208 V/220 V at 50 Hz or 200 V/208 V/220 V/230 V at 60 Hz • 400 V class : Three-phase, 380 V/400 V/415 V/440 V/460 V, 50 Hz/60 Hz		400 V class of R3 requires 200 V single-phase power for control power supply.
	Allowable Voltage Fluctuation	±10%		
	Allowable Frequency Fluctuation	±5%		
Control Characteristics	Control Method	Sine wave PWM method (with vector calculation torque boost function)		
	Frequency Control Range	0 1 Hz to 400 Hz		
	Accel/Decel Time	0.1 s to 6000 0 s (S-curve characteristic supported)		
	Operation Sequence	General-purpose sequence or crane exclusive-use sequence can be selected	General-purpose	Crane exclusive-use sequence for G3 is optional.
	Carrier Frequency	5 kHz, three-phase modulation	15 kHz, two-phase modulation (Adjustable between 0.4 kHz and 15 kHz)	Mass storage types of G3 have carrier frequency with a little different value.
Regenerative Operation	Use of Regenerative Energy	Power supply regenerative method	Resistor discharge method	Regenerative energy of R3 can be reused for other equipment.
	Regenerative Braking Torque	100 %, continuous (about 150%, 1 minute)	• Without resistor option : About 20%, continuous • With resistor option : About 100% to 130%, 10 seconds (10% duty)	To use G3 for cranes, accurate calculation is required to select resistors and braking transistors.

Table A5 Comparison of Functions and Performance of VS-616R3 and VS-G3 (Cont'd)

Item \ Type		VS-616R3	VS-616G3	Remarks
Primary Circuit Characteristics	Inverter Primary Side Power Factor	About 90 % to 95 %	About 80 % to 85 %	The figures are of standard specifications under rated load (• Primary side AC reactor is standard for R3. • This is optional for G3.)
	Inverter Primary Side Harmonic Current	About 35 % to 40 % of fundamental wave	About 65 % to 70 % of fundamental wave	
	Radio Noise	About 120 dB μV or lower (Input side noise filter can be used for radio noise suppression.)		
Dimensions and Weight	Installation area (200 V, 15 kW. G3 with standard resistors)			• Without braking function : R3 = G3 • With braking function · R3 = G3 × 0.44
	Size (200 V, 15 kW G3 with standard resistors)			• Without braking function : R3 = G3 × 1.20 • With braking function : R3 = G3 × 0.53
	Weight (200 V, 15 kW. G3 with standard resistors)	85.8 lb (39 kg)	Inverter : 52.8 lb (24 kg) Resistor : 33 lb (15 kg) Braking unit : 8.8 lb (4 kg)	• Without braking function · R3 = G3 × 1.63 • With braking function R3 = G3 × 0.91
Control Signals	Analog Input	0 V to +10 V, 1 point	0 V to +10 V, 2 points (Applicable at 4 mA to 20 mA)	Relay outputs include fault contact outputs.
	Digital Input	Relay and open connectors, 23 points	Relay and open collectors : 8 points	
	Analog Output	0 V to +10 V, 2 points	0 V to + 10 V, 1 point	
	Digital Output	9 open collector outputs and 1 relay output	2 open collector outputs and 2 relay output	
	Option	PG speed control (Interface incorporated)	AI, DI, AO, DO, transmission operation	
	Connector Type	Connectors : 50-pin × 1, 20-pin × 2	Screw terminals	R3 has screw terminal option.

Notes : *VS-616R3 does not support the following functions.*

(1) Fan, pump, and blower functions
Operation continuance at momentary power loss, fault retry, operation continuance at main frequency command loss, etc.

(2) System interface functions
External fault signals 1 to 4, transmission operation, intermediate UV monitor, and base block monitor, etc.

A5. ADDITIONAL FUNCTIONS PROVIDED BY SOFTWARE (P-ROM NO.) VERSION UP

P-ROM No. of presently used inverter can be seen on the monitoring display Un-12 or on the seal of IC (U22) on the control circuit board.
For terminal functions, see the Par. 2.4.3, and for the constants, see the Par. 4.1.

A5.1 SPEED SEARCH FUNCTION

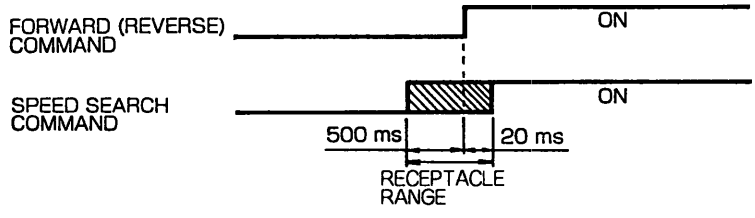
- Speed search function is possible to use when the P-ROM is numbered No. NSN618012 and after.
- Speed search command is output from 1CN-16 terminal by setting the 2nd column of the system constant Sn-10 as follows.

  Sn-10

  { 2nd column = 0 : 1CN-16 terminal outputs "PG integration reset command"
  { 2nd column = 1 : 1CN-16 terminal outputs "Speed search command"

  { 3rd column = 0 : Speed search is started from the highest frequency.
  { 3rd column = 1 : Speed search is started from set frequency

- Speed search command is accepted within the range as shown below. Make a speed search command and forward (or reverse) command simultaneously.



- Speed search control constants are provided in Cn-37 to 41. Conventionally it is unnecessary to be selected. For an elevator sequence, speed search function can not be selected. When it is selected inadvertently, operation error "oPE03" occurs.

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A5.2 WITH PG CONTROL/WITHOUT PG CONTROL SWITCHING DRIVE

This drive is possible when the P-ROM No. is NSN618015 and after.

- To drive the main motor with PG control and an auxiliary motor without PG control by switching one unit inverter is possible.
- PG control cancel command is output from 1CN-14 terminal by setting the 4th column of system constant Sn-10 to "1" as follows.
  1CN-14 "Open" : With PG control, 1CN-14 "Closed" : Without PG control

  Sn-10

  4th column = 0 : 1CN-14 outputs S-curve character cancel command
  ("Closed": S-curve invalid)

  4th column = 1 : 1CN-14 outputs PG control cancel command
  ("Closed" : PG control invalid)

NOTE

When not performing PG speed control (1st column of Sn-11 = 0 or Cn-43 = 0.0 P/R), control status is "Without PG control" (open loop control) despite PG control cancel signal status.

A5.3 PG FREQUENCY RANGE ALTERATION

This function is possible when P-ROM No. is NSN618015 and after.

- PG feedback frequency range of standard VS-613R3 is 50 to 32,767 Hz. (Normally used around 20 kHz at 100% of motor rated speed)
  When setting PG feedback frequency exceeding 32,767 Hz to Cn-43 at 100% of motor rated speed, alarm oPE04 is indicated and motor can not be driven.
- However, by invalidating the oPE04 detection through setting the 1st column of order constant On-04 to "1", drive with PG feedback frequency exceeding 32,767 Hz is possible. (Do not exceed 100 kHz at most)

  On-04

  1st column = 0 : oPE04 detection is valid

  1at column = 1 : oPE04 detection is invalid

NOTES

1. *Order constant is possible to be displayed by setting Sn-03 = 1010.*
2. *Do not set the order constant other than the above since it may result in inverter abnormality.*

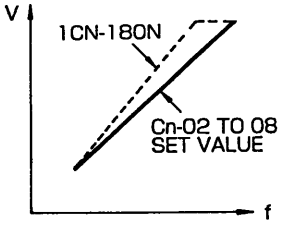
A5.4 AUXILIARY MOTOR TORQUE COMPENSATION

This function is possible when P-ROM No. is NSN618015 and after.

- Possible to add bias to inverter output voltage, when a torque compensation effect is not sufficient due to the motor capacity difference at the switching drive of the main motor and the auxiliary motor by one unit inverter.
  By setting 4th column of system constant Sn-09 to "1", 1CN-18 terminal output voltage alteration function outputs absolute voltage (bias).

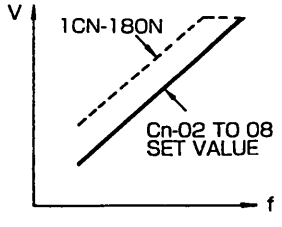
  Sn-09
  4th column = 0 : Output voltage alteration function 1 (CN-18) works by a ratio value.
  4th column = 1 : Output voltage alteration function 1 (CN-18) works by absolute value.

(Sn-09 4th column = 0)



Output voltage = (Cn-02 to 08 set) × bn-13
(V/f changes by bn-13 ratio value)

(Sn-09 4th column = 1)



$$\text{Output voltage} = (\text{Cn-02 to 08 set}) + \frac{\text{Rated voltage}}{(\text{Cn-03})} \times (\text{bn-13} - 1.00)$$

(V/f changes following the absolute value of rated voltage × (bn-13 − 1.00)

Note : *Inverter can not output a voltage exceeding the power supply voltage. Setting range of bn-13 is 0.80 to 1.20. (Initial value is 1.00.)*

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A6. "Cb" (MCCB TRIP) AND GEAR NOISE COUNTER MEASURE

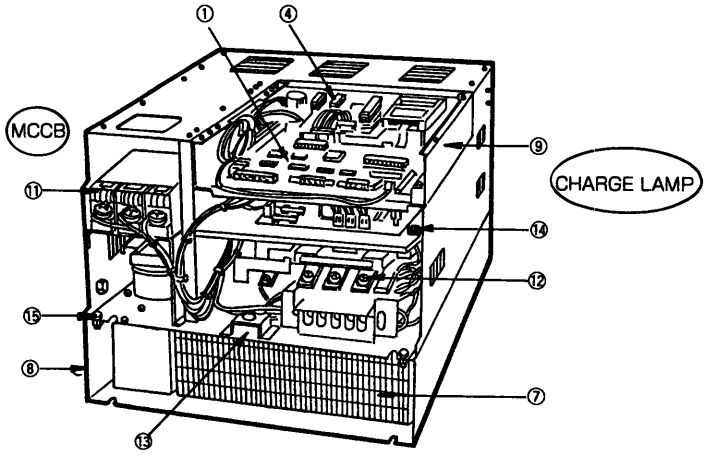
A6.1 INVERTER INTERNAL MCCB TRIP

Because of vibration, etc. during transportation, main circuit protection MCCB installed in VS-616R3 is very rarely left tripped before switching "ON".

- Only when "Cb" (MCCB trip) is indicated by digital operator at inverter first power "ON", release MCCB by the following procedure.

(1) Turn "OFF" the inverter primary power supply and wait approx. 10 minutes until the charge indication lamp turns "OFF".
(2) Pull MCCB ON/OFF lever to "OFF" side fully and push it to the "ON" side.
(3) By turning "ON" the inverter primary power supply, "U1 Cb" blinks 5 seconds and turns to able-to-use status displaying normal indication ("Frequency command F00.00).

[MCCB mounting location]



MCCB functions as main circuit input terminals (R, S, T) as well.

Precaution : When "Cb" error is indicated during inverter operation, take a recovery measure following "Trouble-shooting" described in this instruction manual.
Never release MCCB without checking the cause and performing corrective action. Fail to observe this precaution may induce other equipment damage or personal injury.

A6.2 GEAR NOISE

In cases when setting higher V/f value for gear-coupled loads, gear noise is produced at light load due to regenerative convertor ON/OFF timing.
In these cases, gear noise can be decreased by altering the switching method of the regenerative converter by the following procedure.

[Altering procedure]

(1) Set operator status to Sn-03 = 1010 to display order constant On.
(2) Set order constant to On-01 = 0001.
(3) Set to Sn-03 = 0000 to make order constant unable to be indicated.

A6.3 MOTOR VIBRATION, OR HUNTING AT MIDDLE SPEED RANGE

In case motor vibration, or hunting occurs at the middle speed range (20 to 40 Hz), alter the following constant

[Altering procedure]

(1) Set operator status to Sn-03 = 1010 to make order constant On able to be displayed.
(2) Set order constant to On-09 (Output voltage stabilization time constant) = 1.00 sec → 2.5 sec, or set order constant On-08 (Hunting prevention limiter) = 0% → 5%.
(3) Set Sn-03 to Sn-03 = 0000 to make order constant On unable to be displayed.

A6.4 RADIO NOISE OR HIGH FREQUENCY LEAKAGE CURRENT

The above can be reduced by altering carrier frequency as follows (Carrier frequency is possible to be altered for P-ROM No. NSN618015 and after.)

[Carrier frequency alteration procedure]

(1) Set operator status to Sn-03 = 1010 to make order constant On able to be displayed.
(2) Set order constant to On-02 = 1000 (Carrier frequency = 2.5 kHz)
(3) Set operator status to Sn-03 = 0000 to make order constant On unable to be displayed.

NOTE
Be sure not to alter order constants other than the above since it may cause inverter error or malfunctions.

POWER REGENERATION FUNCTION BUILT-IN TYPE HIGH PERFORMANCE ALL-DIGITAL GENERAL-PURPOSE INVERTER

Varispeed-616R3

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