MEIDEN

MEIDEN
AC SPEED CONTROL EQUIPMENT
THYFREC-VT230S

200V System 0.4 to 90kW
400V System 0.4 to 370kW

INSTRUCTION MANUAL

NOTICE

1. Read this manual thoroughly before using the VT230S, and store in a safe place for reference.
2. Make sure that this manual is delivered to the final user.

MEIDENSHA CORPORATION

ST-3251E July 2001

Contents

Preface

Thank you for purchasing the “Meiden AC Speed Control Equipment THYFREC-VT230S”.
THYFREC-VT230S is a highly functional inverter that is easy to use.
Please read this manual thoroughly before use, and keep the manual at hand for later reference. Also make sure that this manual is delivered to the final users.

WARNING

ALWAYS READ THIS MANUAL THOROUGHLY BEFORE USING THE VT230S.

THIS INVERTER CONTAINS HIGH VOLTAGE CIRCUITS THAT MAY BE FATAL TO HUMANS. USE EXTREME CAUTION DURING INSTALLATION. MAINTENANCE MUST BE PERFORMED BY QUALIFIED TECHNICIANS, AND ALL POWER SOURCES MUST BE DISCONNECTED BEFORE ANY MAINTENANCE. SUFFICIENT NOTICE MUST BE GIVEN TO THE GENERAL OPERATORS AND WORKERS BEFORE STARTING.

- ELECTRIC SHOCK MAY OCCUR IF THE FOLLOWING POINTS ARE NOT OBSERVED.
  (1) DO NOT OPEN THE FRONT COVER WHILE THE POWER IS ON.
  (2) A CHARGE STILL REMAINS IN THE INVERTER WHILE THE INDICATOR IS LIT EVEN IF THE POWER HAS BEEN TURNED OFF. DO NOT OPEN THE FRONT COVER IN THIS CASE. WAIT AT LEAST 20 MINUTES AFTER THE INDICATOR GOES OUT.
  (3) DO NOT CONTACT THE ELECTRICAL CIRCUIT WHILE THE "CHARGE" LED ON THE UNIT IS LIT. PERFORM SERVICING, ETC., AFTER WAITING AT LEAST 20 MINUTES AFTER THE LAMP GOES OUT.
  (4) ALWAYS GROUND THE INVERTER CASE. THE GROUNDING METHOD MUST COMPLY WITH THE LAWS OF THE COUNTRY WHERE THE INVERTER IS BEING INSTALLED.

- THE INVERTER MAY BE DESTROYED BEYOND REPAIR IF THE FOLLOWING POINTS ARE NOT OBSERVED.
  (1) OBSERVE THE INVERTER SPECIFICATIONS.
  (2) CONNECT ADEQUATE CABLES TO THE INPUT/OUTPUT TERMINALS.
  (3) ALWAYS KEEP THE INVERTER INTAKE/OUTTAKE PORTS CLEAN, AND PROVIDE ENOUGH VENTILATION.
  (4) ALWAYS OBSERVE THE CAUTIONS LISTED IN THIS INSTRUCTION MANUAL.

- THERE MAY BE SOURCES OF NOISE AROUND THIS INVERTER AND MOTOR DRIVEN BY THIS INVERTER. CONSIDER THE POWER SUPPLY SYSTEM, INSTALLATION PLACE AND WIRING METHOD BEFORE INSTALLATION.
  INSTALL THIS INVERTER AWAY FROM DEVICES THAT HANDLE MINUTE SIGNALS, SUCH AS MEDICAL EQUIPMENT IN PARTICULAR. ALSO SEPARATE THE DEVICES ELECTRICALLY, AND TAKE SUFFICIENT NOISE MEASURES.

- TAKE SUFFICIENT SAFETY MEASURES WHEN USING THIS INVERTER FOR PASSENGER TRANSPORTATION, SUCH AS IN LIFTS (ELEVATORS).

PRECAUTIONS FOR SAFETY

Items to be observed to prevent physical damage or property damage and to ensure safe use of this product are noted on the product and in this instruction manual.

- Please read this instruction manual and enclosed documents before starting operation to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation. After reading, always store this manual where it can be accessed easily.
- The safety precautions are ranked as "**DANGER**" and "**CAUTION**" in this instruction manual.

DANGER	: When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
CAUTION	: When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

- This instruction manual is written on the premise that the user has an understanding of the inverter. Installation, operation, maintenance and inspection of this product must be done by a qualified person. Even qualified persons must undergo periodic training.

  Qualified refers to satisfying the following conditions.

  - The person has thoroughly read and understood this instruction manual.
  - The person is well versed in the installation, operation, maintenance and inspection of this product, and understands the possible dangers.
  - The person is informed on matters related to starting, stopping, installation, locks and tag displays, and has been trained in the operation and remedies.
  - The person has been trained on the maintenance, inspection and repairs of this product.
  - The person has been trained on protective tools used to ensure safety.

1. Transportation and installation

CAUTION

- Always transport the product with an appropriate amount according to the products weight. Failure to observe this could lead to injuries.
- Install the inverter, dynamic braking unit and resistor, and other peripheral devices on non-combustible material such as metal. Failure to observe this could lead to fires.
- Do not place the product near inflammable items. Failure to observe this could lead to fires.
- Do not hold the front cover while transporting the product. Failure to observe this could lead to injuries from dropping.
- Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter the product. Failure to observe this could lead to fires.
- Install the product in a place that can withstand the weight of the product, and follow the instruction manual. Failure to do so could lead to injuries from dropping.
- Do not install and operate an inverter that is damaged or that is missing parts. Failure to observe this could lead to injuries.
- Always observe the conditions described in the instruction manual for the installation environment. Failure to observe this could lead to faults.

2. Wiring

DANGER

- Always turn the device's input power OFF before starting wiring.
  Failure to do so could lead to electric shocks or fires.
- Carry out grounding that complies with the standards of the country where the inverter is being installed.
  Failure to do so could lead to electric shocks or fires.
- When using the PM motor, even if the inverter is stopped, the voltage will be generated at the output terminal (U, V, W) during rotation. Always carry out wiring while the motor is stopped.
  Failure to do so could lead to electric shocks or injuries.
- Wiring must always be done by a qualified electrician.
  Failure to observe this could lead to electric shocks or fires.
- Always install the device before starting wiring.
  Failure to do so could lead to electric shocks or injuries.
- Prepare a breaker such as an MCCB or fuses that matches the capacity for the inverter's power supply side.
  Failure to do so could lead to fires.

CAUTION

- Do not connect an AC power supply to the output terminals (U, V, W).
  Failure to observe this could lead to injuries or fires.
- Confirm that the product's rated voltage and frequency match the power supply voltage and frequency.
  Failure to do so could lead to injuries or fires.
- Install an overheating protection device on the dynamic braking resistor, and shut off the power with this fault signal.
  Failure to do so could lead to fires in the event of abnormal overheating.
- Do not directly connect a resistor to the DC terminals (between L+1, L+2, and L–).
  Failure to observe this could lead to fires.
- Tighten the terminal screws with the designated tightening torque.
  Failure to do so could lead to fires.
- Correct connect the output side (U, V, W).
  Failure to do so could cause the motor to rotate in reverse and the machine to be damaged.
- Always correctly connect when using the encoder.
  The signal polarity specifications differ according to the encoder. If the specifications differ from the VT230S standard specifications (refer to section 6-9-1), adjust the signal polarity with the signal setting (C50, C51).
  Failure to observe this could lead to reverse rotation or abnormal acceleration of the motor, and to injuries or machine damage.

3. Operation

DANGER

- Always install the front cover before turning the input power ON. Never remove the cover while the power is ON. There are sections in the front PCB that are charged with high voltages.
  Failure to observe this could lead to electric shocks.
- Never touch the switches with wet hands.
  Failure to observe this could lead to electric shocks.
- Never touch the inverter's terminals while the inverter power is ON even if the operation is stopped.
  Failure to observe this could lead to electric shocks.
- Selection of the retry function could lead to unexpected restarting when a fault occurs. The machine may start suddenly if the power is turned ON when the automatic start function is selected. Do not go near the machine.
  (Design the machine so that physical safety can be ensured even if the machine restarts.)
  Failure to do so could lead to injuries.
- The machine may not stop when a stop command is issued if the deceleration stop function is selected and the overvoltage/overcurrent limit function is activated. Prepare a separate emergency stop switch.
  Failure to do so could lead to injuries.
- Resetting of a fault while the run signal is input could lead to unexpected restarting. Always confirm that the run signal is OFF before resetting the alarm.
  Failure to do so could lead to injuries.

CAUTION

- The heat sink and dynamic braking resistor are heated to high temperatures, so never touch them.
  Failure to observe this could lead to burns.
- Do not block the inverter's ventilation holes.
  Failure to observe this could lead to fires.
- The inverter operation can easily be set from low speeds to high speeds, so confirm that the operation is within the tolerable range for the motor or machine before making settings.
  Failure to do so could lead to injuries.
- Prepare holding brakes when necessary. Holding is not possible with the inverter's brake functions.
  Failure to do so could lead to injuries.
- Confirm the operation of the motor as a single unit before operating the machine.
  Failure to do so could lead to injuries or machine damage due to unforeseen movements.
  Always prepare a safety backup device so that the machine is not placed in a hazardous situation when an error occurs in the inverter.
  Failure to do so could lead to injuries or machine damage or fires.

4. Maintenance, inspection and part replacement

DANGER

- Always wait at least 20 minutes after turning the input power OFF before starting inspections.
  Wait at least 20 minutes after turning the input power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the front cover.
  Remove the front cover, and confirm that the "CHARGE" LED on the unit has gone out. Also check that the voltage between terminals L+1 or L+2 and L– is 15V or less before starting the inspections. (Check with the "CHARGE" LED if the unit is not provided with the L– terminal.)
  Failure to observe this could lead to electric shocks.
- Maintenance, inspections and part replacement must be done by a designated person.
  (Remove all metal accessories such as watches, bracelets, etc., before starting the work.)
  (Always use an insulation measure tool.)
  Failure to observe this could lead to electric shocks and injuries.
- Always turn the power OFF before inspecting the motor or machine. A potential is applied on the motor terminal even when the motor is stopped.
  Failure to do so could lead to electric shocks and injuries.
- Do not use parts other than those designated for the replacement parts.
  Contact your inverter dealer for replacement parts.
  Failure to observe this could lead to fires.

CAUTION

- Vacuum the inverter with a vacuum cleaner to clean it. Do not use water or organic solvents.
  Failure to observe this could lead to fires or damage.

5. Others

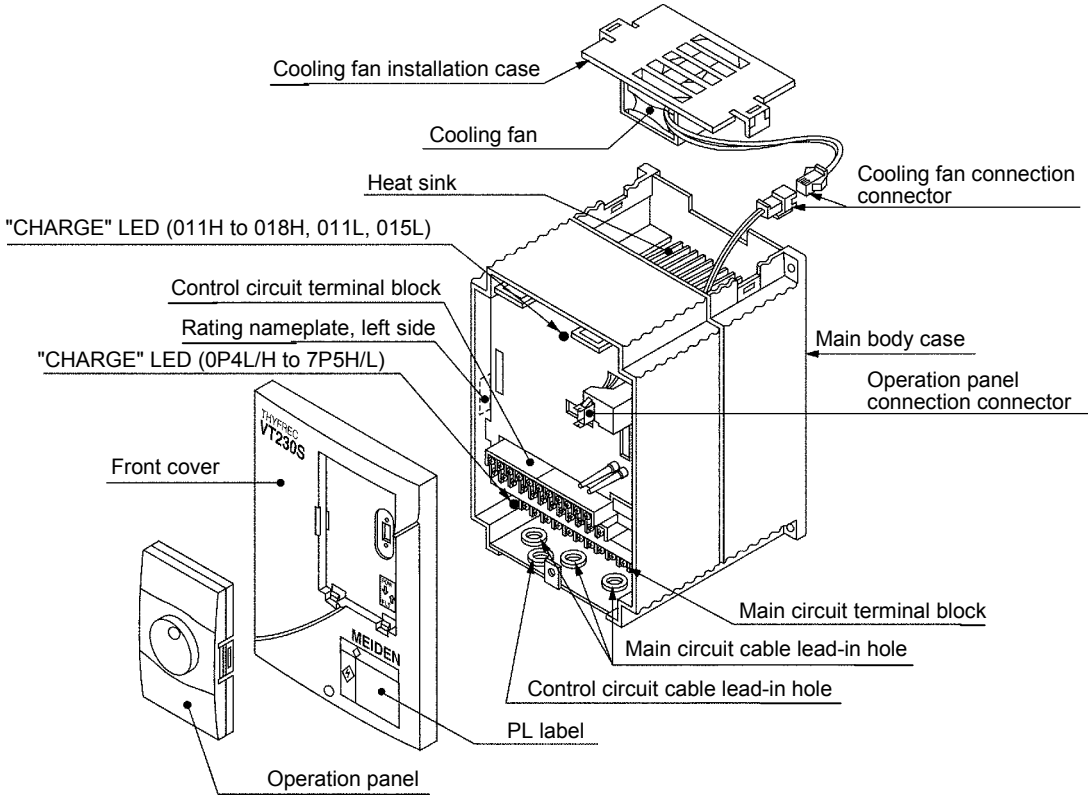
DANGER

- Never modify the product.
  Failure to observe this could lead to electric shocks or injuries.

CAUTION

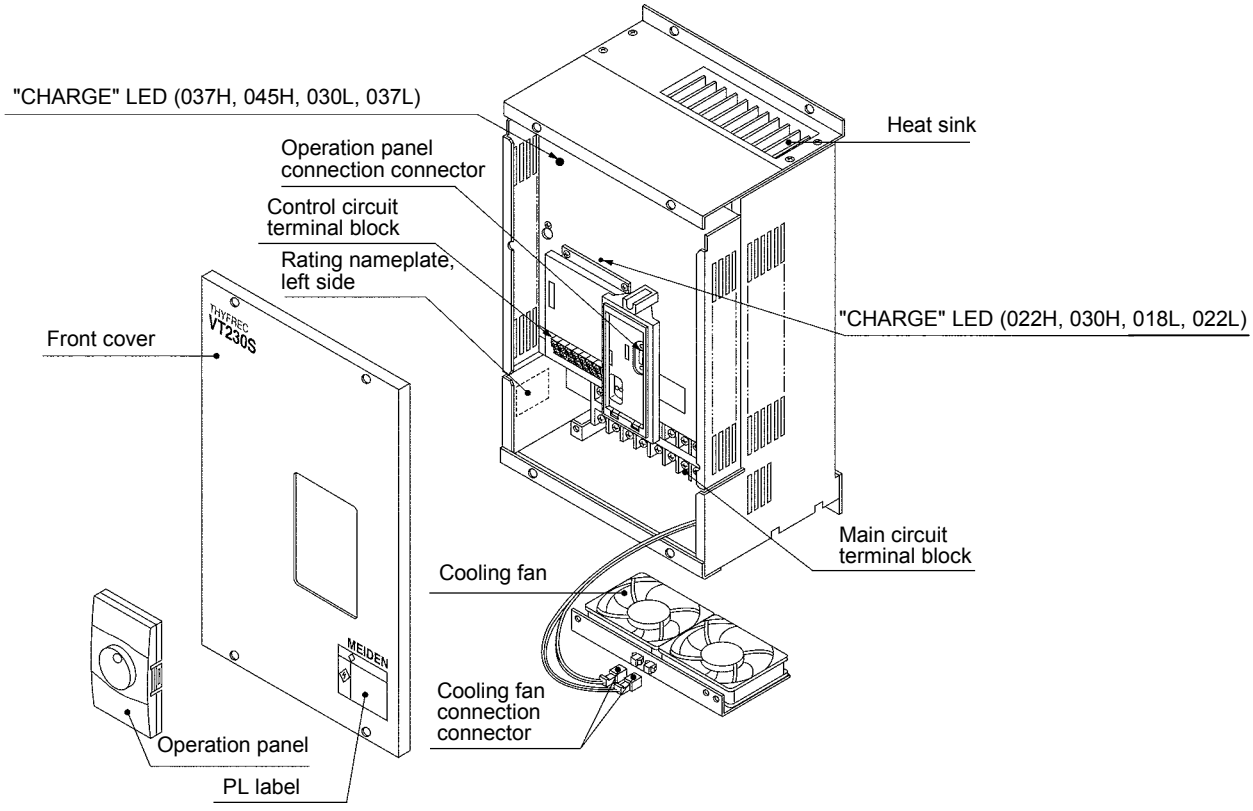
- Dispose of this product as industrial waste.

<Names of each part>

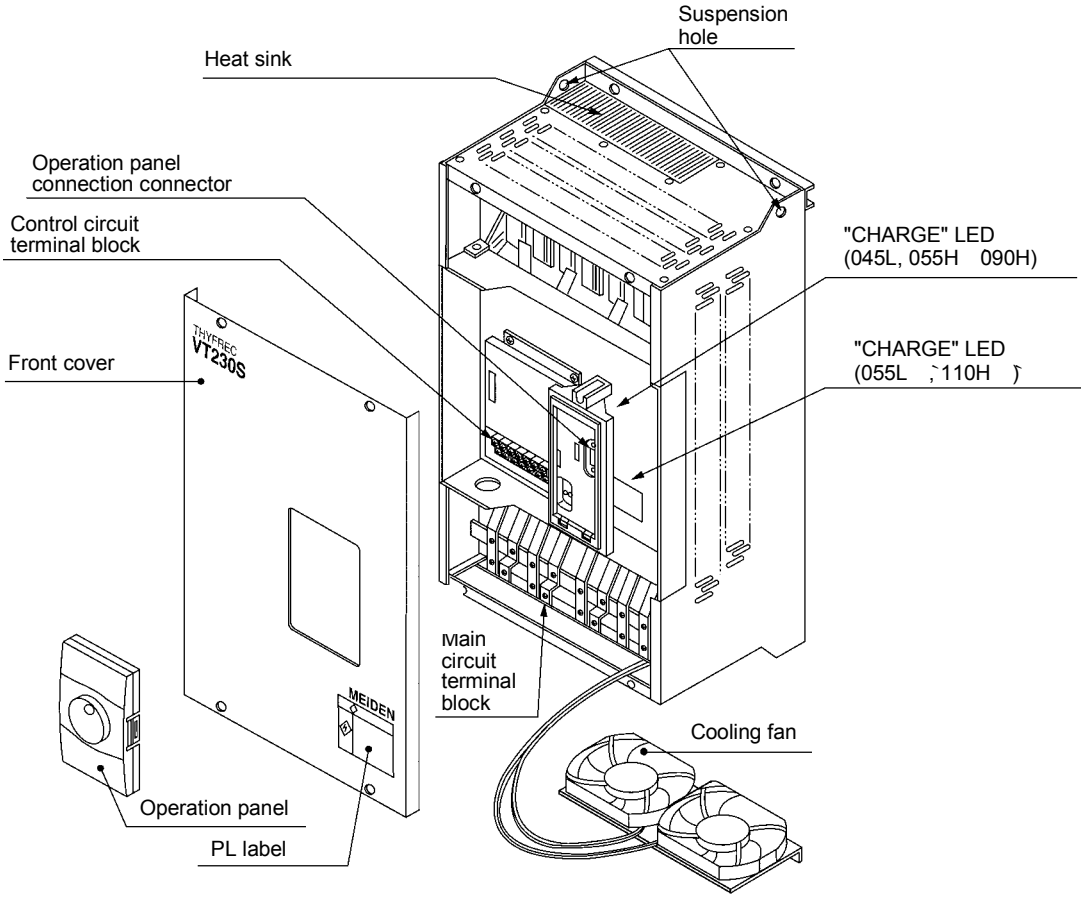


For 015L, 018H and smaller

The presence and quantity of cooling fans will differ according to the capacity.



For 018L ~ 037L, 022H ~ 045H



For 045L and larger, 055H and larger

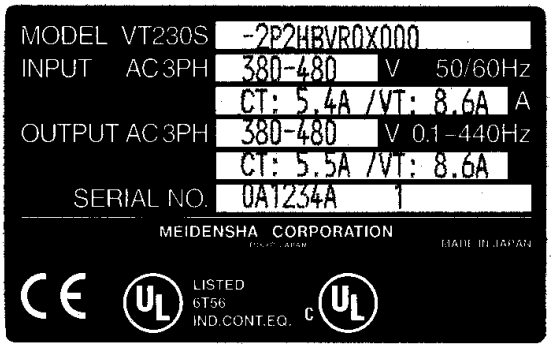
Chapter 1 Delivery Inspection and Storage

1-1 Delivery inspection and storage

(1) Remove the inverter from the packaging, and check the details on the rating nameplate to confirm that the inverter is as ordered. The rating nameplate is on the left side of the unit.
(2) Confirm that the product has not been damaged.
(3) If the inverter is not to be used for a while after purchasing, store it in a place with no humidity or vibration in the packaged state.
(4) Always inspect the inverter before using after storing for a long period. (Refer to 8-1.)

1-2 Details of rating nameplate and type display method

(1) The following details are listed on the rating nameplate.



(Note 1) Refer to Chapter 10 for details on UL Instruction.

(2) Using the above type as an example, the type is displayed as follows:

V T 2 3 0 S 2 P 2 H A V R 0 X 0 0 0

Input voltage and capacity
(Refer to Appendix 1)

Meidensha control No.

Indicates the control PCB option.
(Refer to Table 7-1.)

Indicates main circuit options
A : Standard (no options)
B : With dynamic braking resistor
(Applied only ~ 7P5H/L)
(Option. Refer to 7-3.)

Chapter 2 Installation and Wiring

⚠ CAUTION

- Always transport the product with an appropriate amount according to the products weight.
  Failure to observe this could lead to injuries.
- Install the inverter, dynamic braking unit and resistor, and other peripheral devices on non-combustible material such as metal.
  Failure to observe this could lead to fires.
- Do not place the product near inflammable items.
  Failure to observe this could lead to fires.
- Do not hold the front cover while transporting the product.
  Failure to observe this could lead to injuries from dropping.
- Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter the product.
  Failure to observe this could lead to fires.
- Install the product in a place that can withstand the weight of the product, and follow the instruction manual.
  Failure to do so could lead to injuries from dropping.
- Do not install and operate an inverter that is damaged or that is missing parts.
  Failure to observe this could lead to injuries.
- Always observe the conditions described in the instruction manual for the installation environment.
  Failure to observe this could lead to faults.

2-1 Installation environment

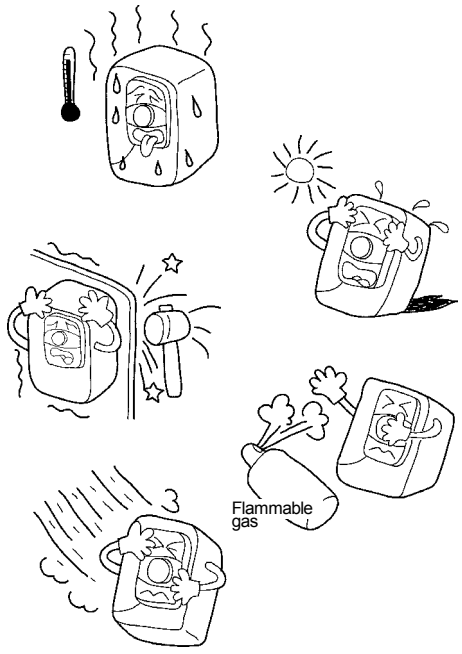
Observe the following points when installing the inverter.

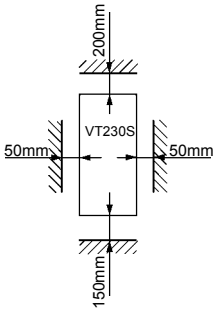
(1) Install the inverter vertically so that the cable lead-in holes face downward.

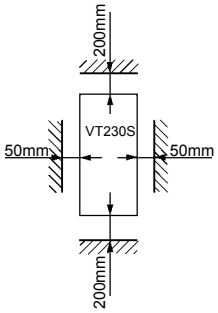
(2) Make sure that the ambient temperature is –10°C to 50°C. (Refer to Appendix 1.)

(3) Avoid installation in the following environment.
- Places subject to direct sunlight
- Places with oil mist, dust or cotton lint, or subject to salty winds
- Places with corrosive gas, explosive gas or high humidity levels
- Places near vibration sources such as dollies or press machines
- Places made of flammable materials such as wood, or places that are not heat resistant

(4) Ensure ventilation space around the inverter. (Refer to Fig. 2-1.)





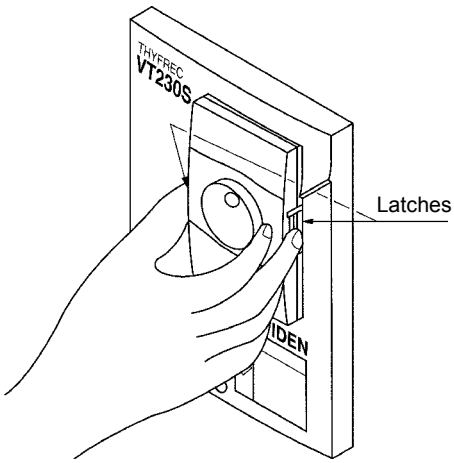


For 015L, 018H and smaller **For 018L, 022H and larger**

Fig. 2-1

2-2 Installation and wiring method

Installation and wiring for the 015L and 018H and below, and the wiring for the 018L and 022H and above are carried out with the front cover removed. Before removing the front cover, always remove the operation panel from the unit. If the front cover is removed without removing the operation panel, the unit could drop off the operation panel and be damaged. To remove the operation panel, press in the left and right latches inward and pull off the panel as shown on the right. When completed with the installation and wiring work, install the front cover, and then install the operation panel. At that time, make sure that the latches on the left and right of the operation panel are securely caught.



(1) 015L, 018H and smaller (Fig. 2-2)

Fix the VT230S at four places when install-ing. The lower two installation sections are notched.
Remove the front cover, and wire to the main circuit and control terminal block.

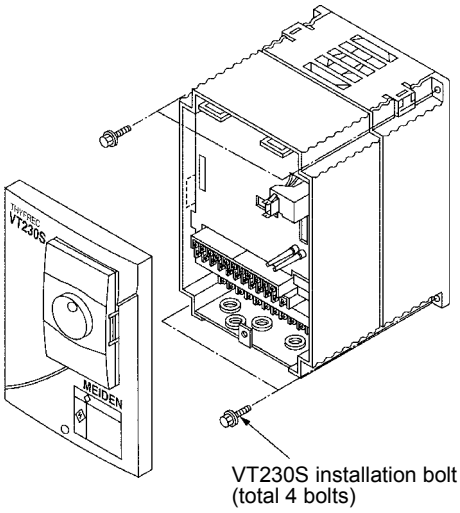


Fig. 2-2

(2) 018L, 022H and larger (Fig. 2-3)

Fix the VT230S at four places when install-ing. The VT230S mass is more than 25kg, so installation by two workers is recommended.
Wire in the same manner as step (1).

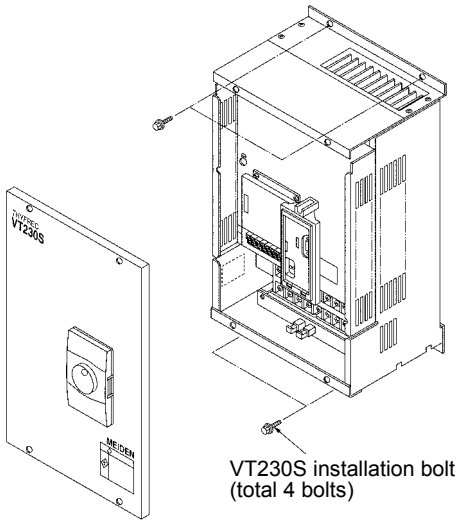


Fig. 2-3

2-3 Precautions for power supply and motor wiring

DANGER

- Always turn the device's input power OFF before starting wiring.
  Failure to do so could lead to electric shocks or fires.
- Carry out grounding that complies with the standards of the country where the inverter is being installed.
  Failure to do so could lead to electric shocks or fires.
- When using the PM motor, even if the inverter is stopped, the voltage will be generated at the output terminal (U, V, W) during rotation. Always carry out wiring while the motor is stopped.
  Failure to do so could lead to electric shocks or injuries.
- Wiring must always be done by a qualified electrician.
  Failure to observe this could lead to electric shocks or fires.
- Always install the device before starting wiring.
  Failure to do so could lead to electric shocks or injuries.
- Prepare a breaker such as an MCCB or fuses that matches the capacity for the inverter's power supply side.
  Failure to do so could lead to fires.

CAUTION

- Do not connect an AC power supply to the output terminals (U, V, W).
  Failure to observe this could lead to injuries or fires.
- Confirm that the product's rated voltage and frequency match the power supply voltage and frequency.
  Failure to do so could lead to injuries or fires.
- Install an overheating protection device on the dynamic braking resistor, and shut off the power with an error signal.
  Failure to do so could lead to fires in the event of abnormal overheating.
- Do not directly connect a resistor to the DC terminals (between L+1, L+2 and L–).
  Failure to observe this could lead to fires.
- Tighten the terminal screws with the designated tightening torque.
  Failure to do so could lead to fires.
- Correct connect the output side (U, V, W).
  Failure to do so could cause the motor to rotate in reverse and the machine to be damaged.
- Always correctly connect when using the encoder.
  The signal polarity specifications differ according to the encoder. If the specifications differ from the VT230S standard specifications (refer to section 6-9-1), adjust the signal polarity with the signal setting (C50, C51).
  Failure to observe this could lead to reverse rotation or abnormal acceleration of the motor, and to injuries or machine damage.

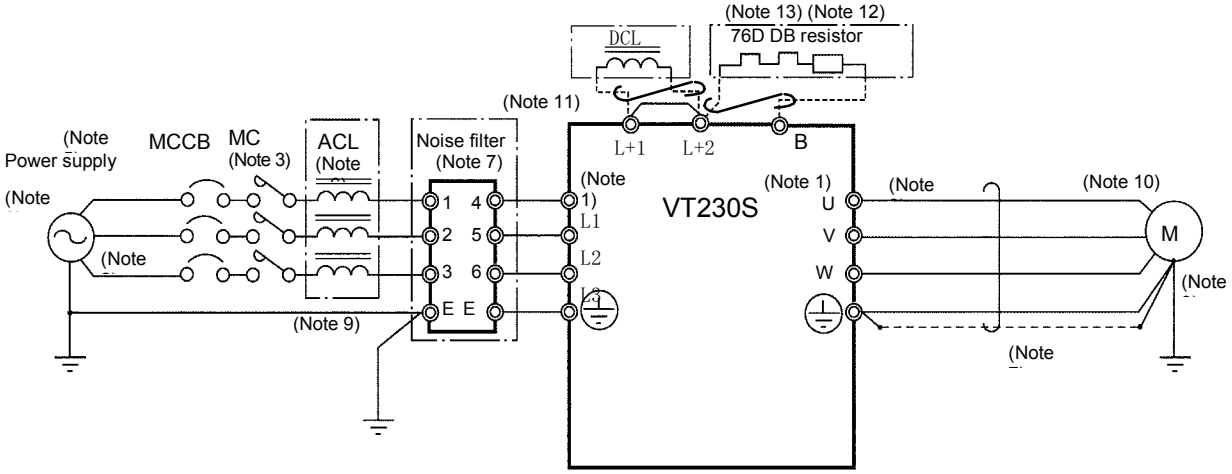
Refer to Fig. 2-4 and wire the main circuits for the power supply and motor, etc.
Always observe the following precautions for wiring.

CAUTION

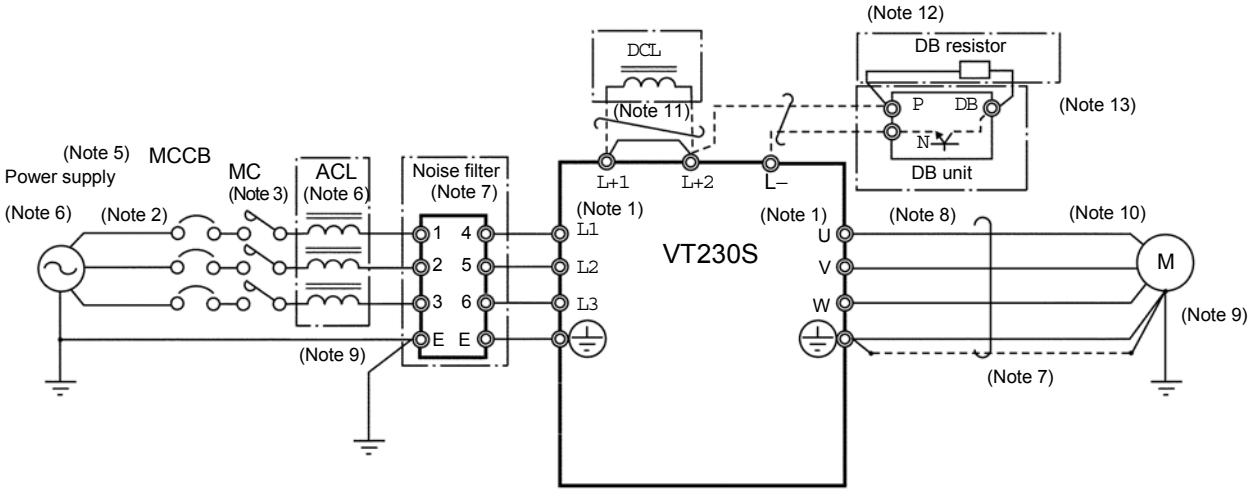
There is a risk of electric shocks.
The VT230S has a built-in electrolytic capacitor, so a charge will remain even when the inverter power is turned OFF. Always observe the following times before carrying out wiring work.

- Wait at least 20 minutes after turning the power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the cover.
- After removing the cover, confirm that the "CHARGE" LED in the unit has gone out. Also check that the voltage between terminals L+1 or L+2 and L– is 15V or less before starting the inspections. (Check with the "CHARGE" LED if the unit is not provided with the L– terminal.)

(a) 7P5L, 7P5H and smaller



(b) 011L~ 075L, 011H ~ 037H



(c) 045H and larger

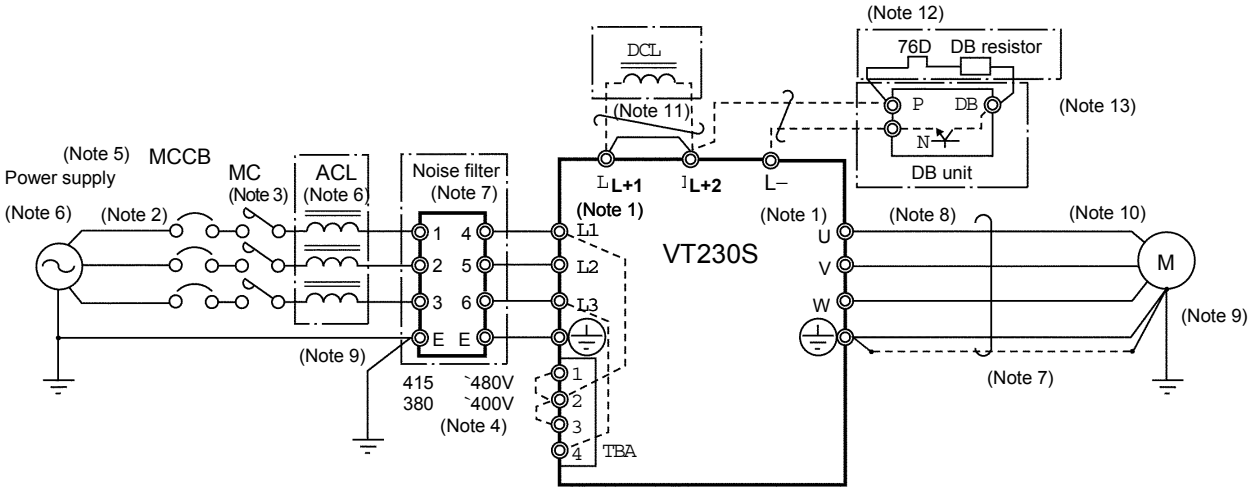


Fig. 2-4 Example of main circuit wiring

(Note 1) Inverter input/output terminals

The inverter input terminals are L1, L2 and L3. The output terminals to the motor are U, V and W. Do not connect the power supply to the U, V, W terminals. Incorrect wiring will lead to inverter damage or fires.

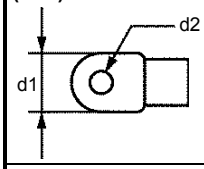
(Note 2) Wire size

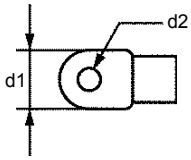
Use wires having the wire size or larger shown in Table 2-1 for the main circuit wiring shown in Fig. 2-5. The applicable wire size range, applicable ring terminal and tightening torque for the main circuit terminal block are shown in Table 2-1.

The applicable wire in Table 2-1 indicates use with the constant torque. When using with a variable torque, select the wire given in the column for the inverter type that is one capacity higher. Note that for the 045H variable torque, the 030L column applies, and for the 037L variable torque, the 037L column applies.

Table 2-1 Applicable wire sizes and terminals

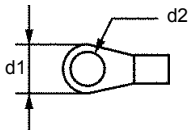
a) Power supply and motor wiring (L1, L2, L3, U, V, W, L+1, L+2, L–)

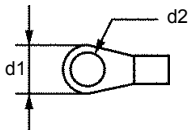
Inverter type VT230S-□	200V Series	~2P2L	4P0L	5P5L	7P5L		011L	015L		018L 022L	030L	037L
	400V Series	~4P0H	5P5H 7P5H	011H	015H	018H	022H		030H	037H 045H		
Applicable wire	mm^2	2	3.5	5.5	8	14		22		38	60	100
	AWG	14	12	10	8	6		4		2	1/0	4/0
Max. ring terminal (mm) 	d1	8.5	9.5	12			16.5		22			28.5
	d2	4.3		5.3			6.4		8.4			10.5
Terminal screw		M4		M5			M6		M8			M10
Tightening torque [N•m]		1.2		2			4.5		9			18

Inverter type VT230S-□	200V Series	045L		055L 075L		
	400V Series	055H 075H	090H 110H	132H 160H	200H	250H 315H
Applicable wire	mm^2	100	150	100●2p	150●2p	200●2p
	AWG or kcmil	4/0	300 (Note 2)	4/0	300●2p	400●2p
Max. ring terminal (mm) 	d1	28.5	36	28.5	36	44
	d2	10.5			17	
Terminal screw		M10			M16	
Tightening torque [N•m]		28.9			125	

Note 1) 2p refers to two parallel connections.
Note 2) kcmil unit

b) DBR wiring (7P5L, 7P5H and smaller L+2, B) (011L, 011H and larger L+2, L–)

Inverter type VT230S-□	200V Series	~2P2L	4P0L	5P5L	7P5L		011L	015L	018L 022L	030L	037L
	400V Series	~4P0H	5P5H 7P5H	011H	015H	018H		022H	030H	037H 045H	
Applicable wire	mm^2	2						3.5	5.5	14	
	AWG	14						12	10	6	
Max. ring terminal (mm) 	d1	8.5		9.5			12		15		16
	d2	4.3		5.3			6.4		8.4		10.5
Terminal screw		M4		M5			M6		M8		M10
Tightening torque [N•m]		1.2		2			4.5		9		18

Inverter type VT230S-□	200V Series	045L		055L 075L		
	400V Series	055H 075H	090H 110H	132H 160H	200H	250H 315H
Applicable wire	mm^2	14			22	
	AWG	6			4	
Max. ring terminal (mm) 	d1	16			30	
	d2	10.5			17	
Terminal screw		M10			M16	
Tightening torque [N•m]		28.9			125	

(Note 3) Breaker for wiring

Install an MCCB or Fuse and MC on the power supply side of the inverter. Refer to Table 7-2 and select the MCCB or Fuses.

Use a fuse to create a UL compatible unit for 400V Series. (Except 055H and larger)

(Note 4) Rated voltage for auxiliary equipment power supply

For the 400V Series (045H and larger), replace the short bar for the auxiliary equipment power supply terminal (TBA) according to the rated voltage of the power supply being used.

For 380 to 400V, short circuit across 2-3 (factory setting state)

For 415 to 480V, short circuit across 1-2

(Note 5) Refer to the appendix 1 for the power supply voltage and frequency, and prepare a power supply suitable for the unit.

(Note 6) Power supply capacity

Make sure that capacity of the transformer used as the inverter's power supply is within the following range. (For 4% impedance transformer)

a) Constant torque (045H and smaller) 500kVA or less

b) Constant torque (055H and larger)
Variable torque Capacity that is 10-times or less inverter capacity

If the above values are exceeded, install an ACL on the inverter's input side.
(Refer to Table 7-2.)

(Note 7) Noise measures

The inverter will generate high harmonic electromagnetic noise, so using the following noise measures is recommended.

a) Insert a noise filter on the input side of the inverter. Refer to Table 7-2 and select the noise filter.
b) Keep the wiring length between the noise filter and inverter to 30cm or less for the 0P4L to 022L, 0P4H to 030H, and 50cm or less for the 030L and larger, 037H and larger.
c) Use a shield cable for the inverter and motor wiring, and connect the screen to the inverter's ⏚ terminal and motor grounding terminal.
d) When using the control circuit wiring explained in Section 2-4 and the main circuit wiring in this section in parallel, separate the wiring by 30cm or more, or pass each of the wiring through metal conduits. If the control circuit wiring and main circuit wiring intersect, make sure that they intersect at a right angle.

(Note 8) Inverter output

a) Do not insert a power factor improvement capacitor on the output side of the inverter.
b) When inserting a magnetic contactor on the output side of the inverter, prepare a sequence control circuit so that the magnetic contactor will not open and close when the inverter runs.
c) Directly connect only the motor to the inverter load, and do not relay through a transformer, etc.

(Note 9) Grounding

Always ground the inverter unit grounding terminal and the ground. Ground according to the regulations of the country where the inverter is being used.

(Note 10) Inverter output surge voltage (For 400V series)

As the inverter output cable is lengthened, the surge voltage applied on the motor also increases. If the wiring between the inverter and motor exceeds 20m, connect a surge absorber dedicated for the inverter output.

(Note 11) DCL

Always short circuit across L+1 and L+2 when not using the DCL. (Factory setting state)
When connecting the optional DCL, connect it to L+1 and L+2.
Twist the wiring to the DCL, and keep the wiring length to 5m or less.

(Note 12) DB unit

When connecting the optional DB unit, follow Fig. 2-4 (b) (c) and connect the L+2 and L– for 011L, 011H and larger.
The DB unit and inverter unit will both be damaged if the connection is incorrect.
Twist the wiring to the DB unit, and keep the wiring length to 3m or less.
Refer to Section 7-2 for details.

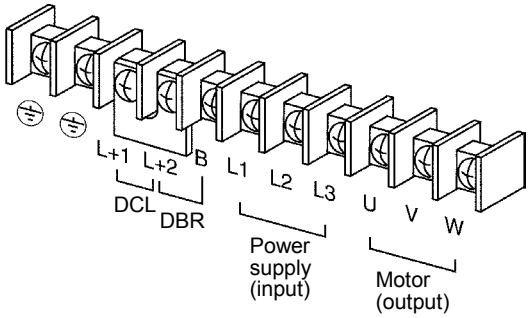
(Note 13) DBR protection

When using the optional DB unit, use the DB unit's overload detection relay (In case of V23-DBU) or insert a thermal relay (76D) to protect the DB resistor and inverter. Refer to section 7-3 for details.

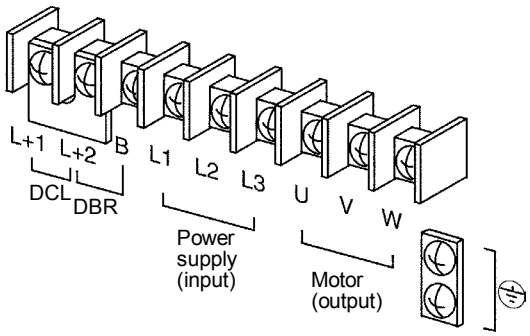
(Note 14) Installation of surge absorber

Install a surge absorber on the magnetic contactor and relay coils installed near the inverter.

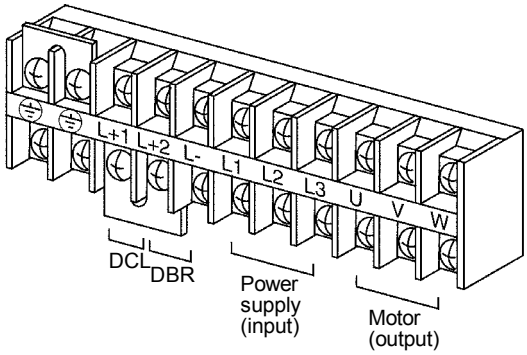
(a) 0P4L ~ 4P0L
0P4H ~ 4P0H



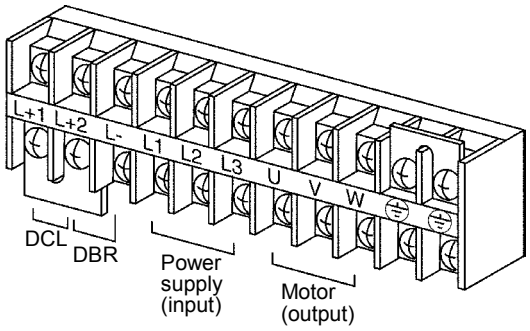
(b) 5P5L, 7P5L
5P5H, 7P5H



(c) 011L, 015L
011H ~ 018H



(d) 022H



(e) 018L ~ 037L
030H ~ 045H

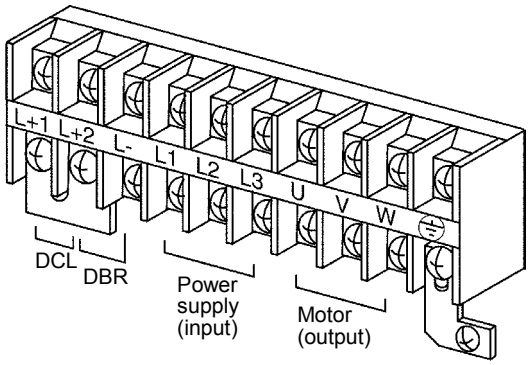
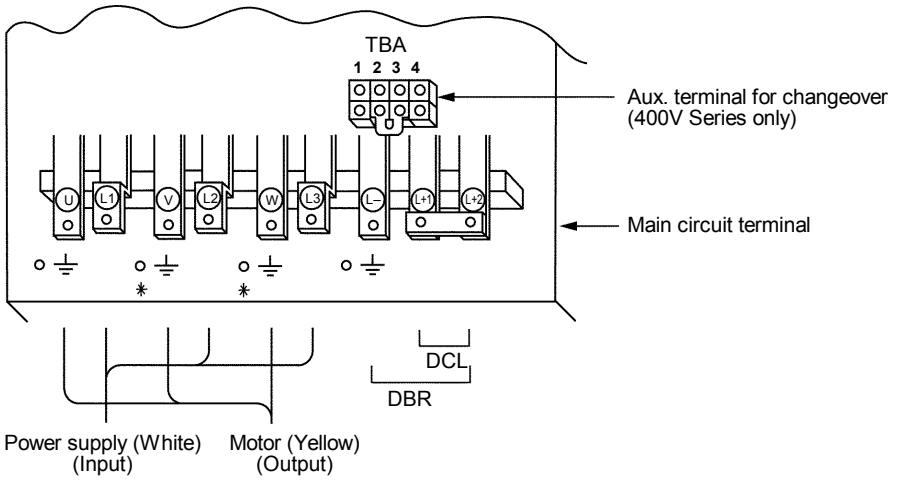


Fig. 2-5 Terminal block layout

(f)

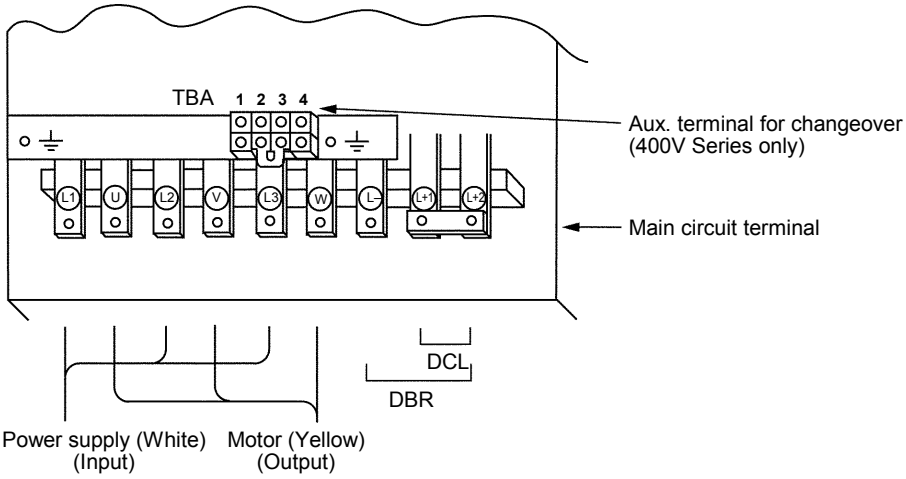
045L 055L
055H 075H
090H 110H

Terminals (*) are for 045L, 055H, 075H.



(g)

075L
132H 160H



(h)

200H

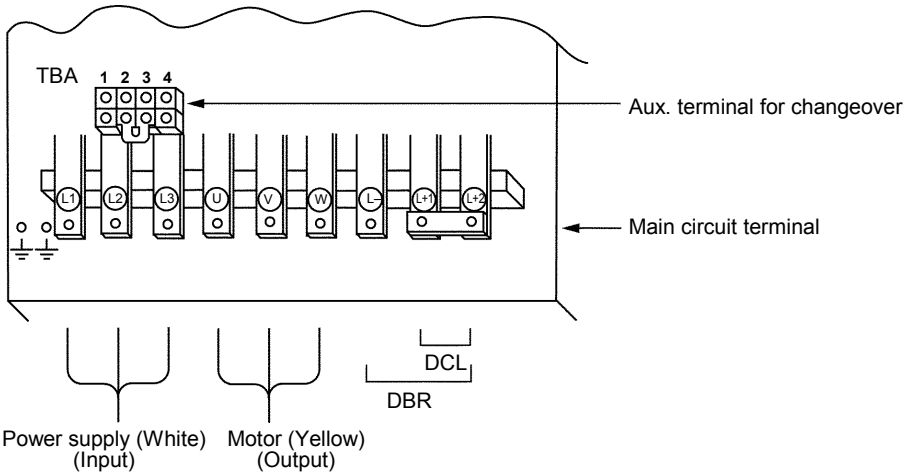


Fig. 2-5 Terminal block layout

(i)

250H 315H

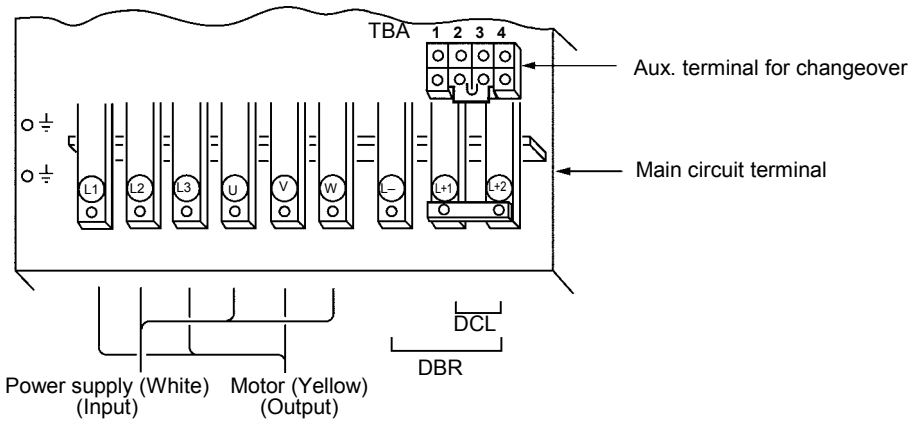
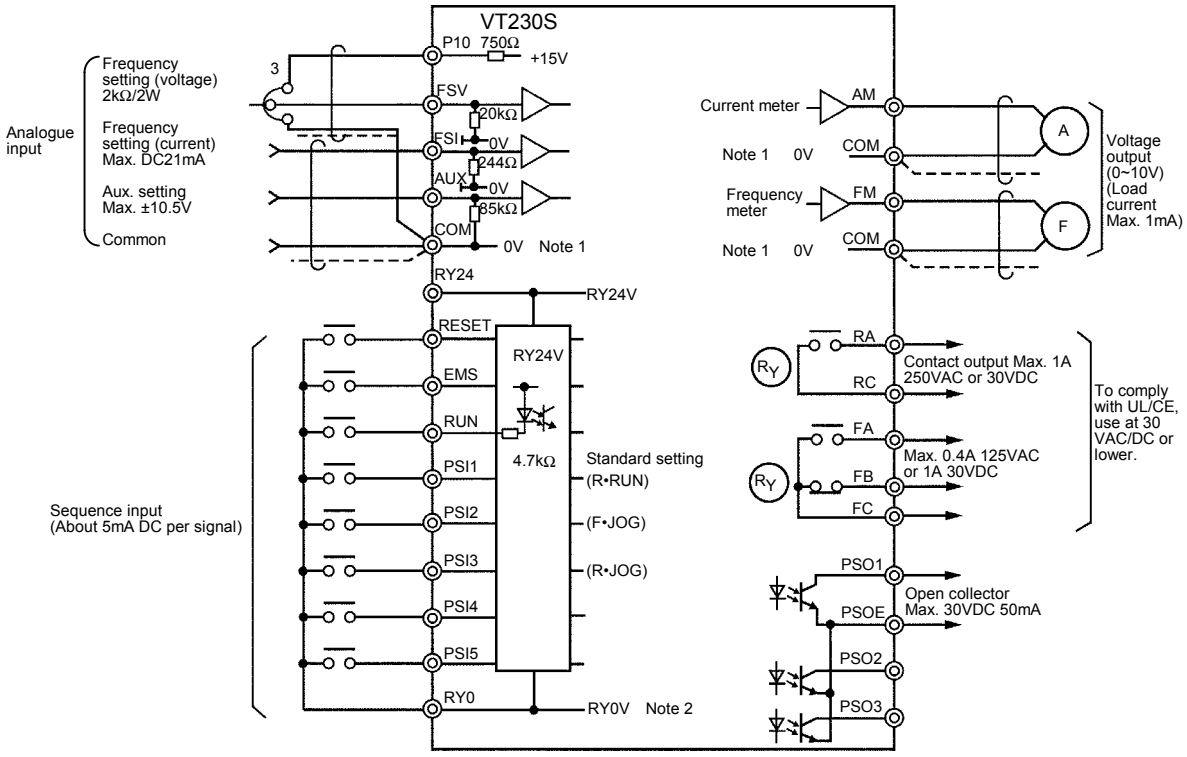


Fig. 2-5 Terminal block layout

2-4 Precautions for wiring to the control signal

(1) When wiring (control circuit wiring) to the control terminal block, separate the main circuit wiring (terminals L1, L2, L3, L+1, L+2, L–, B, U, V, W) and the other drive wires and power wires.
(2) Use a 0.13 to 0.8mm² wire for wiring to the control circuit. The tightening torque must be 0.6N.m.
(3) Use a twisted pair wire or twisted pair shield wire for wiring to the analog signal circuit such as the setters and meter. (Refer to Fig. 2-6.) Connect the shield wire to the TB2 COM terminal of the VT230S. The wire length must be 30m or less.
(4) The analog output is dedicated for the indicators such as the speedometer and ammeter. It cannot be used for control signals such as the feedback control.
(5) The length of the sequence input/output contact wire must be 50m or less.
(6) The sequence input can be changed between sink logic and source logic by changing the short pin (W1). Refer to Table 5-2.
(7) Observe the precautions listed in "Table 5-2 Control input/output circuit".
(8) An example of the control circuit wiring is given in Fig. 2-6.
(9) The layout of the control circuit terminal block is shown in Fig. 2-7, and the functions in Table 5-1. Terminals with the same terminal symbol are connected internally.
(10) After wiring, always check the mutual wiring.
At this time do not carry out a megger check or buzzer check on the control circuit.
- Are there any wire scraps or foreign matter left around the terminals?
- Are any screws loose?
- Is the wiring correct?
- Is any terminal contacting any other terminal?



(Notes)
1. Three COM terminals are internally connected.
2. No connection shall be made between RY0 and COM since this section is insulated.
3. This diagram is an example of the sink logic connection. (Refer to Table 5-2.)

Fig. 2-6

• **Control terminal** (The terminal block is laid out in two rows.)

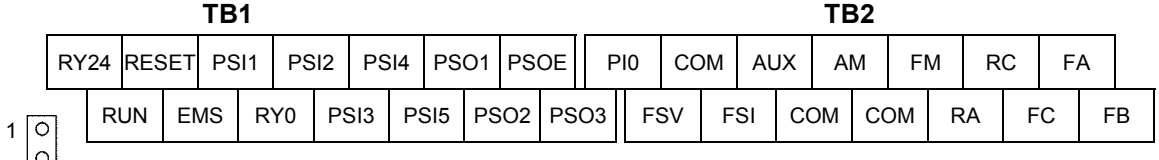


Fig. 2-7

Chapter 3 Test Operation and Adjustment

DANGER

- Always install the front cover before turning the input power ON. Never remove the cover while the power is ON. There are sections in the front PCB that are charged with high voltages.
  Failure to observe this could lead to electric shocks.
- Never touch the switches with wet hands.
  Failure to observe this could lead to electric shocks.
- Never touch the inverter's terminals while the inverter power is ON even if the operation is stopped.
  Failure to observe this could lead to electric shocks.
- Selection of the retry function could lead to unexpected restarting when a fault occurs. The machine may start suddenly if the power is turned ON when the automatic start function is selected. Do not go near the machine.
  (Design the machine so that physical safety can be ensured even if the machine restarts.)
  Failure to do so could lead to injuries.
- The machine may not stop when a stop command is issued if the deceleration stop function is selected and the overvoltage/overcurrent limit function is activated. Prepare a separate emergency stop switch.
  Failure to do so could lead to injuries.
- Resetting of a fault while the run signal is input could lead to unexpected restarting. Always confirm that the run signal is OFF before resetting the alarm.
  Failure to do so could lead to injuries.

CAUTION

- The heat sink and resistor are heated to high temperatures, so never touch them.
  Failure to observe this could lead to burns.
- Do not block the inverter's ventilation holes.
  Failure to observe this could lead to fires.
- The inverter operation can easily be set from low speeds to high speeds, so confirm that the operation is within the tolerable range for the motor or machine before making settings.
  Failure to do so could lead to injuries.
- Prepare holding brakes when necessary. Holding is not possible with the inverter's brake functions.
  Failure to do so could lead to injuries.
- Confirm the operation of the motor as a single unit before operating the machine.
  Failure to do so could lead to injuries or machine damage due to unforeseen movements.
  Always prepare a safety backup device so that the machine is not placed in a hazardous situation when an error occurs in the inverter.
  Failure to do so could lead to injuries or machine damage or fires.

The VT230S has various setting items. Some of these include settings that must be made according to the power supply and motor before actually starting operation.
The method for confirming the VT230S basic operation is explained in this section.

3-1 Control selection

Five control modes can be selected for the VT230S with the Parameter setting C control selection (C30-0).
Refer to Appendix 1 Control Specifications Table for details.

(1) V/f control (constant torque) (C30-0 = 1) : **(Note 1)**
V/f control (voltage – frequency rate constant control) is carried out.

(2) V/f control (variable torque) (C30-0 = 2) : **(Note 1)**
V/f control in respect to a variable torque load, such as a fan or pump, is carried out.

(3) IM speed sensor-less vector control (C30-0 = 3)
Vector control of the IM is carried out without a sensor.
Speed control or torque control can be carried out.

(4) IM speed control with speed sensor (C30-0 = 4) : **(Note 2)**
Vector control of the IM is carried out with a sensor.
This is used when a high-speed response or torque response is required.

(5) PM drive control (C30-0 = 5) : **(Note 3)**
Vector control of the PM is carried out. High-efficiency operation in respect to the IM is possible.

(Note 1) Only the parameters required for each control are displayed. For example, when C30-0 = 1, 2 is selected, parameters that can be used only when C30-0 = 3, 4, 5 is selected will not display.
(Note 2) An optional PCB (V23-DN1 or DN2) for IM speed detection is necessary. (Refer to Table 7-1.)
(Note 3) This applies to the Meidensha standard PM motor. An optional PCB (V23-DN3) for PM speed detection is necessary. (Refer to Table 7-1.)

3-2 Selection of operation mode

The VT230S operation modes include the Local and Remote Modes. These modes can be changed with the LCL + STOP keys while the motor is stopped. The selected mode can be confirmed with the LCL LED on the operation panel. Refer to Section 4-1 for details.

For Local Mode : LCL lights
Operation is carried out from the operation panel.

For Remote Mode : LCL is not lit
Operation is carried out with the terminal block TB1 input terminals.

⚠ CAUTION

Make sure that there is no abnormal noise, smoke or odors at this time.
If any abnormality is found, turn the power OFF immediately.

3-3 Flow of test operation

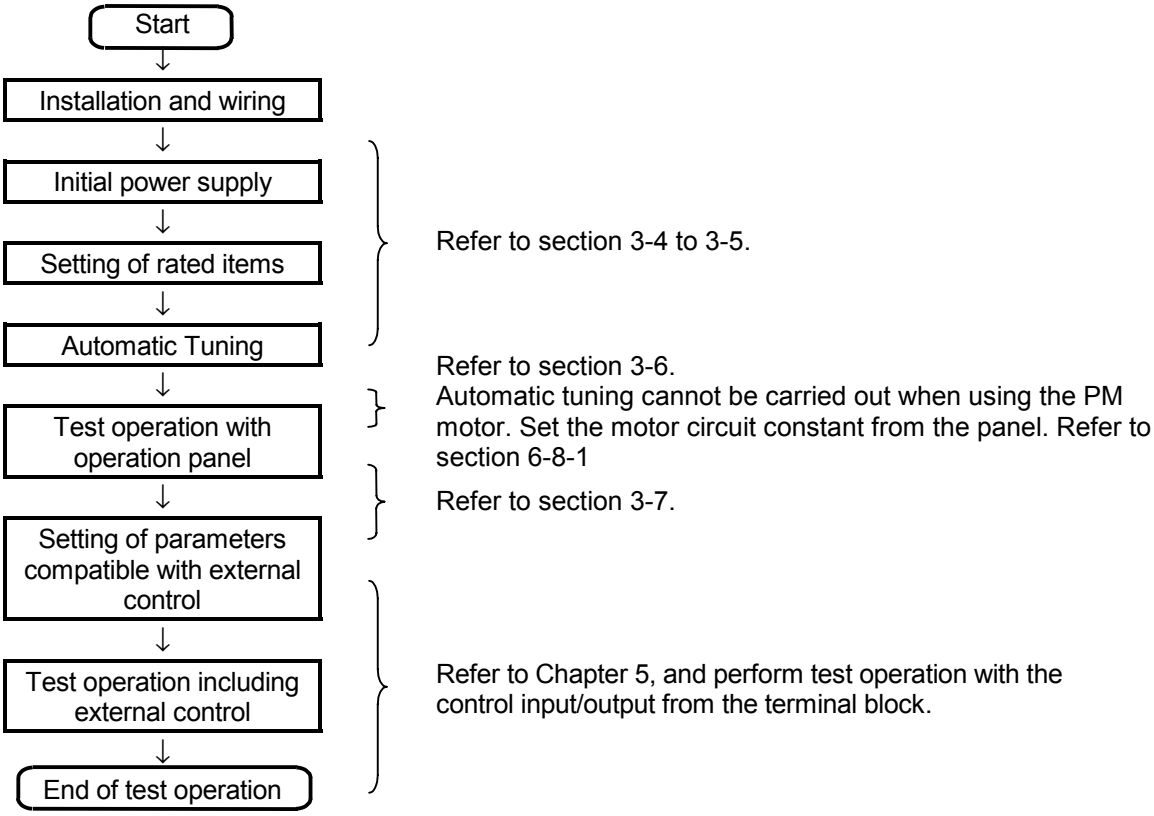


Fig. 3-1 Test operation procedure

⚠ CAUTION

1. Check that the wiring is correct.
2. The power supply must always be kept in the tolerable range.
3. Always check that the inverter rating and motor rating match.
4. Always correctly install the front cover before turning the power on.
5. Assign one worker to operate the switches, etc.
6. Refer to the Chapter 6 and observe the precautions when changing the set values such as torque boost A02-0.

3-4 Preparation for operation

Always confirm the following points before turning ON the power after completing wire.

(1) Remove the coupling and belt coupling the motor and machine, so that the machine can be run as a single unit.

(2) Confirm that the power supply wire is correctly wired to the input terminals (L1, L2, L3).

(3) When using the 400V Series (045H and larger), confirm that the auxiliary equipment power supply terminal (TBA) short bar matches the power supply voltage.

For 380 to 400V :		Short circuit between 2-3 (factory setting)
For 415 to 480V :	(045H)	Short circuit between 1-2
For 415 to 460V:	(055H and larger)	Short circuit between 1-2

(4) Make sure that the power supply is within the tolerable range.

(5) Make sure that motor is connected with the correct phase order.

(6) Fix the motor with the specified method.

(7) Make sure that none of the terminal section screws are loose.

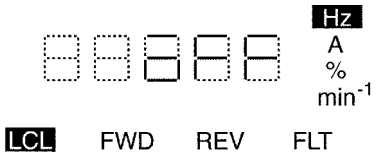
(8) Make sure that there is no short circuit state in the terminals caused by wire scraps, etc.

(9) Always correctly install the front cover and outer cover before turning the power ON.

(10) Assign an operator, and make sure that the operator operates the switches.

3-5 Settings of data before operation

(1) Turn ON the MCCB, and then turn ON the inverter power. All LEDs will light momentarily on the indicator, and then "•••••", "d00-0" will display before displaying "oFF".
The "LCL" and "Hz" LED will also light.



(2) Refer to Section 4-5, and confirm the rating parameters.

3-6 Automatic tuning

Automatic tuning measures the constants of the connected motor, and automatically adjusts the parameters so that the system is used to the fullest.

VT230S automatic tuning can be carried out in respect to the following four types of control by using the parameter setting control selection (C30-0).

V/f control (constant torque)	(C30-0 = 1) (Default)
V/f control (variable torque)	(C30-0 = 2)
IM speed sensor-less vector control	(C30-0 = 3)
IM vector control with speed sensor	(C30-0 = 4)

(Note1) C30-0 is hardware option function setting. If changing, set A05-2 (Parameter skip) to 1(Display)
(Note2) The PM motor control dose not have Automatic tuning. Refer to 6-8 for details.

3-6-1 V/f control (constant torque) (C30-0 = 1), V/f control (variable torque) (C30-0 = 2) automatic tuning

(1) Automatic tuning

The following two modes can be selected for the V/f control (constant torque) or V/f control (variable torque) automatic tuning.

Using the Parameter setting B automatic tuning function (B19-0), select the automatic tuning mode to match the working conditions. **(Note 1) (Note 2)**

1) B19-0 = 1: Mode 1: V/f control simple adjustment mode (Execution time: approx. 10 seconds)

   The basic parameters, such as boost voltage and brake voltage, are adjusted without rotating the motor.
   The following parameters are automatically adjusted by executing Mode 1.

Table 3-6-1

Parameter No.	Name
A02-2	Manual torque boost setting
A03-0	DC brake voltage
B02-0, 1	R1: Primary resistance

2) B19-0 = 2: Mode 2: V/f control high-function adjustment mode (Execution time: approx. 1 minute)

   The parameters related to the slip compensation and max. torque boost are adjusted while rotating the motor.
   The magnetic saturation characteristics are measured at the voltage boost, and are adjusted to match the max. torque boost.
   The following parameters are automatically adjusted by executing Mode 2.

Table 3-6-2

Parameter No.	Name
A02-2	Manual torque boost setting
A03-0	DC brake voltage
B02-0, 1	R1: Primary resistance
A02-5	Slip compensation gain
A02-6	Max. torque boost gain

(Note 1) The automatic tuning function (B19-0) cannot be used in modes other than control selected with the Parameter setting C control selection (C30-0). In this case, the following cannot be selected.

B19-0 = 3: Mode 3: Vector control basic adjustment mode
B19-0 = 4: Mode 4: Vector control expanded adjustment mode

(Note 2) If the base frequency of the motor is applied on a motor exceeding 120Hz, select Mode 1 (B19-0 = 1). Adjust the slip compensation gain (A02-5) and max. torque boost gain (A02-6) manually.

⚠ CAUTION

Precautions for executing V/f control (constant torque) V/f control (variable torque) automatic tuning

- During automatic tuning, the motor may rotate, so always confirm safety before starting automatic tuning.
- Separate the motor from the load and machine, etc., and run the motor as a stand alone unit during automatic tuning.
- Even when Mode 1 is executed, the motor may rotate due to vibration, etc.
  If the vibration is large, turn the (STOP) key immediately to stop operation.
- Always check the safety on the load side before executing automatic tuning, regardless of the Mode 1 or 2 setting.
  With Mode 2, the motor will automatically start rotating.
- If the automatic tuning function does not end correctly, always turn the inverter power OFF before investigating or confirming the operation.
- Automatic tuning can be carried out only in the Local Mode.
- If the motor has an unstable frequency band, automatic tuning may not end normally. In this case, the maximum torque boost function cannot be used.
- Always ground the motor and inverter.
- If the load is less than 30% and the fluctuation does not occur, automatic tuning can be carried out with the load and machine connected. However, the performance may not be complete.
- Always carry out automatic tuning before using the maximum torque boost function.
- The contact output FLT will function if the automatic tuning does not end correctly. In equipment that uses this contact, keep the operation of the related devices in mind.

(2) Automatic tuning operation procedures

Carry out automatic tuning with the following procedures.

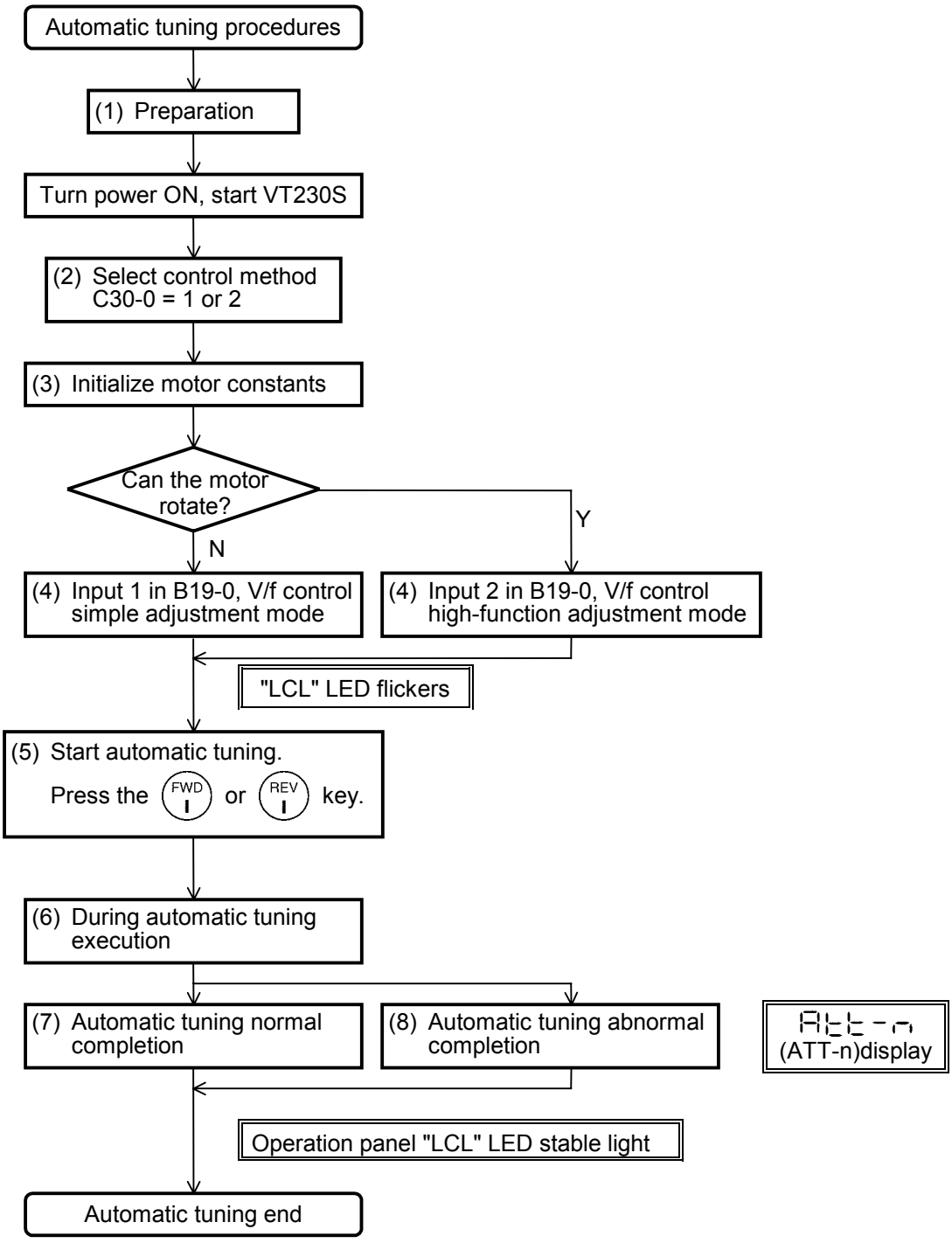


Fig. 3-2 V/f control (constant torque) and V/f control (variable torque) automatic tuning procedures

1) Preparation

Separate the motor and load, machine, etc., and confirm the safety on the load side.

2) Selection of control method

- Set A05-2 to 1. (Set the hardware option function display ON.)
- With parameter setting C control selection (C30-0), select one of the following to match the load conditions

  V/f control (constant torque) (C30-0 = 1), or
  V/f control (variable torque) (C30-0 = 2)

* The default value is V/f control (constant torque) (C30-0 = 1).

3) Initialization of motor constants

Input the motor rating nameplate value parameters. Automatic tuning will automatically change the parameters, so it is recommended to write down the values set in Table 3-6-1 or Table 3-6-2.

Table 3-6-3

Parameter No.	Name	
B00-0	Rated input voltage setting	[No.]
B00-1	Max/base frequency simple setting	[Hz]
B00-2	Motor rated output	[kW]
B00-3	Rated output voltage	[V]
B00-4	Max. frequency	[Hz]
B00-5	Base frequency	[Hz]
B00-6	Motor rated current	[A]
B00-7	Carrier frequency	[kHz]

* The max. frequency cannot be set below the base frequency, and the base frequency cannot be set above the max. frequency.

4) Selection of automatic tuning function

- Set A05-0 to 1. (Set the expanded setting display ON.)
- Using the parameter setting B automatic tuning function (B19-0), select the automatic tuning mode to match the working conditions. Refer to section 3-6-1 for details.
- The automatic tuning standby state will be entered when the SET key is pressed.
- During the automatic tuning standby state and the automatic tuning execution state, the LCL LED will flicker.
- To exit the automatic tuning standby state, press the STOP key.

5) Starting automatic tuning

Automatic tuning will start when the FWD key or REV key is pressed according to the required rotation direction.

To stop, press the STOP key or input the emergency stop signal (EMS) from the terminal block.

* Keys other than STOP and RST/MOD are disabled during automatic tuning.

6) During automatic tuning execution

The progression state can be confirmed with D22-0.
Refer to section 3-6-4 for details.

7) Normal completion of automatic tuning

When the automatic tuning ends normally, the "LCL" LED will change from a flicker to a stable light.
Refer to section 3-6-1 for the adjustment items.

8) Abnormal completion of automatic tuning

If the automatic tuning ends abnormally, a message will appear. Investigate and check according to the error codes.
Refer to section 3-6-3 for details on the error codes.

3-6-2 IM speed sensor-less vector control (C30-0 = 3) and IM vector control with speedsensor (C30-0 = 4) automatic tuning

(1) Automatic tuning

The following two modes can be selected for the IM speed sensor-less vector control or IM vector control with speed sensor automatic tuning.

Using the parameter setting B automatic tuning function (B19-0), select the automatic tuning mode to match the working conditions. **(Note 1)**

1) B19-0 = 3: Mode 3: Vector control basic adjustment mode (Execution time: approx. 30 seconds)

   The basic parameters for vector control are automatically adjusted.
   The following parameters are automatically adjusted by executing Mode 3.

Table 3-6-4

Parameter No.	Name
B01-9	No-load output voltage
B02-0, 1	R1 : Primary resistance
B02-2, 3	R2' : Secondary resistance
B02-4, 5	Lσ : Leakage inductance
B02-6, 7	M' : Excitation inductance

2) B19-0 = 4: Mode 4: Vector control extended adjustment mode (Execution time: approx. 1 minute)

   This mode is selected to carry out constant output range operation. **(Note 2)**
   The following parameters are automatically adjusted by executing Mode 4.

Table 3-6-5

Parameter No.	Name
B01-9	No-load output voltage
B02-0, 1	R1 : Primary resistance
B02-2, 3	R2' : Secondary resistance
B02-4, 5	Lσ : Leakage inductance
B02-6, 7	M' : Excitation inductance
B34-0 to 7	M variable compensation table

(Note 1) The automatic tuning function (B19-0) cannot be used in modes other than control selected with the parameter setting C control selection (C30-0). In this case, the following cannot be selected.

B19-0 = 1: Mode 1: V/f control simple adjustment mode
B19-0 = 2: Mode 2: V/f control high-function adjustment mode

(Note 2) When carrying out constant output operation, the excitation inductance fluctuation must be compensated.
Assign the operation range to the table reference speed in B33-0 to 7.
Note that the motor will rotate to the max. speed in this case, so take special care to safety.

⚠ CAUTION

Precautions for executing IM speed sensor-less vector control or IM vector control with speedsensor automatic tuning

- During automatic tuning, the motor may rotate, so always confirm safety before starting automatic tuning.
- Separate the motor from the load and machine, etc., and run the motor as a stand alone unit during automatic tuning.
- The motor may vibrate and rotate during automatic tuning.
  If the vibration is large, turn the (STOP) key immediately to stop operation.
- Always check the safety on the load side before executing automatic tuning. The motor will automatically start rotating during automatic tuning.
- If the automatic tuning function does not end correctly, always turn the inverter power OFF before investigating or confirming the operation.
- Automatic tuning can be carried out only in the Local Mode.
- Always ground the motor and inverter.
- If the load is less than 10% and the fluctuation does not occur, automatic tuning can be carried out with the load and machine connected. However, the performance may not be complete.
- In case that the load is higher than 10% or the fluctuation occurs, if R1: Primary resistance, R2': Secondary resistance, Lσ : Leakage inductance, M': Excitation inductance (For the calculations of R2', Lσ, M', refer to section 6-6 B02-0 ~9 : Motor circuit constant) are input from the motor data and Automatic turning : B19-0 = 5 is carried out, no load voltage is set automatically, so that the running of vector control can be performed.
- The contact output FLT will function if the automatic tuning does not end correctly. In equipment that uses this contact, keep the operation of the related devices in mind.

(2) Automatic tuning operation procedures

Carry out automatic tuning with the following procedures.

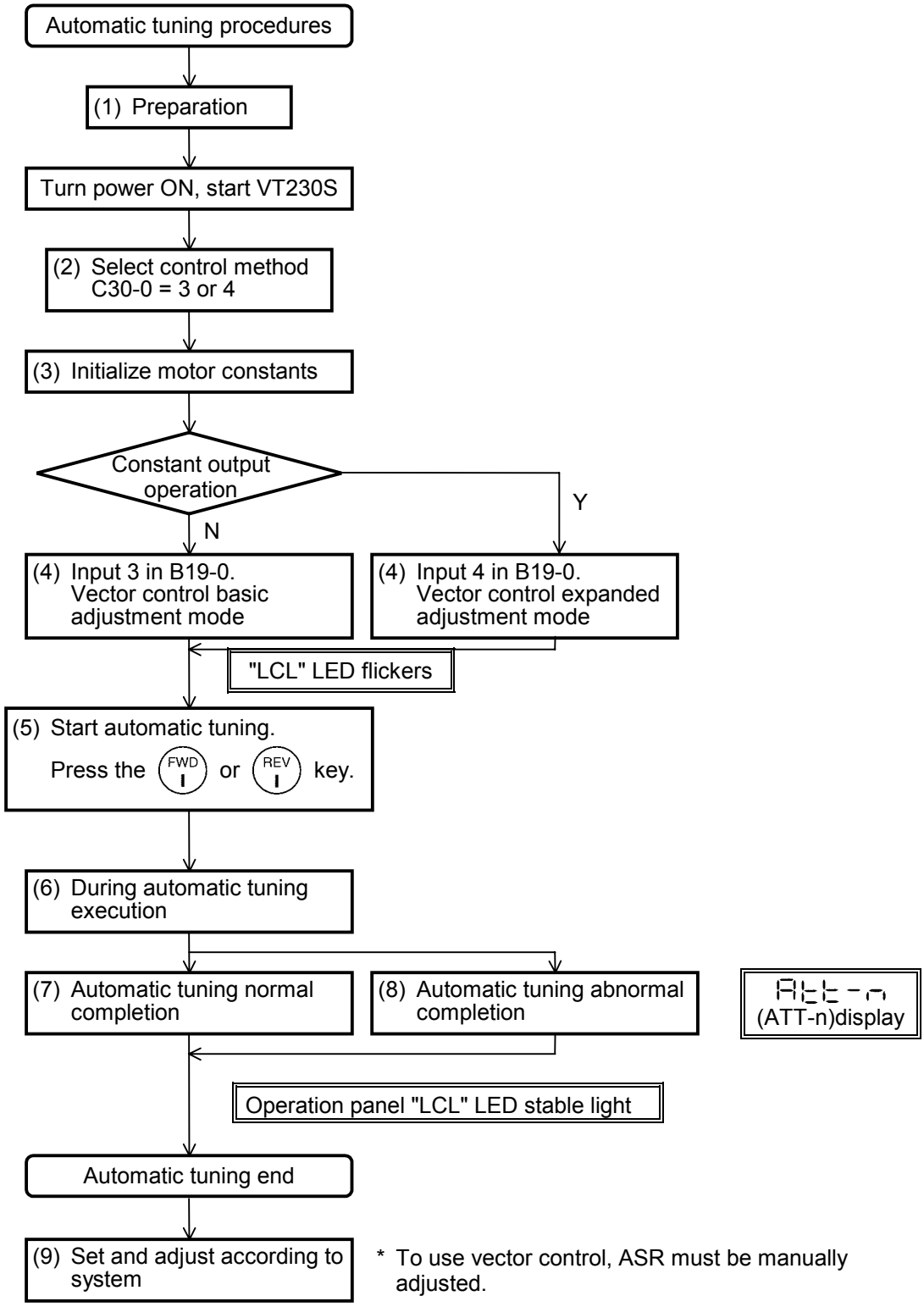


Fig. 3-3 IM speed sensor-less vector control and IM vector control with speed sensor automatic tuning procedures

1) Preparation

Separate the motor and load, machine, etc., and confirm the safety on the load side.

2) Selection of control method

- Set A05-2 to 1. (Set the hardware option function display ON.)
- With parameter setting C control selection (C30-0), select one of the following to match the load conditions

  IM speed sensor-less vector control (C30-0 = 3), or
  IM vector control with speed sensor (C30-0 = 4)

* The default value is V/f control (constant torque) (C30-0 = 1).

3) Initialization of motor constants

Input the motor rating nameplate value parameters. Automatic tuning will automatically change the parameters, so it is recommended to write down the values set in Table 3-6-4 or Table 3-6-5.

Table 3-6-6

Parameter No.	Name	
B01-0	Rated input voltage setting	[No.]
B01-1	Motor rated output	[kW]
B01-2	No. of motor poles	[Pole]
B01-3	Rated output voltage	[V]
B01-4	Max. speed	[min^{-1}]
B01-5	Base speed	[min^{-1}]
B01-6	Motor rated current	[A]
B01-7	Carrier frequency	[kHz]
B01-8	No. of encoder pulses	[P/R] : **(Note 1)**

* When carrying out constant output operation, the excitation inductance fluctuation must be compensated.
Assign the operation range to the table reference speed in B33-0 to 7. When B34-0 to 7 are set to the default values (100%), B33-0 to 7 will be assigned automatically. (Note 2)
Note that the motor will rotate to the max. speed in this case, so take special care to safety.

* The max. speed cannot be set below the base speed, and the base speed cannot be set above the max. speed.

(Note 1) Always input when using the speed sensor.
(Note 2) Automatic assignment is available from CPU version 114.0 and ROM version 115.0 and above.

4) Selection of automatic tuning function

- Set A05-0 to 1. (Set the expanded setting display ON.)
- Using the parameter setting B automatic tuning function (B19-0), select the automatic tuning mode to match the working conditions. Refer to section 3-6-2 for details.
- The automatic tuning standby state will be entered when the SET key is pressed.
- During the automatic tuning standby state and the automatic tuning execution state, the "LCL" LED will flicker.
- To exit the automatic tuning standby state, press the STOP key.

5) Starting automatic tuning

Automatic tuning will start when the FWD key or REV key is pressed according to the required rotation direction.

To stop, press the STOP key or input the emergency stop signal (EMS) from the terminal block.

* Keys other than STOP and RST/MOD are disabled during automatic tuning.

6) During automatic tuning execution

The progression state can be confirmed with D22-0.
Refer to section 3-6-4 for details.

7) Normal completion of automatic tuning

When the automatic tuning ends normally, the "LCL" LED will change from a flicker to a stable light.
Refer to section 3-6-2 for the adjustment items.

8) Abnormal completion of automatic tuning

If the automatic tuning ends abnormally, a message will appear. Investigate and check according to the error codes.
Refer to section 3-6-3 for details on the error codes.

9) Settings and adjustments to match system

The control parameters are adjusted to match the user's system. The main adjustment parameters are shown below.

- A10-0: ASR response : Set the speed control response with a [rad/s] unit. If the speed tracking is slow, increase this value. Note that if this value is too high, hunting may occur.
- A10-1: Machine time constant 1 : Set the time required to accelerate from zero to the base speed with the rated torque.

$$Tm\ [msec] = 10.968 \times J\ [kgm^2] \times N\ base\ [min^{-1}]/Power\ [W]$$

J: Total inertia [kgm^2] N base: Base speed [min^{-1}]

- A10-2: Cumulative time constant compensation coefficient: Increase the compensation coefficient if the overshooting is high during speed control.
- A10-3: ASR drive torque limiter : Increase this value when a drive torque is required.
- A10-4: ASR regenerative torque limiter : Increase this value when a regenerative torque is required.

10) Adjustment when using IM speed sensor-less vector control

Adjust the following items to use the speed sensor-less vector control at a high accuracy.

- **Fine adjustment of primary resistance**

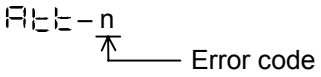
  In the no-load (only inertia load) state, carry out trial operation at the minimum operation speed to be used, and finely adjust the primary resistance(B02-0,1). For forward run, adjust so that D11-4 (ASR output) is near zero on the positive side. (Note)
  Make sure that the D11-4 (ASR output) does not reach the negative side during forward run. If adjusting it on the positive side during forward run, stopping with the regenerative limiter (B31-3, 4, 5, 6) may not be possible in rare case.
  (Note) The Mantissa section of Primary resistance (B02-0) can be set during run and the Exponent section of Primary resistance (B20-1) can not be set during run.

- **Adjustment of estimated speed integral gain**

- Confirm that D00-3 (motor speed on % uint) is stable (±1% or less) during trial operation. If not stable, decrease (to approx. half) the speed estimated proportional gain (B31-1).

3-6-3 Automatic tuning error messages

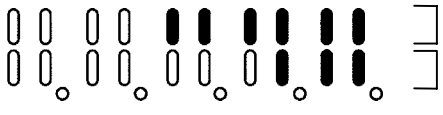
If automatic tuning ends abnormally, the following message will appear. Investigate and confirm the state following the error code.



No.	Cause and remedy
n=1	The motor may not be connected correctly. Check the connection. The B00 and B01 parameters may not be set correctly. Check the parameter setting. The motor with the special circuit constants may be applied. Change B19-1and B19-2 parameters.
n=2	The B00 and B01 parameters may not be set correctly. Check the parameter setting.
n=3	The load and machine may not be separated. Separate the load and machine. Lengthen the acceleration time (A01-0). Lengthen the deceleration time (A01-1). If the motor vibrates, increase the torque stabilizing gain (B18-2).
n=4	The load and machine may not be separated. Separate the load and machine. If the motor vibrates, increase the torque stabilizing gain (B18-2).
n=5	When the motor does not stop Increase the acceleration/deceleration time (A01-0, A01-1). When the motor does stop The B00 and B01 parameters may not be set correctly. Check the parameter setting.
n=6	The B00 and B01 parameters may not be set correctly. Check the parameter setting.

3-6-4 Automatic tuning progression state display

Details on the progression state of automatic tuning can be confirmed with the monitor parameter: D22-0 display.



Upper line : Indication of steps required for tuning. (LED light)

Lower line : Indication of completed steps. (LED light)
A flickering LED indicates that the step is currently being executed.

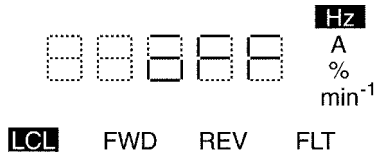
3-7 Test operation with operation panel

The test operation with the operation panel is performed with the following procedure.

⚠ CAUTION

Make sure that signals are not input into the RUN, EMS, PSI1 ~ 5 terminals on the sequence input terminals at this time.

(1) Turn ON the power supply.
All LEDs will light momentarily on the numeral indicator, and then "•••••", "d00-0" will display before displaying "OFF".
The "LCL" and "Hz" LED will also light.
Set 3 (panel fixed) for the speed setting No. of input selection C02-0. Refer to section 4-5 for details on changing the parameters.



⚠ CAUTION

The motor will run. Confirm the safety around the motor before starting the next step.

(2) Press the FWD key.
The "FWD" LED will light and the display will change from "OFF" to "10.00". This is because the local setting frequency (A00-0) is set to 10Hz as the default setting.

⚠ CHECK

1. Did the motor run?
2. Is the run direction correct? Check the wiring and operation if abnormal.
3. Is the rotation smooth?

(3) Press the REV key and confirm that the motor runs in reverse.

(4) Press the STOP key and stop the motor.

(5) Press the FWD key. The motor will forward run at 10Hz.

(6) Press the RST/MOD key once. The display will alternate between "A00-0" and "10.00".

(7) Press the SET key once.
The display will stop at "10.00", and the last digit will flicker.
This completes the preparation for changing the output frequency. The digit to change can be moved with the LCL key. The output frequency can be incremented/decremented with the knob.

(8) Move the digit with the LCL key, and using the knob, raise the frequency to 50Hz. Then, press the SET key. The output frequency will rise to 50Hz.

CAUTION

A 10-second acceleration and 20-second deceleration ramp time are set as defaults. The motor will slowly increase its speed to the set value. Increase the speed by approx. 10Hz at a time with the knob.

(9) Press the STOP key when the motor speed reaches 50Hz. The display will decrease to 0.00 in 20 seconds. The "FWD" or "REV" LED will flicker for two seconds while the DC-brake is applied and the motor will stop.

(10) Press the REV key to test the reverse run.

This completes the test operation with the operation panel.
Refer to Chapter 4 and make the adjustments according to the user application.

Chapter 4 Operation Panel

4-1 Details of operation panel

The configuration of the operation panel is shown in Fig. 4-1.

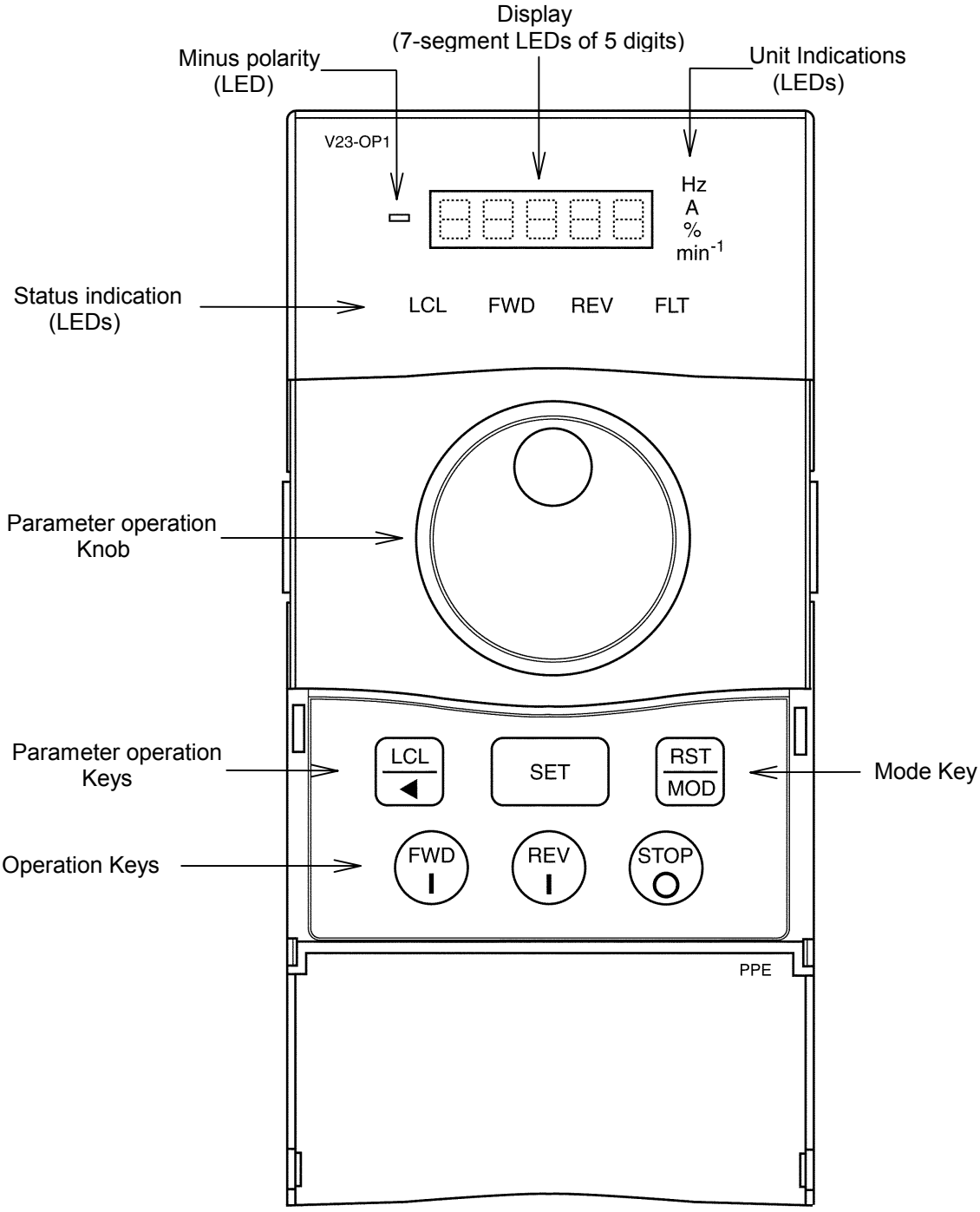


Fig. 4-1

The functions of each section are shown in Table 4-1.

Table 4-1 Functions of operation panel

Status indications LEDs			
	FWD (Forward)	The drive is running in the forward direction.	When both LEDs flicker simultaneously, it indicates that DC Brake or pre-excitation is in action. If only the "FWD" or "REV" LED is flickering, this indicates that a command in the reverse direction has been received, and the drive is decelerating.
	REV (Reverse)	The drive is running in the reverse direction.	
	FLT (Fault)	The drive has detected a fault and has stopped. The drive can be reset from the Operation Panel (STOP + RST/MOD) or from the terminal block (RESET signal).	
	LCL (Local)	The drive is in the Local Mode and can be operated from the Operation Panel (FWD, REV and STOP only). When LED is off, the drive is in the Remote Mode and can be controlled from the terminal block (sequence input signals). To change Modes between Local and Remote, press STOP + LCL .	
Unit indication LEDs			
	Hz A % min^{-1}	Indicates the unit of the parameter value shown on the display.	
Minus polarity indication LED			
	—	Lights when the number on the display is a minus number.	
Operation keys			
	FWD	Starts the drive in the forward direction. (in Local Mode only)	
	REV	Starts the drive in the reverse direction. (in Local Mode only)	
	STOP	Stops the drive. The motor will either coast to a stop or ramp down to a stop as selected on C00-1.	
	STOP + LCL	Changes control Modes from Local to Remote, or vice-versa. When the drive is in Local Mode, "LCL" LED is on. **(Note)**	
	STOP + RST/MOD	Resets a fault, putting out FLT LED.	
Parameter operation keys **Parameter operation knob**			
	RST/MOD (Mode)	Changes display Modes in the following order. Monitor → Parameter-A → Parameter-B → Parameter-C → Utility mode-U	
	SET	Fixes Parameter number or set its values.	
		Increases Parameter Block. Increases Parameter Number or its values.	
		Decreases Parameter Block. Decreases Parameter Number or its values.	
	LCL (◄)	Param. select	Changes Parameter Block for the desired Parameter. To change to the next Block up, turn first. For the next Block down, turn first.
		Valve change	Moves the cursor to the desired digit for adjustment. The cursor is on the flickering digit.

(Note) The drive is default set so that a Local/Remote selection is disabled while the drive is running. Even while the drive is at a stop, this selection cannot be made if operating commands such as RUN, JOG, etc., are being received at the terminal. This lock can be released with Parameter C09-2.

4-2 Modes and parameters

The parameters used differ according to the control mode (C30-0). The parameters include the V/f control (constant torque, variable torque) parameters, the IM vector control (sensor-less, with sensor) and the PM motor control parameters.

These parameters are grouped into Modes and Blocks according to their functions and frequency of usage.

4-2-1 V/f control (constant torque) mode and V/f control (variable torque) mode

The configuration of the parameters is shown in Fig. 4-2.

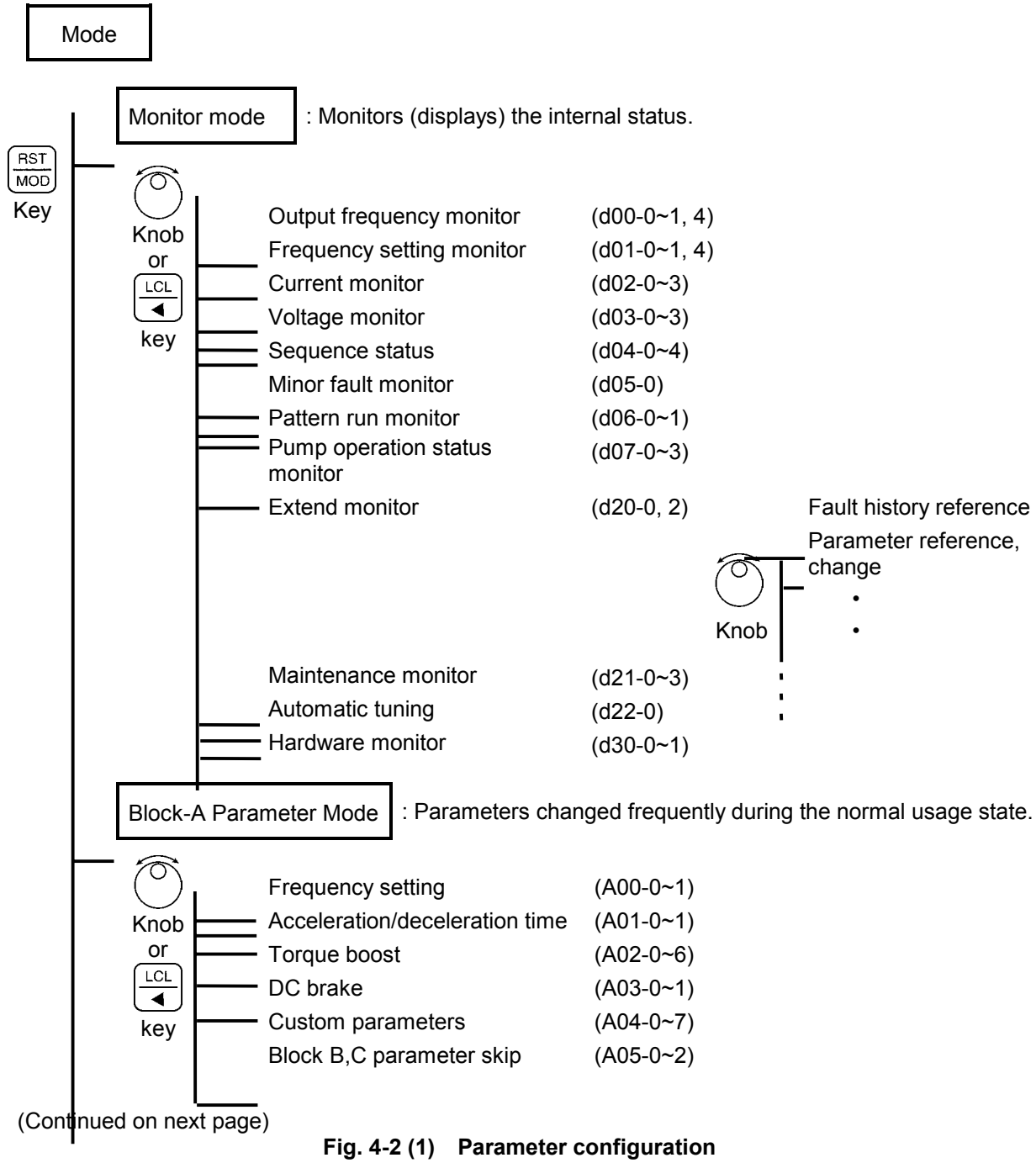


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Fig. 4-2 (1) Parameter configuration

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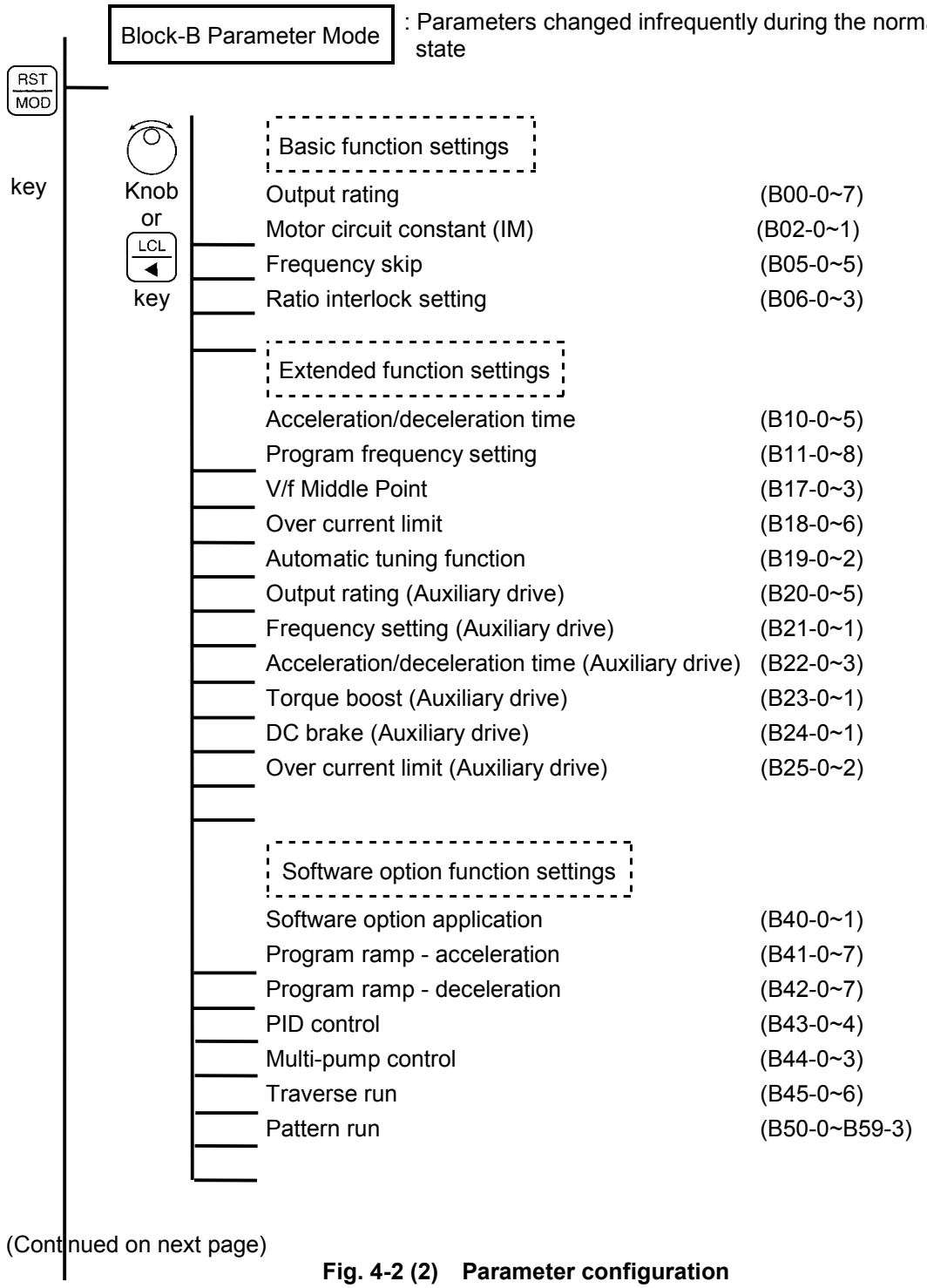

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Fig. 4-2 (2) Parameter configuration

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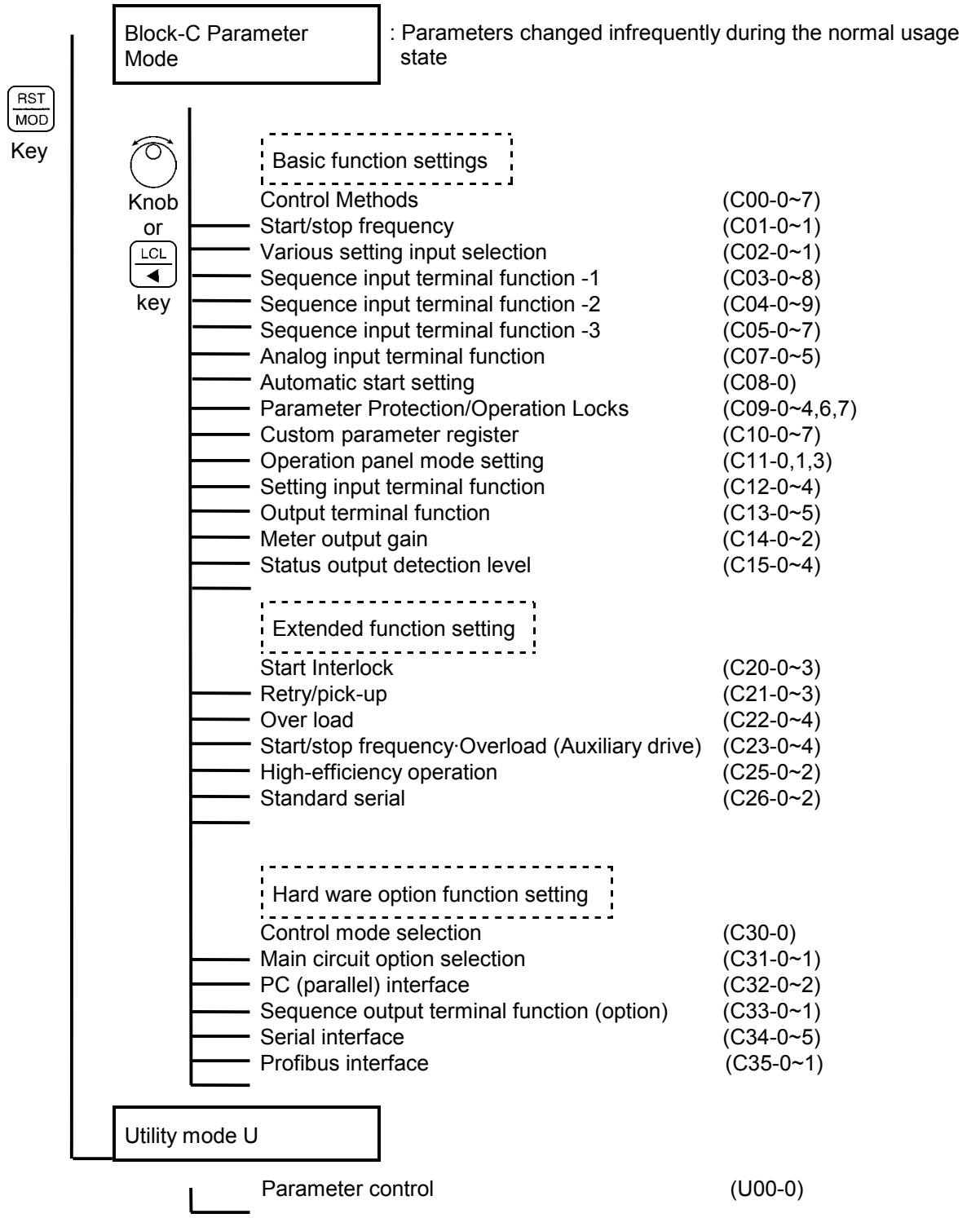

(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 3 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-2 (3) Parameter configuration

4-2-2 IM speed sensor-less vector control , and IM vector control with speed sensor

The configuration of the parameters is shown in Fig. 4-3.

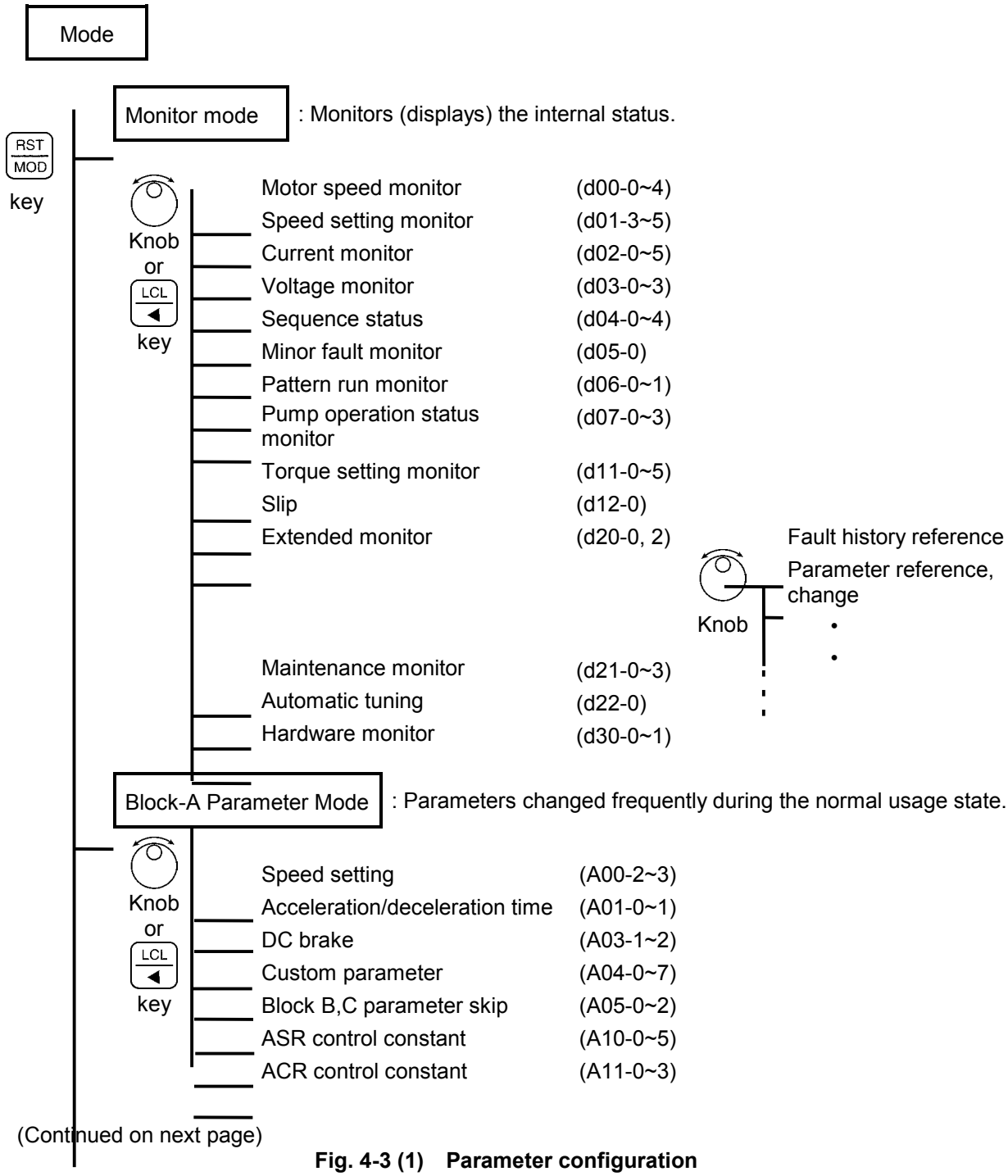

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Fig. 4-3 (1) Parameter configuration

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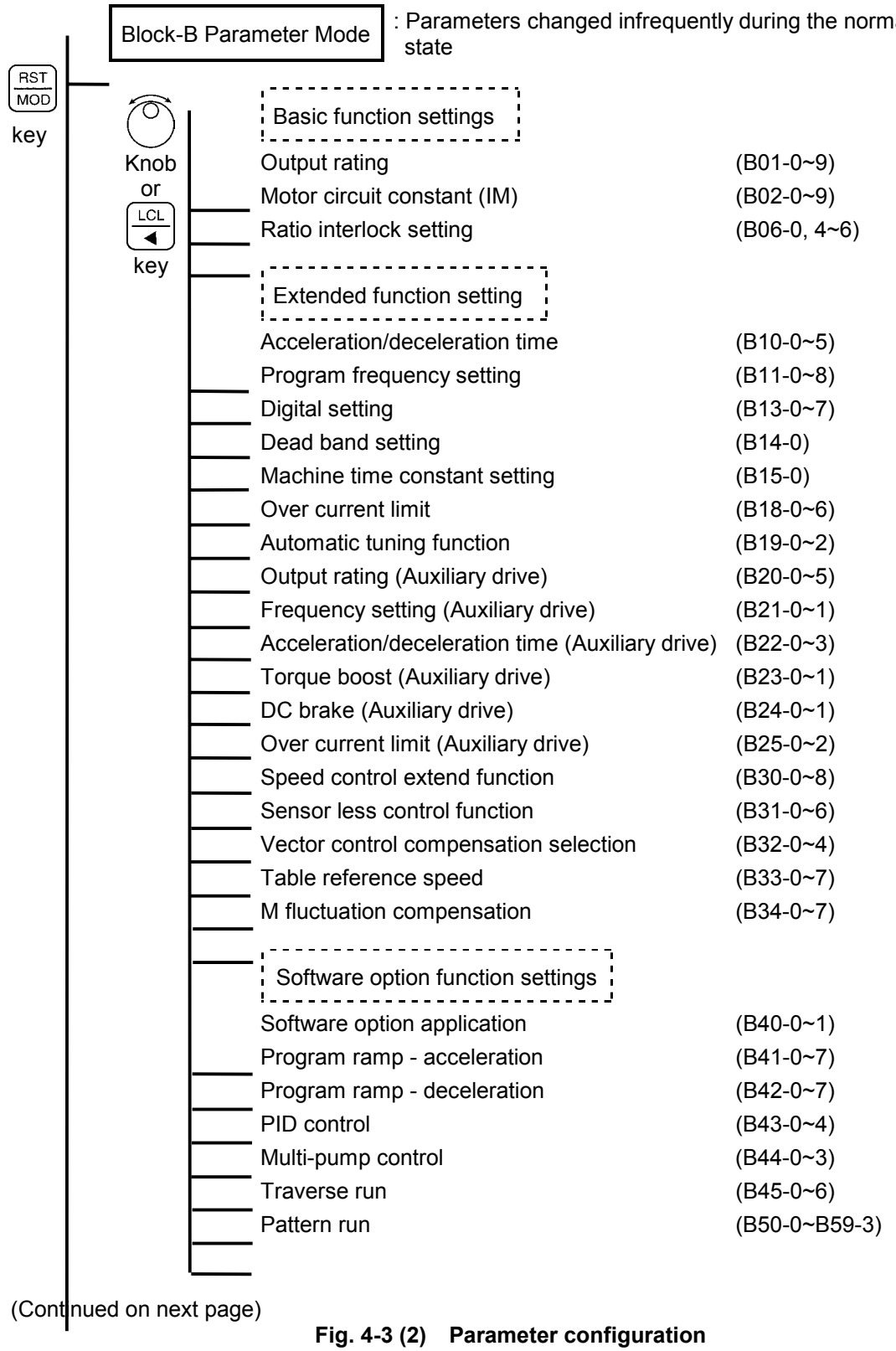

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Fig. 4-3 (2) Parameter configuration

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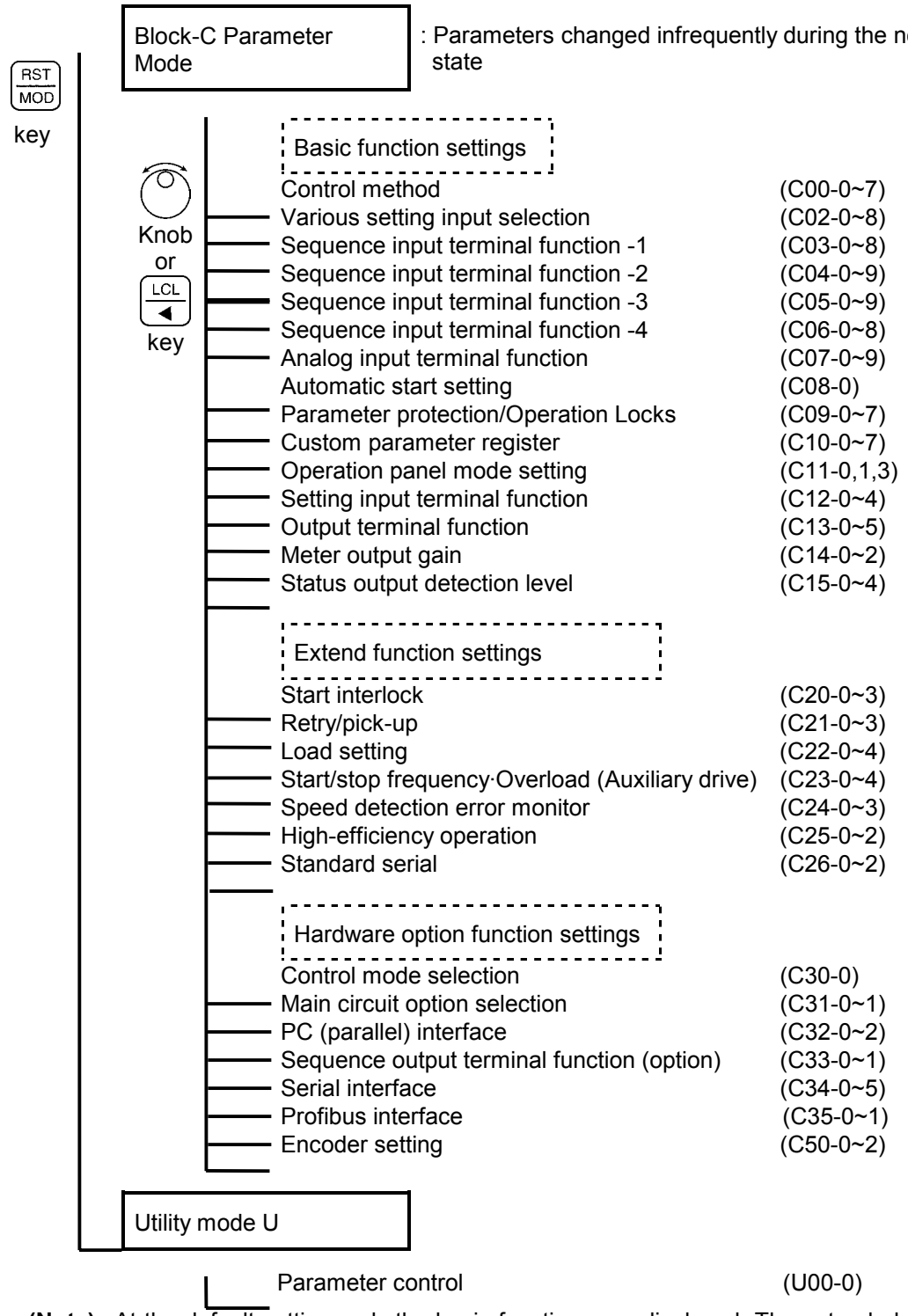

(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 3 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-3 (3) Parameter configuration

4-2-3 PM motor control mode

The configuration of the parameters is shown in Fig. 4-4.

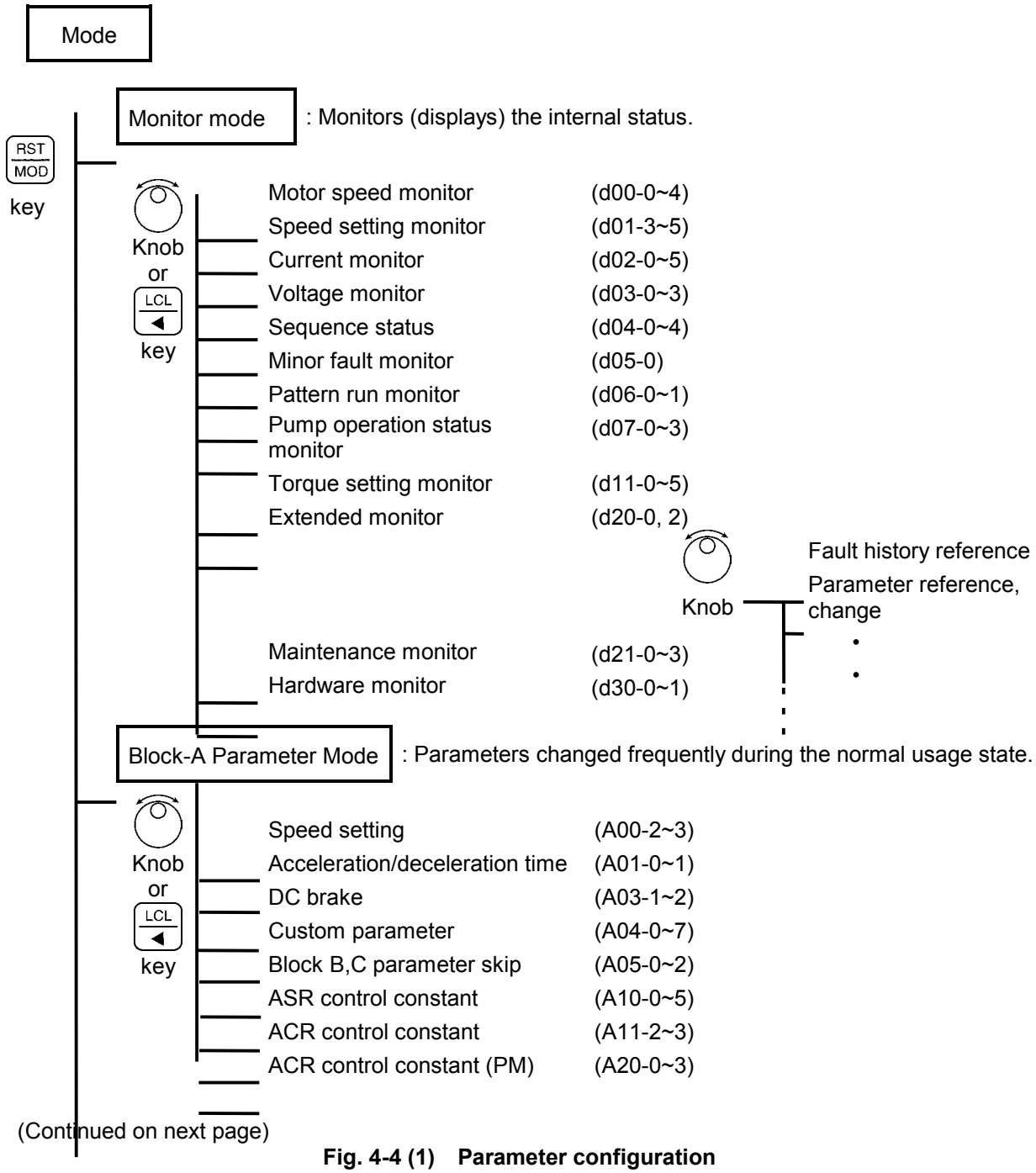

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Fig. 4-4 (1) Parameter configuration

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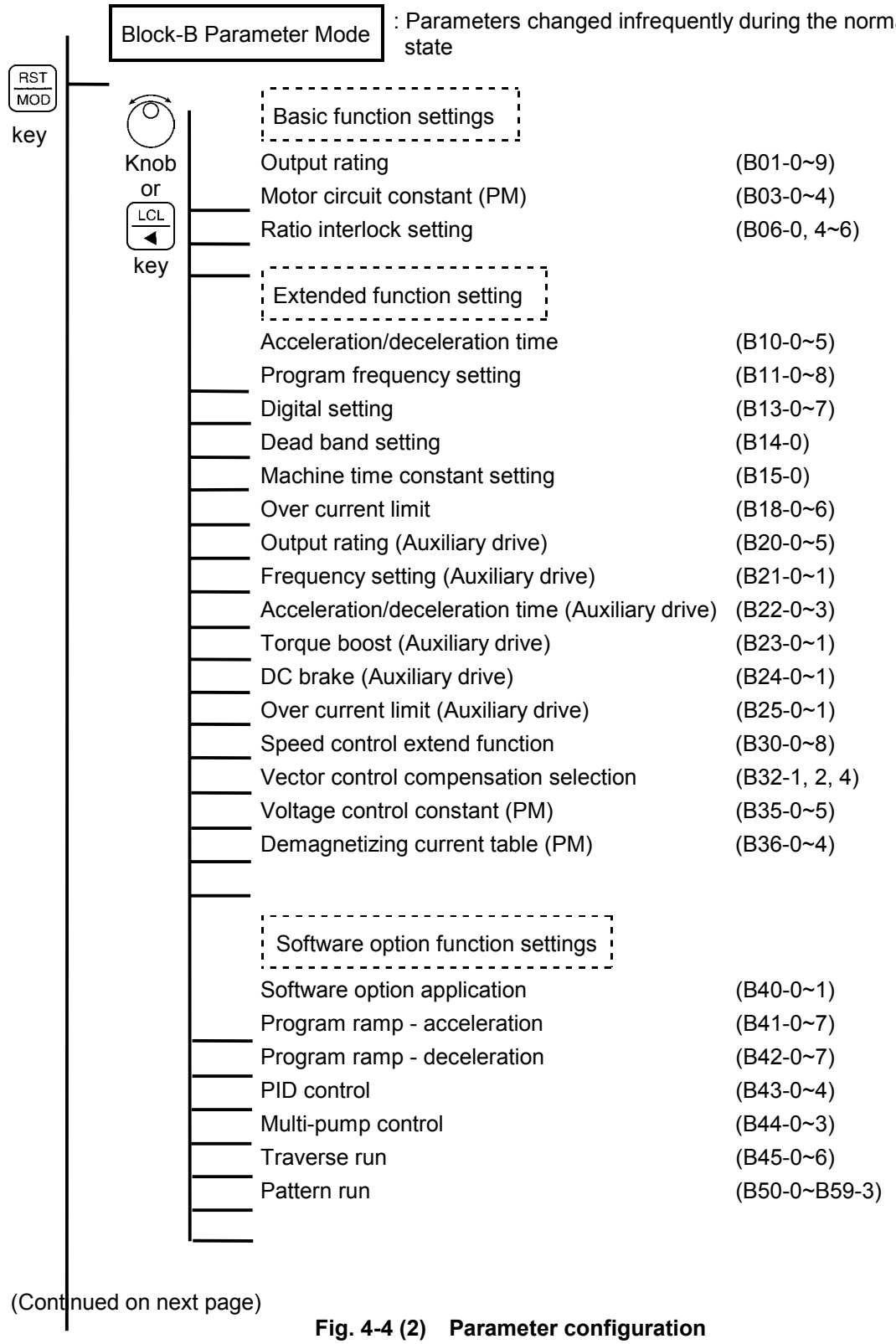

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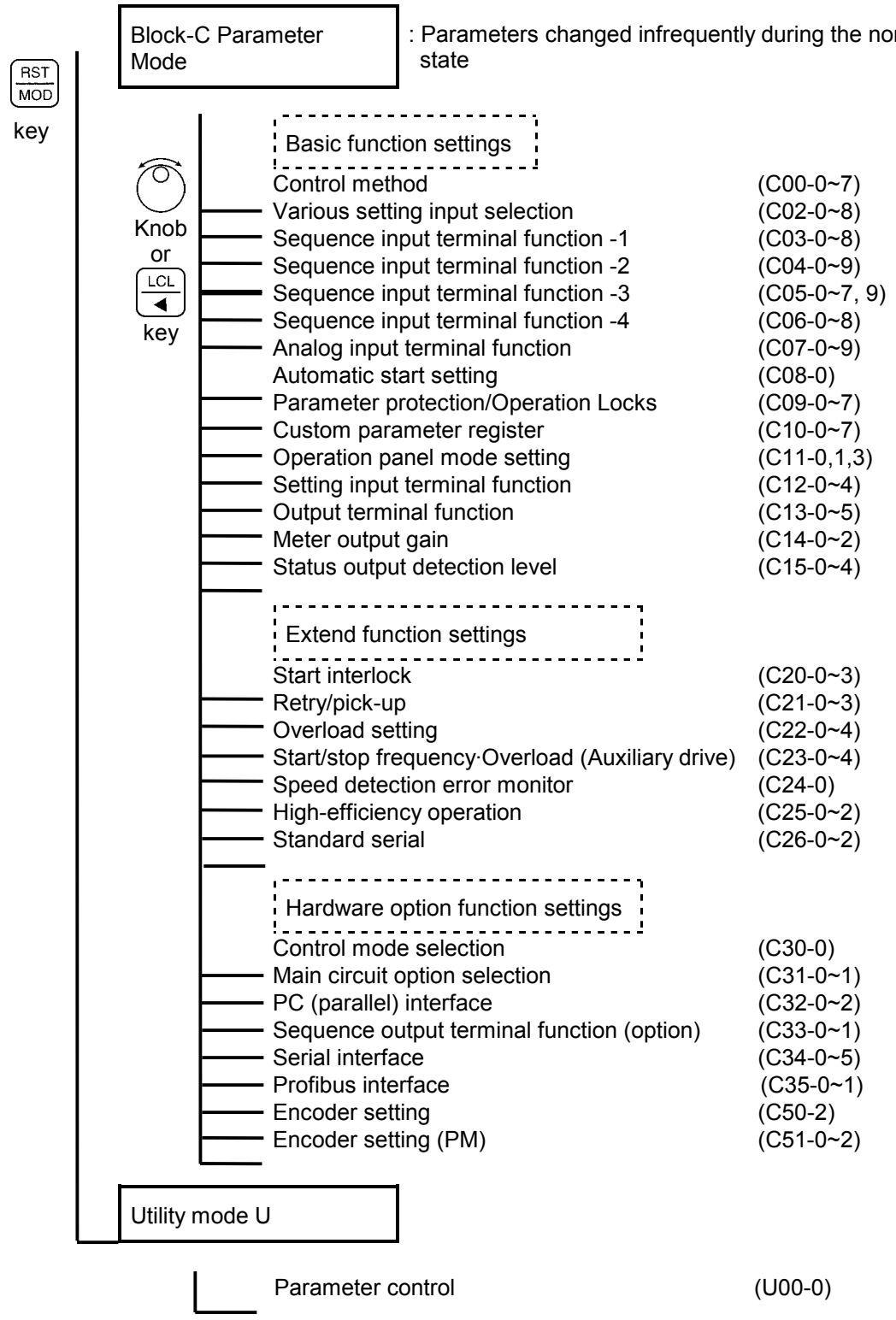
Fig. 4-4 (2) Parameter configuration

(Continued from previous page)



(Note) At the default setting, only the basic functions are displayed. The extended function, software option function, hardware option function parameters are skipped.
Thus, to change these parameters, change parameter A05-0 to 3 (parameter B, C block skip setting), so that the target parameters are displayed.

Fig. 4-4 (3) Parameter configuration

4-3 Changing modes

The modes on the operation panel will change between five modes each time when the RST/MOD key is pressed.
The monitor mode , d20-0,2 are the entries into the Extended Monitor Mode.

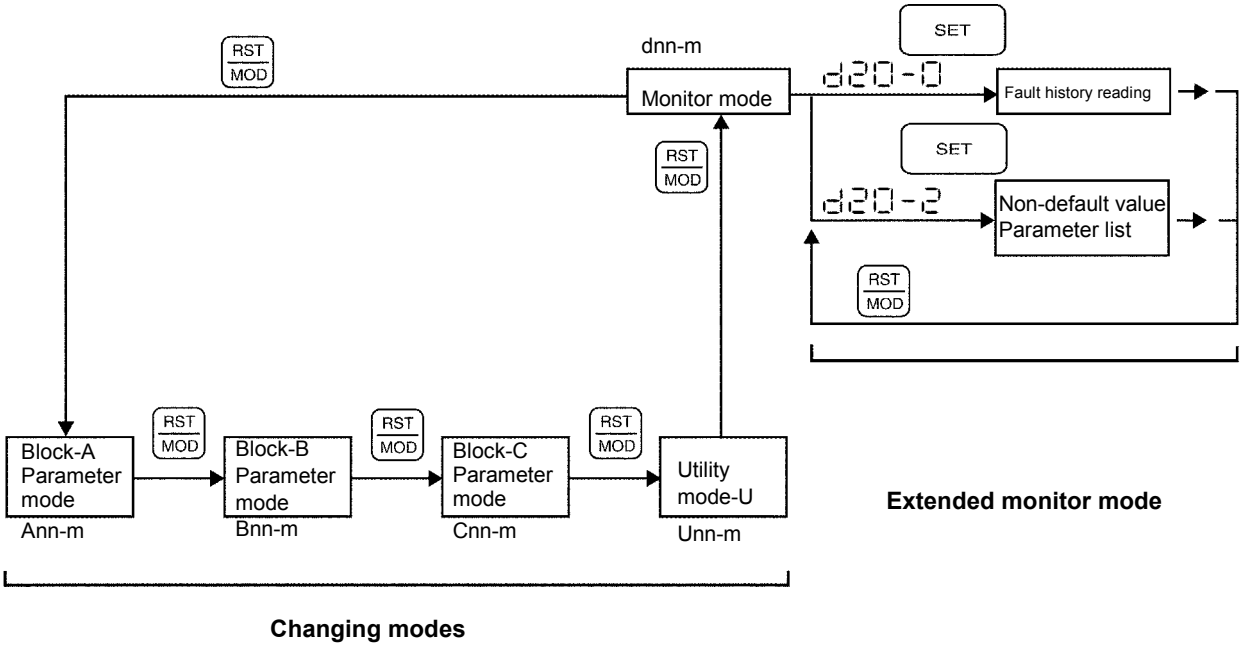


Fig. 4-5 Parameter mode changeover

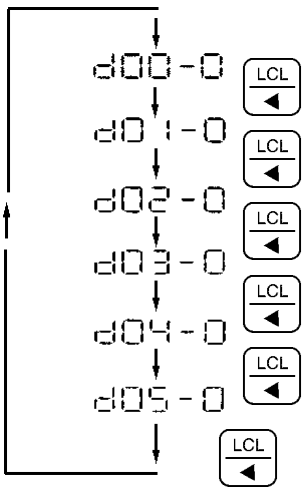
4-4 Reading parameters in monitor mode

1) Refer to Section 6.1 for the Parameters that can be read in Monitor Mode.
2) The case for the V/f control (constant torque) (C30-0=1) of control section (C30-0) is shown below.
3) The following is an example for reading the output current as a percentage and then showing the output frequency as Hz.

＜Keys＞	＜Display＞		＜Explanation＞
		●Hz	
(1)	60.00		d00-0 : Output frequency
(2) LCL	d01-0		Parameter block changes to d01 block.
(3) LCL	d02-0		Parameter block changes to d02 block.
(4)	d02-1		Parameter number increases.
	↓		
(5)	65.4	●%	After one second, the display will show the output current as a percentage.
(6)	d02-0		Parameter number decreases.
(7) LCL	d01-0		Parameter block number decreases.
(8) LCL	d00-0		Parameter block number decreases again.
	↓		
(9)	60.00	●Hz	After one second, the display will show the output frequency as Hz.

4) Press SET to show the Parameter Number on the display while monitoring.

5) Press LCL repeatedly to return to d00-0 from (5) as shown in the right sequence.



4-5 Reading and adjusting block-A & B & C parameters

1) Refer to Sections 6-2 to 6-5, for the details of the Block-A, B and C parameters.

2) The case for the V/f control (constant torque) (C30-0=1) of control section (C30-0) is shown below.

3) The following is an example for changing "maximum output frequency (Fmax) (b00 – 4)" in Block-B parameters, and then for changing "DC Breaking Time (A03 – 1)" in Block-A parameters.

＜Keys＞	＜Display＞	＜Explanation＞
Change the Parameter: B00-4 (maximum output frequency (Fmax) from 50.0 (default value) to 60.0		
	50.00 ●Hz	(In Monitor Mode)
(1) RST/MOD	A00-0	Changes to the Block-A Parameter setting Mode.
(2) RST/MOD	b00-0	Changes to the Block-B Parameter setting Mode.
(3)	b00-4	Increase the parameter No. from parameter B00-0 to B00-4.
	↓ ↑	
	50.0	The display will alternate between Parameter Number B00-4 and the present setting value 50.0.
(4) SET **(Note 2)**	50.0	Enable the value to be changed. The preset setting value will display.
(5) LCL/◀ 2 times	50.0	Press LCL/◀ two times to move the flicker to the digit that is to be changed. (**Note:** Parameter B00-4 cannot be changed while the inverter is running.)
(6)	60.0	Change the flicker digit from 5 to 6.
(7) SET	b00-4	Fix the data. Changing of Parameter B00-4 to 60.0 will be completed.
	↓ ↑	
	60.0	The display will alternate between the Parameter Number B00-4 and the present value. (Parameter Number Changing Mode.)

＜Keys＞	＜Display＞	＜Explanation＞
Change the parameter A03-1 (DC Breaking Time) from 2.0 (default value) to 3.5.		
	b00-4	(In Block-B Parameter Setting Mode)
(8) RST/MOD	C00-0	Changes to the Block-C Parameter Setting Mode.
(9) RST/MOD	U00-0	Changes to the Utility Mode. (For future use)
(10) RST/MOD	d00-0	Changes to the Monitor Mode.
(11) RST/MOD	A00-0	Changes to the Block-A Parameter Setting Mode.
(12) LCL/◀ 3 times **(Note 1)**	A03-1	Increase the Parameter Block Number from A00 to A03. Increase the Parameter Number.
	↓ ↑	
(13)	2.0	The display will alternate between Parameter Number A03-1 and the present value 2.0.
(14) SET **(Note 2)**	2.0	Enable the value to be changed. The preset setting value will display.
(15) LCL/◀	2.0	Press LCL/◀ once to move the flicker to the digit that is to be changed.
(16)	3.0	Change the flicker digit from 2 to 3.
(17) LCL/◀	3.0	Move the flickering digit to the digit to be changed
2 times		
(18)	3.5	Change the flicker digit from 0 to 5.
(19) SET	A03-1	Fix the data. Changing of parameter A03-1 to 3.5 will be completed.
	↓ ↑	
	3.5	The display will alternate between the Parameter Number A03-1 and the present value. (Parameter Number Changing Mode.)

(Note 1) When the Block Number is changed by LCL/◀, it will change to the next Block Number either up or down according to , turned immediately before.

(Note 2) If F-LIn (RUN) displays while the parameter is being set in (4) and (14), the parameter is one that can only be changed while the inverter is stopped. In this case, stop the motor first, and then press SET again.

4-6 Reading the changed parameters (Non-default value parameter list)

1) The Monitor Parameter d20-2 is the entry into the Block-A, B and C Non-Default Value Parameter Listing Mode.

2) In this Non-Default Value Parameter Listing Mode, the display will show the Block-A, B and C Parameters that have different values from their default values. These Parameter values can also be read and changed in this mode.

3) The case for the V/f control (constant torque) (C30-0=1) of control selection (C30-0) is shown below.

4) The following is an example for reading C14-0 (FM output gain) and changing its value.
Note that C14-0 is set to default value when the unit is shipped from the factory.

＜Keys＞	＜Display＞	＜Explanation＞
	b00-4	(In Block-B Parameter Setting Mode)
(1) RST/MOD	C00-0	Change to Block-C Parameter Setting Mode.
(2) RST/MOD	U00-0	Change to the Utility Mode (For future use)
(3) RST/MOD	d00-0	Change to the Monitor Mode.
(4) LCL/◀ 6 times	d20-2	Increase the Parameter Block Number from d00 to d20.
	↓	Increase the parameter number.
(5)	rLSt	Go to d20-2 (Non-Default Value Parameter List Mode Entry).
(6) SET	A03-1	After one second, [LST] will display. Enter the Non-Default Value Parameter List Mode.
	↓ ↑	
(7)	3.5	The display will alternate between the Parameter No. of the parameter (A03-1) changed first from the default value and the present setting value.
	b00-4	The next Non-default Value Parameter Number will display. If (7) is turned, the next Non-Default Value Parameter Number will increment or decrement and display.
	↓ ↑	
	60.0	
(8)	C 14-0	The Parameter C14-0 (FM Output Gain) will display.
	↓ ↑	
	1.03	
(9) SET	1.03	Select parameter C14-0. The setting value change state will be entered.

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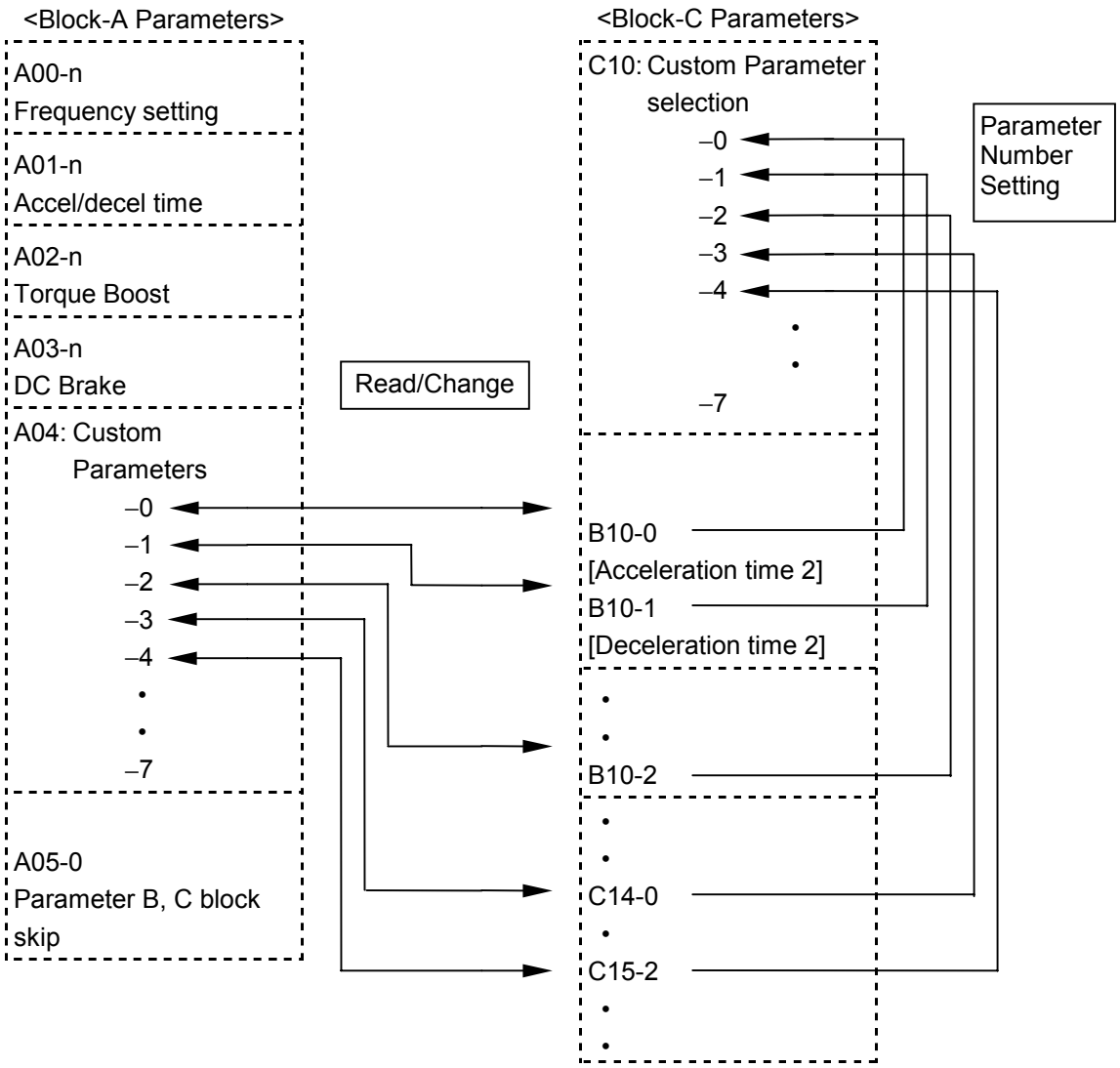
(10) 	0.98	Change the setting value from 1.03 to 0.99.
(11) SET	C 14-0 ↓ ↑ 0.99	This completes changing of the setting value.
(12) 	C 15-2 ↓ ↑	The next Non-Default Parameter Number will display.
(13) 	100.0 ↓ ↑	The display will alternate between d. CHG and d.END to indicate the end of the Non-Default Value Parameter List.
	d. CHG ↓ ↑ d. End	If LCL ◀ is pressed after this, the Non-Default Value Parameter List will display again from the first.
(14) RST MOD	d20-2 ↓	End the Non-Default Value Parameter List Mode. The Monitor Parameter Selection status will be entered. (After one second, [LST] will display.)
	rLSt	

4-7 Customizing block-B,C parameter

1) Block-B, C parameters can be assigned to any Block-A Parameter in the range of A04-0 to A04-7, and can be read and changed in the Block-A Parameter Setting Mode.

2) To use this function, set parameter No. to be displayed in A04-0 to 7 in parameter C10-0 to 7.

3) The case for the V/f control (constant torque) (C30-0=1) of control selection is shown below.



4) The following is an example for changing the value of a Custom Parameter.

<Keys>	<Display>	<Explanation>
Register parameter B10-0 on Parameter C10-0 (Custom Setting).		
(1) RST/MOD, LCL/◀	C 10-0 ↓ ↑ 1.99.9	(Mode and Parameter Number Change to C10-0) The display shows Parameter C10-0. The value 1.99.9 indicates that no Parameter has been registered on Parameter C10-0.
(2) SET	1.99.9	Select Parameter Number C10-0.
(3)	1.99.0	Set the sub-number of B10-0 to "0".
(4) LCL/◀	1.98.0	Each time LCL/◀ is pressed, the flickering digit will move to the digit to be changed.
(5)	1.10.0	Turn the knob key until the high-order digit reaches the block No. 10.
(6) SET	C 10-0 ↓ ↑ 1.10.0	Selection of the parameter No. C10-0 is completed. **Note)** For parameter C, set as 2.xx.x.
Change parameter B10-0 which has been assigned to A04-0.		
(7) RST/MOD 3 times	A03-1 A04-0	Enter the Block-A Parameter Setting Mode. The Custom Parameter Number A04-0 will display.
(8)	↓ ↑ 10.0	The display will alternate between Parameter Number A04-0 and the value of Parameter Number B10-0 (Acceleration cushion time 2). Parameter Number A04-0 is the same value as that of Parameter Number B10-0.
(9) SET	10.0	Parameter B10-0 can be changed now.
(10)	9.5	Change the value as required.
(11) SET	A04-0 ↓ ↑ 9.5	Store the new value.

Note 1) If the Parameters C10-n values are either 1.99.9 or any other undefined values, Parameters A04-n will be skipped during Parameter scan.

Note 2) If all the C10 Parameters are set at 1.99.9. all the A04 Parameter block will be skipped during Parameter scan.

4-8 Reading fault history

1) Parameter number d20-0 in the Monitor Mode is an entry into the Fault History Mode.
2) The following is an example in which the Fault History Mode is entered.

＜Keys＞	＜Display＞	＜Explanation＞
(1) LCL ◀ 6 times	60.00 ●Hz	(D00-0 will display in the Monitor Mode.)
	d20-0	Select Monitor Parameter D20-0.
	↓	
	rEHJ	The [ERR] symbol will display after one second.
		Select and enter the Fault History Mode.
(2) SET	E00	The fault history number Emm-n and the fault code will display alternately.
	↓ ↑	
	oC-2	Scan the contents of the fault buffer using the LCL ◀ key and knob.
(3) SET or RST MOD	d20-0	End the Fault History Mode and return to the Monitor Mode.
	↓	
	rEHJ	

3) The Fault History Buffer is configured as shown below.

Change of display	Fault sequence	Fault History number	Display (Example)	Explanation
	Fault 1 (the latest)	E00	oC-3	Latest Fault Codel
		E01	Pn-1	Secondary Fault Code
		E02	14.20 ●Hz	Output frequency at the Fault
LCL ◀		E03	4.7 ●A	Output current at the Fault
	Fault 2	E10	UC-2	No Secondary Fault
		E11	-----	
		E12	60.00 ●Hz	
LCL ◀		E13	2.9 ●A	
	Fault 3	E20	-----	Indicates that no Fault has been recorded.
		E21	-----	
		E22	-----	
LCL ◀		E23	-----	
	Fault 4	E30	-----	Indicates that no Fault has been recorded.
		E31	-----	
		E32	-----	
		E33	-----	

4) Set parameter C09-6 to 1 to clear the Fault History Buffer.
5) Refer to the Appendix 3 for details on the fault codes.

Chapter 5 Control Input/Output

5-1 Input/Output Terminal Function

The terminal block and input/output functions related to control are as shown in Tables 5-1.

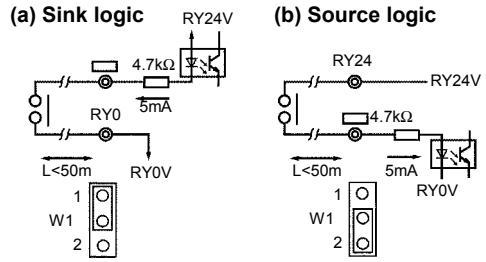
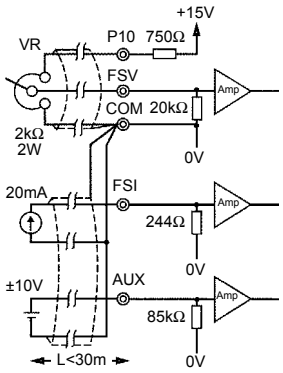
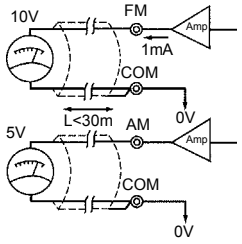
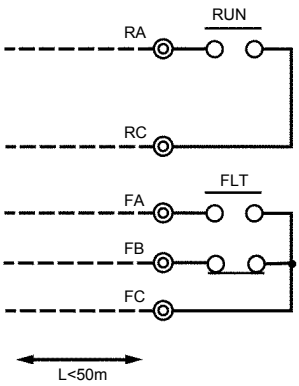
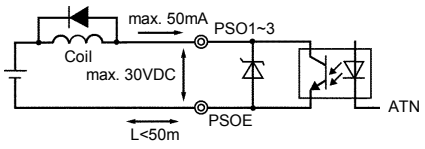
Table 5-1 Terminal block functions (TB1, TB2)

Symbol		Name	Features
Sequence input	RY0, RY24	Relay input common	This is a common terminal for relay input signals specified below. The sink/source logic can be changed with W1.
	PSI1~PSI5	Programmable input	These commands can be arbitrarily led to the input signal circuit in the control PCB through relay input selective setting (C03 to C06).
	EMS	Emergency stop	While the VT230S is stopped, all operational commands are inhibited. If it is ON during operation, the VT230S is led into a stopping sequence. As for stopping method, either ramp down stop or coast-to-stop is available. It is also possible to output this signal as a fault (FLT). (C00-4)
	RESET	Fault reset	A faulty condition is reset. With this signal, a fault status output (FLT LED, FAULT relay operation) is turned OFF and operation is made possible again.
	RUN	Forward run	This is a command for forward run. A command for run/reverse mode or a selfhold mode can be selected. This feature is available in the remote operation mode (LCL LED unlighted). (C00-0)
Analog input	FSV	Voltage/frequency setting	This is mainly used for setting the frequency (speed) input. A maximum frequency (speed) setting is available at a 10V input. This setting is valid when VFS of the internal relay signal is ON. (C04-1, C07-0=2, C12-0=1)
	FSI	Current/frequency setting	This is mainly used for setting the frequency (speed) input. A maximum frequency (speed) setting is available at a 20mA input. This setting is valid when IFS of the internal relay signal is ON. (C04-2, C07-1=3, C12-1=1)
	AUX	Auxiliary input	This is mainly used for setting the frequency (speed) input. A maximum frequency (speed) setting is available at a ±10V input. This setting is valid when AUX of the internal relay signal is ON. (C04-3, C07-2=4, C12-2=1)
	COM	Analog input common	This is a common terminal for FSV, FSI and AUX signals.
Analog output	FM	Frequency meter	This is a voltage output signal for a frequency meter. In a standard mode, a 10V output is available at the maximum frequency. This output voltage can be adjusted to 0.2 to 2.0 times 10V. (Max. output is, however, approximately 11 volts.) Internal parameters other than those of frequency can also be output. (C13-0, C14-0)
	AM	Ammeter	This is a voltage output signal for ammeter. In standard arrangements, an output of 5V is available for the rated current. This output voltage adjustment of 0.2 to 2.0 times of 5V is also available. Internal parameters other than those of current can also be output. (C13-1, C14-1)
	COM	Analog output common	This is a common terminal for a frequency meter and ammeter.
	P10	FSV source	This is a 10V source used when a frequency (speed) setter is connected to the FSV input circuit. The frequency (speed) setter to be used should be a variable resistor of 2W and 2kΩ.
Sequence output	RC, RA	RUN	This is a contact to be ON during operation or DC braking. Other internal signals can be output with the C13-2 setting.
	FC, FA, FB	Fault	These contacts function when a fault occurs (when the FLT lamp is lit). When a fault occurs, the section FA-FC is closed and the section FB-FC is open.
	PSO1	READY (1)	This is the open collector output that turns ON at READY. Other internal signals can be output with the C13-3 setting.
	PSO2	Current detection	This is the open collector output that turns ON when the output current reaches the setting. (C15-1) Other internal signals can be output with the C13-4 setting.
	PSO3	Frequency (speed) attainment	This is the open collector output that turns ON when the output frequency (speed) reaches the setting. (C15-0) Other internal signals can be output with the C13-5 setting.
	PSOE	Open collector output common	These are the common terminals for the PSO1, 2 and 3 signals.

5-2 Control Input/Output Circuit

Examples of the control input/output circuit wiring are shown in table 5-2. The precautions must be observed during wiring.

Table 5-2 Control input/output circuit

<table>
<tr><th>Function</th><th>Example of wirings</th><th>Precautions</th></tr>
<tr><td>Sequence input</td><td> 
</td><td>1. Wiring must not be longer than 50m.
2. The allowable leakage current is 0.5mA.
3. Use a minute current contact.
4. Do not connect to the analog input/output.
5. The sink/source logic can be changed with W1. (1: Sink 2: Source)</td></tr>
<tr><td>Analog input and P10 output</td><td> 
</td><td>1. Use 2kΩ/2W rating setter for the external variable resistor.
2. The maximum input rating of FSV is −0.0 to +10.5V.
3. Use a shielded wire shorter than 30m for the wiring.
4. For shield connections, open the mate side, and connect to COM terminal on the VT230S side.
5. The maximum input rating for FSI is 0 to +21mA or 0 to +5.25V.
6. Do not connect to the sequence input.</td></tr>
<tr><td>Analog output</td><td> 
</td><td>1. Use a 10V full scale meter (impedance: 10kΩ or higher).
2. The maximum output current is 1mA.
3. Use a shielded wire shorter than 30m for the wiring.
4. For shield connections, open the mate side, and connect to COM terminal on the VT230S side.</td></tr>
<tr><td>Sequence output (Relay output)</td><td> 
</td><td>1. Use within the rated range shown below. To comply with UL/CE, use at 30VAC/DC or less.
<table>
<tr><th></th><th>RUN</th><th>FLT</th></tr>
<tr><td>Rated capacity (resistance load)</td><td>250VAC 1A
30VDC 1A</td><td>125VAC 0.4A
30VDC 1A</td></tr>
<tr><td>Max. voltage</td><td>250VAC</td><td>250VAC
220VDC</td></tr>
<tr><td>Max. current</td><td>1A</td><td>1A</td></tr>
<tr><td>Switching capacity</td><td>100VA
100W</td><td>50VA
60W</td></tr>
</table>
2. The wire must be shorter than 50m.</td></tr>
<tr><td>Sequence output (Open collector output)</td><td> 
</td><td>1. To drive an L load, such as a coil, insert the fly wheel diode shown in the drawing.
2. Keep the wiring length to 50m or less.
3. Use within the following rating range. 30VDC, 50mA</td></tr>
</table>

5-3 Programmable sequence input function (PSI)

The sequence signal input contacts include the three types of data sent from the basic PCB terminal block, the operation panel and the serial communication. The reset signals (RESET) are all input at logical OR from the input point, and the emergency stop signal (EMS) is input at the logical OR of the terminal block and serial transmission data.
For the other sequence signals, the input point can be determined with the input point changeover command (COP) or system parameter settings (J1, J2) from the operation panel.

The standard sequence input of the basic PCB terminal block includes the three fixed function inputs of forward run, reset and emergency stop. There are also five programmable sequence inputs. For the programmable input, the function can be selected from Table 5-3 and randomly assigned. By connecting the relay interface option (type: V23-RY0), extension up to nine channels is possible. The programmable input terminals are PSI1 to PSI5. When extended, the terminals are PSI1 to PSI9. The default settings are as shown below.

Default settings

Symbol	Setting
PSI1	Reverse run
PSI2	Forward jogging
PSI3	Reverse jogging
PSI4	None
PSI5	None

The fixed input signal functions are given in Table 5-1, and the programmable input signal functions are given in Table 5-3.

The general control block diagram of the IM speed sensor-less vector control and the IM vector control with speed sensor is shown in Fig.5-1.

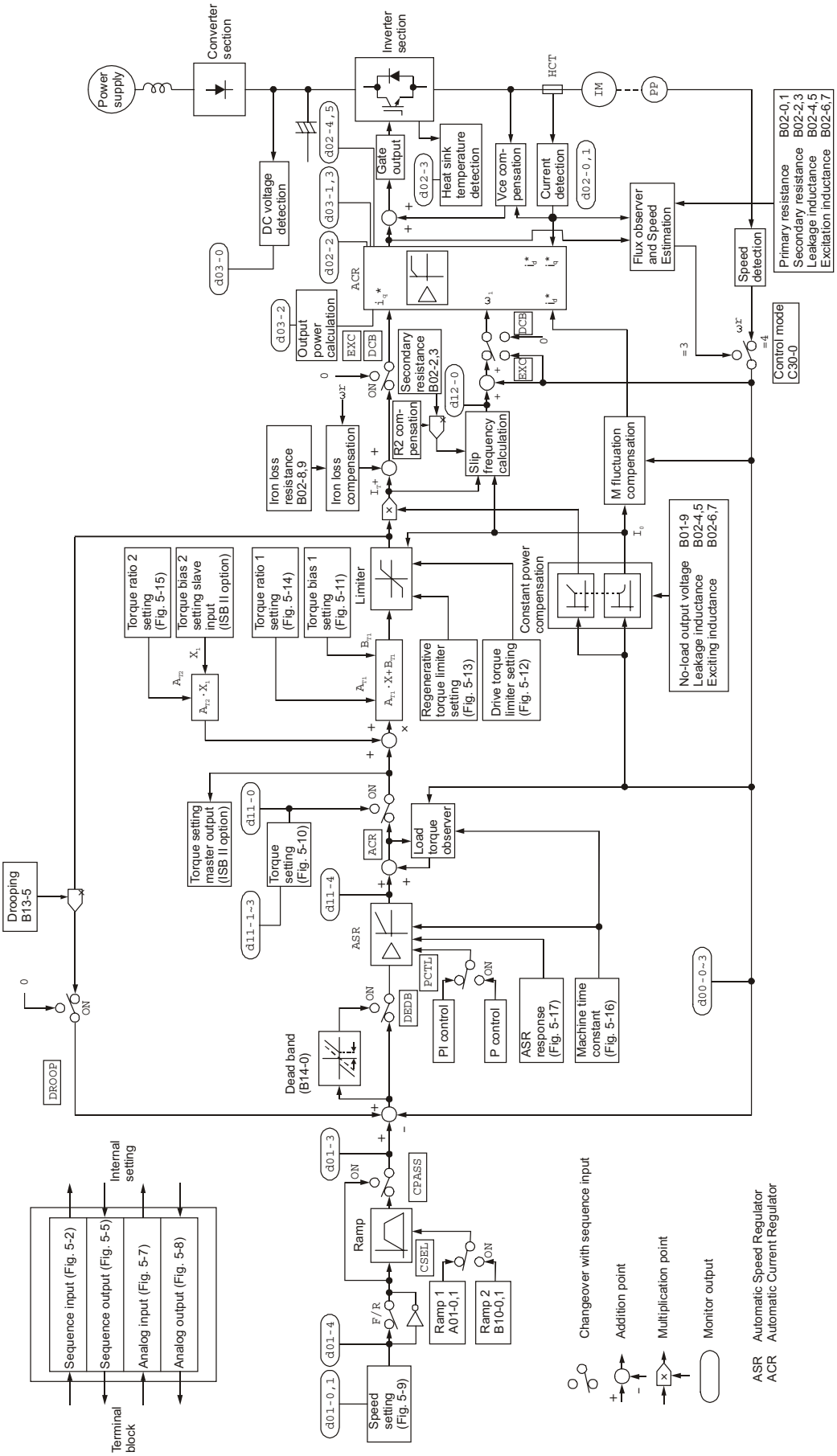


Fig. 5-1 Block diagram for IM vector control

Table 5-3 Programmable sequence input functions (1)

Connection of PSI1 to PSI9 is possible. Note that PSI6 to PSI9 are options.
The connection is done with data Nos.: C03 to C06

<table>
<tr><th>Symbol</th><th>Name</th><th colspan="2">Function</th></tr>
<tr><td>R RUN</td><td>Reverse run</td><td colspan="2">This is a command for reverse run. A command of reverse run mode (C00-0=2) is available in the run/reverse mode.</td></tr>
<tr><td>F JOG</td><td>Forward jogging</td><td colspan="2" rowspan="2">These are jogging commands. If this signal is ON while RUN is OFF, operation then conforms to the setting of jogging (A00-1 or 3) made within the control circuit. For stoppage, either ramp down stop or coast-stop is available.</td></tr>
<tr><td>R JOG</td><td>Reverse jogging</td></tr>
<tr><td>HOLD</td><td>Hold</td><td colspan="2">This is a stop signal generated when the setting is to be the self-hold mode during the operating mode. The VT230S stops with this signal turned off. Input of RUN or R RUN can be held with this signal turned on.</td></tr>
<tr><td>BRAKE</td><td>DC brake</td><td colspan="2">DC brake can be operated with this signal.
In the case of PM motor control, DC excitation takes place. Shaft torsion will occur according to the load torque.</td></tr>
<tr><td>COP</td><td>Serial transmission selection</td><td colspan="2">The settings and sequence commands from serial transmission are validated. By selecting the control changeover method (C00-6), the input point of the auxiliary operation sequence during COP ON can be selected.
<table><tr><th>COP</th><th>C00-6</th><th>Input point</th></tr><tr><td rowspan="2">ON</td><td>1</td><td>Terminal block input</td></tr><tr><td>2</td><td>Serial transmission input</td></tr></table>For resetting and emergency strop, the terminal block and serial transmission are both valid regardless of the C00-6 setting.</td></tr>
<tr><td>C SEL</td><td>Ramp selection</td><td colspan="2">Accel./decel. ramp performance is switched over. Accel./decel. time 2 (B10-0, 1) is available with ON, and accel./decel. time 1 (A01-0, 1 Note that B22-0,1 is used when the auxiliary drive is selected) is available with OFF.</td></tr>
<tr><td>I PASS</td><td>Ratio interlock bypass</td><td colspan="2">Ratio interlock operation is bypassed.</td></tr>
<tr><td>CPASS</td><td>Ramp bypass</td><td colspan="2">The ramp function is bypassed.</td></tr>
<tr><td>VFS</td><td>Speed setting 1</td><td>The frequency (speed) setting is carried out with the input selected with C07-0.</td><td rowspan="5">When inputs are entered simultaneously, setting is selected in accordance with following preference order.
JOG>CFS>PROG>AUX>IFS>VFS</td></tr>
<tr><td>IFS</td><td>Speed setting 2</td><td>The frequency (speed) setting is carried out with the input selected with C07-1.</td></tr>
<tr><td>AUX</td><td>Speed setting 3</td><td>The frequency (speed) setting is carried out with the input selected with C07-2.</td></tr>
<tr><td>PROG</td><td>Program function enable</td><td>Used for multiple setting. Selection of 8 steps (PROG0~PROG7) is made with S0~S3, SE.</td></tr>
<tr><td>CFS</td><td>Serial communication setting select</td><td>The setting from the serial communication option is selected.</td></tr>
<tr><td>S0 to S3
SE</td><td>Program setting selection</td><td colspan="2">When PROG is ON, the program frequency (speed) 0~7 are selected (B11-0~7). The BCD/Direct input mode can be selected with B11-8.</td></tr>
<tr><td>FUP</td><td>Frequency (speed) increase</td><td colspan="2" rowspan="2">The currently selected direct frequency (speed) setting (A00-0, A00-2) or program frequency (speed) setting 0 to 7 (B11-0~7) is increased or decreased.
When the ON state continues, the frequency is incremented/decremented with the currently valid ramp rate.</td></tr>
<tr><td>FDW</td><td>Frequency (speed) decrease</td></tr>
</table>

Table 5-3 Programmable sequence input functions (2)

Symbol	Name	Function
BUP	Ratio interlock bias increase	When IVLM is ON and the BUP, BDW ON state continues, the sequential ratio bias will increase/decrease at the currently valid ramp rate. When IVLM turns OFF, the bias increase/decrease value will be cleared to zero. The BUP, BDW operation will be invalidated.
BDW	Ratio interlock bias decrease	
IVLM	Ratio interlock bias increase/ decrease selection	
AUXDV	Auxiliary drive selection	The auxiliary drive setting is validated with this signal. This operation is valid during the inverter stopping.
PICK	Pick-up	While this signal is ON, pick-up operation is effected as soon as RUN or R RUN is ON.
EXC	Pre-excitation	Pre-excitation operation takes place. Pre-excitation operation refers to establishing only the flux in the motor without generating toque. If torque is required immediately from the start of operation, use pre-excitation operation beforehand to establish the flux in the motor.
ACR	ACR	ACR operation is selected.
PCTL	P Control	ASR control is changed from the PI control to the P control.
LIM1	Drive torque limiter changeover	The drive torque limiter reduction setting by the analog input or serial transmission is validated.
LIM2	Regenerative torque limiter changeover	The regenerative torque limiter reduction setting by the analog input or serial transmission is validated.
MCH	Machine time constant changeover	During ASR operation, ASR gain is changed over. Machine time constant 2 (B15-0) is available with ON, and machine time constant 1 (A10-1) is available with OFF.
RF0	0 setting	The speed setting is changed to 0rpm.
DROOP	Drooping changeover	Drooping function is validated. (B13-5)
DEDB	Dead band setting	The dead band setting of ASR is validated. (B14-0)
TRQB1	Torque bias setting 1	The torque bias input 1 is valid.
TRQB2	Torque bias setting 2	The torque bias input 2 is valid.
PIDEN	PID control selection	The PID control is validated.

(Note) ASR: Automatic Speed Regulator
ACR: Automatic Current Regulator

5-4 Programmable sequence output function (PSO)

As a standard, the sequence outputs include five channels (1C contact output: one channel, 1a contact output: one channel, open collector output: three channels). Of the five channels, one channel is fixed to the fault output, but the other channels can be set to arbitrarily output the signals given in Table 5-4. By connecting the relay or PC interface option (type: V23-RY0, V23-PI0), extension up to seven channels is possible. The programmable output terminals are RA-RC, PSO1, PSO2 and PSO3 as standard. When extended, the terminals are RA-RC and PSO1 PSO5. The default values are as shown on the right.

Default values

Terminal symbol	Setting
FA-FB-FC	Fault: Fixed
RA-RC	Run
PSO1-PSOE	Ready (1)
PSO2-PSOE	Current detection
PSO3-PSOE	Frequency (speed) attainment

The functions of the programmable output signals are given in Table 5-4.

Table 5-4 Programmable sequence output functions

Symbol	Name	Function
RUN	Run	This turns ON during running, jogging or DC braking. Turning ON or OFF during pre-excitation can be selected. C00-7: 1 – RUN output: ON during pre-excitation; 2 – RUN output: OFF during pre-excitation
FLT	Fault	This turns ON during a fault.
MC	Charge completed	This turns ON when the DC main circuit voltage reaches a voltage higher than the MC ON level.
RDY1	Ready (1)	This turns ON when there is no fault, EMS is not activated, and pre-charging is completed.
RDY2	Ready (2)	This turns ON when there is no fault and pre-charging is completed.
LCL	Local	This turns ON when the operation mode is local (operation from the operation panel).
REV	Reverse run	V/f: This turns ON while the output frequency is reverse running. VEC, PM: This turns ON while the motor is reverse running.
IDET	Current detection	This turns ON when the output current reaches the detection level (C15-1) or higher.
ATN	Frequency (speed) attainment	This turns ON when the output frequency (speed) reaches the set frequency (speed). The detection reach width is set with C15-0.
SPD1	Speed detection (1)	This turns ON when the output frequency (speed) absolute value reaches a speed higher than the speed set with the detection level (C15-2).
SPD2	Speed detection (2)	This turns ON when the absolute motor speed reaches a speed higher than that set in the detection level (C15-3).
COP	Transmission selection	This turns ON when serial transmission operation is selected.
EC0~EC3	Fault code 0 to F	This outputs the fault details with a 4-bit binary code. EC0 is the low-significant bit, and EC3 is the most significant bit. Refer to Appendix 3 for details on the fault codes.
ACC	Acceleration	This turns ON during acceleration.
DCC	Deceleration	This turns ON during deceleration.
AUXDV	Auxiliary drive selection	This turns ON when the auxiliary drive parameter setting is validated by the sequence input AUXDV.
ALM	Minor fault	This turns ON during a minor fault.
FAN	Fan control	This turns ON during running, jogging, pre-excitation and DC braking. A three minute off delay is provided, so even if the above operations turn OFF, this control will not turn OFF for three minutes. This is used for external fan control.
ASW	Automatic start wait	When C08-0 is selected and the automatic start function is used, this will turn ON while waiting for automatic start.
ZSP	Zero speed	This turns ON when the output frequency (speed) absolute value is below the level set with zero speed (C15-4).
LL MT	PID lower limit output	This turns ON when the feedback value exceeds the lower limit value (<B43-4) during PID control.
ULMT	PID upper limit output	This turns ON when the feedback exceeds the upper limit value (>B43-3) during PID control.

(Note) "ON" indicates that the contact is closed.

5-5 Sequence input logic

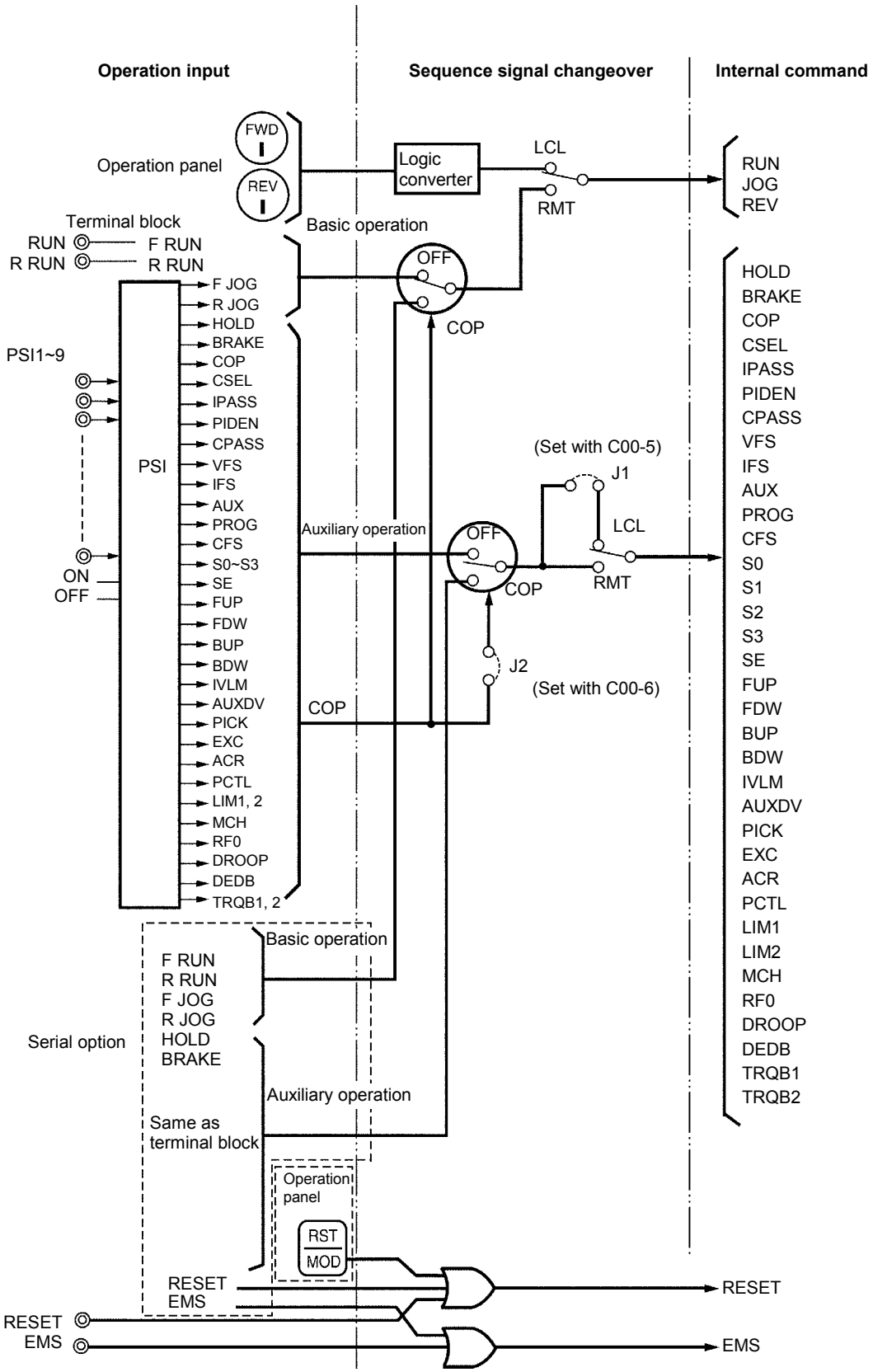


Fig. 5-2 Sequence input logic

5-6 Changing of terminal functions

The programmable input terminals (PSI1 to PSI9) can be connected to arbitrarily internal commands. The internal state can be connected to the programmable output terminal (RA-RC and PSO1 to PSO5) to lead in the ON/OFF signals.

5-6-1 Sequence input terminal assignment and monitoring

The parameters can be assigned to the terminal block as shown in Fig. 5-3 according to the parameter Nos. C03 to C06. Each internal signal can be fixed to ON (set value to 16) or OFF (set value to 0). Fig. 5-4 shows the case when the ON state of each internal signal is shown on the d04 monitor. This monitoring is performed with D04-0 to 2. RUN, R RUN, F JOG and R JOG are displayed with a combination of RUN, REV and JOG converted into an internal command.

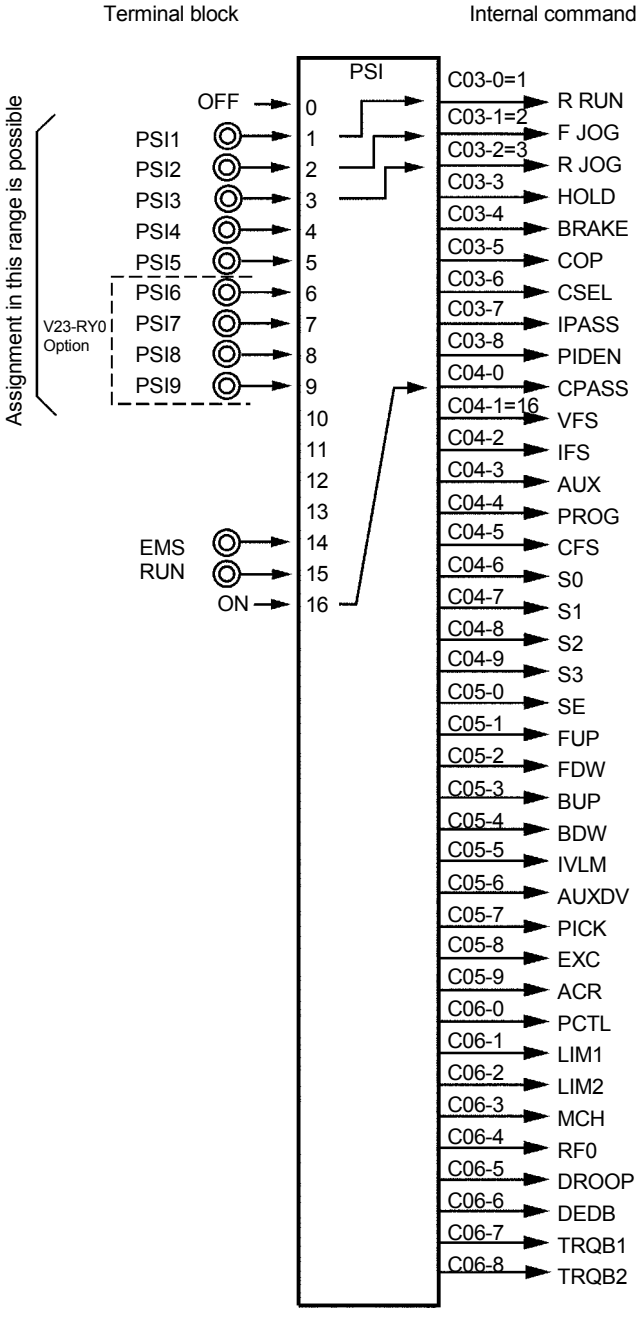


Fig. 5-3 Assignment of sequence input

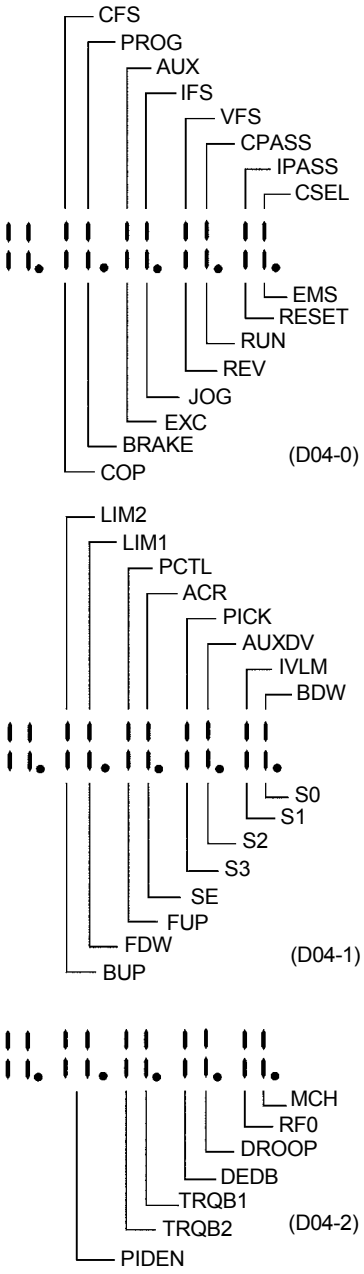


Fig. 5-4 Sequence input monitor

5-6-2 Sequence output terminal assignment and monitoring

The ON/OFF of the internal signals can be output to the RA-RC and PSO1 to 5-PSO terminals as shown in Fig. 5-5 with the parameter Nos. C13-2 to 5 and C33-0 to 1. The ON/OFF of each signal can be monitored as shown in Fig. 5-6. This monitoring is executed with D04-3, 4.

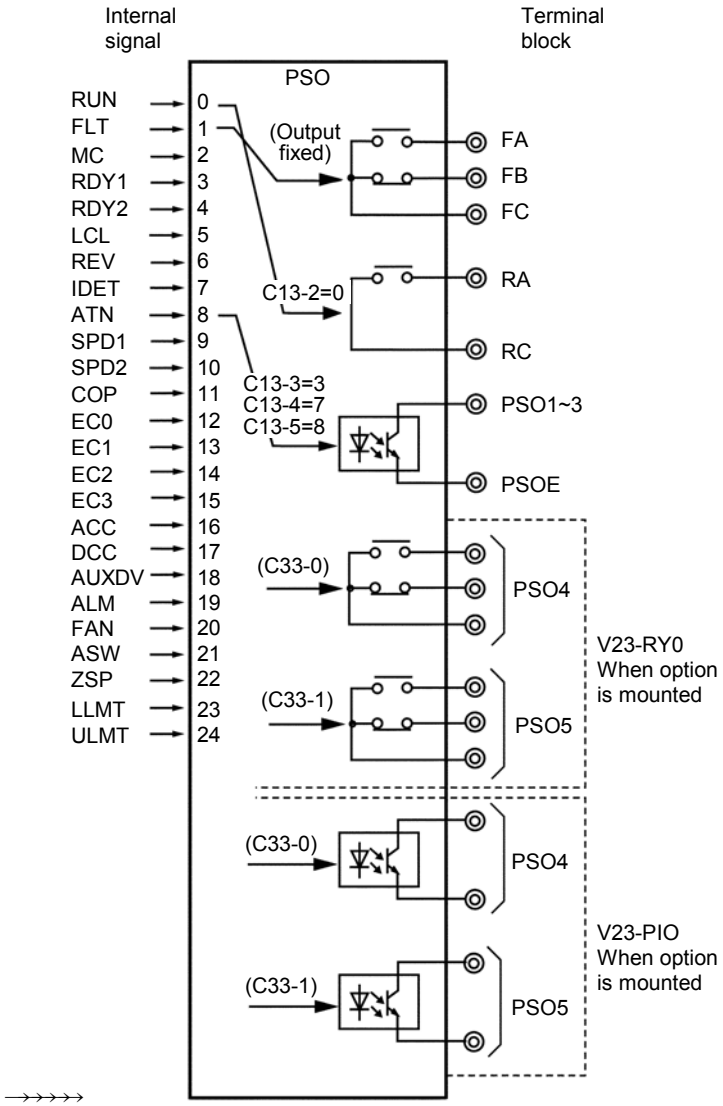


Fig. 5-5 Assignment of sequence output

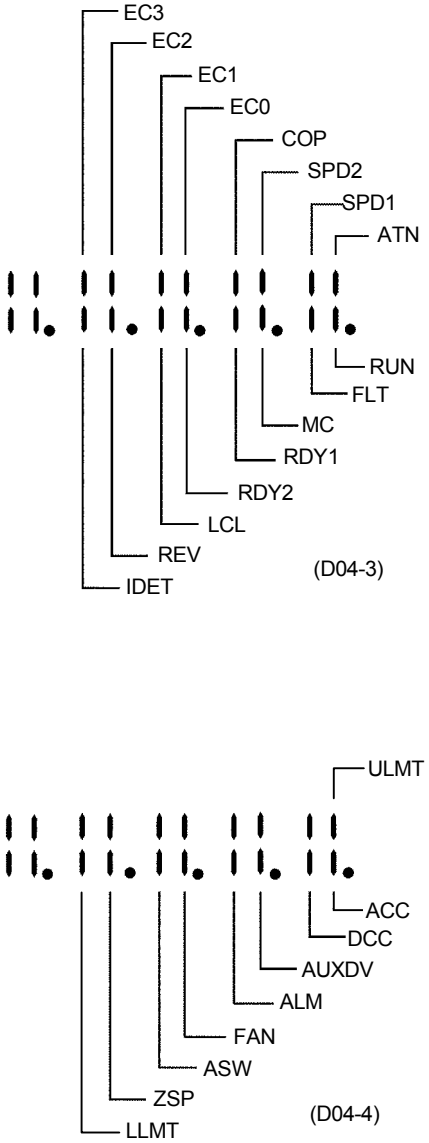


Fig. 5-6 Sequence output monitor

5-7 Programmable analog input function (PAI)

5-7-1 Types of analog inputs

As a standard, there are three channels for the analog input. Each analog input can be connected to the internal setting signals shown in Table 5-5 by using the programmable input function.

Table 5-5 Types of internal setting signals assigned to analog input

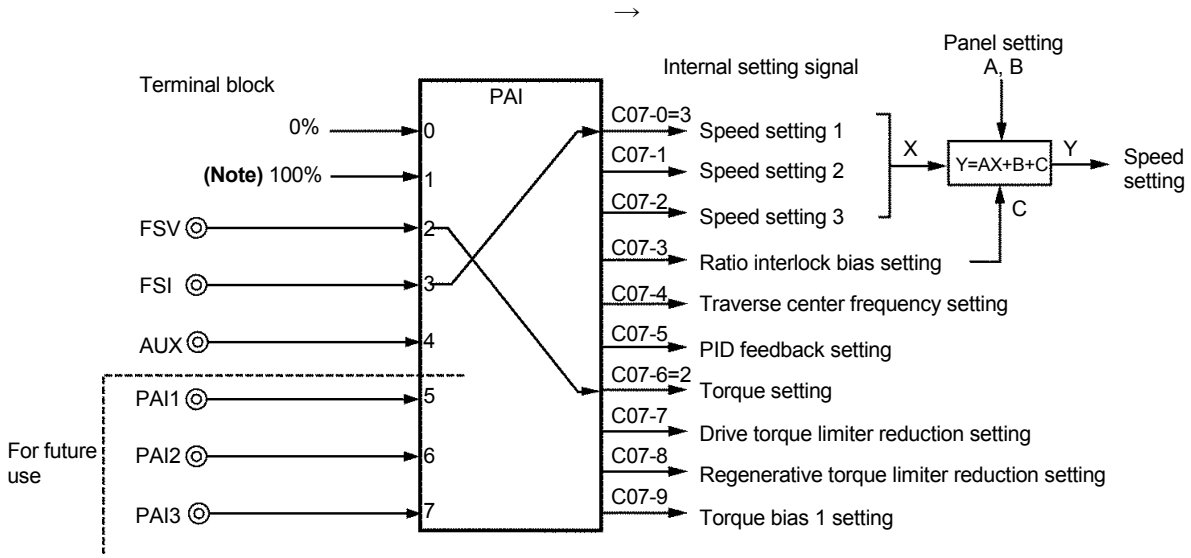
Signal name	Setting range (Note 1)			Function
	FSV	FSI	AUX	
	0~10V 0~5V 1~5V	4~20mA 0~20mA	−10~10V −5~5V	
			1~5V	
Speed setting 1 Speed setting 2 Speed setting 3	0~100%		−100~100%	This is the speed setting. The + polarity is the forward run setting, and the – polarity is the reverse run setting. If the analog input is selected with the speed setting, the speed setting can be changed between 1, 2 and 3 with the sequence input (VFS, IFS, AUX).
			0~100%	
Ratio interlock bias setting	0~100%		−100~100%	This is the bias setting for the sequential ratio operation.
			0~100%	
Traverse center frequency setting	0~100%		(0~10V / 0~5V) 0~100% **(Note 2)**	This is the center frequency setting for traverse operation.
			0~100%	
PID feedback	0~100%		(0~10V / 0~5V) 0~100% **(Note 2)**	This can be used as the feedback input to configure a feedback loop. Do not use the programmable analog output (FM, AM) as the PID feedback signal.
			0~100%	
Torque setting	0~300%		−300~300%	This is the torque setting for ACR operation. The + polarity is the forward run direction torque, and the – polarity is the reverse run direction torque. The torque setting can be limited by using the torque limiter (A11-2, 3).
			0~300%	
Drive torque limiter reduction setting	0~100%		(0~10V / 0~5V) 0~100% **(Note 2)**	The drive torque limit (A10-3 or A11-2) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.
			0~100%	
Regenerative torque limiter reduction setting	0~100%		(0~10V / 0~5V) 0~100% **(Note 2)**	The regenerative torque limit (A10-4 or A11-3) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.
			0~100%	
Torque bias 1 setting	0~300%		−300~300% 0~300%	This is added to ASR output during ASR operation, or to the torque setting during ACR operation. This function is valid when the torque bias (TRQB1) is turned ON with the sequence function.
			0~300%	

(Note 1) Select each analog input mode with C12-0 to 2.

(Note 2) AUX: The setting is limited to 0% during the −10 to 0V and −5 to 0V input.

5-7-2 Setting the analog input

The analog input can be assigned to the random internal setting signals given in Table 5-5 by setting parameter C07-0 to 9 as shown in Fig. 5-7.
The setting is completed by setting the data corresponding to the analog input (FSV, FSI, AUX) in C07-0 to 9. Set "0" for the internal setting signals that are not to be used.



(Note) The torque setting is 300% when C07-6 is 1.

Fig. 5-7 Analog input assignment

The sequential ratio operation can be carried out in respect to speed settings 1 to 3. (Refer to 6-6, B06.)

5-8 Programmable analog output function (PAO)

5-8-1 Types of analog outputs

As a standard, there are 2 channels for the analog output (10-bit). As shown in Fig. 5-8, internal data can be assigned to the FM and AM terminals.
The default setting is shown below.

Default settings

Terminal symbol	Setting
FM	Output frequency
AM	Output current (Motor)

5-8-2 Setting the analog output

A following internal data can be output to FM, AM terminals with parameters C13-0 and 1 as shown in Fig. 5-8. The setting is completed by setting the output data number in C13-0 and 1.
If the gain needs to be adjusted, use C14-0, 1, C40.

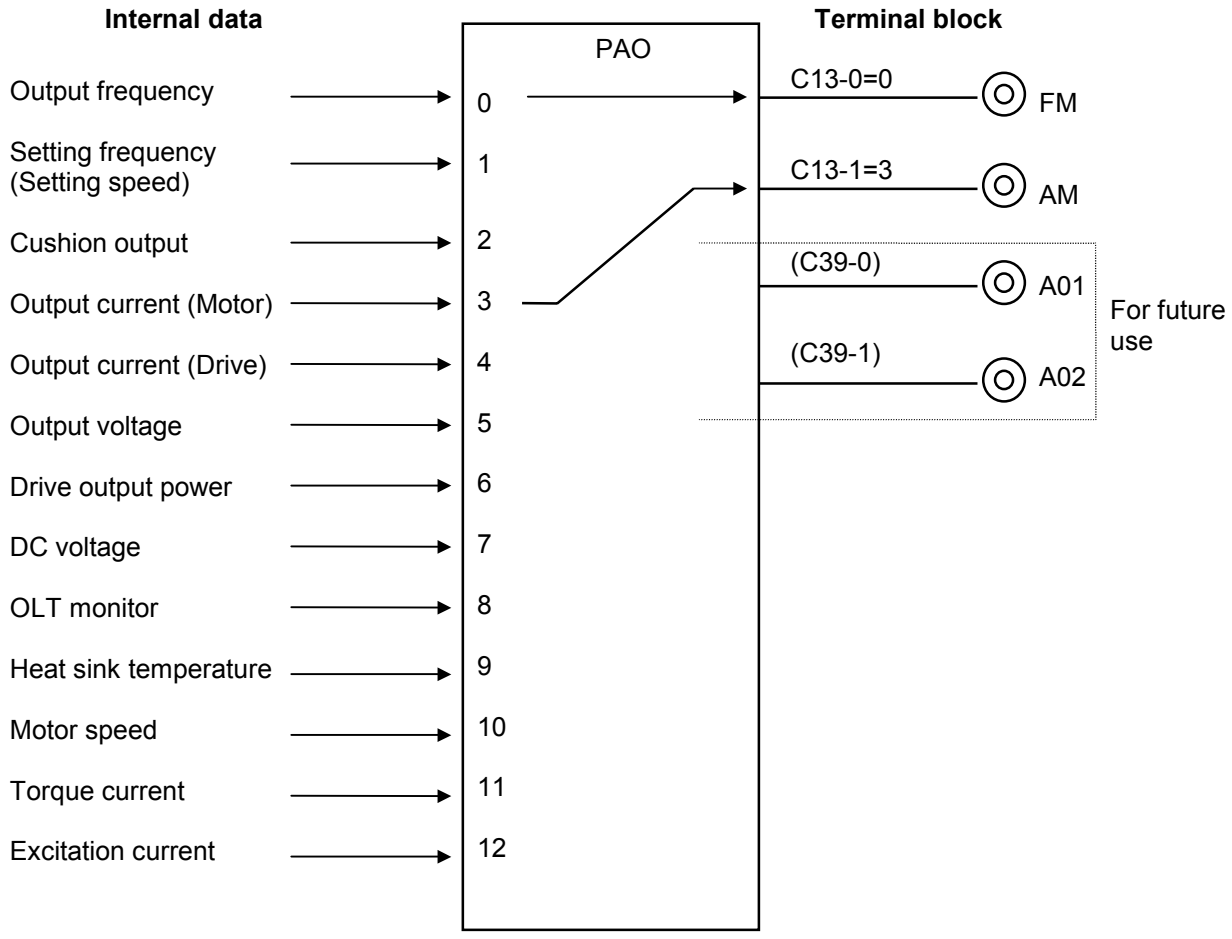


Fig. 5-8 Analog output assignment

5-9 Selecting the setting data

5-9-1 Speed setting

(1) Speed setting selection

The nine types of speed setting inputs shown below can be used.
One of the nine types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog speed setting 1 Analog speed setting 2 Analog speed setting 3	This is a setting value issued with an analog input.
Serial	Serial speed setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Serial interface option (Type: V23-SL0 required) • PROFIBUS interface option (Type: V23-SL6 required) • Standard serial transmission (using operation panel connector)
Parallel	Parallel speed setting	This is a setting value issued from the host sequencer with parallel transmission. A PC interface option (type: V23-PI0) is required.
Panel	Panel speed setting	This is the setting value issued from the parameter (A00-0, 2).
	Panel jogging setting	This is a setting value issued from the parameter (A00-1, 3).
	Traverse pattern operation	This is the traverse pattern operation setting value with parameter (B45-0 to 6).
	Pattern operation	This is the pattern operation setting value with parameter (B50-0 to B59-3).

(2) Speed setting selection sequence

The relation of the speed setting and changeover sequence is as shown below.
Refer to Section 6-5 B06 (Ratio interlock setting) for details.

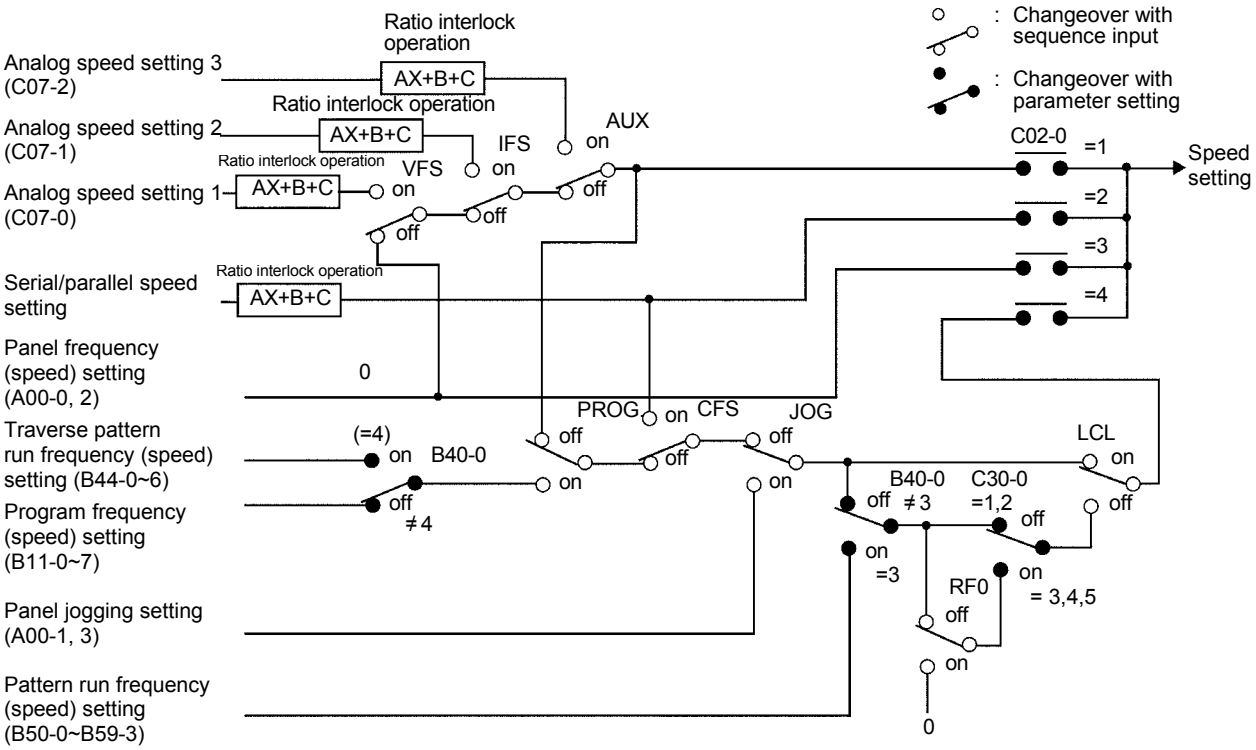


Fig. 5-9 Speed setting selection

5-9-2 Torque setting

(1) Torque setting selection

The following three types of torque setting inputs can be used.
One of the three types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog torque setting	This is a setting value issued from the analog input.
Serial	Serial torque setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Serial interface option (Type: V23-SL0 required) • PROFIBUS interface option (Type: V23-SL6 required) • Standard serial transmission (using operation panel connector)
Panel	Panel torque setting	This is a setting value issued from the parameter (B13-0).

(2) Torque setting selection sequence

The relation of the torque setting and changeover sequence is as shown below.

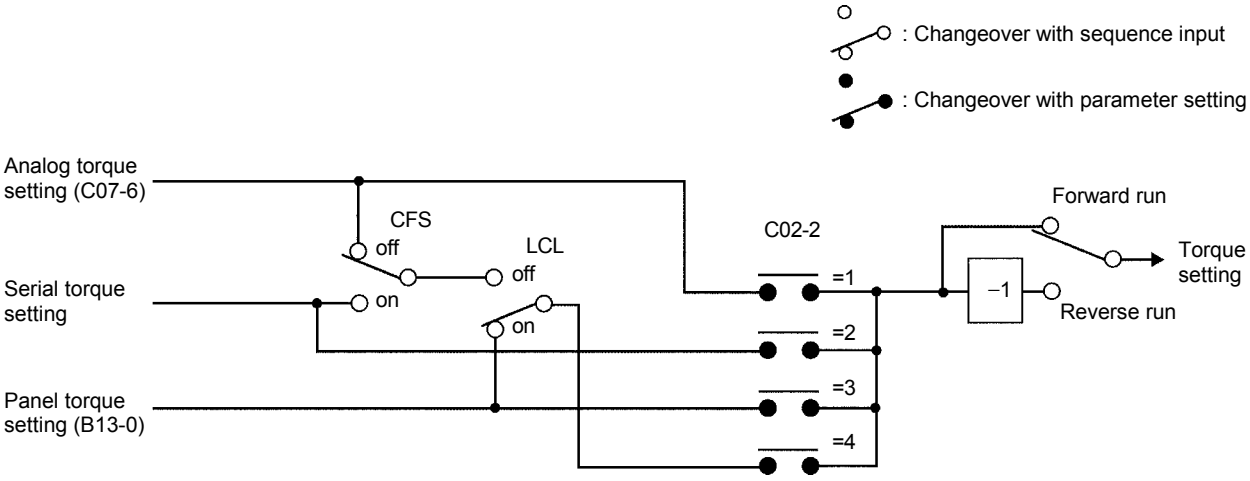


Fig. 5-10 Torque setting selection

5-9-3 Torque bias 1 setting

(1) Torque bias 1 setting selection

The following three types of torque bias 1 setting inputs can be used.
One of the three types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog torque bias 1 setting	This is a setting value issued from the analog input.
Serial	Serial torque bias 1 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Serial interface option (Type: V23-SL0 required) • PROFIBUS interface option (Type: V23-SL6 required) • Standard serial transmission (using operation panel connector)
Panel	Panel torque bias 1 setting	This is a setting value issued from the parameter (B13-2).

(2) Torque bias 1 setting selection sequence

The relation of the torque bias 1 setting and changeover sequence is as shown below.

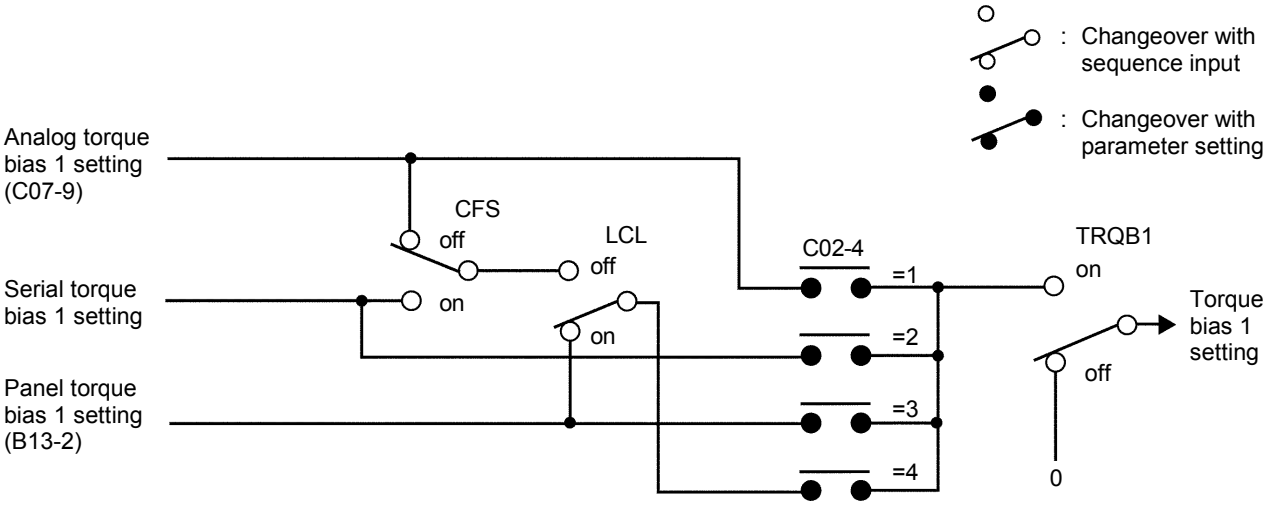


Fig. 5-11 Torque bias 1 setting selection

5-9-4 Torque limiter setting

(1) Torque limiter reduction setting selection

The torque limiter can be set independently for the drive side and regeneration side in the ASR mode and ACR mode. The setting parameters are as shown below. If the emergency stop sequence is valid, the regeneration side limiter value will become the emergency stop limiter value.

A10-3 : ASR drive torque limiter setting
A10-4 : ASR regenerative torque limiter setting
A10-5 : Emergency stop regenerative torque limiter setting
A11-2 : ACR drive torque limiter setting
A11-3 : ACR regenerative torque limiter setting

For each limiter input, the limiter value can be reduced by external or internal settings. The final limiter value is the results of multiplying the above panel setting values with the reduction ratio.

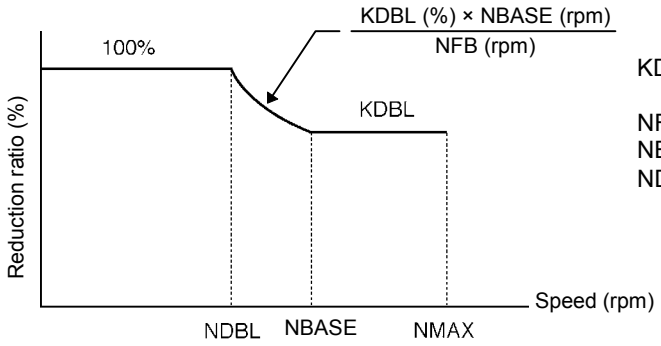
(1-1) External reduction setting

The limiter reduction setting input from an external source includes the following two types independently for the drive and regeneration.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Analog	Analog drive torque limiter reduction setting	This is a setting value issued with an analog input. The drive torque limit (A10-3 or A11-2) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.
	Analog regenerative torque limiter reduction setting	This is a setting value issued with an analog input. The regenerative torque limit (A10-4, A10-5 or A11-3) is multiplied using 0V to +10V as 0 to 100%, and the limit value is reduced. This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.
Serial	Serial driver torque limiter reduction setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Serial interface option (Type: V23-SL0 required) • PROFIBUS interface option (Type: V23-SL6 required) • Standard serial transmission (using operation panel connector) The data is set in the range of 0 to 100%, is multiplied with the drive torque limiter value (A10-3, A11-2), and the limiter value is reduced. This function is valid when the drive limiter changeover (LIM1) is turned ON with the sequence input.
	Serial regenerative torque limiter reduction setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the following serial transmission. • Serial interface option (Type: V23-SL0 required) • PROFIBUS interface option (Type: V23-SL6 required) • Standard serial transmission (using operation panel connector) The data is set in the range of 0 to 100%, is multiplied with the regenerative torque limiter value (A10-4, A10-5, A11-3), and the limiter value is reduced. This function is valid when the regenerative limiter changeover (LIM2) is turned ON with the sequence input.

(1-2) Internal reduction setting

When the double rating speed ratio setting (B13-4) is changed, the torque limiter reduction pattern will be generated as shown below, and will be multiplied with the drive torque limiter value (A10-3 or A11-2) and regenerative torque limiter value (A10-4, A10-5, A11-3).



KDBL : B13-4
Double rating speed ratio (%)
NFB : Speed detection (rpm)
NBASE : Base speed (rpm)
NDBL : NBASE × KDBL (rpm)

(2) Torque limiter setting selection sequence

The relation of the torque limiter setting and changeover sequence is as shown below.

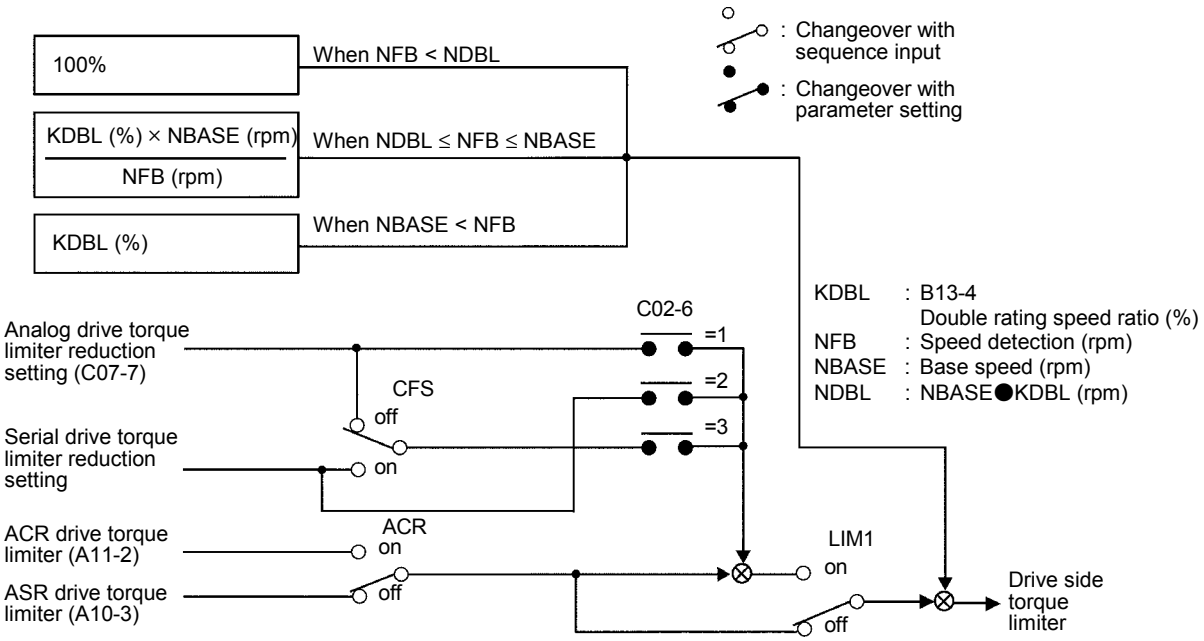


Fig. 5-12 Drive torque limiter setting selection

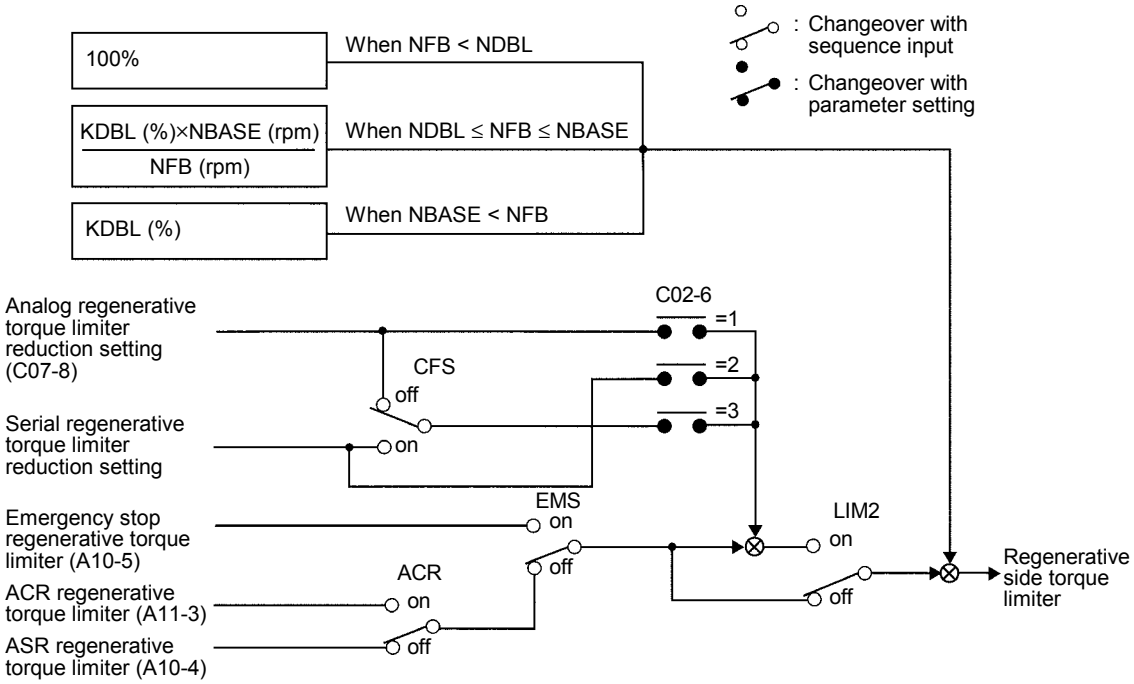


Fig. 5-13 Regenerative torque limiter setting selection

5-9-5 Torque ratio 1 setting

(1) Torque ratio 1 setting selection

The following two types of torque ratio 1 setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Torque ratio 1 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the PROFIBUS interface option (Type: V23-SL6 required).
Panel	Panel torque ratio 1 setting	This is a setting value issued from the parameter (B13-1).

(2) Torque ratio 1 setting selection sequence

The relation of the torque ratio 1 setting and changeover sequence is as shown below.

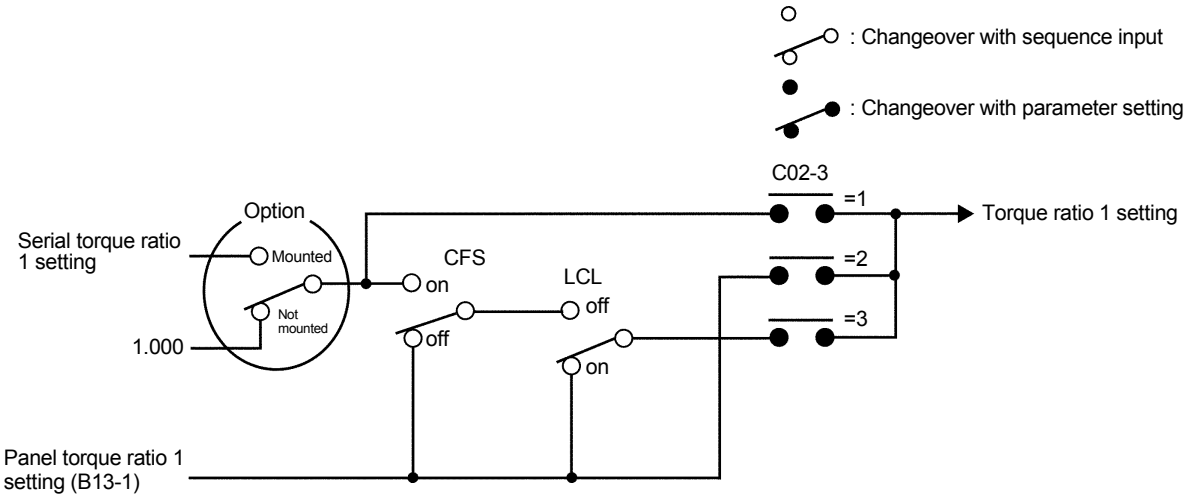


Fig. 5-14 Torque ratio 1 setting selection

5-9-6 Torque ratio 2, torque bias 2 setting

(1) Torque ratio 2 setting selection

The following two types of torque ratio 2 setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Torque ratio 2 setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the PROFIBUS interface option (Type: V23-SL6 required).
Panel	Panel torque ratio 2 setting	This is a setting value issued from the parameter (B13-3).

(2) Torque ratio 2 setting selection sequence

The relation of the torque ratio 2 setting and changeover sequence is as shown below.

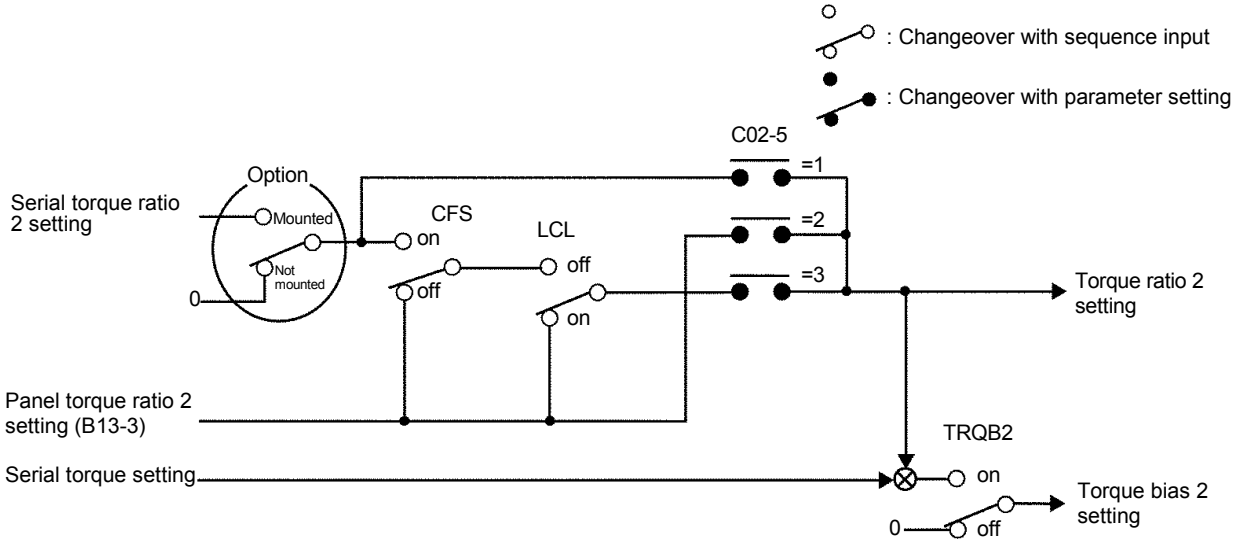


Fig. 5-15 Torque ratio 2 setting selection

5-9-7 Machine time constant setting

(1) Machine time constant setting

The following three types of machine time constant setting inputs can be used.
One of the three types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	Machine time constant	This is a setting value issued from the host computer with serial transmission. Setting is possible with the PROFIBUS interface option (Type: V23-SL6 required).
Panel	Panel machine time constant −1	This is a setting value issued from the parameter (A10-1).
	Panel machine time constant −2	This is a setting value issued from the parameter (B15-0).

(2) Machine time constant setting and changeover sequence

The relation of the machine time constant setting and changeover sequence is as shown below.

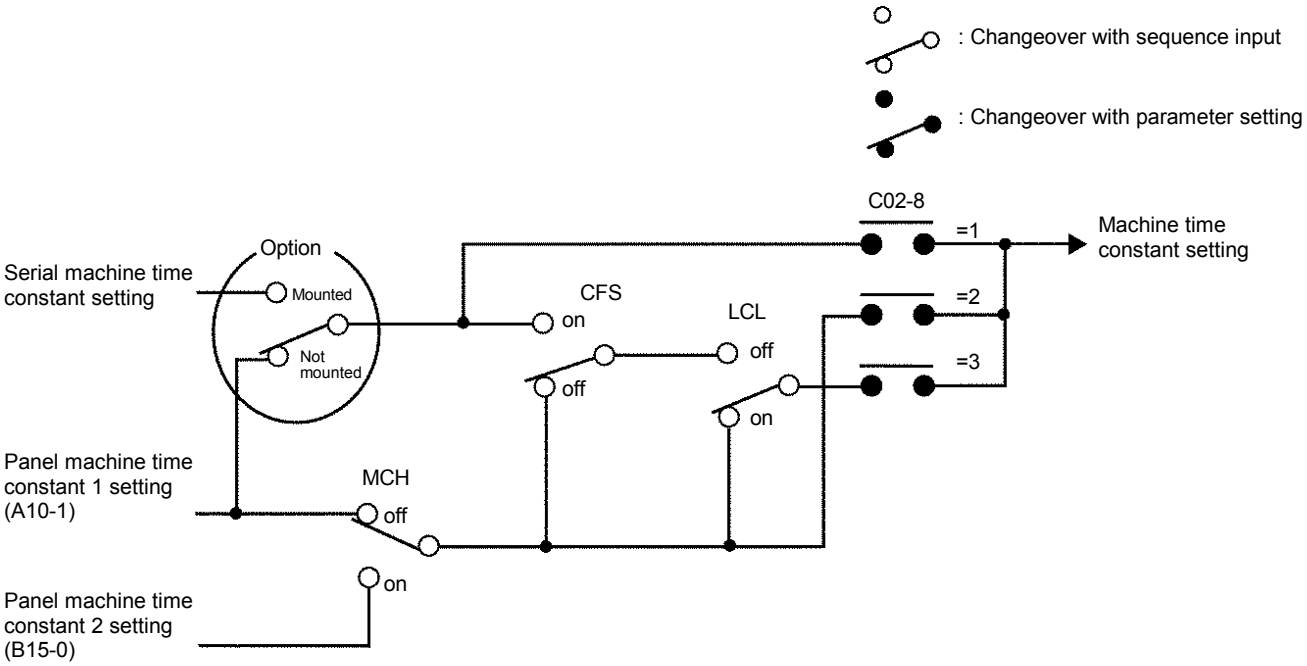


Fig. 5-16 Machine time constant setting selection

5-9-8 ASR response setting

(1) ASR response setting selection

The following two types of ASR response setting inputs can be used.
One of the two types of inputs can be selected by setting a parameter or with the sequence input.

Setting input point	Setting data	Explanation
Serial	ASR response setting	This is a setting value issued from the host computer with serial transmission. Setting is possible with the PROFIBUS interface option (Type: V23-SL6 required).
Panel	Panel ASR response setting	This is a setting value issued from the parameter (A10-0).

(2) ASR response setting and changeover sequence

The relation of the ASR response setting and changeover sequence is as shown below.

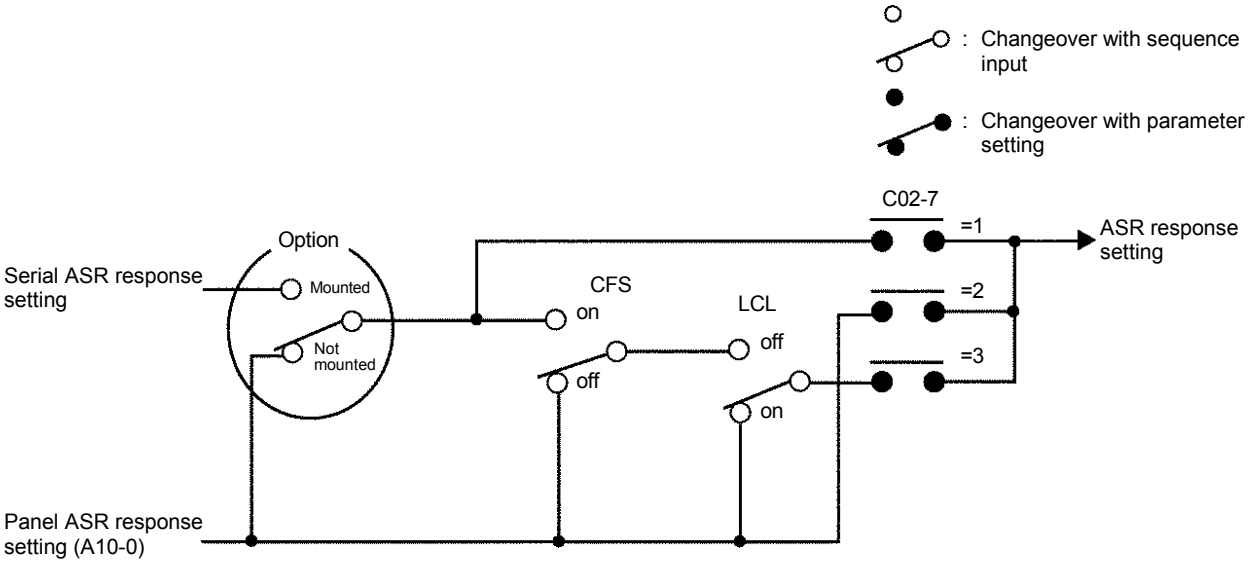


Fig. 5-17 ASR response setting selection

Chapter 6 Control Functions and Parameter Settings

6-1 Monitor parameters

The monitor mode sequentially displays the frequency, power supply, etc., parameters recognized by the VT230S.
The symbols shown at the right of the list show the application of each parameter as shown below.

ST : Indicates parameters that apply for all control modes (C30-0 = 1 to 5) including V/f control (constant torque, variable torque), sensor-less vector control, vector control with sensor and PM motor control.
V/f : Indicates parameters that apply for V/f control (constant torque, variable torque) (C30-0 = 1, 2).
VEC : Indicates parameters that apply for IM speed sensor-less vector control and IM speed vector control with sensor (C30-0 = 3, 4).
PM : Indicates parameters that apply for PM motor control (C30-0 = 5).

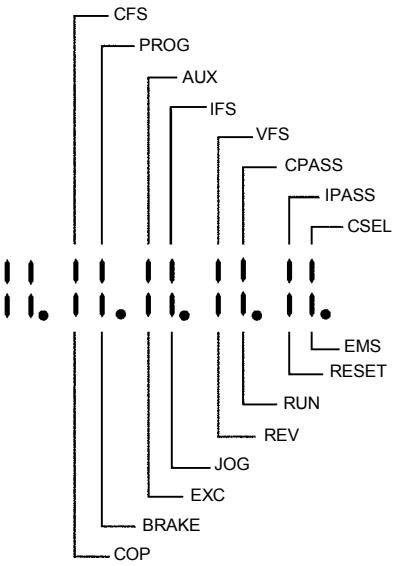
Monitor parameters list

No.	Parameter	Unit	Remarks	Application			
				ST	V/f	VEC	PM
D00 – Output frequency monitor							
0	Output frequency in Hz	Hz	OFF will display when the gate is closed. bk displays while the DC brake is in action. PU is displayed during pick up.	○			
1	Output frequency in %	%					
2	Motor speed in min^{-1}	min^{-1}	The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity. (This is displayed even when stopped.)			○	○
3	Motor speed in %	%					
4	Output frequency/motor speed random scale display (Note 1)		When V/f control operation (C30-0 = 1, 2) or auxiliary drive operation is selected, a value obtained by multiplying D00-0: output frequency with the random scale display coefficient: C14-2 will be displayed. When IM vector control or PM motor control (C30-0 = 3 to 5) is selected, a value obtained by multiplying D00-2: motor speed with the random scale display coefficient, C14-2 will be displayed. If the value exceeds the range of -99999 to 99999, OUEr will be displayed.				
D01 – Frequency setting monitor							
0	Setting frequency in Hz	Hz	The currently selected frequency setting value is displayed.		○		
1	Setting frequency in %	%	The max. frequency is displayed as 100%.		○		
3	Ramp function output speed	min^{-1}	The set speed at ASR input point is displayed. The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity.			○	○
4	Ramp function input speed	min^{-1}	The set speed at the ramp function's input point is displayed. The forward run direction is displayed with the + polarity, and the reverse run direction with the – polarity.			○	○
5	Setting frequency/input speed random scale display (Note 1)		When V/f control operation (C30-0 = 1, 2) or auxiliary drive operation is selected, a value obtained by multiplying D00-4: setting frequency with the random scale display coefficient: C14-2 will be displayed. When IM vector control or PM motor control (C30-0 = 3 to 5) is selected, a value obtained by multiplying D01-4: input speed with the random scale display coefficient, C14-2 will be displayed. If the value exceeds the range of -99999 to 99999, OUEr will be displayed.				
D02 – Current monitor							
0	Output current Amps	A	OFF will display when the gate is closed.	○			
1	Output current in %	%	The motor rated current is displayed as 100%.	○			
2	Overload (OLT) monitor	%	OLT functions when this value reaches 100%.	○			
3	Heatsink temperature	°C		○			
4	Torque current detection	%	The torque current detection value is displayed using the motor rated current as 100%. The forward run direction torque is displayed with the + polarity, and the reverse run direction torque with the – polarity.			○	○
5	Excitation current detection	%	The excitation current's detection value is displayed using the motor rated current as 100%. With the PM motor control, the demagnetizing current is indicated with – polarity.			○	○

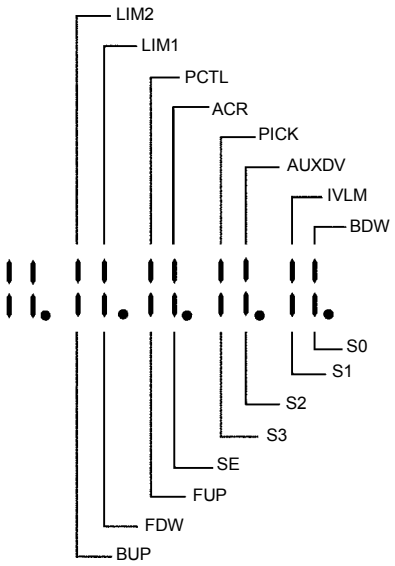
Note 1) D00-4 and D01-5 are available from CPU version 124.0 and ROM version 125.2 and above.

Monitor parameters list

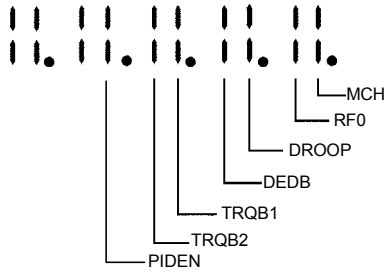
No.	Parameter	Unit	Remarks	Application			
				ST	V/f	VEC	PM
D03 – Voltage monitor							
0	DC voltage	V	Displays the voltage of the DC link circuit in the main circuit.	○			
1	Output voltage (command)	V	Displays output voltage command. The display may differ from the actual output voltage. It depends on the power supply voltage. OFF will display when the gate is closed.	○			
2	Output power	kW	Displays the inverter's output power. OFF will display when the gate is closed.	○			
3	Carrier frequency	kHz	The current carrier frequency is displayed.	○			
D04 – Sequence status							
0 ~ 2	Input		The ON/OFF state of the internal sequence data will display. The correspondence of each LED segment and signal is shown in the next page.	○			
3 ~ 4	Output			○			
D05 – Minor fault monitor							
0	Minor fault		The internal minor fault status will display. The correspondence of each LED segment and signal is shown in the next page.	○			
D06 – Pattern run monitor							
0	Step No.		The current step No. will display.	○			
1	Remaining time	Hrs	The remaining time of current step will display	○			
D07 – Pump operation status monitor							
0	Pump operation status		This indicates the ON/OFF status of the pump. The correspondence of the LED segments and signals is shown below.	○			
1	Next ON pump No.		0 is displayed when all pumps are ON.	○			
2	Next OFF pump No.		0 is displayed when all pumps are OFF.	○			
1	Passage time	Hrs	This displays the continuous ON/OFF time of the current pump. This is cleared when the pump operation is changed over.	○			



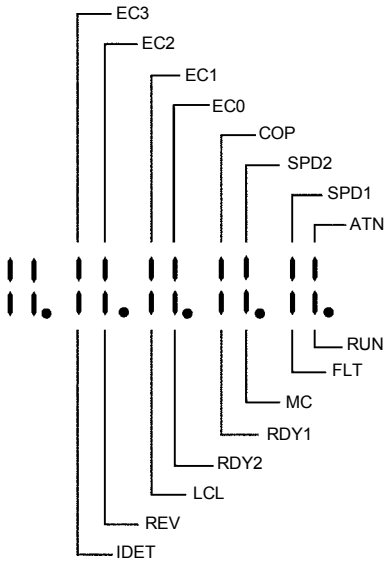
Sequence input (D04-0)



Sequence input (D04-1)

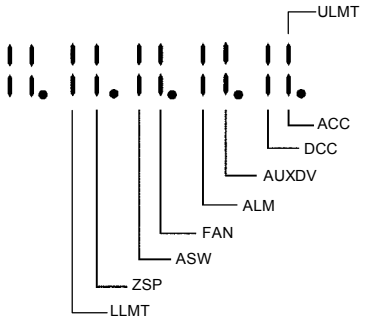


Sequence input (D04-2)

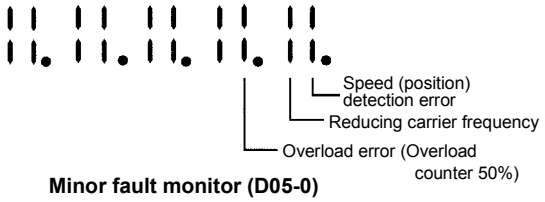


Sequence output (D04-3)

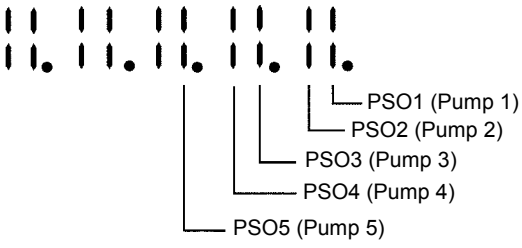
●●●●●



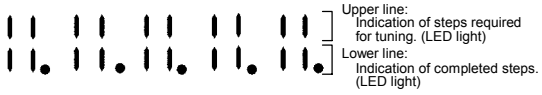
Sequence output (D04-4)



Minor fault monitor (D05-0)



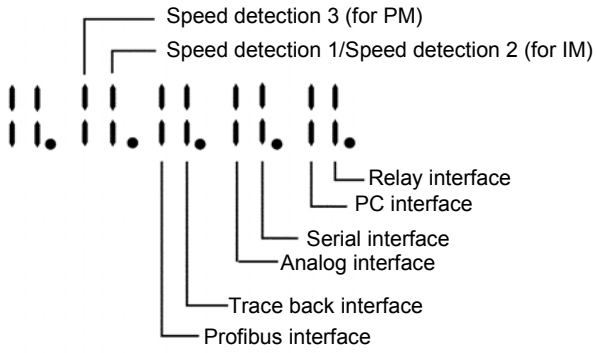
Pump operation status monitor (D07-0)



Automatic tuning (D22-0)

Monitor parameters list

No.	Parameter	Unit	Remarks	Application			
				ST	V/f	VEC	PM
D11 – Torque setting							
0	Torque setting input point	%	The currently selected torque setting of the current control input points is selected.			○	○
1	Analog torque setting	%	The setting value input from the analog torque setting is displayed.			○	○
2	Serial communication torque setting	%	The setting value input from the serial communication torque setting is displayed.			○	○
3	Operation panel torque setting	%	The torque set with the operation panel (B13-0) is displayed.			○	○
4	ASR output	%	The ASR output is displayed.			○	○
5	Torque setting (after torque limiter limit)	%	The forward run direction torque is displayed with the + polarity, and the reverse run direction torque with the – polarity.			○	○
D12 – Slip							
0	Slip	%	The slip is displayed as a percentage in respect to the base speed.			○	
D20 – Extended monitor							
0	Fault history reading entry		The fault history reference mode will display when SET is pressed.	○			
2	Non-default value parameter list mode entry		The mode for referring to and changing parameters that differ from the default value will display SET is pressed.	○			
D21 – Maintenance monitor							
0	Cumulative conductivity time	Hrs	The cumulative power ON time after product shipment will be counted and displayed.	○			
1	Cumulative runt time	Hrs	The cumulative run time after product shipment will be counted and displayed.	○			
2	CPU version		Display for maker control.	○			
3	ROM version		Display for maker control.	○			
D22 – Automatic tuning							
0	Automatic tuning progression display		The progression state of automatic tuning is displayed.		○	○	
D30 – Hardware monitor							
0	Inverter type		This indicates the inverter type.	○			
1	Option PCB		This indicates the mounted optional PCB. The correspondence of the LED segments and signals is shown below.	○			



Option PCB monitor (D30-1)

6-2 Block-A parameters

The parameters used most frequently have been grouped in Block-A.

Block-A parameters list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
A00 – Frequency setting										
0	Local frequency setting	Hz	10.00	0.10	Max. fre-quency	This is the frequency set from the operation panel.		○		
1	Frequency setting for jogging	Hz	5.00	0.10	Max. fre-quency	This is the frequency setting for jogging.		○		
2	Local speed setting	min^{-1}	300.0	–Max. speed	Max. speed	This is the speed set from the operation panel.			○	○
3	Speed setting for jogging	min^{-1}	100.0	–Max. speed	Max. speed	This is the speed setting for jogging.			○	○
A01 – Acceleration/deceleration time										
0	Acceleration time – 1	sec	10.0	0.1	6000.0	The value can be displayed in units of 0.1 or 10 times as set on B10-5. The time to reach the max. frequency or max. speed from 0 is set.	○			
1	Deceleration time – 1	sec	20.0	0.1	6000.0		○			
A02 – Torque boost										
0	Manual torque boost selection		2.	1.	2.	1: Disable = 2: Enable		○		
1	Automatic torque boost selection		1.	1.	2.	1: Disable = 2: Enable		○		
2	Manual torque boost setting (Note 1)	%	Inverter rating	0.00	20.00	Set the boost voltage at 0Hz. This is automatically adjusted by the automatic tuning.		○		
3	Square reduction torque setting (Note 1)	%	0.00	0.00	25.00	Set the reduced voltage at Base frequency/2.		○		
4	R1 drop compensation gain (Note 1)	%	100.0	0.0	100.0			○		
5	Slip compensation gain (Note 1)	%	0.00	0.00	20.00	Set the motor's rated slip. This is automatically adjusted by the automatic tuning.		○		
6	Maximum torque boost gain (Note 1)	%	0.00	0.00	50.00	This is automatically adjusted by the automatic tuning.		○		
A03 – DC Brake										
0	DC braking voltage (Note 1)	%	Inverter rating	0.01	20.00	This is automatically adjusted by the automatic tuning.		○		
1	DC braking time	sec	2.0	0.0	20.0		○			
2	DC braking current	%	50.	0.	150.				○	○
A04 – Custom parameters										
0 1 2 3 4 5 6 7	Custom– 0 – 1 – 2 – 3 – 4 – 5 – 6 – 7					Set the parameter Nos. to be displayed in this block in C10-0~7. This block displays when the above settings are not made.	○			
A05 – Block B, C parameter skip										
0	Extended setting		2.	1.	2.	= 1 : Display, = 2 : Skip	○			
1	Software option function		2.	1.	2.	= 1 : Display, = 2 : Skip	○			
2	Hardware option function		2.	1.	2.	= 1 : Display, = 2 : Skip	○			

Note 1) From CPU version 114.0 and ROM version 115.0 and above, the digit after the decimal point has been changed from one digit to two digits.

Block-A parameters list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
A10 – ASR control constant 1										
0	ASR response	rad/s	10.0	1.0	300.0	The required ASR response radian frequency is set.			○	○
1	Machine time constant－1	ms	1000.	1.	20000.	The time to accelerate the motor and load's torque inertia to the base speed at the rated torque is set.			○	○
2	Integral time constant compensation coefficient	%	100.	20.	500.	The compensation coefficient applied on the integral time constant of the speed regulator (ASR) is set.			○	○
3	ASR drive torque limiter	%	100.0	0.1	300.0	The limit values for the ASR drive side and regenerative side are set.			○	○
4	ASR regenerative torque limiter	%	100.0	0.1	300.0				○	○
5	Emergency stop regenerative torque limiter	%	100.0	0.1	300.0	The ASR regenerative side limit value applied during the emergency stop mode is set.			○	○
A11 – ACR control constant										
0	ACR response	rad/s	1000.	100.	6000.	The ACR gain and time constant are set. This will affect the current response. If the gain is too low or too high, the current will become unstable, and the over current protection will function. Normally adjust the response between 500 and 1000, and the time constant between 5 and 20ms.			○	
1	ACR time constant	ms	20.0	0.1	300.0				○	
2	ACR drive torque limiter	%	100.0	0.1	300.0	The ACR drive side and regenerative side limit values are set.			○	○
3	ACR regenerative torque limiter	%	100.0	0.1	300.0				○	○
A20 – ACR control constant (PM)										
0	ACR response (PM)	rad/s	1500.	100.	6000.	The ACR gain and time constant are set. This will affect the current response. If the gain is too low or too high, the current will become unstable, and the over current protection will function. Normally adjust the response between 500 and 2000, and the time constant between 5 and 20ms.				○
1	ACR time constant (PM)	ms	10.0	0.1	300.0					○
2	d axis current command cushion time	ms/I1	10.0	0.1	100.0	This is the cushion setting to prevent instability caused by overshooting, etc., when the current command changes suddenly. Set at how many ms to change the current command value equivalent to the motor rated current. Normally, a value 5ms or more is set.				○
3	q axis current command cushion time	ms/I1	10.0	0.1	100.0					○

6-3 Block-B parameters

The Block-B parameters are divided into the basic functions, extended functions and software option functions.

Block-B parameters (Basic function of V/f control) list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Unit</th><th rowspan="2">Default</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Function</th><th colspan="4">Application</th></tr>
<tr><th>ST</th><th>V/f</th><th>VEC</th><th>PM</th></tr>
<tr><td colspan="10">B00 – Output rating</td></tr>
<tr><td>0</td><td>Rated input voltage setting</td><td></td><td>7.</td><td>1.</td><td>7.</td><td>Select the rated input voltage from the following table.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="6">When this data is changed, the output voltage data will be changed to the same value.
Small size (Note 1)<table><tr><th>Value</th><th>200V system</th><th>400V system</th></tr><tr><td>1</td><td>200V</td><td>380V</td></tr><tr><td>2</td><td>200V</td><td>400V</td></tr><tr><td>3</td><td>200V</td><td>415V</td></tr><tr><td>4</td><td>220V</td><td>440V</td></tr><tr><td>5</td><td>230V</td><td>460V</td></tr><tr><td>6</td><td>230V</td><td>480V</td></tr><tr><td>7</td><td>230V</td><td>400V</td></tr></table>Large size (Note 2)<table><tr><th>Value</th><th>200V system</th><th>400V system</th></tr><tr><td>1</td><td>200V</td><td>380V</td></tr><tr><td>2</td><td>200V</td><td>400V</td></tr><tr><td>3</td><td>220V</td><td>415V</td></tr><tr><td>4</td><td>220V</td><td>440V</td></tr><tr><td>5</td><td>230V</td><td>460V</td></tr><tr><td>6</td><td>230V</td><td>460V</td></tr><tr><td>7</td><td>230V</td><td>400V</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>Max./base frequency simple setting</td><td></td><td>1.</td><td>0</td><td>9</td><td>Select the output frequency rating from the combination below.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="6"><table><tr><th>Value</th><th>Ftrq [Hz]</th><th>Fmax [Hz]</th></tr><tr><td>0</td><td colspan="2">Free setting on B00-4 and B00-5</td></tr><tr><td>1</td><td>50</td><td>50</td></tr><tr><td>2</td><td>60</td><td>60</td></tr><tr><td>3
4</td><td>50</td><td>60
75</td></tr></table><table><tr><th>Value</th><th>Ftrq [Hz]</th><th>Fmax [Hz]</th></tr><tr><td>5</td><td>50</td><td>●100</td></tr><tr><td>6
7
8
9</td><td>60</td><td>70
80
90
120</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Motor rated output</td><td>kW</td><td>Inverter rating</td><td>0.10</td><td>750.00</td><td>The motor rated output at the base frequency is set.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>3</td><td>Rated output voltage</td><td>V</td><td>230.
/400.</td><td>39.</td><td>480.</td><td>DC-AVR does not operate when set to 39. The input voltage equals the output voltage at the base frequency.
DC-AVR operates so that the set voltage is attained at the base frequency when not set to 39.
When the rated input voltage setting (B00-0) is changed, this data is also changed to the rated input voltage value.
This cannot be set above the rated input voltage.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>4</td><td>Max. frequency</td><td>Hz</td><td>50.0</td><td>3.0</td><td>440.0</td><td rowspan="2">When "B00-1" is a value other than 0, this will be rewritten with the data set in the simple setting.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>5</td><td>Base frequency</td><td>Hz</td><td>50.0</td><td>1.0</td><td>440.0</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>6</td><td>Motor rated current</td><td>A</td><td>Inverter rating</td><td>Inverter rating × 0.3</td><td>Inverter rating</td><td>This is the reference value for the overcurrent limit, OLT, current % display and meter output.</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td rowspan="2">7</td><td>Carrier frequency
(Small size : Note 1)</td><td></td><td>17.0</td><td>1.0</td><td>21.0</td><td>The noise can be lowered by changing the PWM carrier frequency and control method, and changing the sound of the magnetic noise generated from the motor. This can be changed while running.
1.0 to 15.0 : Monotone sound method
(Carrier frequency: 1.0 to 15.0kHz)
15.1 to 18.0 : Soft sound method 1
(Basic carrier frequency: 2.1 to 5.0kHz)
18.1 to 21.0 : Soft sound method 2
(Basic carrier frequency: 2.1 to 5.0kHz)</td><td></td><td>○</td><td></td><td></td></tr>
<tr><td>Carrier frequency
(Large size : Note 2)</td><td></td><td>10.0</td><td>1.0</td><td>14.0</td><td>1.0 to 8.0 : Monotone sound method
(Carrier frequency: 1.0 to 8.0kHz)
8.1 to 11.0 : Soft sound method 1
(Basic carrier frequency: 2.1 to 5.0kHz)
11.1 to 14.0 : Soft sound method 2
(Basic carrier frequency: 2.1 to 5.0kHz)</td><td></td><td>○</td><td></td><td></td></tr>
</table>

Block-B parameters (Basic function of vector control) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B01 – Output rating										
0	Rated input voltage setting		7.	1.	7.	Select the rated input voltage from the following table.			○	○
						When this data is changed, the output voltage data will also be changed to the same value.				

Small size (Note 1)

Value	200V system	400V system
1	200V	380V
2	200V	400V
3	200V	415V
4	220V	440V
5	230V	460V
6	230V	480V
7	230V	400V

Large size (Note 2)

Value	200V system	400V system
1	200V	380V
2	200V	400V
3	220V	415V
4	220V	440V
5	230V	460V
6	230V	460V
7	230V	400V

1	Motor rated output	kW	Inverter rating	0.10	750.00	The motor's rated output at the base speed is set.			○	○
2	No. of motor poles	Pole	4.	2.	16.				○	○
3	Rated output voltage	V	230. /400.	40.	480.	The motor terminal voltage during full load at the base speed is set.			○	○
4	Max. speed	min^{-1}	1800.	150.	7200.	The max. motor speed is set. Set a value that is 4-times or less of the base speed. In the case of PM motor control, set a value 1.2 times or less of the base speed.			○	○
5	Base speed	min^{-1}	1800.	150.	7200.	The motor base speed is set. When higher than this speed, the flux control during vector control will be weakened.			○	○
6	Motor rated current	A	Inverter rating	Inverter rating × 0.3	Inverter rating	The motor current during full load at the base speed is set.			○	○
7	Carrier frequency (Small size : Note 1)		17.0	1.0	21.0	The noise can be lowered by changing the PWM carrier frequency and control method, and changing the tone of the magnetic noise generated from the motor. This can be changed while running. 1.0 to 15.0 : Monotone sound method (Carrier frequency: 1.0 to 15.0kHz) 15.1 to 18.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 18.1 to 21.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)			○	○
	Carrier frequency (Large size : Note 2)		10.0	1.0	14.0	1.0 to 8.0 : Monotone sound method (Carrier frequency: 1.0 to 8.0kHz) 8.1 to 11.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 11.1 to 14.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)			○	○
8	No. of encoder pulses	P/R	1000.	60.	10000.				○	○
9	No-load output voltage	V	160.	20.	500.	The motor terminal voltage during no-load at the base speed is set.			○	○

Note 1) Small size : 0P4H→045H, 0P4L→037L
Note 2) Large size : 055H and larger, 045L and larger

Block-B parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B02 – Motor circuit constant (IM)										
0	R1: Primary resistance (Mantissa section)	mΩ	Inverter rating	0.100	9.999	The motor circuit constant is set.		○	○	
1	R1: Primary resistance (Exponent section)		Inverter rating	–3	4			○	○	
2	R2': Secondary resistance (Mantissa section)	mΩ	1.000	0.100	9.999	This combination means below R2' = 1.000 × 10^0 [mΩ]			○	
3	R2': Secondary resistance (Exponent section)		0	–3	4				○	
4	Lσ: Leakage inductance (Mantissa section)	mH	1.000	0.100	9.999				○	
5	Lσ: Leakage inductance (Exponent section)		0	–3	4				○	
6	M': Excitation inductance (Mantissa section)	mH	1.000	0.100	9.999				○	
7	M': Excitation inductance (Exponent section)		0	–3	4				○	
8	Rm: Iron loss resistance (Mantissa section)	mΩ	1.000	0.100	9.999				○	
9	Rm: Iron loss resistance (Exponent section)		0	–3	5				○	
B03 – Motor circuit constant (PM)										
0	R1: PM motor primary resistance (Mantissa section)	mΩ	1.000	0.001	9.999	This combination means below R1 = 1.000 × 10^0 [mΩ]				○
1	R1: PM motor primary resistance (Exponent section)		0.	–1.	4.					○
2	Ld: PM motor d axis inductance (Mantissa section)	mH	1.000	0.001	9.999	This combination means below Ld = 1.000 × 10^0 [mH]				○
3	Lq: PM motor q axis inductance (Mantissa section)	mH	1.000	0.001	9.999					
4	Ld, Lq: PM motor inductance (Exponent section)		0.	–1.	4.					○
B05 – Frequency skip										
0	Skip frequency – 1	Hz	0.1	0.1	440.0			○		
1	Skip band – 1	Hz	0.0	0.0	10.0					
2	Skip frequency – 2	Hz	0.1	0.1	440.0					
3	Skip band – 2	Hz	0.0	0.0	10.0					
4	Skip frequency – 3	Hz	0.1	0.1	440.0					
5	Skip band – 3	Hz	0.0	0.0	10.0					
B06 – Ratio interlock setting										
0	Coefficient		1.000	–10.000	10.000		○			
1	Bias	Hz	0.00	–440.00	440.00			○		
2	Upper limit	Hz	440.00	–440.00	440.00					
3	Lower limit	Hz	0.10	–440.00	440.00	The upper limit be larger than the lower limit.				
4	Bias	min^{-1}	0.	–7200.	7200.				○	○
5	Upper limit	min^{-1}	7200.	–7200.	7200.					
6	Lower limit	min^{-1}	–7200.	–7200.	7200.	The upper limit be larger than the lower limit.				

Block-B parameters (Extended function constants) list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Unit</th><th rowspan="2">Default</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Function</th><th colspan="4">Application</th></tr>
<tr><th>ST</th><th>V/f</th><th>VEC</th><th>PM</th></tr>
<tr><td colspan="11">B10 – Acceleration/deceleration time</td></tr>
<tr><td>0</td><td>Acceleration ramp time－2</td><td>sec</td><td>10.0</td><td>0.1</td><td>6000.0</td><td rowspan="2">The acceleration/deceleration ramp time valid when the sequence input ramp 2 selection is ON (CSEL=ON) is set.
Set a time between 0 and the max. frequency or max. speed.
The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).</td><td rowspan="2">○</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>1</td><td>Deceleration ramp time－2</td><td>sec</td><td>20.0</td><td>0.1</td><td>6000.0</td></tr>
<tr><td>2</td><td>Acceleration ramp time for jogging</td><td>sec</td><td>5.0</td><td>0.1</td><td>6000.0</td><td rowspan="2">The acceleration/deceleration time value when the JOG sequence (F JOG, R JOG) is valid is set.
Set a time between 0 and the max. frequency or max. speed.
The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).</td><td rowspan="2">○</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>3</td><td>Deceleration ramp time for jogging</td><td>sec</td><td>5.0</td><td>0.1</td><td>6000.0</td></tr>
<tr><td>4</td><td>S-shape characteristics (Ts)</td><td>sec</td><td>0.0</td><td>0.0</td><td>5.0</td><td>Set to 1/2 of less of the ramp time.
S-shape pattern is possible by setting this parameter.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>Time unit</td><td></td><td>1.</td><td>1.</td><td>3.</td><td>The acceleration/deceleration ramp time setting unit can be changed by setting an acceleration/deceleration ramp time with a wider range. This parameter will affect all acceleration/ deceleration ramp time parameters.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td colspan="11">B11 – Program frequency (speed) setting</td></tr>
<tr><td>0</td><td>Program frequency (speed) –0</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td><td rowspan="8">Select as follows with S0, S1, S2, S3 and SE .
(1) For binary mode (B11-8=1)
<table><tr><th colspan="5">Sequence command</th><th rowspan="2">Selected frequency</th></tr><tr><th>SE</th><th>S3</th><th>S2</th><th>S1</th><th>S0</th></tr><tr><td rowspan="8">*</td><td rowspan="8">*</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-0</td></tr><tr><td>OFF</td><td>OFF</td><td>ON</td><td>B11-1</td></tr><tr><td>OFF</td><td>ON</td><td>OFF</td><td>B11-2</td></tr><tr><td>OFF</td><td>ON</td><td>ON</td><td>B11-3</td></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>B11-4</td></tr><tr><td>ON</td><td>OFF</td><td>ON</td><td>B11-5</td></tr><tr><td>ON</td><td>ON</td><td>OFF</td><td>B11-6</td></tr><tr><td>ON</td><td>ON</td><td>ON</td><td>B11-7</td></tr></table>SE and S3 are not used.
(2) For direct select mode (B11-8=2)
<table><tr><th colspan="5">Sequence command</th><th rowspan="2">Selected frequency</th></tr><tr><th>SE</th><th>S3</th><th>S2</th><th>S1</th><th>S0</th></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Previous values</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>B11-0</td></tr><tr><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>B11-1</td></tr><tr><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>B11-2</td></tr><tr><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-3</td></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>OFF</td><td>Previous values</td></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td><td>B11-4</td></tr><tr><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td><td>B11-5</td></tr><tr><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td><td>B11-6</td></tr><tr><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td><td>B11-7</td></tr></table>When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held. If there are no previous values because the power has been turned ON, etc., "0" will be set.</td><td rowspan="8">○</td><td rowspan="8"></td><td rowspan="8"></td><td rowspan="8"></td></tr>
<tr><td>1</td><td>Program frequency (speed) –1</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>2</td><td>Program frequency (speed) –2</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>3</td><td>Program frequency (speed) –3</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>4</td><td>Program frequency (speed) –4</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>5</td><td>Program frequency (speed) –5</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>6</td><td>Program frequency (speed) –6</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>7</td><td>Program frequency (speed) –7</td><td>%</td><td>10.00</td><td>0.00</td><td>100.00</td></tr>
<tr><td>8</td><td>Selection mode setting</td><td></td><td>1.</td><td>1.</td><td>2.</td><td>= 1 : Binary mode
= 2 : Direct select mode
Select the program frequency setting (B11) and program ramp (B41, B42) selection mode.</td><td>○</td><td></td><td></td><td></td></tr>
</table>

Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B13 – Local setting										
0	Torque setting (Note 1)	%	0.0	–300.0	300.0	This is the torque setting from the operation panel.			○	○
1	Torque ratio 1 setting		1.000	0.001	5.000				○	○
2	Torque bias 1 setting	%	0.0	–300.0	300.0				○	○
3	Torque ratio 2 setting		1.000	–5.000	5.000				○	○
4	Double rating speed ratio setting	%	100.0	0.1	100.0	This sets the torque limiter reduction pattern changeover point. Set as a per-centage in respect to the base speed.			○	○
5	Drooping setting	%	0.00	0.00	20.00	By adjusting this parameter, the torque-motor speed drooping characteristics can be achieved.			○	○
6	ASR gain compensation in constant power range	%	100.0	0.0	150.0	This sets the ASR P gain compensation value at the max. speed. By adjusting this parameter, the ASR P gain can be compensated in the constant power range. If ASR hunting occurs in the sensor-less vector control's constant output range, set a smaller value.			○	○
7	ACR gain compensation in constant power range	%	100.0	0.0	150.0	This sets the ACR P gain compensation value at the max. speed. By adjusting this parameter, the ACR P gain can be compensated in the constant power range.			○	○
B14 – ASR dead band setting										
0	ASR dead band setting	%	0.0	0.0	100.0	The non-sensitive range of the ASR input is set.			○	○
B15 – Machine time constant setting 2										
0	Machine time constant－2	ms	1000.	10.	20000.	The time to accelerate the motor and load's torque inertia to the base speed at the rated torque is set. This is valid when the sequence input machine time constant changeover is ON (MCH = ON).			○	○
B17 – V/f middle point										
0	Frequency 2	Hz	0.0	0.0	Max.frequency	These parameters should be set: Base frequency ≥ B17-0 ≥ B17-2 B17-1 ≥ B17-3		○		
1	Voltage 2	%	0.0	0.0	100.0			○		
2	Frequency 1	Hz	0.0	0.0	Max.frequency			○		
3	Voltage 1	%	0.0	0.0	100.0			○		
B18 – Over current limit										
0	Over current limit	%	150.	50.	300.		○			
1	Regenerative current limit	%	10.	5.	300.	Set to 10% when not using the DBR option.	○			
2	Torque stabilization gain		1.00	0.	4.00	Increase if the motor vibrates.	○			
3	Over current limit function gain		0.25	0.	2.00	Decrease if current hunting occurs.	○			
4	Current stabilization gain		0.25	0.	2.00		○			
5	Over current stall prevention gain		1.00	0.	2.00		○			
6	Over current stall pre-vention time constant		100.	10.	1001.	P control will be applied if 1001 is set.	○			
B19 – Automatic tuning function										
0	Automatic tuning selection		0.	0.	4	The automatic tuning mode is selected. 1: Basic adjustment for V/f Control 2: Extended adjustment for V/f Control 3: Basic adjustment for Vector Control 4: Extended adjustment for Vector Control 5: Calculation of no load voltage for Vector Control (Note 1)		○	○	

Note 1) From CPU version 114.0 and ROM version 115.0 and above, the default value has been changed from 100.0 to 0.0.

Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
1	Initial proportion compensation gain	%	100.	0.	500.	When the motor with special circuit parameters is applied, the initial condition of Auto Tuning is set. Set these value if Auto Tuning is completed incorrectly and try to Auto Tuning again. Set these value to increase or decrease with 50% step. (Note 3)		○	○	
2	Initial time constant compensation gain	%	100.	0.	500.			○	○	
B20 – Output rating (Auxiliary drive)										
0	Max./base frequency simple setting		1.	0.	9.	Select the output frequency rating from the combination below.	○			
			Value / **Ftrq [Hz]** / **Fmax [Hz]**: 0 – Free setting on B20-2, 3; 1 – 50 / 50; 2 – 60 / 60; 3, 4 – 50 / 60, 75. **Value** / **Ftrq [Hz]** / **Fmax [Hz]**: 5 – 60 / 100; 6 – 60 / 70; 7 – 80; 8 – 90; 9 – 120.							
1	Rated output voltage	V	230. /400.	40.	480.	DC-AVR operates so that the set voltage is attained at the base frequency. When the rated input voltage setting (B00-0) is changed, this data is also changed to the rated input voltage value. This cannot be set above the rated input voltage.	○			
2	Max. frequency	Hz	50.0	3.0	440.0	When "B20-0" is a value other than 0, this will be rewritten with the data set in the simple setting.	○			
3	Base frequency	Hz	50.0	1.0	440.0		○			
4	Motor rated current	A	Inverter rating	Inverter rating × 0.3	Inverter rating	This is the reference value for the overcurrent limit, OLT, current % display and meter output.	○			
5	Carrier frequency (Small size : Note 1)		17.0	1.0	21.0	The noise can be lowered by changing the PWM carrier frequency and control method, and changing the sound of the magnetic noise generated from the motor. This can be changed while running. 1.0 to 15.0 : Monotone sound method (Carrier frequency: 1.0 to 15.0kHz) 15.1 to 18.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 18.1 to 21.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)	○			
	Carrier frequency (Large size : Note 2)		10.0	1.0	14.0	1.0 to 8.0 : Monotone sound method (Carrier frequency: 1.0 to 8.0kHz) 8.1 to 11.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz) 11.1 to 14.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)	○			
B21 – Frequency setting (Auxiliary drive)										
0	Local frequency setting	Hz	10.00	0.10	Max. fre-quency	This is the frequency set from the operation panel.	○			
1	Frequency setting for jogging	Hz	5.00	0.10		This is the frequency setting for jogging.	○			
B22 – Acceleration/deceleration time (Auxiliary drive)										
0	Acceleration time – 1	sec	10.0	0.1	6000.0	The time to reach the max. frequency from 0 is set. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○			
1	Deceleration time – 1	sec	20.0	0.1	6000.0		○			
2	Acceleration ramp time for jogging	sec	5.0	0.1	6000.0	The acceleration/deceleration time value when the JOG sequence (F JOG, R JOG) is valid is set. Set a time between 0 and the max. frequency. The unit can be changed to ×0.1s, ×10s with the time unit setting (B10-5).	○			
3	Deceleration ramp time for jogging	sec	5.0	0.1	6000.0					

Note 1) Small size : 0P4H～045H, 0P4L～037L
Note 2) Large size : 055H and larger, 045L and larger
Note 3) This parameter is available from CPU version : 114.0, ROM version : 115.0.

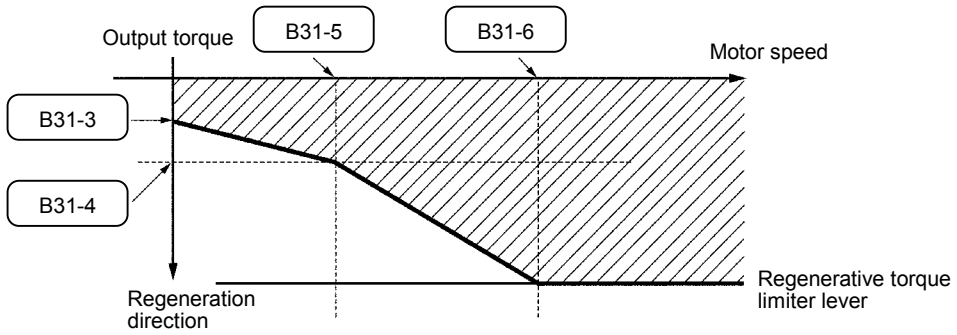
Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B23 – Torque boost (Auxiliary drive)										
0	Manual torque boost setting (Note 1)	%	Inverter rating	0.00	20.00	Set the boost voltage at 0Hz.	○			
1	Square reduction torque setting (Note 1)	%	0.00	0.00	25.00	Set the reduced voltage at Base frequency/2.	○			
B24 – DC Brake (Auxiliary drive)										
0	DC braking voltage (Note 1)	%	Inverter rating	0.01	20.00		○			
1	DC braking time	sec	2.0	0.0	20.0		○			
B25 – Over current limit (Auxiliary drive)										
0	Over current limit	%	150.	50.	300.		○			
1	Regenerative current limit	%	10.	5.	300.	Set to 10% when not using the DB option.	○			
2	Torque stabilization gain		1.00	0.	4.00	Increase if the motor vibrates.	○			
B30 – Speed control extended function										
0	Load torque observer gain		0.0	0.0	200.0	Set the observer gain for the load torque observer. To increase the responsiveness of the external disturbance response characteristics, set a large gain. Note that if the gain is set too high, the output torque could hunt. When set to zero, the load torque observer will not function.			○	○
1	Model machine time constant	ms	500.	10.	20000.	Set the model machine time constant used by the load torque observer.			○	○
2	ASR proportional item change rate limit	%	50.0	1.0	400.0	If the speed setting value or motor speed change suddenly, this will prevent the ASR's P item from suddenly changing.			○	○
3	Speed setting LPF time constant	ms	0.	0.	1000.	Overshooting can be suppressed by setting this to the filter time constant equivalent to the speed response.			○	○
4	Speed detection LPF time constant	ms	2.	0.	1000.	The speed detection noise is cut.			○	○
5	Speed detection LPF time constant for ASR	ms	5.	0.	1000.	Set the low path filter time constant used for the speed detection value input into the speed regulator.			○	○
6	Speed detection LPF time constant for compensation	ms	20.	0.	1000.	Set the low path filter time constant used for the speed detection value for constant output range compensation or iron loss compensation, etc.			○	○
7	Torque current command setting LPF time constant	ms	0.	0.	1000.	Set the low path filter time constant used for the torque current command.			○	○
8	LPF time constant for drooping	ms	100.	0.	1000.	Set the low path filter time constant used for drooping value input into the speed regulator.			○	○

Note 1) From CPU version 114.0 and ROM version 115.0 and above, the digit after the decimal point has been changed from one digit to two digits.

Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B31 – Sensor-less control function										
0	Flux observer gain		1.20	0.50	1.50	This is the feedback gain for the flux observer. If hunting occurs at the estimated speed in the high-speed operation range, adjust within the range of 1.2 to 0.9.			○	
1	Speed estimated proportional gain	%	0.00	0.00	100.00	This is the proportional gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.			○	
2	Speed estimated integral gain	%	1.00	0.00	100.00	This is the integral gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.			○	
3	Regenerative compensation torque limiter 1	%	10.0	0.1	100.0	The regenerative torque limiter can be changed in the low-speed area. The shaded section shows the operation range. If operation is unstable within the shaded line range, set the parameter so that the unstable point is not within the shaded line area.			○	
4	Regenerative compensation torque limiter 2	%	20.0	0.1	100.0					
5	Regenerative compensation low-speed area setting 1	%	10.0	0.1	100.0					
6	Regenerative compensation low-speed area setting 2	%	20.0	0.1	100.0					



Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B32 – Vector control compensation selection										
0	High-speed flux control gain (Note 1)		1.	1.	2.	= 1: Disable = 2: Enable This is the control gain used for high-speed control of the secondary flux when starting operation. Use this to control the secondary flux at a high speed at the start of operation or during operation in a constant output range. High speed control is possible by increasing the gain, but if increased too high, the magnetizing current may hunt.			○	
1	Temperature compensation selection		1.	1.	2.	= 1: Disable = 2: Enable If a torque accuracy is required when vector control with sensor is selected (C30-0 = 4), or if speed accuracy is required when sensor-less vector control is selected (C30-0 = 3), the parameter fluctuation of the primary resistance value and secondary resistance value caused by a rise in temperature can be compensated.			○	○
2	Voltage saturation compensation selection		2.	1.	2.	= 1: Disable = 2: Enable If the output voltage in control is larger than the voltage that can be output by the inverter, select this control to limit the exciting current to prevent the current or torque from hunting. Select this when raising the output voltage to near the input voltage, or when the input voltage changes. Note that if voltage saturation occurs, some torque ripple will occur. In this case, lower the B01-9 no-load voltage setting to avoid voltage saturation.			○	○
3	Iron loss compensation selection		1.	1.	2.	= 1: Disable = 2: Enable This compensates the torque error caused by iron loss. The iron loss resistance value (B02-8, 9) must be set.			○	
4	ACR voltage model FF selection		2.	1.	2.	= 1: Disable = 2: Enable The voltage fluctuation caused by the leakage inductance is feed forward controlled. The current regulator (ACR) response speed will be increased. Select this if the current hunts in the high-speed operation range during sensor-less control.			○	○

Note 1) From CPU version 122.0 and ROM version 123.0 and above, this has been changed from selection to gain adjustment.

Block-B parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B33 – M fluctuation compensation table reference speed										
0	Table reference speed 0	min^{-1}	200	100.	7200.	This is the reference speed for changing the compensation amount according to the operation speed. If all of B34 is set to the default value (=100%), these will be automatically set when adjusted with automatic tuning mode 4 (B19-0=4). (Note 1)			○	
1	Table reference speed 1	min^{-1}	400	100.	7200.					
2	Table reference speed 2	min^{-1}	600	100.	7200.					
3	Table reference speed 3	min^{-1}	800	100.	7200.					
4	Table reference speed 4	min^{-1}	1000	100.	7200.					
5	Table reference speed 5	min^{-1}	1200	100.	7200.					
6	Table reference speed 6	min^{-1}	1400	100.	7200.					
7	Table reference speed 7	min^{-1}	1600	100.	7200.					
B34 – M fluctuation compensation										
0	M fluctuation compensation coefficient 0	%	100.0	50.0	150.0	This compensates the exciting inductance fluctuation according to the B33 table reference speed. Set the compensation table so that the output voltage is constant during no-load operation through the entire operation range. * This is adjusted with the automatic tuning mode 4 (B19-0 = 4).			○	
1	M fluctuation compensation coefficient 1	%	100.0	50.0	150.0					
2	M fluctuation compensation coefficient 2	%	100.0	50.0	150.0					
3	M fluctuation compensation coefficient 3	%	100.0	50.0	150.0					
4	M fluctuation compensation coefficient 4	%	100.0	50.0	150.0					
5	M fluctuation compensation coefficient 5	%	100.0	50.0	150.0					
6	M fluctuation compensation coefficient 6	%	100.0	50.0	150.0					
7	M fluctuation compensation coefficient 7	%	100.0	50.0	150.0					
B35 – Voltage control constant (PM)										
0	Demagnetizing control operation voltage allowance	%	10.0	5.0	100.0	% of rated voltage				○
1	Demagnetizing current limit value	%	50.0	10.0	200.0	Ratio of rated voltage				○
2	Demagnetizing current control proportional gain	times	0.10	0.01	99.99					○
3	Demagnetizing current control integral time constant	ms	10.	2.	1000.					○
4	Flux temperature fluctuation compensation range	%	0.0	0.0	50.0					○
5	Flux temperature fluctuation compensation time constant	s	1000.	1.	9999.					○
B36 – Demagnetizing current table (PM)										
0	Demagnetizing current table 0	%	0.0	0.0	100.0	Demagnetizing current table (Motor rated current reference) (at torque command 25%)				○
1	Demagnetizing current table 1	%	0.0	0.0	100.0	(at torque command 50%)				○
2	Demagnetizing current table 2	%	0.0	0.0	100.0	(at torque command 75%)				○
3	Demagnetizing current table 3	%	0.0	0.0	100.0	(at torque command 100%)				○
4	Demagnetizing current table 4	%	0.0	0.0	100.0	(at torque command 150%)				○

Note 1) Automatic setting is available with CPU version 114.0 and ROM version 115.0 and above.

Block-B parameters (S/W option constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application ST	V/f	VEC	PM
B40 – Software option function										
0	Function selection – 1		1	1.	4.	= 1 : Following functions are not used. = 2 : Program ramp function use = 3 : Pattern run use = 4 : Traverse run use	○			
1	Function selection – 2		1	1.	3.	= 1 : Following functions are not used. = 2 : PID use = 3 : PID, multi-pump control use	○			
B41 – Program ramp – acceleration										
0	Acceleration time – 0	sec	10.0	0.1	6000.0	Select as follows with S0, S1, S2, S3 and SE.	○			
1	– 1	sec	10.0	0.1	6000.0					
2	– 2	sec	10.0	0.1	6000.0					
3	– 3	sec	10.0	0.1	6000.0					
4	– 4	sec	10.0	0.1	6000.0					
5	– 5	sec	10.0	0.1	6000.0					
6	– 6	sec	10.0	0.1	6000.0					
7	– 7	sec	10.0	0.1	6000.0					
B42 – Program ramp – deceleration										
0	Deceleration time – 0	sec	20.0	0.1	6000.0	Select as follows with S0, S1, S2, S3 and SE.	○			
1	– 1	sec	20.0	0.1	6000.0					
2	– 2	sec	20.0	0.1	6000.0					
3	– 3	sec	20.0	0.1	6000.0					
4	– 4	sec	20.0	0.1	6000.0					
5	– 5	sec	20.0	0.1	6000.0					
6	– 6	sec	20.0	0.1	6000.0					
7	– 7	sec	20.0	0.1	6000.0					

The binary mode or direct input mode is selected with B11-8.

(1) For binary mode (B11-8=1)

Sequence command SE	S3	S2	S1	S0	Selected ramp time
*	*	OFF	OFF	OFF	B41-0 B42-0
		OFF	OFF	ON	B41-1 B42-1
		OFF	ON	OFF	B41-2 B42-2
		OFF	ON	ON	B41-3 B42-3
		ON	OFF	OFF	B41-4 B42-4
		ON	OFF	ON	B41-5 B42-5
		ON	ON	OFF	B41-6 B42-6
		ON	ON	ON	B41-7 B42-7

* : SE and S3 are not used.

(2) For direct select mode (B11-8=2)

Sequence command SE	S3	S2	S1	S0	Selected ramp time
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B41-0 B42-0
OFF	OFF	OFF	ON	OFF	B41-1 B42-1
OFF	OFF	ON	OFF	OFF	B41-2 B42-2
OFF	ON	OFF	OFF	OFF	B41-3 B42-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B41-4 B42-4
ON	OFF	OFF	ON	OFF	B41-5 B42-5
ON	OFF	ON	OFF	OFF	B41-6 B42-6
ON	ON	OFF	OFF	OFF	B41-7 B42-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held. If there are no previous values because the power has been turned ON, etc., "0" will be set.

Block-B parameters (S/W option constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B43 – PID control										
0	Proportional gain		1.00	0.01	10.00		○			
1	Integral time constant	sec	10.0	0.0	30.0		○			
2	Differential time constant	sec	0.000	0.000	1.000		○			
3	Upper limit	%	100.	50.	100.	The maximum frequency (B00-4,B20-2) and maximum speed (B01-4) are 100%	○			
4	Lower limit	%	0.	0.	50.		○			
B44 – Multi-pump control										
0	No. of controlled pumps	units	3.	1.	5.	Set the No. of pumps to be ON/OFF controlled.	○			
1	Holding time	sec	60.	3.	3600.	If the time that the PID output is applied on the upper/lower limiter is longer than this setting, the pump's ON/OFF control will be carried out.	○			
2	Continuous operation limit time	Hrs	8.	2.	48.	If the pump's ON/OFF control is not carried out for longer than the time set here, the pumps will change from that operating to the longest to that operating the shortest so that the operation time of each pump is equal.	○			
3	Changeover time	sec	3.	1.	120.	Set the time for changing from the pump that has been operating the longest to the pump that has been operating the shortest.	○			
B45 – Traverse run										
0	Center frequency (speed) (FH)	%	20.00	5.00	100.00		○			
1	Amplitude (A)	%	10.0	0.1	20.0	Set (A/FH) × 100.	○			
2	Drop (D)	%	0.0	0.0	50.0	Set (D/A) × 100.	○			
3	Acceleration time (B)	sec	10.0	0.5	60.0		○			
4	Deceleration time (C)	sec	10.0	0.5	60.0		○			
5	Deviated traverse (X)	%	10.0	0.0	20.0	Set (X/FH) × 100.	○			
6	Deviated traverse (Y)	%	10.0	0.0	20.0	Set (Y/FH) × 100.	○			
B50 – Pattern run step-0										
0	Mode		0.	0.	2.	= 0 : Stop = 1 : Forward run = 2 : Reverse run	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
B51 – Pattern run step-1										
0	Mode		0.	0.	2.	= 0 : Stop = 1 : Forward run = 2 : Reverse run	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
B52 – Pattern run step-2										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	1.					
B53 – Pattern run step-3										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	2.					
B54 – Pattern run step-4										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	3.					

Block-B parameters (S/W option constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
B55 – Pattern run step-5										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	4.					
B56 – Pattern run step-6										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	5.					
B57 – Pattern run step-7										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	6.					
B58 – Pattern run step-8										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return (return destination is –4)	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	7.					
B59 – Pattern run step-9										
0	Mode		0.	0.	3.	= 0 : Stop = 1 : Forward run = 2 : Reverse run = 3 : Return (return destination is –4)	○			
1	Frequency (speed)	%	10.00	0.00	100.00					
2	Time	sec	1.0	0.1	6000.0					
3	Return destination step		0.	0.	8.					

6-4 Block-C parameters

The Block-C parameters are divided into the basic functions, extended functions and hardware option functions.

Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C00 – Control methods										
0	Run command method		1.	1.	3.	Run command method is set. = 1 : F·RUN, R·RUN = 2 : RUN, REV = 3 : Pulse switch over (Pulse inputs for F·RUN and R·RUN)	○			
1	RUN/STOP methods		2.	1.	2.	Set the stopping method for RUN operation. = 1 : Coast to stop = 2 : Ramp down to stop	○			
2	Jog stop method		2.	1.	2.	Set the stopping method for JOG operation. = 1 : Coast to stop = 2 : Ramp down to stop	○			
3	Emergency stop (EMS) input logic		1.	1.	2.	Emergency stop input logic is set. = 1 : Close to stop = 2 : Open to stop	○			
4	Emergency stop (EMS) mode		1.	1.	3.	Set the stopping method for the emergency stop. = 1 : Coast to stop without a fault output = 2 : Coast to stop with a fault output = 3 : Ramp down to stop	○			
5	Control source switchover method (J1 setting)		1.	1.	2.	Set whether to validate the remote auxiliary operation sequence for the local operation mode. = 1 : Disables = 2 : Enables	○			
6	Control source switchover method (J2 setting)		1.	1.	2.	Select the No. of auxiliary operation sequence input points when the COP command is ON. = 1 : Terminal block input = 2 : Serial input	○			
7	Run contact output condition selection		1.	1.	2.	The conditions for turning the sequence RUN output ON are set. = 1 : ON at pre-excitation = 2 : OFF at pre-excitation	○			
C01 – Start/stop frequency										
0	Start frequency	Hz	1.0	0.1	60.0			○		
1	Stop frequency (DC brake start)	Hz	1.0	0.1	60.0			○		

Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C02 – Various setting input selection										
0	Speed setting input points selection		4.	1.	4.	= 1 : Analog fixed = 2 : Serial/parallel fixed = 3 : Panel fixed = 4 : Sequence	○			
1	Traverse center frequency input points selection		2.	1.	3.	= 1 : Analog fixed = 2 : Panel fixed = 3 : Sequence	○			
2	Torque setting input points selection		3.	1.	4.	= 1 : Analog fixed = 2 : Serial fixed = 3 : Panel fixed = 4 : Sequence			○	○
3	Torque ratio 1 setting input points selection		2.	1.	3.	= 1 : Serial fixed = 2 : Panel fixed = 3 : Sequence			○	○
4	Torque bias 1 setting input points selection		3.	1.	4.	= 1 : Analog fixed = 2 : Serial fixed = 3 : Panel fixed = 4 : Sequence			○	○
5	Torque ratio 2 setting input points selection		2.	1.	3.	= 1 : Serial fixed = 2 : Panel fixed = 3 : Sequence			○	○
6	Drive/regenerative torque limit input points selection		3.	1.	3.	= 1 : Analog fixed = 2 : Serial fixed = 3 : Sequence			○	○
7	ASR response input points selection		2.	1.	3.	= 1 : Serial fixed = 2 : Panel fixed = 3 : Sequence			○	○
8	Machine time constant input points selection		2.	1.	3.	= 1 : Serial fixed = 2 : Panel fixed = 3 : Sequence			○	○

Block-C parameters (Basic function constants) list

No.	Parameter		Unit	Default	Min.	Max.	Function	Application			
								ST	V/f	VEC	PM
C03 – Sequence input terminal function – 1											
0	R·RUN	Reverse run		1.	0.	16.		○			
1	F·JOG	Forward jogging		2.				○			
2	R·JOG	Reverse jogging		3.				○			
3	HOLD	Hold signal		0.				○			
4	BRAKE	DC brake		0.				○			
5	COP	Serial transmission selection		0.				○			
6	CSEL	Ratio selection		0.				○			
7	IPASS	Ramp interlock bypass		0.				○			
8	PIDEN	PID control selection		0.				○			
C04 – Sequence input terminal function – 2											
0	CPASS	Ramp bypass		0.	0.	16.		○			
1	VFS	Speed setting 1		16.				○			
2	IFS	Speed setting 2		0.				○			
3	AUX	Speed setting 3		0.				○			
4	PROG	Program function enable		0.				○			
5	CFS	Serial communication setting select		0.				○			
6	S0	Program setting selection		0.				○			
7	S1	Program setting selection		0.				○			
8	S2	Program setting selection		0.				○			
9	S3	Program setting selection		0.				○			
C05 – Sequence input terminal function – 3											
0	SE	Program setting selection		0.	0.	16.		○			
1	FUP	Frequency (speed) increase		0.				○			
2	FDW	Frequency (speed) decrease		0.				○			
3	BUP	Ratio interlock bias increase		0.				○			
4	BDW	Ratio interlock bias decrease		0.				○			
5	IVLM	Ratio interlock bias increase/decrease selection		0.				○			
6	AUXDV	Auxiliary drive selection		0.				○			
7	PICK	Pick-up		0.				○			
8	EXC	Pre-excitation		0.						○	
9	ACR	ACR		0.						○	○
C06 – Sequence input terminal function – 4											
0	PCTL	P control		0.	0.	16.				○	○
1	LIM1	Drive torque limiter changeover		0.						○	○
2	LIM2	Regenerative torque limiter changeover		0.						○	○
3	MCH	Machine time constant changeover		0.						○	○
4	RF0	0 setting		0.						○	○
5	DROOP	Drooping changeover		0.						○	○
6	DEDB	Dead band setting		0.						○	○
7	TRQB1	Torque bias setting 1		0.						○	○
8	TRQB2	Torque bias setting 2		0.						○	○

Value	Input terminal
0	OFF fixed
1	PSI1
2	PSI2
3	PSI3
4	PSI4
5	PSI5
6	PSI6
7	PSI7
8	PSI8
9	PSI9
10	PL0 Program output
11	1 (For future use)
12	2
13	3
14	EMS
15	RUN
16	ON fixed

To use PSI6 to PSI9, the relay interface option must be provided.

Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C07 – Analog input terminal function										
0	Speed setting 1		2.	0.	7.		○			
1	Speed setting 2		3.	0.	7.		○			
2	Speed setting 3		0.	0.	7.		○			
3	Ratio interlock bias setting		0.	0.	7.		○			
4	Traverse center frequency		0.	0.	7.		○			
5	PID feedback		0.	0.	7.		○			
6	Torque setting		0.	0.	7.				○	○
7	Drive torque limiter reduction setting		1.	0.	7.	PAI4 to PAI6 Are for future.			○	○
8	Regenerative torque limiter reduction setting		1.	0.	7.				○	○
9	Torque bias 1 setting		0.	0.	7.				○	○
C08 – Automatic start setting										
0	Auto start (To F·RUN/R·RUN)		1.	1.	3.	= 1 : off = 2 : on without pick-up = 3 : on with pick-up (re-start after a momentary power loss)	○			
C09 – Parameter protection/operation locks										
0	Parameter protection		1.	1.	9.	Set to prevent unintentional operation from the operation panel (OPU). Set whether to enable or prohibit data changing for each parameter function unit as shown above.	○			
1	Operation panel lock		1.	1.	3.	= 1 : Enable control from Operation Panel = 2 : Disable control from Operation Panel (except for STOP key , if pressed for 2 seconds, will stop the drive) = 3 : Only STOP key is available	○			
2	LCL switchover protection		1.	1.	2.	= 1 : Disables switchover while the drive is running = 2 : Enables switchover while the drive is running	○			
3	Reveres run sequence (R RUN) prohibit		1.	1.	2.	Set this to prevent unintentional reverse run operation. When set to "2", the sequence input "R RUN" operation command will be disabled. Note that if the reverse run setting (negative value) is input into the speed setting during "F·RUN" operation, reverse run will start. = 1 : Enable = 2 : Prohibit	○			

Value	Input terminal
0	0% fixed
1	100% fixed
2	FSV
3	FSI
4	AUX
5	PAI4 (OP)
6	PAI5 (OP)
7	PAI6 (OP)

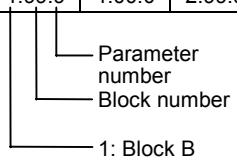
Parameter protection:

○ : Unprotected (changeable)
× : Protected (unchangeable)

value	Block A	Block B, C			
		Basic	Extn.	S/W	H/W
1	○	○	○	○	○
2	×	×	×	×	×
3	○	×	×	×	×
4	○	×	○	×	×
5	○	×	○	○	×
6	○	○	○	○	○
7 ~ 8	×	×	×	×	×
9	○	○	○	○	○

Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C09 – Parameter protection/operation locks										
4	Reverse run jogging sequence (R JOG) prohibit		1.	1.	2.	Set this to prevent unintentional reverse jogging operation. When set to “2”, the “R·JOG” operation command will be disabled. Note that if the reverse run setting (negative value) is input into the jogging setting during “F·JOG” operation, reverse run will start. = 1 : Enable = 2 : Prohibit	○			
5	Reverse run during ACR mode prohibit		1.	1.	2.	Set this to prevent unintentional reverse run operation. When set to “2”, reverse run during ACR operation will be prohibited. The reverse run speed will be limited to approx. 1% if reverse run is started. This setting is ignored in the V/f mode. = 1 : Enable = 2 : Prohibit			○	
6	Fault history buffer clear		0.	0	9999	Set 1 for the setting value to clear the fault history details. The clearing operation will not take place at a setting other than 1. 1: Clear fault history	○			
7	Default value load		0.	0	9999	9: All default values load (excluding maintenance) 10: Parameter A 11: Parameters B, C basic functions 12: Parameters B, C extended functions 13: Parameter B software option function Parameter C hardware option function 14: Parameters B basic functions 15: Parameters B extended functions 16: Parameter B software option function 17: Parameters C basic functions 18: Parameters C extended functions 19: Parameter C hardware option function	○			
C10 – Custom parameter register										
0	Custom– 0		1.99.9	1.00.0	2.99.9	Set for each parameter No. to be displayed and changed as an A04-0 to 7 custom parameter. **Example)** To set B13-0 (torque setting), set as 1.13.0.	○			
1	– 1									
2	– 2									
3	– 3									
4	– 4									
5	– 5									
6	– 6									
7	– 7									



Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application ST	V/f	VEC	PM
C11 – Operation panel mode setting										
0	Initial mode		1.	1.	2.	The initial operation mode for when the power is turned ON is set = 1 : Local = 2 : Remote	○			
1	Run command status		1.	1.	3.	The initial operation mode for when the power is turned ON, if using the automatic start function (when C08-0 =2 or 3) during the local operation mode (operation from operation panel) is set. If =2 is set, forward run will start when the run enable state is entered after the power is turned ON. = 1 : Stop = 2 : Forward run = 3 : Reverse run	○			
3	Operation panel monitor parameter		0.0	0.0	99.9	Set the monitor parameter No. to be displayed initially when the power is turned ON.	○			
C12 – Setting input terminal function										
0	FSV terminal input mode		1.	1.	3.	= 1: 0 ~ 10V, = 2: 0 ~ 5V, = 3: 1 ~ 5V	○			
1	FSI terminal input mode		1.	1.	2.	= 1: 4 ~ 20mA, = 2: 0 ~ 20mA	○			
2	AUX terminal input mode		1.	1.	3.	= 1: 0 ~ ±10V,= 2: 0 ~ ±5V,=3: 1 ~ 5V	○			
3	Filter time constant for FSV/FSI and AUX input		1.	1.	2.	= 1: 8ms = 2: 32ms	○			
4	AUX input gain		1.000	0.000	5.000		○			
C13 – Output terminal function										
0	FM output parameters		0.	0.	12.	Select the setting value from the following table, and output.	○			
1	AM output parameters		3.	0.	12 .		○			

The terminal voltage can be changed freely with parameters C14-0.1

Value	Parameter	Terminal voltage
0	Output frequency	10V at Max. frequency
1	Setting frequency Setting speed	10V at Max. frequency 10V at Max. speed
2	Ramp output	10V at Max. frequency 10V at Max. speed
3	Output current (Motor)	5V at Motor rated current
4	Output current (Drive)	5V at drive rated current
5	Output voltage	10V at Motor rated voltage
6	Motor output power	5V at (Motor rated voltage × Motor rated current)
7	DC voltage	5V at 300V (200V Series) 5V at 600V (400V Series)
8	OLT monitor	10V at 100%
9	Heat sink temperature	10V at 100°C
10	Motor speed	10V at Max. speed
11	Torque current	5V at Motor rated current
12	Excitation current	5V at Motor rated current

Note : 11: Torque current and 12 : Excitation current are available from CPU version : 114.0 and ROM version 115.0.

No.	Parameter	Unit	Default	Min.	Max.	Function	ST	V/f	VEC	PM
2	RC-RA output parameters		0.	0.	24.	Select the setting value from the following table, and output.	○			
3	PSO1 output parameters		3.	0.	24.		○			
4	PSO2 output parameters		7.	0.	24.		○			
5	PSO3 output parameters		8.	0.	24.		○			

Value	Output signal	Value	Output signal	Value	Output signal	Value	Output signal
0	RUN	8	ATN	16	ACC	24	ULMT
1	FLT	9	SPD1	17	DCC		
2	MC	10	SPD2	18	AUXDV		
3	RDY1	11	COP	19	ALM		
4	RDY2	12	EC0	20	FAN		
5	LCL	13	EC1	21	ASW		
6	REV	14	EC2	22	ZSP		
7	IDET	15	EC3	23	LLMT		

Block-C parameters (Basic function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C14 – Meter output gain										
0	Output gain for FM		1.00	0.20	2.00	10V at Max. frequency when this is set to 1.00. 5V at the rated current when this is set to 1.00. (Max. 11V)	○			
1	Output gain for AM		1.00	0.20	2.00		○			
2	Random scale display coefficient (Note 1)		30.00	0.01	100.00	Set the coefficient for the D00-4 and D01-5 random scale display.				
C15 – Status output detection level										
0	Attainment (ATN) detection width	%	1.0	0.0	20.0	The attained output (ATN) operation width is set.	○			
1	Current (IDET) detection level	%	100.	5.	300.	The current detection (IDET) operation level is set.	○			
2	Speed detection (SPD1) level – 1	%	95.0	1.0	105.0	The speed detection (SPD1, SPD2) operation level is set.	○			
3	Speed detection (SPD2) level – 2	%	50.0	1.0	105.0		○			
4	Zero speed detection (ZSP) level	%	1.00	0.00	50.00	The zero speed detection (ZSP) operation level is set.	○			

Note 1) C14-2 is available from CPU version 124.0 and ROM version 125.2 and above.

Block-C parameters (Extended function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C20 – Start interlock										
0	Start/stop frequency (speed)	%	0.0	0.0	20.0	The motor will stop when below this frequency setting.	○			
1	Start/stop frequency (speed) hysteresis	%	1.0	0.0	20.0		○			
2	Interlock frequency (speed)	%	0.0	0.0	20.0	The motor will not start when the setting is above this frequency. (When using with the setting start, set a value that is larger than the setting start frequency.) When C20-0=0, the setting start/stop will not operate. When C20-2=0, the setting interlock will not operate.	○			
3	RUN delay timer	sec	0.00	0.00	10.00		○			
C21 – Retry/pick-up										
0	Number of retries		0.	0.	10.		○			
1	Retry wait time	sec	5.	1.	30.		○			
2	Pick-up wait time	sec	2.	1.	10.		○			
3	Pick-up current limit value	%	100.	50.	300.	Do not set a value less than the excitation current.	○			
C22 – Overload										
0	Overload setting	%	100.	50.	105.	Note that when this parameter is changed, Parameters C22-1 and C22-2 will automatically be adjusted to the value of this setting.	○			
1	0Hz overload	%	100.	20.	105.	The maximum value is as set on C22-2.	○			
2	0.7Base freq.overload	%	100.	50.	105.	The minimum value is as set on C22-1.	○			
3	DBR overload	%	1.6	0.0	10.0	This parameter is for setting %ED of DBR operation. When DBR transistor or DBR built in the unit is used, set the parameter within the specification. When 0.0 is set, the protection function is disabled. When the external DB unit is used, set to 0.0. (Note 1)	○			
4	Motor power loss braking setting	%	50.	0.	70.	This function is valid when control mode selection is C30=1,2 or auxiliary drive is selected and DB option selection is C31-0=3,4	○			
	C22-0~2: The max. value differs according to the load characteristic selection (C30-0). When C30-0=2 (when variable torque is selected), these max. value is 100.									
C23 – Start/stop frequency·Overload (Auxiliary drive)										
0	Start frequency	Hz	1.0	0.1	60.0		○			
1	Stop frequency (DC brake start)	Hz	1.0	0.1	60.0		○			
2	Overload setting	%	100.	50.	105.	Note that when this parameter is changed, Parameters C23-3, 4 will automatically be adjusted to the value of this setting.	○			
3	0Hz overload	%	100.	20.	105.	The maximum value is as set on C23-4.	○			
4	0.7Base freq.overload	%	100.	50.	105.	The minimum value is as set on C23-3.	○			

Note 1) This parameter is available from CPU version : 114.0 and ROM version 115.0.

Block-C parameters (Extended function constants) list

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Parameter</th><th rowspan="2">Unit</th><th rowspan="2">Default</th><th rowspan="2">Min.</th><th rowspan="2">Max.</th><th rowspan="2">Function</th><th colspan="4">Application</th></tr>
<tr><th>ST</th><th>V/f</th><th>VEC</th><th>PM</th></tr>
<tr><td colspan="11">C24 – Speed detection error monitor</td></tr>
<tr><td>0</td><td>Over speed protection level</td><td>%</td><td>105.0</td><td>20.0</td><td>200.0</td><td>The over speed protection operation level is set.</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>1</td><td>Control mode change-over during speed detection error</td><td></td><td>1.</td><td>1.</td><td>3.</td><td>Select control at speed detection error
= 1 : Speed detection error not monitored
= 2 : Speed detection error monitored (Do not change to sensor-less vector control)
= 3 : Speed detection error monitored (Switch to sensor-less vector control)
Set whether to monitor speed detec-tion errors, such as wire breakage of the speed detector circuit, and to change over from vector control to sensor-less vector control.
When PM motor control (C30-0 = 5) is selected, the function changing over to sensor-less vector control is disabled. In this case, select 1 or 2.</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>2</td><td>Speed detection error level</td><td>%</td><td>10.0</td><td>10.0</td><td>100.0</td><td rowspan="2">The conditions for judging the speed detection error are set.
Set as C24-2 ≥ C24-3.</td><td></td><td></td><td>○</td><td>○</td></tr>
<tr><td>3</td><td>Speed detection error recovery level</td><td>%</td><td>5.0</td><td>1.0</td><td>100.0</td><td></td><td></td><td>○</td><td></td></tr>
<tr><td colspan="11">C25 – High-efficiency operation</td></tr>
<tr><td>0</td><td>Voltage reduction time</td><td>sec</td><td>10.0</td><td>0.1.</td><td>30.0</td><td>Set the time for the output voltage to drop from the V/f setting value to 0V.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>Voltage lower limit setting value</td><td>%</td><td>100.</td><td>50.</td><td>100.</td><td>When selecting a high-efficiency operation function, set 10 to 99.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Cooling fan ON / OFF control</td><td></td><td>2.</td><td>1.</td><td>2.</td><td>=1 : ON / OFF control is enabled. FAN is ON when inverter runs.
=2 : ON / OFF control is disabled. FAN is always ON. (Note 1)</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td colspan="11">C26 – Standard serial transmission setting</td></tr>
<tr><td>0</td><td>Parameter change protection</td><td></td><td>1.</td><td>1.</td><td>5.</td><td>The parameters with a ○ mark below can be changed.
<table><tr><th>Set-ting value</th><th>Block A Para-meter</th><th colspan="4">Block B, C Parameter</th></tr><tr><th></th><th></th><th>Basic</th><th>Extend</th><th>S/W</th><th>H/W</th></tr><tr><td>1</td><td>○</td><td>○</td><td>○</td><td>○</td><td>○</td></tr><tr><td>2</td><td>×</td><td>×</td><td>×</td><td>×</td><td>×</td></tr><tr><td>3</td><td>○</td><td>×</td><td>×</td><td>×</td><td>×</td></tr><tr><td>4</td><td>○</td><td>×</td><td>○</td><td>×</td><td>×</td></tr><tr><td>5</td><td>○</td><td>×</td><td>○</td><td>○</td><td>×</td></tr></table>○: Changeable × : Unchangeable</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>Station No.</td><td></td><td>1.</td><td>0.</td><td>32</td><td>Set the local station No.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>Response timer</td><td>sec</td><td>0.00</td><td>0.00</td><td>2.00</td><td>Set the minimum time from receiving command to returning an answer.</td><td>○</td><td></td><td></td><td></td></tr>
<tr><td colspan="11">Refer to Instruction Manual (ST-3298) for other details.</td></tr>
</table>

Note 1) This parameter is available from CPU version : 114.0 and ROM version 115.0.

Block-C parameters (H/W option function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C30 – Control mode selection										
0	Control mode selection		—	1.	5.	The control mode is set. = 1 : V/f control (constant torque: overload characteristics 150% for one minute.) = 2 : V/f control (variable torque: overload characteristics 120% for one minute.) = 3 : IM speed sensor-less vector control = 4 : IM speed vector control with sensor = 5 : PM motor control	○			
C31 – Main circuit option selection										
0	DBR option selection		1.	1.	4.	= 1 : Without motor power loss braking, Without DB = 2 : Without motor power loss braking, With DB = 3 : With motor power loss braking, Without DB = 4 : With motor power loss braking, With DB	○			
1	Ground fault detection function		1.	1.	2.	= 1 : Enabled = 2 : Disabled	○			
C32 – PC (parallel) interface										
0	Input mode (strobe)		1.	1.	3.	= 1 : 16-bit strobe = 2 : 8-bit time multiplexed strobe = 3 : 16-bit sample	○			
1	Input mode (input logic)		1.	1.	2.	= 1 : 1 at closed circuit = 2 : 1 at opened circuit	○			
2	Data format		1.	0.	10.	Set according to the following table.	○			

Setting data	Format	Setting resolution	Setting range
0	16-bit binary	0.01Hz/LSB (0.1rpm/LSB)	0 to 440.00Hz (0.0 to 6553.5rpm or Nmax)
1	16-bit binary	0.1Hz/LSB (1rpm/LSB)	440.0Hz (0 to Nmax rpm)
2	16-bit binary	0.01%/LSB	100.00%
3	16-bit binary	0.1%/LSB	100.0%
4	16-bit BCD	0.01Hz/LSB (0.1rpm/LSB)	99.99Hz (0.0 to 999.9rpm)
5	16-bit BCD	0.1 Hz/LSB (1rpm/LSB)	100.0Hz (0 to Nmax rpm)
6	16-bit BCD	0.01%/LSB	99.99%
7	16-bit BCD	0.1%/LSB	100.0%
8	8-bit binary	1/255%	100.0%
9	12-bit binary	1/4095%	100.0%
10	16-bit binary	1/65535%	100.0%

Hz = Frequency setting [For V/F control (constant torque, reduced torque) (C30-0 = 1, 2)]

rpm: Speed setting (For IM speed sensor-less vector control (C30-0 = 3); For IM speed vector control (C30-0 = 4); For PM motor control (C30-0 = 5))

Set this when the PC interface option (V23-PL0) has been mounted.
Refer to the instruction manual (ST-3303) for other details.

Block-C parameters (H/W option function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application ST	V/f	VEC	PM
C33 – Sequence output terminal function (Option)										
0	PSO4 Output parameters		5.	0.	24.	Set this when the relay interface option (V23-RY0) and PC interface option (V23-PI0) are mounted. Refer to Instruction Manual (ST-3301) for other details.	○			
1	PSO5 Output parameters		6.	0.	24.		○			

Value	Output signal
0	RUN
1	FLT
2	MC
3	RDY1
4	RDY2
5	LCL
6	REV
7	IDET

Value	Output signal
8	ATN
9	SPD1
10	SPD2
11	COP
12	EC0
13	EC1
14	EC2
15	EC3

Value	Output signal
16	ACC
17	DCC
18	AUXDV
19	ALM
20	FAN
21	ASW
22	ZSP
23	LLMT

Value	Output signal
24	ULMT

No.	Parameter	Unit	Default	Min.	Max.	Function	Application ST	V/f	VEC	PM
C34 – Serial interface										
0	Baud rate [bps]		1.	1.	6.	= 1 : 300 = 4 : 2400 = 2 : 600 = 5 : 4800 = 6 : 1200 = 6 : 9600	○			
1	Transmission system		1.	1.	2.	= 1 : 1 : 1 = 2 : 1 : N	○			
2	Parity check		1.	1.	3.	= 1 : None, = 2 : Even, = 3: Odd	○			
3	Parameter change protection		1.	1.	5	The parameters with a ○ mark below can be changed.	○			
4	Station No.		1.	0.	32.	Set the local station's station No.	○			
5	Response timer	sec	0.00	0.00	2.00	Set the minimum time from receiving the command to returning an answer.	○			

Set-ting value	Block A Para-meter	Block B, C Parameter Basic	Extend	S/W	H/W
1	○	○	○	○	○
2	×	×	×	×	×
3	○	×	×	×	×
4	○	×	○	×	×
5	○	×	○	○	×

○: Changeable × : Unchangeable

Set this when the serial interface option (V23-SL0) is mounted.
Refer to the instruction manual (ST-3304) for other details.

No.	Parameter	Unit	Default	Min.	Max.	Function	Application ST	V/f	VEC	PM
C35 – Profibus interface										
0	Station number		1.	0.	126.		○			
1	Transmission error detection		1.	1.	2.	=1 : Disable the detect =2 : Enable the detect (For future use)	○			

Note 1) This parameter is available from CPU version : 114.0 and ROM version 115.0.

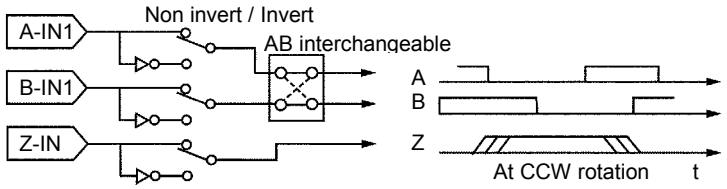
Block-C parameters (H/W option function constants) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
C50 – Encoder setting										
0	Encoder pulse divided output setting		4.	1.	1024.	The pulse input from the encoder can be divided in half, and output to an external source from PAOUT and PBOUT on the speed detection PCB (V23-DN1, -DN2). Adjust the setting value so that the output pulse is up to 70kHz.			○	
1	Encoder output pulse No. selection		1.	1.	2.	= 1 : 2-phase input = 2 : 1-phase input When using vector control with speed sensor, set whether the number of pulses input from the encoder is a 2-phase input or 1-phase input.			○	
2	Encoder ABZ pulse type selection		0.	0.	15.	Refer to Table C50-2			○	○

Table C50-2

Setting No.	A-IN1 Non invert / Invert	B-IN1 Non invert / Invert	Z-IN Non invert / Invert	AB inter-change
0	–	–	–	No inter-change
1	Invert	–	–	
2	–	Invert	–	
3	Invert	Invert	–	
4	–	–	Invert	
5	Invert	–	Invert	
6	–	Invert	Invert	
7	Invert	Invert	Invert	
8	–	–	–	AB inter-change
9	Invert	–	–	
10	–	Invert	–	
11	Invert	Invert	–	
12	–	–	Invert	
13	Invert	–	Invert	
14	–	Invert	Invert	
15	Invert	Invert	Invert	

●Note) "–" means Non invert●



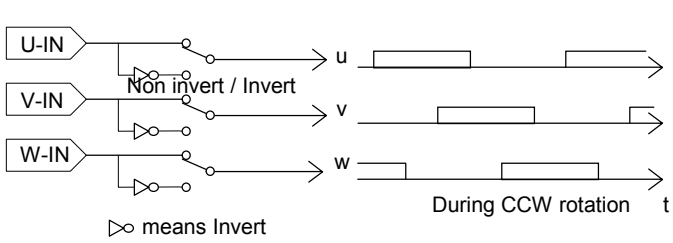
▷○ means Invert

C51 – Encoder setting (PM)										
0	Encoder UVW pulse type selection	–	0	0	7.	Refer to Table C51-0.				○
1	Z-IN → U phase winding phase angle	deg	0.0	0.0	359.9	Electrical angle from Z-IN to U phase				○
2	Z-IN → u pulse angle	deg	0.0	0.0	359.9	Electrical angle from Z-IN to u pulse				○

Table C51-0

Setting No.	U-IN Non invert / Invert	V-IN Non invert / Invert	W-IN Non invert / Invert
0	–	–	–
1	Invert	–	–
2	–	Invert	–
3	Invert	Invert	–
4	–	–	Invert
5	Invert	–	Invert
6	–	Invert	Invert
7	Invert	Invert	Invert

●Note)●–" means Non invert●



▷○ means Invert

6-5 Block-U parameters

Block-U parameters (Utility mode) list

No.	Parameter	Unit	Default	Min.	Max.	Function	Application			
							ST	V/f	VEC	PM
U00 – Parameter Control										
0	Parameter copy function		0.	0.	9999.	The parameter copy function is executed while the inverter is stopped. = 1001 : Save The parameter data is saved from the inverter to the operation panel. = 2002 : Load The parameter data is loaded from the operation panel to the inverter. If parameter data outside the setting range, such as for a different inverter capacity, could be loaded, the settings of the parameters not within the setting range may be uncertain. In this case, always turn the power OFF and ON once. If d.EHr appears when the power is turned ON, enter D20-2 and set the uncertain data. = 3003 : Verify check The operation panel and inverter parameter data contents are verified and checked. If the parameters differ, EP.EHr will appear. = 4004 : Clear The parameter data of operation panel is cleared. (Note 1)	○			

Note 1) This parameter is available from CPU version : 114.0 and ROM version 115.0.

6-6 Function explanation

A00-0 **Local frequency setting**

A00-2 **Local speed setting**

This is the frequency (speed) setting selected in the local operation mode ("LCL" LED lit).

The output frequency (speed) changes immediately according to the operation.

Refer to section 5-9-1 for details on selecting the speed setting.

A00-1 **Frequency setting for jogging**

A00-3 **Speed setting for jogging**

This is the frequency (speed) setting selected when executing jogging run with the sequence command F JOG or R JOG.
An acceleration/deceleration time exclusive for jogging can be set with parameters B10-2 and 3.

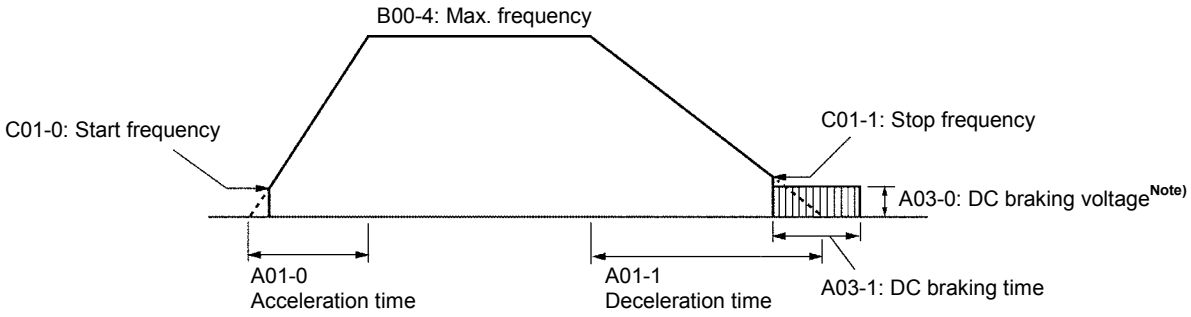
B10-2: Acceleration ramp time for jogging
B10-3: Deceleration ramp time for jogging

A01-0, 1 **Acceleration/deceleration times**

A03-0, 1 **DC brake**

C01-0, 1 **Start/stop frequency**

(V/f control: C30-0 = 1, 2)

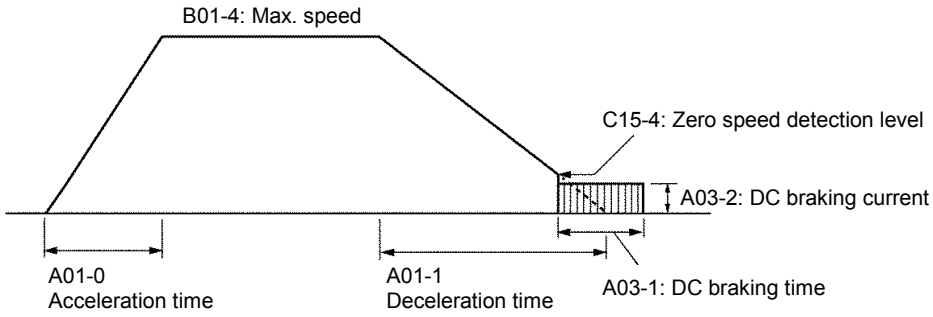


This is the acceleration/deceleration ramp time validated during normal use (when sequence command CSEL is OFF). The inverter may trip if the set time is too short.

Increase the DC braking voltage in units of 1% or less at a time while monitoring the output current. The inverter may trip if the setting is too high.

(Note) When automatic tuning is carried out, the DC braking voltage is automatically adjusted.

(IM vector control : C30-0 = 3, 4)
(PM motor control : C30-0 = 5)



A02-0 Manual torque boost selection

When manual torque boost is selected, the manual torque boost setting will be valid regardless of the automatic torque boost selection state.

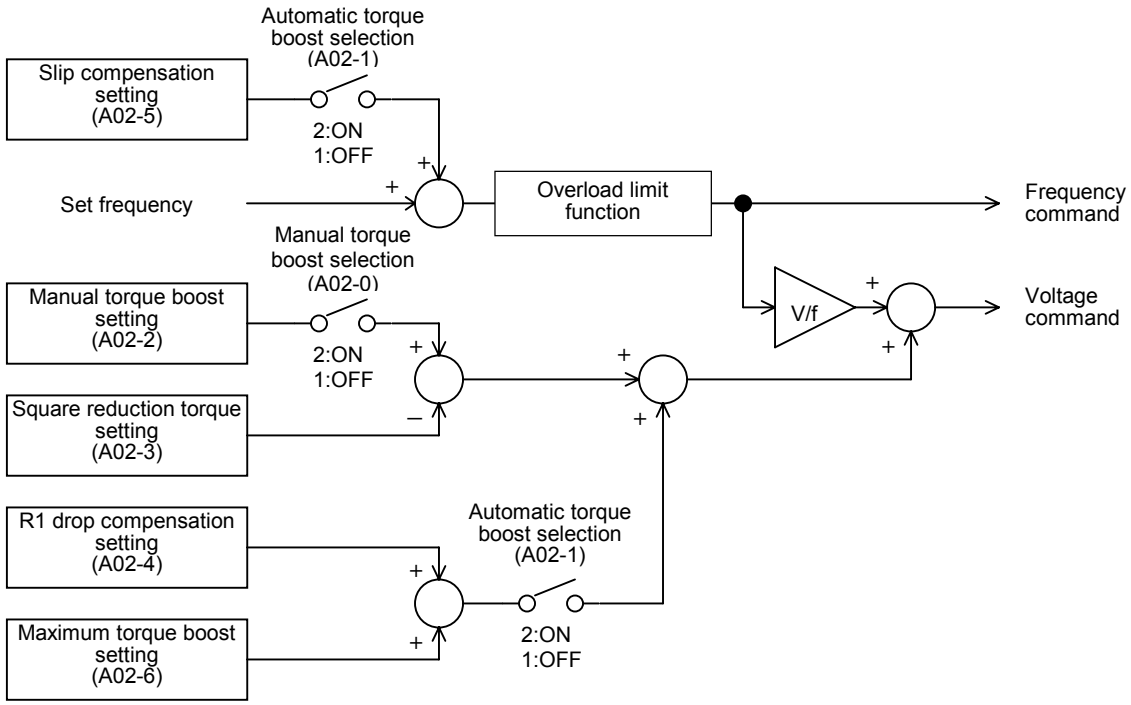
A02-1 Automatic torque boost selection

When automatic torque boost is selected, the R1 drop compensation, slip compensation and maximum torque boost functions will be valid.

(Note 1) To validate only the slip compensation function when manual torque boost is selected, set all settings other than the slip compensation function (A02-5) to 0 (set A02-3, 4, 6 to 0).

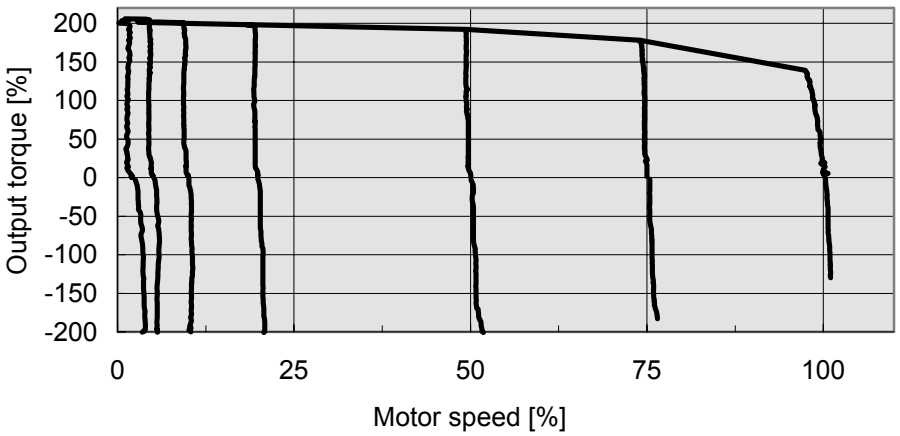
(Note 2) The square reduction torque setting is always valid regardless of the torque boost selection state.
To invalidate the square reduction torque setting, set (A02-3) to 0.

Torque boost selection block diagram



- **Automatic torque boost function**

  The automatic torque boost function carries out voltage boosting and slip compensation using the current detection value. This allows the torque to be improved when starting and at low speed regions. By carrying out automatic turning, the gain, etc., for the automatic torque boost function will be automatically adjusted. Using this function, a 200% starting torque can be output with the Meidensha standard 3-phase induction motor during a 150% output current. Even with a motor that cannot output a 200% torque due to design, the maximum torque of the motor can be output. The main characteristics with the Meidensha standard 3-phase induction motor are shown below.



<Meidensha standard 3-phase induction motor 1.5kW-4P>

⚠ CAUTION

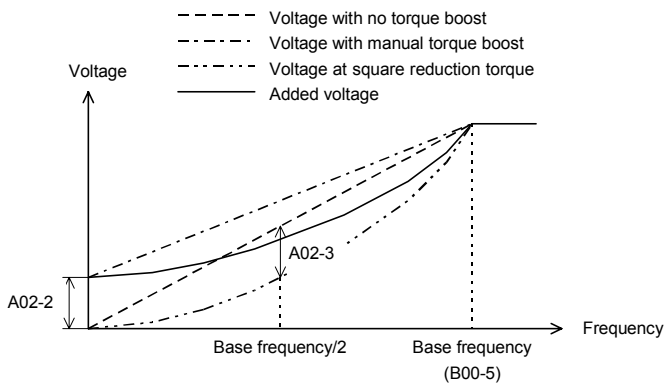
- When using only manual torque boost, carry out automatic tuning (B19-0 = 1).
- When using automatic torque boost, always carry out automatic tuning (B19-0 = 2).
- The maximum torque is not output instantly. It takes approx. 3 seconds for the maximum torque to be reached.
- If the motor vibrates abnormally, etc., the automatic torque boost cannot be used.
- If the parameters automatically set with automatic tuning are set manually, the motor rotation could become unstable.
- With a motor with which the base frequency greatly exceeds the commercial frequency, or with a motor with a large constant output range, the rotation may be unstable and a sufficient torque may not be output.
- When outputting the maximum torque continuously, consider the heat generated on the motor side, etc.

A02-2 **Manual torque boost setting [%]**

This is automatically set by automatic tuning.
When setting manually, set the boost voltage at 0Hz as a percentage in respect to the rated output voltage (B00-3).

A02-3 Square reduction torque setting [%]

Set the reduction torque at the base frequency (B00-5)/2 as a percentage in respect to the rated output voltage (B00-3).



(Note) When both A02-2 and A02-3 are set, the voltage will be added as shown below.

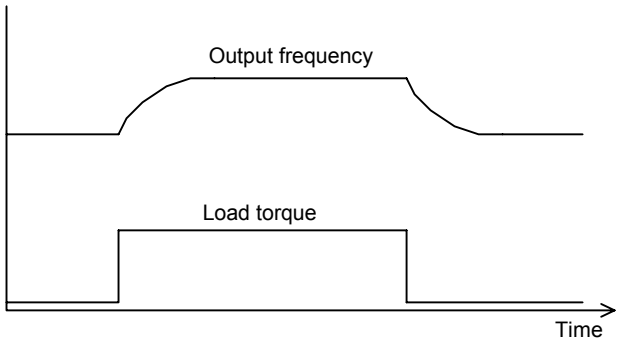
A02-4 R1 drop compensation gain [%]

Set how much to compensate the voltage drop caused by R1 (B02-0, 1: Motor primary resistance value) measured with automatic tuning. Normally set 100% of the default value.

(Note 1) If set too low, the sufficient torque may not be attained.

A02-5 Slip compensation gain [%]

This is automatically set by auto-matic tuning.
When setting manually, set the slip frequency for the motor rated load as a percentage in respect to the base frequency (B00-5).
The output frequency changes according to the motor rated torque as shown below.



(Note 1) This will not function in respect to the regenerative torque.
(Note 2) The output frequency will respond with a time constant of approx. 500ms in respect to the changes in the load torque.
(Note 3) When set too high, the motor rotation could become instable.

A02-6 Maximum torque boost gain [%]

This is automatically set by automatic tuning.
The optimum boost value for outputting the maximum torque is set as a percentage in respect to the rated output voltage (B00-3).
Normally, a value of 10 to 30% is set by automatic tuning.

(Note 1) When adjusted manually, the sufficient torque may not be attained.
(Note 2) If set too high, the rotation may become unstable and may trip.

A04-0~7

Custom parameters

C10-0~7: The parameters selected with the custom parameter selection can be displayed. Refer to section 4-7 for details.

A05-0~2

Block B, C parameter skip

The parameter display is skipped for each function in the extended functions, software option functions and hardware option functions.
Unnecessary displays can be reduced with this parameter, allowing operation to be simplified.
All displays are set to skip as the default.

A10-0

ASR response

This is used to calculate the gain of the ASR.
ASR gain :

$$\text{Kp} = \text{ASR response (A10-0) [rad/s]} \times \frac{\text{Machine time constant (A10-1 or B15-0) [ms]}}{1000}$$

ASR integral time constant :

$$\text{Ti} = \frac{4}{\text{ASR response (A10-0) [rad/s]}} \times \frac{\text{Compensation coefficient (A10-0)[\%]}}{100}$$

A10-1

Machine constant – 1

This is used to calculate the ASR gain. This is valid when the sequence input machine time constant changeover is OFF (MCH = OFF).

$$\text{TM [s]} = \frac{GD^2\ [\text{kgm}^2] * 1.027 * (\text{Nbase}[\text{min}^{-1}])^2}{375 * \text{Power [W]}}$$

TM : Machine time constant
GD^2 : Total GD of motor and load
Nbase : Base speed
Power : Motor rated output

A10-3
A10-4
A10-5
A11-2
A11-3

ASR drive torque limiter
ASR regenerative torque limiter
Emergency stop regenerative torque limiter
ACR drive torque limiter
ACR regenerative torque limiter

The output current is limited by the overcurrent limit value (B18-0) so the torque may not be generated to the value set with this parameter.

$$\frac{\sqrt{(\text{Exciting current})^2 \times (\text{Torque current})^2}}{\text{Motor rated current (B01-6)}} \times 100 \leq \text{B18-0}$$

B00-7
B01-7

Carrier frequency

The PWM carrier frequency and control method can be changed to change the tone of the magnetic sound generated from the motor. The relation of the setting range and control method is shown below.

1) For 0P4H→045H, 0P4L→037L
- 1.0 to 15.0 : Mono sound method (Actual carrier frequency: 1.0 to 15.0kHz)
- 15.1 to 18.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz)
- 18.1 to 21.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)

2) For 055H and larger, 045L and larger
- 1.0 to 8.0 : Mono sound method (Actual carrier frequency: 1.0 to 8.0kHz)
- 8.1 to 11.0 : Soft sound method 1 (Basic carrier frequency: 2.1 to 5.0kHz)
- 11.1 to 14.0 : Soft sound method 2 (Basic carrier frequency: 2.1 to 5.0kHz)

[Mono sound method]

This control method has a constant PWM carrier frequency. When a low carrier frequency is set, an annoying magnetic sound may be generated.

[Soft sound method]

This control method changes the PWM carrier frequency at a set cycle. As the frequency elements of the magnetic sound is dispersed, the tone is similar to a cicada. If the beat sound that is generated due to the operation frequency is annoying, there may be cases when the beat sound can be suppressed by changing between method 1 and 2.

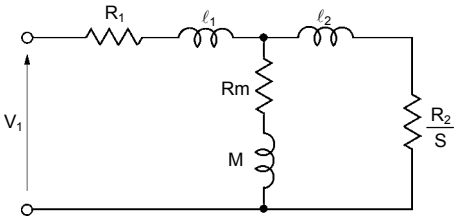
(Note 1) There are cases when the setting value and actual carrier frequency (reference carrier frequency for soft sound method) differ. Confirm the actual carrier frequency with D03-3.

(Note 2) There are cases when the effect of noise onto the inverter's peripheral devices can be reduced by lowering the carrier frequency.

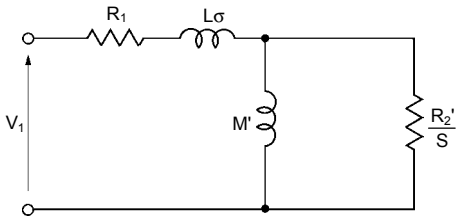
(Note 3) If set to higher than the specified carrier frequency, the output current must be deleted. Refer to Fig. 1-2 in Appendix 1 for details.

(Note 4) If the heat sink temperature 70°C is exceeded and the output current exceeds 90%, the carrier frequency will automatically change to 4kHz.

B02-0~9 Motor circuit constant (IM)



T-type equivalence circuit



T-I type equivalence circuit

$M' = M^2/(\ell_2 + M)$

$L\sigma = (\ell_1 + M) \quad M^2/(\ell_2 + M)$

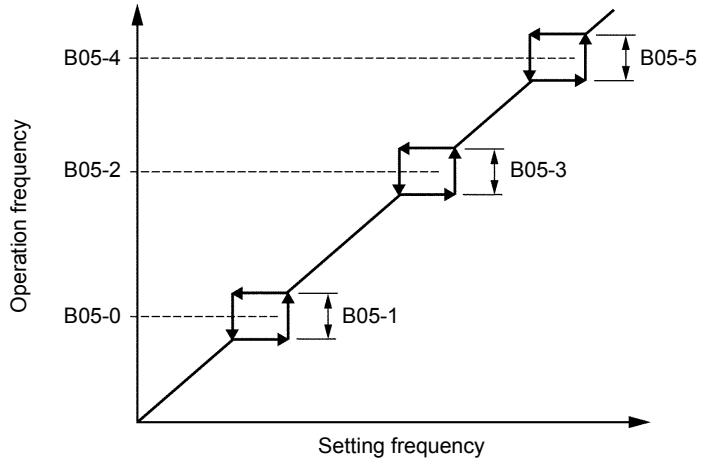
$R_2' = \left(\frac{M}{\ell_2 +}\right)^2 \cdot R_2$

B03-0~4 Motor circuit constant (PM)

Refer to section 6-9-3 for details.

B05-0~5 Frequency skip

By setting this parameter, the motor's mechanical resonance point at a specific frequency can be skipped.
Valid only during V/f control.



(Note) This function controls the frequency setting, so the above skip frequency area will be passed with a ramp function.

B06-0~6

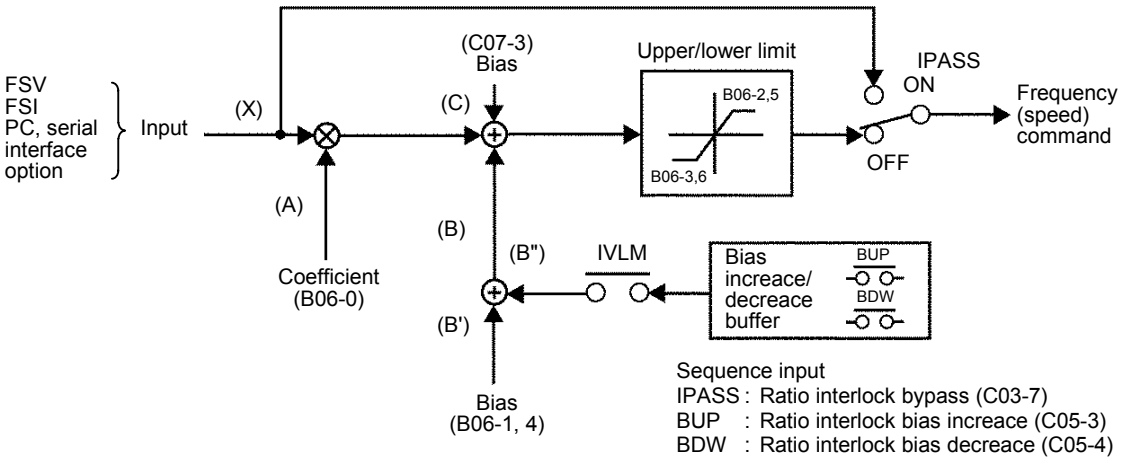
Ratio interlock setting

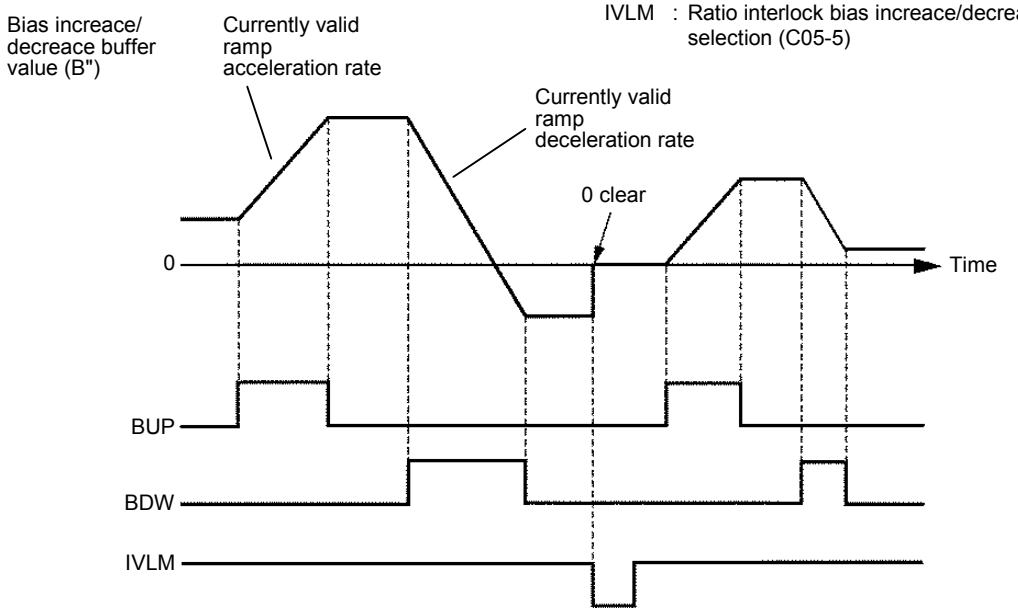
The ratio interlock operation executes the following expression and corresponds to each speed setting input signal.

Y = AX + B + C

X: Frequency (speed) setting input
Y: Frequency (speed) command (operation results)

A: Coefficient (B06-0)
B: Bias (B06-1, 4 where B" = 0)
C: Bias (C07-3)



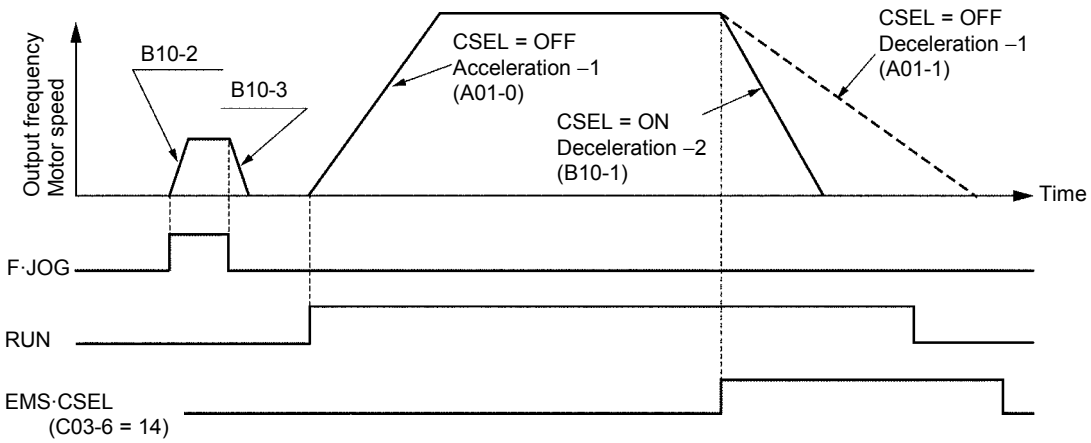


(Ratio interlock bias increace/decreace function)

When IVLM turns ON, the bias value increaced or decreaced by BUP/BDW is added to the ratio interlock bias value (B') as the above (B").
If BUP turns ON while IVLM is ON, the bias increace/decreace buffer value (B") increaces with the currently valid acceleration ramp rate. When BDV turns ON, the bias increace/decreace buffer value (B") decreaces with the currently valid deceleration ramp rate.
If both BUP and BDW turn OFF while IVLM is ON, the current bias increace/decreace buffer value (B") is held.
If IVLM turns OFF, the current bias increace/decreace buffer value(B") is cleared to zero, and the BUP and BDW operations are ignored.
Even when the operation command (RUN) turns OFF, the current bias increace/decreace buffer value (B") is cleared to zero. The BUP and BDW operations are also ignored in this case.

B10-0	**Acceleration ramp time –2**
B10-1	**Deceleration ramp time –2**
B10-2	**Acceleration ramp time for jogging**
B10-3	**Deceleration ramp time for jogging**

The ramp up/down time can be switched by turning the sequence command CSEL ON. Set the CSEL command input terminal with C03-6.
The ramp time for jogging can be set independently with B10-2 and -3.



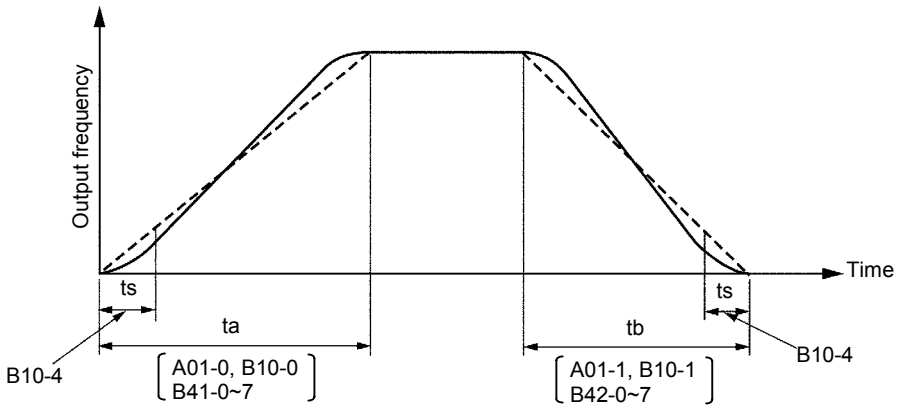
The above run example shows the case when the sequence command CSEL is connected to the EMS terminal (C03-6=14), and the run is decelerated with ramp down time –2 during emergency stop.

(Note) The ramp time is set as the acceleration/deceleration time for 0Hz ↔ maximum frequency (B00-4) and 0 ↔ maximum speed (B01-4) in either case.

B10-4

S-shape characteristics

Acceleration/deceleration with the S-shape pattern is possible by setting this parameter.



This parameter indicates the time of the section shown with ts above.
The total acceleration/deceleration times ta and tb will not change.
When this parameter is set, all acceleration and deceleration will be as shown above.

(Note) Set so that the relation of the B10-4 setting and acceleration/deceleration time is as shown below.

B10-4 Setting value (ts) × 2 ≤ acceleration/deceleration time (ta, tb)

B10-5

Time unit multiplier

The acceleration/deceleration time setting unit can be changed when an acceleration/ deceleration time in a wider range is to be set.

B10-5 = 1 (standard): × 1
2 : × 0.1
3 : × 10

This parameter will affect all acceleration/deceleration time parameters.

B11-0~7
B11-8

Program frequency (speed) setting
Selection mode setting

This is the frequency (speed) setting for when running program run (multi-step frequency (speed) setting) by turning the sequence command PROG ON. Set using the maximum frequency (B00-4,B20-2) and maximum speed (B01-4) as 100%.The following program frequency settings can be selected with the sequence commands S0, S1, S2, S3, SE and selection mode setting (B11-8) as shown below.

(1) For binary mode

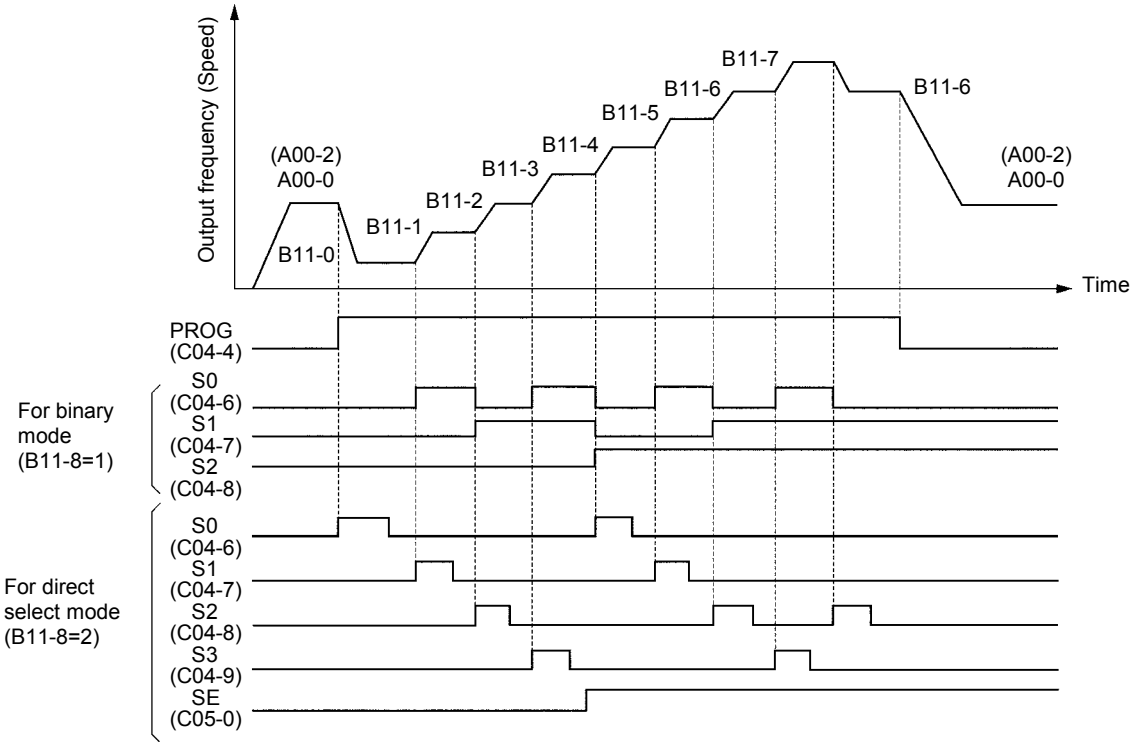
Sequence command					Selected frequency
SE	S3	S2	S1	S0	
*	*	OFF	OFF	OFF	B11-0
		OFF	OFF	ON	B11-1
		OFF	ON	OFF	B11-2
		OFF	ON	ON	B11-3
		ON	OFF	OFF	B11-4
		ON	OFF	ON	B11-5
		ON	ON	OFF	B11-6
		ON	ON	ON	B11-7

* : SE and S3 are not used.

(2) For direct select mode

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B11-0
OFF	OFF	OFF	ON	OFF	B11-1
OFF	OFF	ON	OFF	OFF	B11-2
OFF	ON	OFF	OFF	OFF	B11-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B11-4
ON	OFF	OFF	ON	OFF	B11-5
ON	OFF	ON	OFF	OFF	B11-6
ON	ON	OFF	OFF	OFF	B11-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held.
If there are no previous values because the power has been turned ON, etc., "0" will be set.



Program run example
(When RUN is ON)

Set the PROG command input terminal with C04-4. Set the S0, S1, S2, S3 and SE input terminals with C04-6~C05-0.

B13-0 **Torque setting**

Refer to section 5-9-2 for details on selecting the torque setting.

B13-1 **Torque ratio 1 setting**

Refer to section 5-9-5 for details on selecting the torque ratio 1 setting.

B13-2 **Torque bias 1 setting**

Refer to section 5-9-3 for details on selecting the torque bias 1 setting.

B13-3 **Torque ratio 2 setting**

Refer to section 5-9-6 for details on selecting the torque ratio 2 setting.

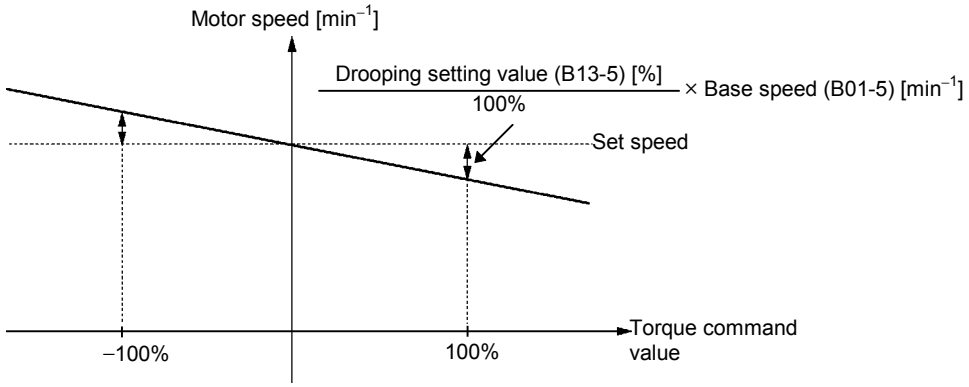
B13-4 **Double rating speed ratio setting**

Refer to section 5-9-4 for details.

B13-5 **Drooping setting**

Set the drooping value within the range of the following expression. If it becomes unstable, adjust the drooping setting value or the related parameters.

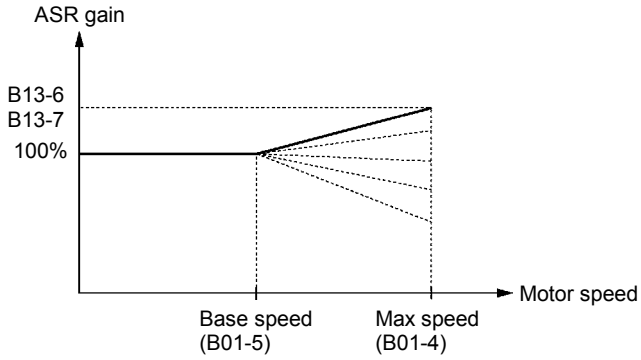
$$\frac{\text{Drooping setting value (B13-5) [\%]}}{100\ [\%]} \times \text{ASR response (A10-0) [rad/s]} \times \frac{\text{Machine time constant (A10-1 or B15-0) [ms]}}{1000} < 0.5$$



B13-6 **ASR gain compensation in constant power range**

B13-7 **ACR gain compensation in constant power range**

Increase or decrease each ASR gain and ACR gain in power constant speed range.



B14-0 **ASR dead band setting**

Refer to Fig. 5-1 for details.

B15-0 **Machine time constant 2**

This is used to calculate the ASR gain. This is valid when the sequence input machine time constant changeover is ON (MCH = ON).

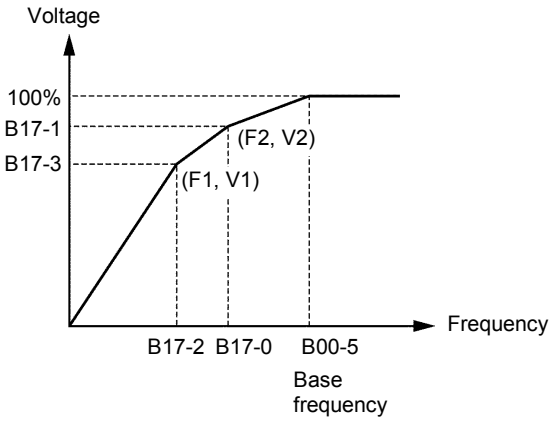
$$TM\ [s] = \frac{GD^2\ [kgm^2] * 1.027 * (Nbase[min^{-1}])^2}{375 * Power\ [W]}$$

TM : Machine time constant
GD^2 : Total GD of motor and load
Nbase : Base speed
Power : Motor rated output

B17-0~3 **V/f middle point**

A V/f characteristic as shown on the right can be obtained for motors having special V/f characteristics.

(Note) Set so that F1 ≤ F2 ≤ Base frequency (B00-5) and V1 ≤ 2.

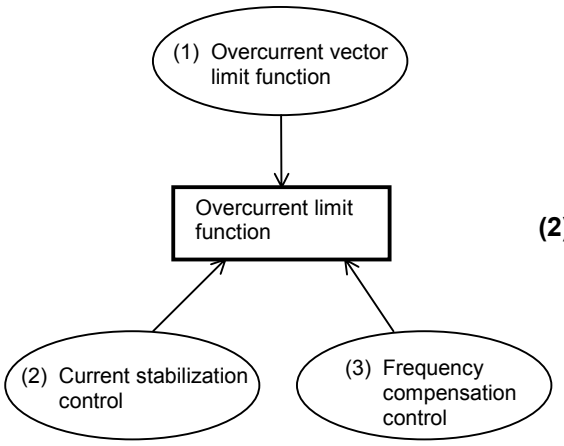


B18-0	**Over current limit**
B18-3	**Over current limit function gain**
B18-4	**Current stabilization gain**
B18-5	**Over current stall prevention gain**
B18-6	**Over current stall prevention time constant**

The over current limit is a function that lowers the output frequency and suppresses the current so that the motor current does not exceed this parameter setting value during starting or constant running. The setting uses the motor rated current (B00-6) as 100%. Normally, set the default value (150%).

(Note) Set a value larger than the motor no-load current.

The overcurrent limit function is configured of the following three control blocks.



(1) Overcurrent vector limit function

This uses the overcurrent as a vector, and generates a suppressing voltage vector instantly to suppress the current. The response is adjusted with the over current limit gain (B18-3).
Normally, set the default value (0.25).
If the setting value is increased, the response will become faster, but the operation may become unstable.

(2) Current stabilization control

This suppresses the sudden changes in the current phase during overcurrent suppression by controlling the output frequency. The response is adjusted with the over current stabilization gain (B18-4).
Normally, set the default value (0.25).
If the setting value is increased, the torque vibration will be reduced, but the operation may become unstable.

(3) Frequency compensation control

This feeds back the voltage suppressed with the overcurrent vector limit function to the frequency command and prevents stall. The response is adjusted with the over current stall prevention gain (B18-5) and over current stall prevention time constant (B18-6).
Normally, set the default value (B18-5 = 100, B18-6 = 100).
If the gain setting value (B18-5) is increased or the time constant value (B18-6) is decreased, the response will become faster, but the operation may become unstable.

(Note) The overcurrent limit function is valid at all times regardless of whether automatic tuning has been executed.

B18-1 **Regenerative current limit**

The regenerative torque to deceleration running is limited. Set to 10% when not using the DB option. When using the DB option, calculate the value with the following formula and set.

$$\text{B18-1 setting value} = \left[\left(\frac{V2}{\text{DBR resistance value}} \right) / \text{Motor capacity [kW]} \right] \times 100\ [\%]$$

where V2=148.2 for the 200V system and V2=593 for the 400V system.

B18-2 **Torque stabilization gain**

This function suppresses the hunting phenomenon that causes the current to abnormally vibrate during motor operation.
Normally, the default value (1.00) is set, and the setting value is increased appropriately according to the hunting.
Note that the hunting phenomenon occurs easily in the following cases.

- During a light load or no load
- When the system inertia is low
- When the motor's secondary time constant is high (high-efficiency motor)
- When carrier frequency is high

(Note) The hunting phenomenon at a frequency exceeding 66Hz cannot be suppressed.

B19-0 **Automatic tuning function**

Refer to section 3-6 for details.

B35-0 **Demagnetizing control operation voltage allowance (PM motor control)**
B35-1 **Demagnetizing current limit value (PM motor control)**
B35-2 **Demagnetizing current control proportional gain (PM motor control)**
B35-3 **Demagnetizing current control integral time constant (PM motor control)**

Refer to section 6-9-5 for details.

B35-4 **Flux temperature fluctuation compensation range (PM motor control)**
B35-5 **Flux temperature fluctuation compensation time constant (PM motor control)**

Refer to section 6-9-6 for details.

B36-0~4 **Demagnetizing current table 0 to 4 (PM motor control)**

Refer to section 6-9-4 for details.

B40-0~1

Software option function

The program cushion, pattern operation, traverse operation, PID and multi-pump functions can be selected as the software option functions.
The validity of these functions is selected with B40-0, 1. Two or more functions cannot be used simultaneously. Select one function from B40-0 to 1.

B40-0 = 1: The following functions are not used.
2: Program ramp function use (B41-0~B42-7)
3: Pattern run function use (B50-0~B59-3)
4: Traverse function use (B45-0~6)

B40-1 = 1: The following functions are not used.
2: PID use (B43-0~4)
3: PID, multi-pump control use (B43-0~B44-3)

The parameters related to each function are shown in parentheses.

B41-0~7	**Program ramp – acceleration**
B42-0~7	**Program ramp – deceleration**

The motor can be run with program frequency (speed) setting 0 to 7 using the sequence commands PROG and S0, S1, S2, S3, SE and selection mode setting (B11-8). The program ramp time can also be switched at this time and the motor run.
If PROG is OFF, only the program ramp time can be changed with S0, S1, S2, S3 and SE.
The ramp time selected with S0, S1, S2, S3 and SE is as shown below.

(1) For binary mode (B11-8 = 1)

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
*	*	OFF	OFF	OFF	B41-0 B42-0
		OFF	OFF	ON	B41-1 B42-1
		OFF	ON	OFF	B41-2 B42-2
		OFF	ON	ON	B41-3 B42-3
		ON	OFF	OFF	B41-4 B42-4
		ON	OFF	ON	B41-5 B42-5
		ON	ON	OFF	B41-6 B42-6
		ON	ON	ON	B41-7 B42-7

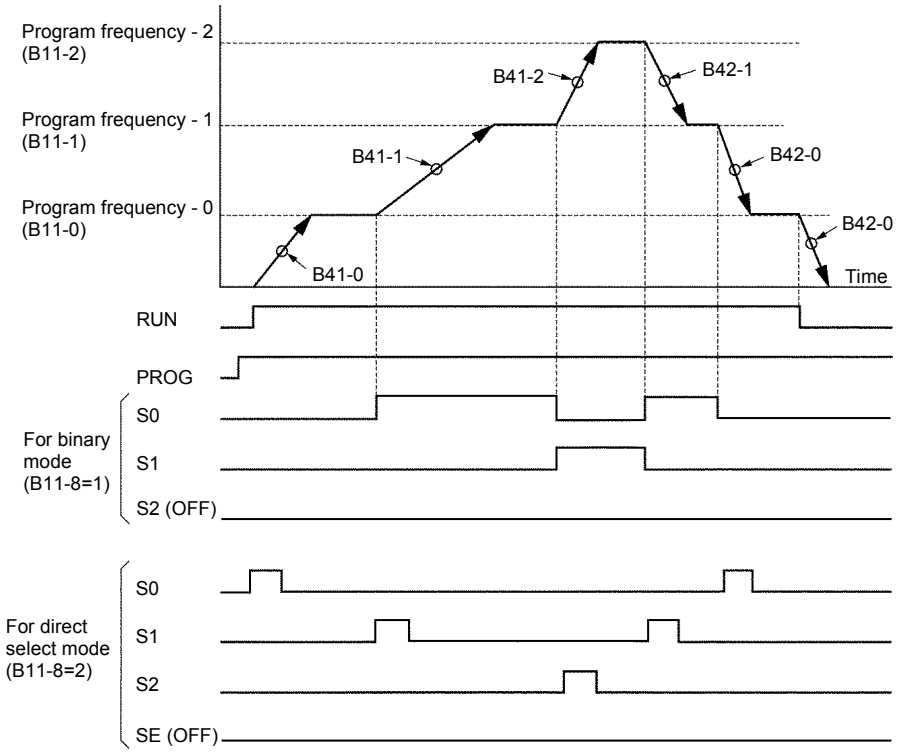
* : SE and S3 are not used.

(2) For direct select mode (B11-8 = 2)

Sequence command					Selected frequency
SE	S3	S2	S1	S0	
OFF	OFF	OFF	OFF	OFF	Previous values
OFF	OFF	OFF	OFF	ON	B41-0 B42-0
OFF	OFF	OFF	ON	OFF	B41-1 B42-1
OFF	OFF	ON	OFF	OFF	B41-2 B42-2
OFF	ON	OFF	OFF	OFF	B41-3 B42-3
ON	OFF	OFF	OFF	OFF	Previous values
ON	OFF	OFF	OFF	ON	B41-4 B42-4
ON	OFF	OFF	ON	OFF	B41-5 B42-5
ON	OFF	ON	OFF	OFF	B41-6 B42-6
ON	ON	OFF	OFF	OFF	B41-7 B42-7

When S0 to S3 are all OFF, or when two or more are set between S0 and S3, the previous values will be held.
If there are no previous values because the power has been turned ON, etc., "0" will be set.

An example of combination with the program frequency (speed) setting is shown below.

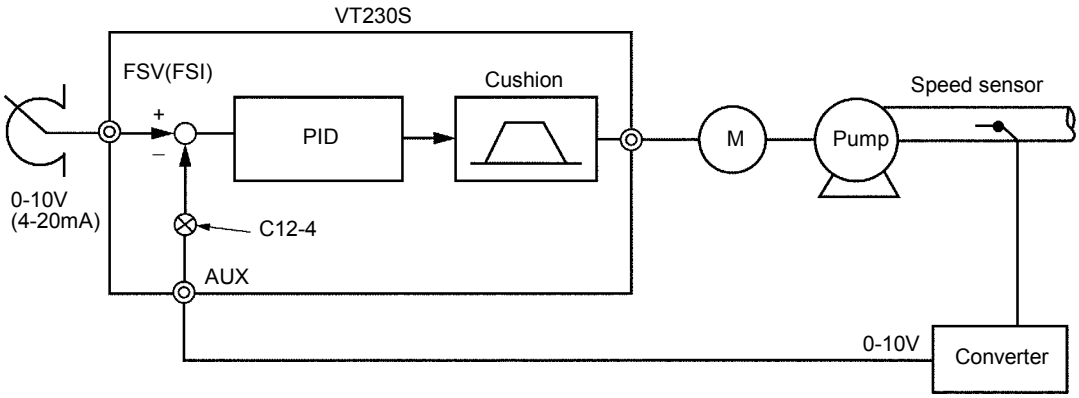


(Note) The acceleration/deceleration ramp time-2 (B10-0, 1) will be selected by turning the sequence command CSEL ON even when using the program ramp (B40-0=2).

B43-0~4

PID control

The foiiowing type of feedback loop can be configured by using the analog input (FSV,FSI,AUX) for feedback.

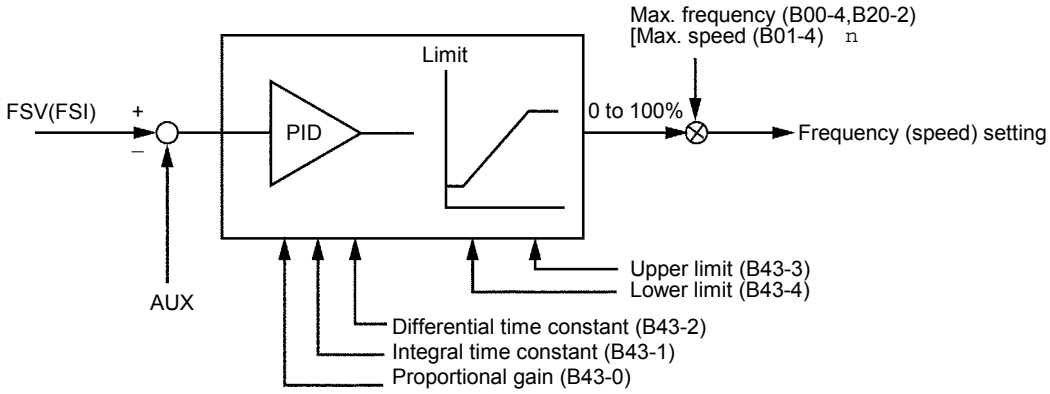


Example of PID control configuration

(Note 1) PID control functions only in the remote mode (LCL OFF). It does not function during the local mode (LCL ON). In this case, the normal operation mode is entered.

(Note 2) PID control functions in respect to the sequence command RUN. It does not function in respect to the sequence commands JOG or BRAKE.

The PID operation block is shown below.



(1) To validate or invalidate PID control during operation, turn the sequence input command PIDEN ON or OFF. The sequence input command PIDEN is assigned to the sequence input terminals with C03-8.

(2) Refer to Fig. 5-9 and select the setting input. The setting input can be changed between the parameter setting and sequence input.
If the setting value is a Hz unit, the percentage conversion value using the maximum frequency (B00-4,B20-2) as 100% will be input.

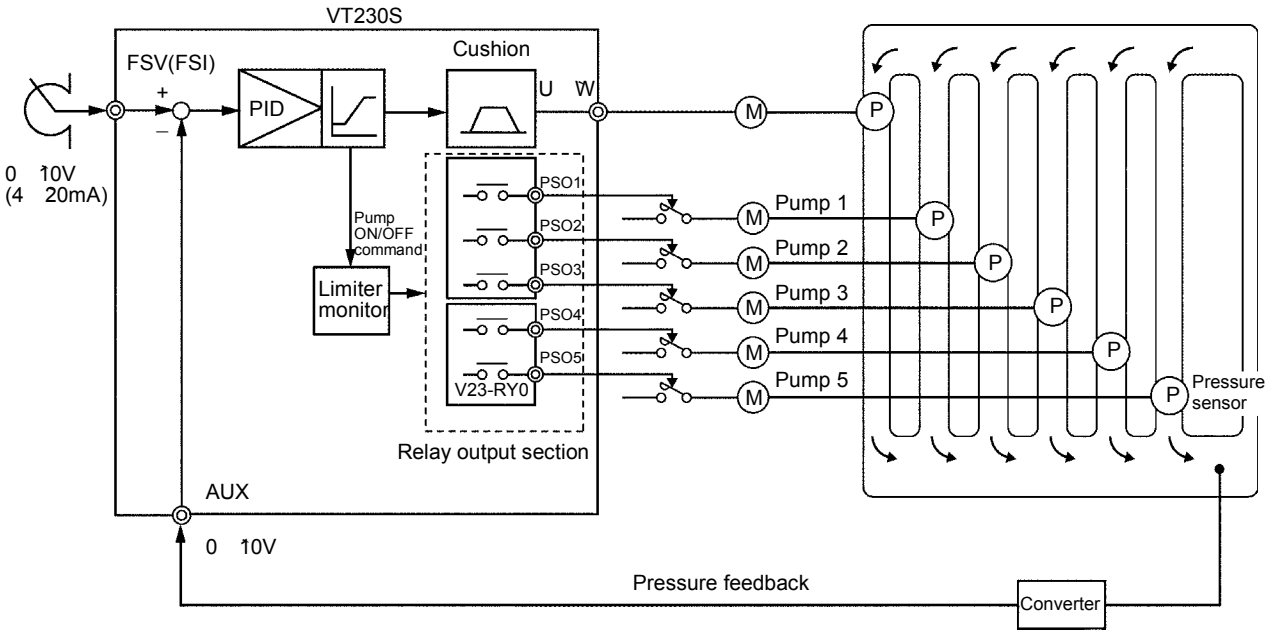
(3) Set the analog input to be used as the feedback input with C07-5.
Also set the level of the analog input to be used with C12-0 to 4.
When using the AUX input, set the feedback input between 0 and 10V when C12-2 is 1, and between 0 and 5V when C12-2 is 2.

(4) The internal signal (lower limit over: LLMT, upper limit over: ULMT), which indicates that the feedback value has exceeded the upper limit (B43-3) and lower limit (B43-4) can be output as a sequence. Set either 23 or 24 for C13-2 to 5.

B44-0~3

Multi-pump control

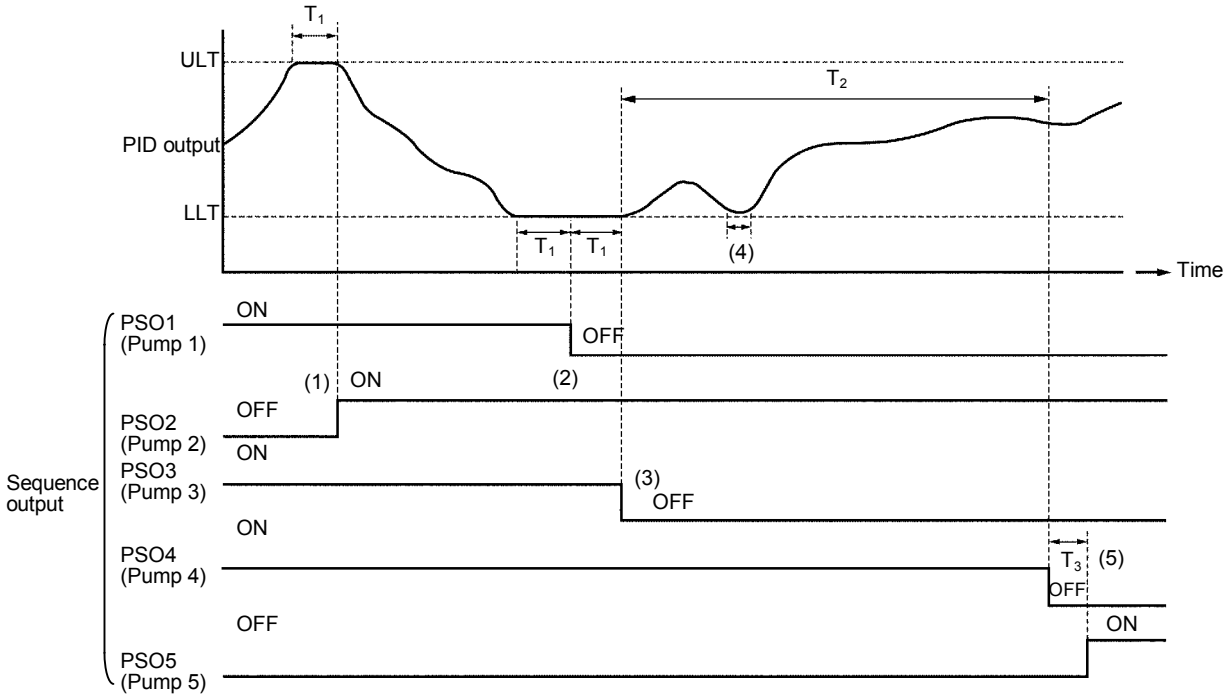
Multi-pump controls refers to operating up to six pumps (one variable speed control pump, and up to five ON/OFF control pumps) in parallel using five relay outputs provided in the inside of one VT230S and VT230S. The pressure in the flow passage is controlled to be constant.
The pressure step of the ON/OFF controlled pumps is interpolated by a pump that is variable-speed controlled by the VT230S, which has the PID control function. This maintains the pressure's continuation.
The relay outputs used for the pump's ON/OFF control are the VT230S standard relay output PSO1 to 3 (open collector output) and the relay interface option (V23-RY0) relay output PSO4 to 5 (contact output). The system configuration is shown below.



Example of system configuration
(When operating five ON/OFF control pumps)

1) Multi-pump control operation

An example of actual operation for the multi-pump control is shown below.



ULT : PID output upper limit value in VT230S.
LLT : PID output lower limit value in VT230S.
T_1 : Holding time
T_2 : Continuous operation time limit
T_3 : Changeover time

ON/OFF control pump changeover operation (when operating five pumps)

The ON/OFF control of multiple pumps is carried out so that the operation time of each pump is equal.

(1) When the PID output reaches ULT and T_1 is passed, the pump 2 (PSO2) with the shortest operation time turns ON.

(2) When the PID output reaches LLT and T_1 is passed, the pump 1 (PSO1) with the longest operation time turns OFF.

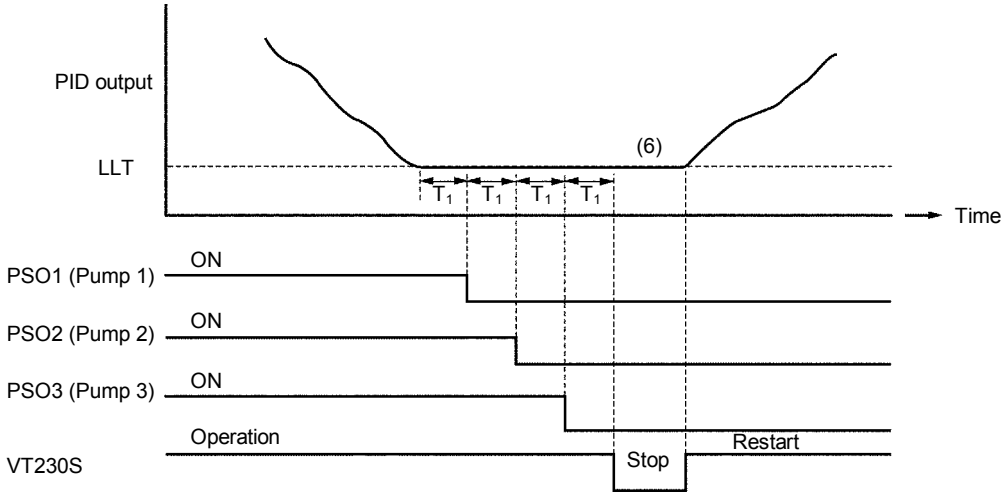
(3) Following (2), when the PID output matches LLT for the time of T_1, the pump 3 (PSO3) with the longest operation time turns OFF.

(4) When the time that the PID output and LLT match dose not reach T_1, the pump OFF control will not be carried out.

(5) If the time that the pump's ON/OFF control is not carried out reaches T_2, the pump 4 (PS04) with the longest operation time will turn OFF, and the pump 5 (PSO5) with the shortest operation time will turn ON after T_3.

Other restrictions related to the pump's ON/OFF control are given below.

(6) When the PID output reaches LLT, the pumps will sequentially turn OFF from the pump having the longest operation time following the restriction (2) in the previous page. However, if there are no pumps to turn OFF, the VT230S will stop. When the PID output rises and leaves LLT, the VT230S will resume operation. The FWD and REV LEDs will flicker during the automatic stop operation.



VT230S automatic operation/stop (when there are three ON/OFF control pumps)

(7) When the operating command (RUN) for the inverter turns OFF, all commands for the pump will simultaneously turn OFF.

(8) If a fault occurs in the inverter, the following operation will take place.
- As long as the operation command (RUN) ON state is held, the pump's ON/OFF command will be held. Equalization of each pump's operation time will also be continued.
- When the operating command (RUN) turns OFF, all commands for the pump will simultaneously turn OFF.

(9) When the inverter's power is turned OFF, the operation time history for each pump will be lost.

2) Preparation for operation

(1) Set the number of pumps to be ON/OFF controlled in parameter B44-0.
One to five pumps can be set. The relation of the pump No. recognized in the inverter and the relay output terminals is as follows.

Pump No.	Relay output terminals	
1	Standard	PSO1
2		PSO2
3		PSO3
4	Option	PSO4
5		PSO5

The pumps are turned on in the order of pump No. 1 to 5.
The relay outputs not being used for ON/OFF control can be used as normal programmable outputs, and the internal status signal of the VT230S can be output. (C13-3 to 5,C33-0 to 1)
If there are for to five pumps, V23-RY0 must be used.
Refer to the Instruction Manual (ST-3302) for details on V23-RY0.

(2) The PID control function is used with the multi-pump control. Refer to the explanation on B43-0 to 4 for details on setting the PID control related parameters (B43-0 to 4), selecting the pressure command input, and selecting the feedback input.
Multi-pump control is always carried out in the remote mode (LCL OFF).
The operating command is issued from the external sequence input terminal (RUN, R·RUN).
Turn the sequence input command PIDEN ON to validate PID control.

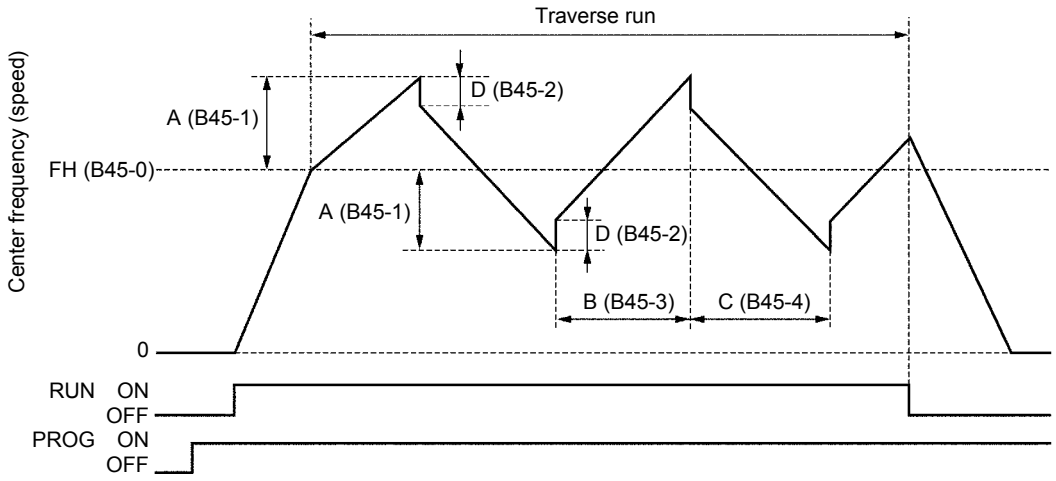
(3) Refer to the operation explanation drawing in section (1) and set the parameters B44-1 to 3.

(4) By using the setting interlock function (C20 = 0 to 3), the VT230S run/stop can be controlled by the pressure command input (FSV, FSI). In this case, the operation command (RUN, R·RUN) is always ON.
Refer to the explanation on C20-0 to 3.

B45-0~6

Traverse run

Traverse is operation in which the frequency fluctuates with the pattern shown below. This is effective for evenly winding up the thread on a bobbin in a weaving system.



1) Traverse run

(1) To carry out traverse run, turn the sequence command PROG ON. (Normal operation will take place if PROG is OFF.)

(2) If the sequence command RUN or R RUN is turned ON, first, the frequency (speed) will increased as high as the center frequency (speed) in ramp mode(A01-0) at the center frequency (speed), and then traverse run will start.

(3) When RUN (or R RUN) is turned OFF, the frequency(speed) will decreased to a stop in ramp mode (A01-1) .

(4) During traverse operation, overcurrent limit (OCL) and overvoltage limit (OVL) will not function. However, these will function while accelerating or decelerating during start or stop.

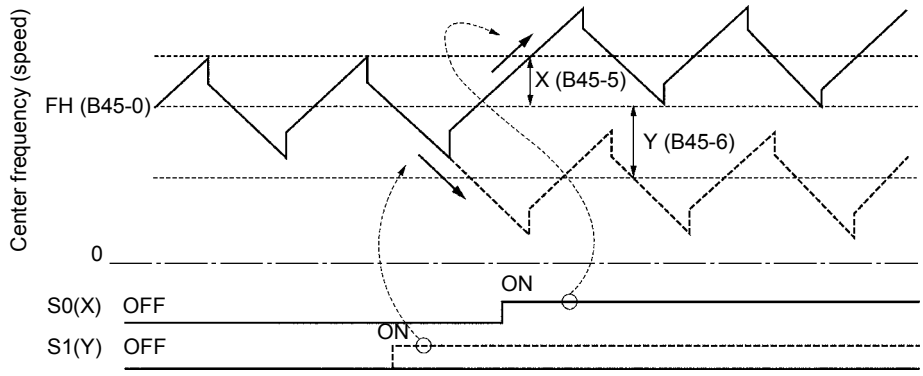
(5) The traverse center frequency (rotation speed) input point can be selected with C02-1.

C02-1 = 1: Analog fixed (C07-4)
= 2: Panel fixed (B45-0)
= 3: Sequence (S0, S1)

When using traverse run, set B11-8 to 1 (selection mode setting: binary mode).
If C02-1 is set to 1, the setting from an external source selected with C07-4 will be the center frequency (speed).
When C02-1 is set to 3, and traverse run is being carried out by turning the PROG command ON, the following operations 2) and 3) will take place when the sequence command S0 and S1 signals are input.

2) Deviated traverse X, Y operation

The deviated traverse operation shown below takes place with the sequence commands S0 (X) and S1 (Y) when carrying out traverse operation with the PROG command ON.



The center frequency (speed) rises by X (B45-5) only while S0 (X) is ON.
The center frequency (speed) lowers by X (B45-6) only while S1 (Y) is ON.
The rising and lowering timing is the traverse rising and lowering extension operation as shown above.

Deviated traverse (X, Y) operation

3) Changing the center frequency (speed) with settings from an external source

While the PROG command is ON and the traverse operation is taking place, when the sequence commands S0 and S1 both turn ON, the center frequency value (speed) value will be the value set from an external source selected with C07-4.
If only S0 or S1 is ON, the deviated traverse X, Y operation explained in section 2) will take place.
If both S0 and S1 are turned ON, the center frequency (speed) will be the value set from the external terminal. However, the frequency will first return to the center frequency (speed) before rising or lowering to the newly set value. After that, the same operation will take place even when the setting value is changed from an external source.

4) Precautions for application

(1) If the parameter No. B45-0 to 6 setting data is changed during traverse operation, the output frequency (speed) will return to the center frequency (speed) once. Then, traverse operation based on the newly set data will take place.
When returning to the center frequency (speed), the output frequency (speed) will change in ramp mode (A01-0, 1).

(2) The overcurrent limit (OCL) and overvoltage limit (OVL) functions will not activate during traverse operation, so carefully consider the inverter capacity, motor capacity and traverse related setting values when designing the system.

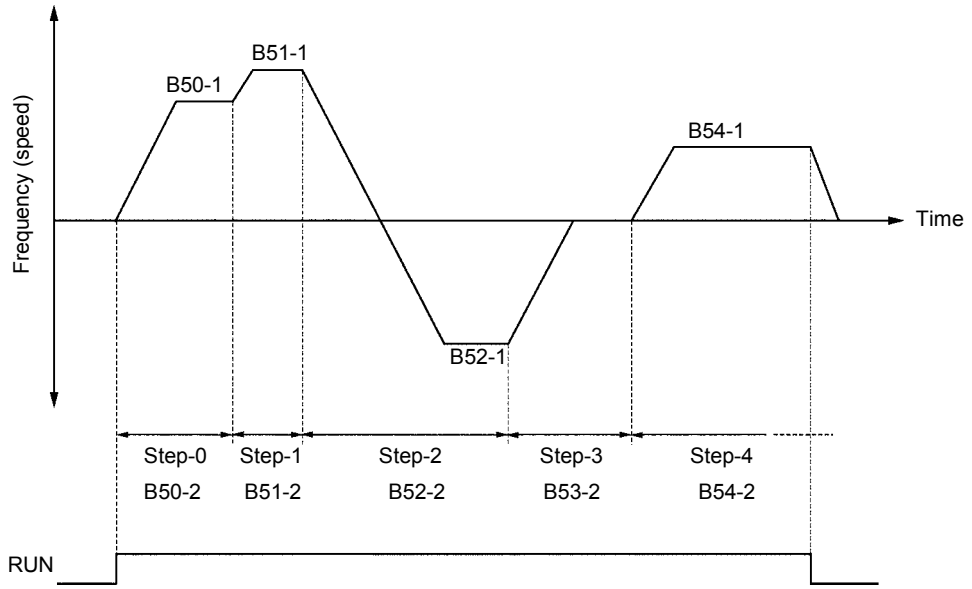
(3) The output frequency (speed) is limited between 5.00 and 100.00% during traverse operation.

(4) When carrying out deviated traverse, take care not to turn the S0(X) and S1(Y) commands ON simultaneously.
If turned ON simultaneously, the 3) center frequency (speed) will change.

B50-0 ~B59-3

Pattern run function

The frequency (speed), run direction and time can be changed automatically with the pattern run function.



(1) A max. of ten patterns can be set. Program in the B50-B59 blocks as shown below. The speed setting input point is selected with C02-0 = 4 (sequence).
n is the step No. from 0 to 9.

B5n-0: Run mode
= 0: Stop
= 1: Forward run
= 2: Reverse run
= 3: Final step (set when repeating before B59)

B5n-1: Run frequency (speed) [%]

B5n-2: Run time [sec.]

B5n-3: Return destination step
= 0 ~ 8
(Set the No. of the step to be executed next when B5n-0 = 3.)

(2) The sequence command functions will be as shown below during pattern running.

RUN: Pattern run starts when this turns ON, and operation starts from the run frequency (speed) and operation time applied when the operation was previously stopped. The inverter will stop when this is turned OFF.

(Note 1) The pattern running operates with the remote mode (LCL OFF).
(Note 2) The R·RUN, F·JOG, and R·JOG commands are invalid during pattern running.

S0: Proceeds to the next step at the edge from OFF to ON. (Skip)
By turning this signal ON/OFF with S1 ON (hold), the step can be proceeded in synchronization with the peripheral machine regardless of the internal timer.

S1: The internal timer operation will stop when ON. (Hold).
Use this to pause the pattern run.

S2: When this is turned ON, the operation will be reset to step 0.

The S0 and S1 functions are valid only when RUN is ON. The S2 function is not related to the ON/OFF setting of RUN, and is valid at all times.
When the mode is changed to the local mode (LCL ON), this will be reset to step 0.
During pattern run, set B11-8 to 1 (selection mode setting: binary mode).

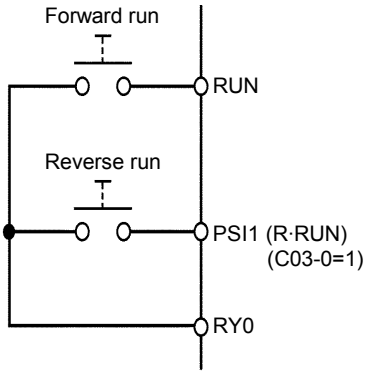
(3) When using pattern run, the sequence status output (D04-4) ACC and DCC functions will change as shown below.

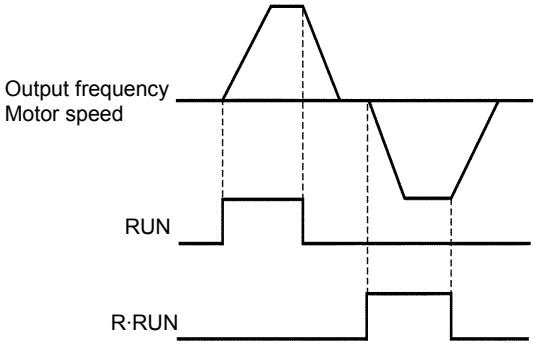
ACC: Turns ON when the last step of the pattern run is being executed. (EOS)

DCC: Operates with the reverse logic of the above ACC. (EOS)

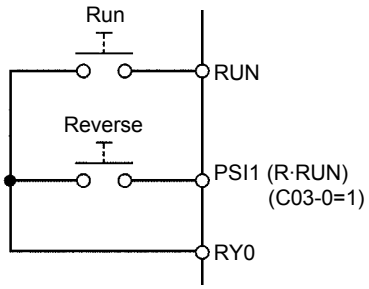
C00-0 **Run command method**

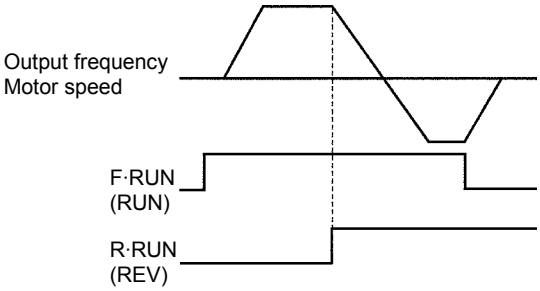
= 1: F·RUN, R·RUN



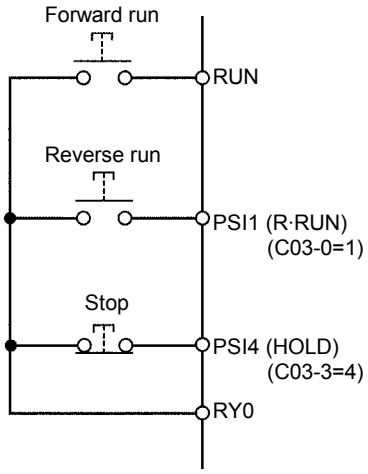


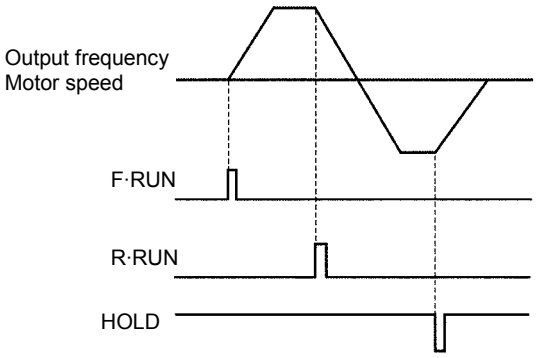
= 2: RUN, REV





= 3: Self hold



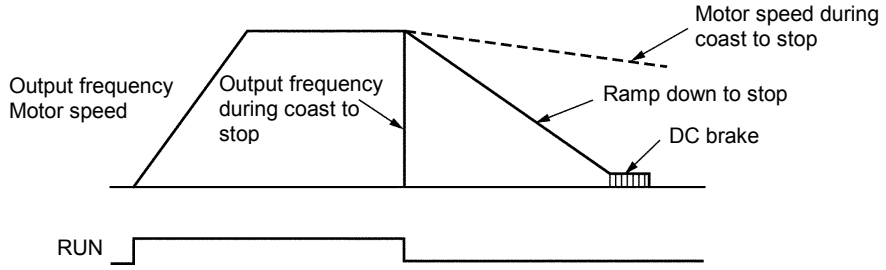


C00-1 **RUN/STOP methods**

C00-2 **Jog stop method**

= 1: Coast to stop
= 2: Deceleration stop

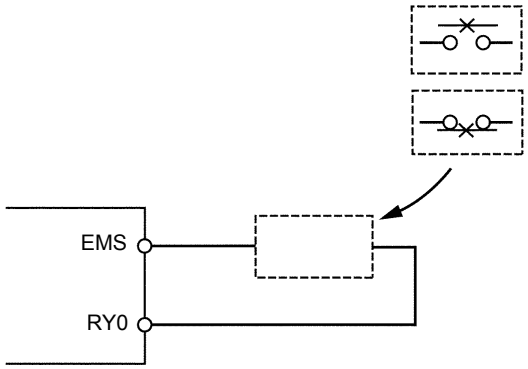
Coast to stop refers to stopping by turning the output OFF simultaneously with the stop command (RUN and R·RUN OFF).
Deceleration stop refers to stopping by decelerating to the stopping frequency with the ramp down after the stop command, and then applying the DC-brake to stop.



(Note) To restart after coast to stop, confirm that the motor has stopped. The inverter may trip if attempted when the motor is running. (For V/f control)

C00-3 **Emergency stop (EMS) input logic**

= 1: Close to stop (when a contact is connected)
= 2: Open to stop (when b contact is connected)



C00-4 **Emergency stop (EMS) mode**

= 1: Coast to stop, without fault output
= 2: Coast to stop, with fault output (When the EMS signal turns ON, the output will be shut off, and FLT will be output.)
= 3: Ramp down to stop (without fault output)

C00-5 **Control source switchover method (J1 setting)**

J1 setting =1: OFF =2: ON
Select whether to use the terminal block input signals with the local operation mode.
Refer to section 5-5 for details.

C00-6 **Control source switchover method (J2 setting)**

J2 setting =1: OFF =2: ON
Select the auxiliary command input when the COP command is ON.
Refer to section 5-5 for details.

C02-0~8 **Various setting input selection**

Refer to section 5-9 for details.

C03-0~7 **Sequence input terminal function – 1**
C04-0~9 **Sequence input terminal function – 2**
C05-0~9 **Sequence input terminal function – 3**
C06-0~8 **Sequence input terminal function – 4**

Refer to section 5-3, 5-6 for details. Refer to the explanation for B06-0 to 6 (ratio interlock bias increace/decreace function) for details on C03-7 and C05-3 to 4.

C07-0~9 **Analog input terminal function**

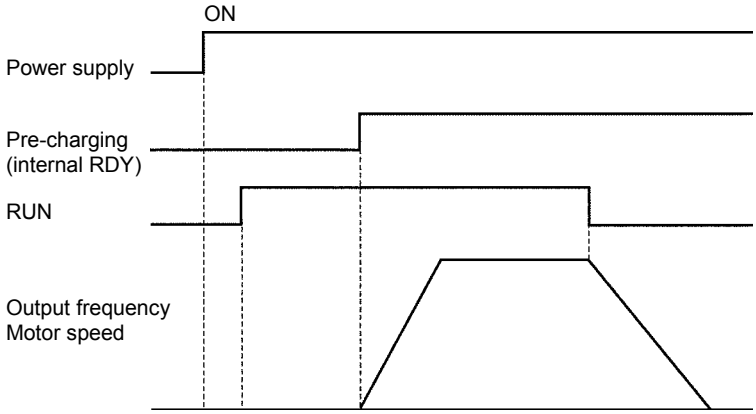
Refer to section 5-7 for details.

C08-0 **Automatic start setting**

= 1: OFF (runs with the run command ON after pre-charging)

= 2: ON without pick-up

If the run command is ON when the power is turned on, run will start after the inverter is charged.

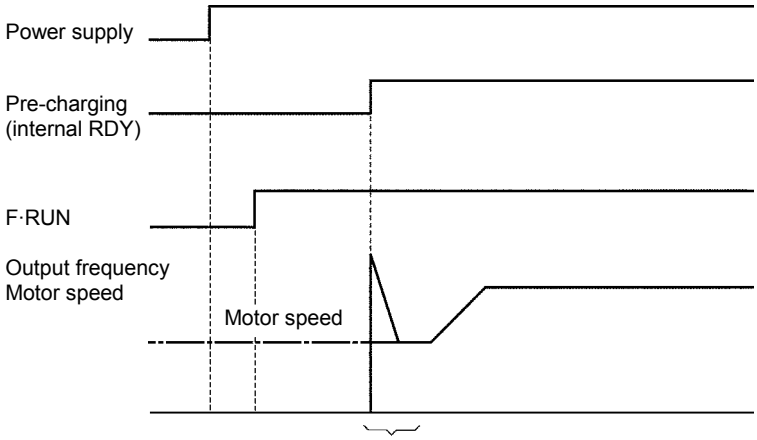


= 3: ON with pick-up

If the run command turns ON when the power turns ON, pick-up will start when the inverter charging is completed, and then operation will start.

Set this when using momentary restart.

The speed can be detected with the IM vector control with sensor and PM motor control (C30-0 = 4, 5). As pickup operation is not carried out, set C08-0 to 2.



(For V/f control, IM speed sensor-less vector control C30-0=1,2,3)

(Note) If auto start is used, undervoltage fault will not be detected. However, EC0~3 will output the undervoltage code.

C09-0 Parameter protection

Set this parameter to prevent unintentional operations from operation panel.
Changing of the data can be protected per function group with the setting value as shown below.

○ : Unprotected (changeable)
× : Protected (unchangeable)

value	Block A	Block B, C			
		Basic	Extn.	S/W	H/W
1	○	○	○	○	○
2	×	×	×	×	×
3	○	×	×	×	×
4	○	×	○	×	×
5	○	×	○	○	×
6	○	○	○	○	○
7 ~ 8	×	×	×	×	×
9	○	○	○	○	○

(Note 1) Set 2 to prohibit all changes.
(Note 2) Set 1 to allow all changes. The 9 setting is for maker maintenance, so do not set it.

C09-1 Operation panel lock

[FWD] , [REV] , [STOP] key operations are protected.
= 1: All operation possible
= 2: All operation prohibited
Note, the motor will stop when the [STOP] key is pressed for two seconds
= 3: Only [STOP] key can be operated.

C09-2 LCL switchover protection

= 1: LCL mode switchover ([STOP] + [SET]) during running disabled
(Note) Even when stopped, if the terminal block's RUN, R.RUN, F.JOG or R JOG is ON, switchover to remote is not possible.
= 2: LCL mode switchover ([STOP] + [SET]) during running enabled

C09-6 Fault history buffer clear

The fault history details can be cleared by setting the value to 1 and then pressing [SET] key. This setting will not be registered in the internal memory. Thus, this parameter must be set each time.
Nothing will occur if set to a value other than 1.
Use this before handing the unit over to the final user.

C09-7

Default value load

All values per function group are changed to the default values.

9: All default values load (excluding maintenance)
10: Parameter A
11: Parameters B, C basic functions
12: Parameters B, C extended functions
13: Parameter B software option function
Parameter C hardware option function
14: Parameters B basic functions
15: Parameters B extended functions
16: Parameter B software option function
17: Parameters C basic functions
18: Parameters C extended functions
19: Parameter C hardware option function

Nothing will occur when values other than the above are set.
This parameter setting value will not be registered in the internal memory.

(Note) The setting values exceeding 2000 are codes for maker maintenance, so do not set. If set, the following inverter operation may be abnormal.

C10-0~7

Custom parameter register

Set the No. of Block B, C parameter to be displayed on A04-0~7.
To set block B parameter B10-1, set as 0.10.1.
To set block C parameter C14-0, set as 1.14.0.
Refer to section 4-7 for details.

C12-0

FSV terminal input mode

C12-1

FS1 terminal input mode

C12-2

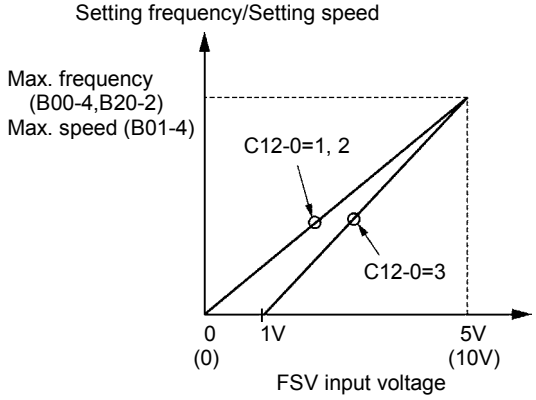
AUX terminal input mode

C12-3

Filter time constant for FSV/FSI and AUX input

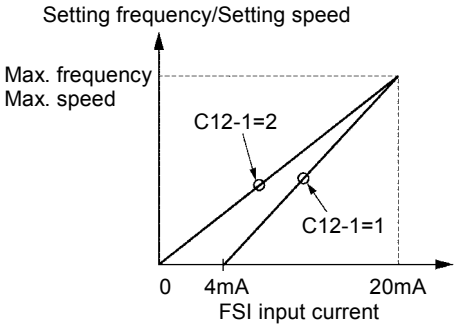
As an example, the relation of the analog input value and speed setting value when using FSV, FSI and AUX as the speed setting 1 (C07-0 = 2 to 4) is shown below. Refer to Table 5-5 for the relation of the analog input value and each setting value when using as the torque setting or ratio interlock bias setting, etc.

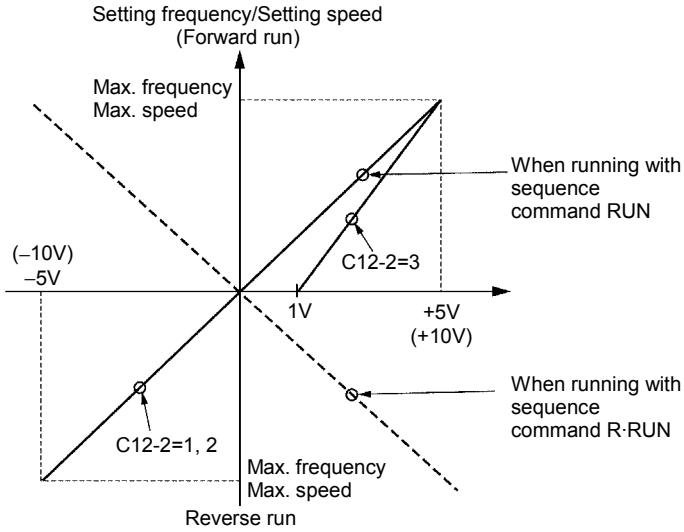
C12-0 = 1: 0~10V
= 2: 0~5V
= 3: 1~5V



C12-1 = 1: 4~20mA
= 2: 0~20mA

C12-2 = 1: 0~±10V
= 2: 0~±5V
= 3: 1~5V





C12-3 = 1: 8ms
= 2: 32ms

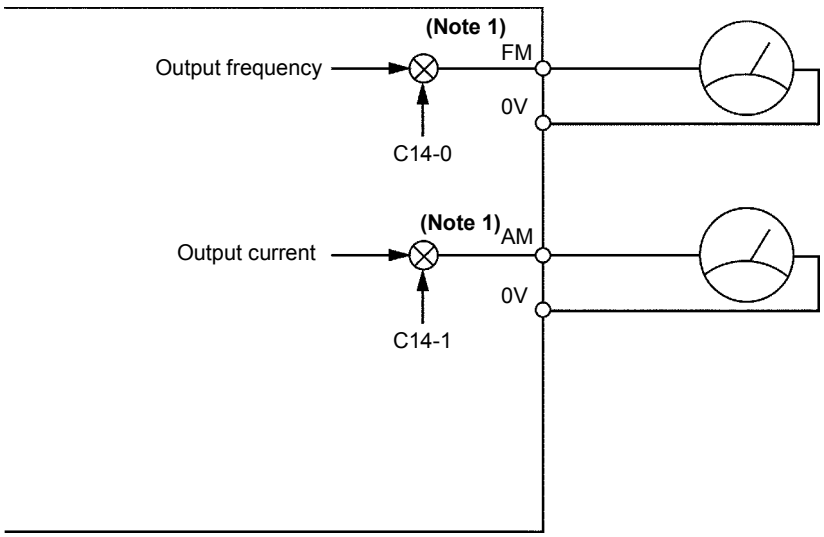
Fluctuation of the setting value caused by noise, etc., can be suppressed by increasing the time constant.

C13-2~5 **PSO output terminal parameter**

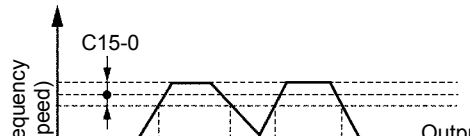
Refer to section 5-6-1 for details.

C14-0 **Output gain for FM**

C14-1 **Output gain for AM**



(Note 1) The maximum output voltage of the FM and AM outputs is approx. 11V.
Thus, even if a large value is set in C14-0 and 1, a voltage exceeding 11V will not be output.

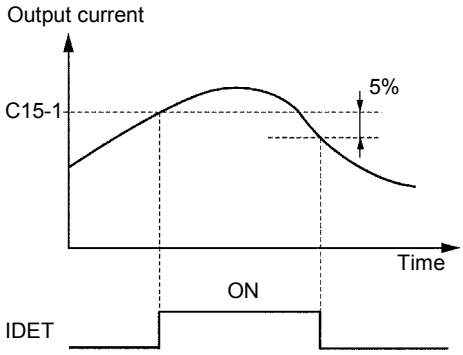


C15-0 **Attainment (ATN) detection width**

The attained output ATN operation width is set.

C15-1 **Current (IDET) detection level**

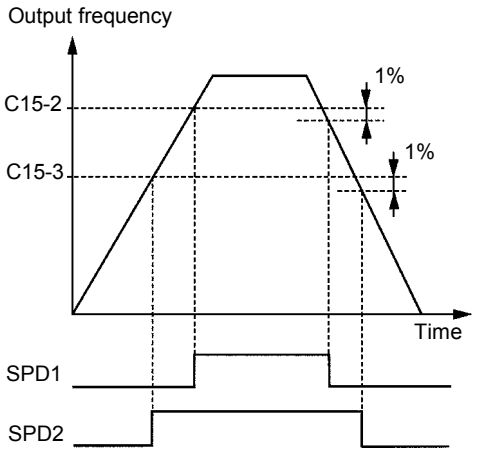
The current detection (IDET) operation level is set. Set with a percentage of the rated current (B00-6, B01-6).
A 5% hysteresis will occur with the IDET operation.



C15-2 **Speed detection (SPD 1) level – 1**

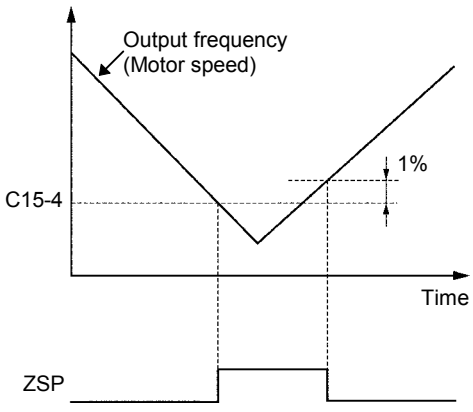
C15-3 **Speed detection (SPD 2) level – 2**

The speed detection SPD 1 and 2 operation level is set.
Set with a percentage to the max. frequency (B00-4) or max. speed (B01-4).
The output frequency or the motor speed will be the comparison target.
A 1% hysteresis will occur with SPD1 and 2 operation.



C15-4 **Zero speed detection (ZSP) level**

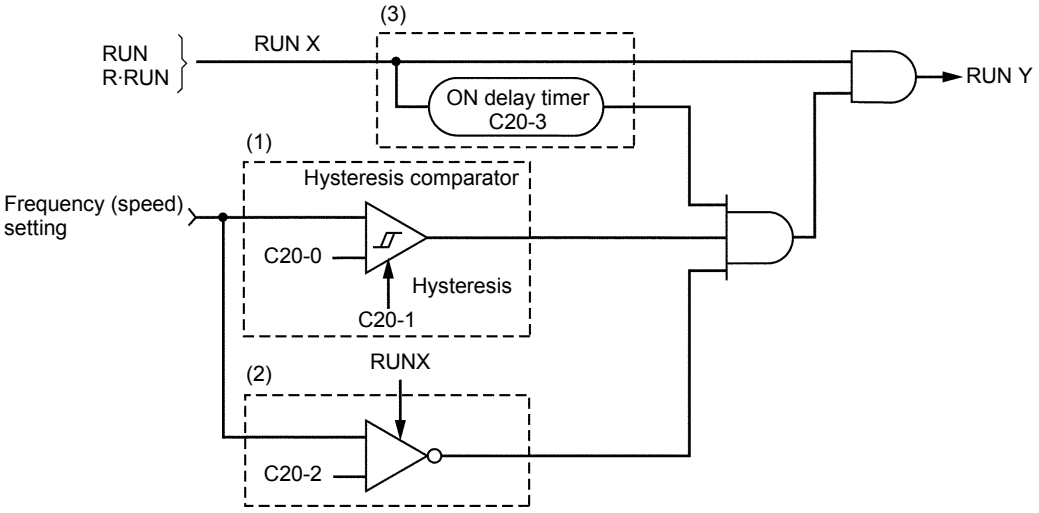
The zero speed detection ZSP operation level is set.
Set with a percentage to the max. frequency (B00-4) or max. speed (B01-4).
The output frequency or the motor speed will be the comparison target.
A 1% hysteresis will occur with ZSP operation.



C20-0
C20-1
C20-2
C20-3

Start/stop frequencies (speeds)
Start/stop frequency (speed) hysteresis
Interlock frequency (speed)
Run delay timer

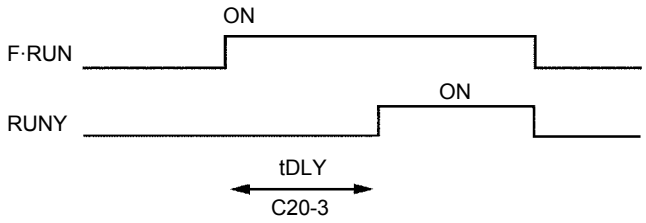
The following types of interlock can be obtained for the run RUN and R·RUN commands.



(1) Setting start/stop function
The motor will run when the frequency (speed) setting is higher than the C20-0 setting value, and will stop when lower.
Starting and stopping with the setter is possible with this function.

(2) Start interlock
If the frequency (speed) setting value is larger than C20-2 when the run command (RUN X) is ON, the motor will not start.
Use this function when the frequency setting is to be lowered when starting for safety purposes.
(Note) The setting start/stop and start interlock functions cannot be used simultaneously. Thus, set C20-0 or C20-2 to 0.

(3) Run delay timer
The motor will be delayed from the run command (RUN X) by the time set in C20-3.



This is used for synchronization with peripheral machines such as mechanical brakes.
The run delay timer will not function in the jogging or local modes.

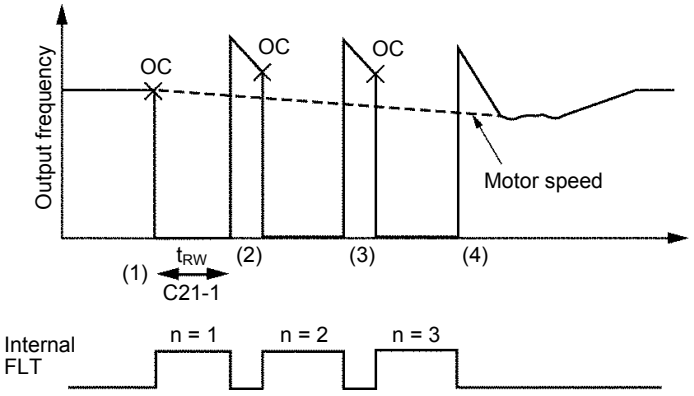
(Note 1) Set the parameter setting values to 0 when not using (1),, (2) or (3).
(Note 2) The (1), (2) and (3) functions will not function during jogging run.
(Note 3) The (3) function will not function during the local mode.
(Note 4) When interlock is applied on (1), (2) or (3), the FWD and REV LED will flicker.

C21-0
C21-1

Number of retries

Retry wait time

Retry is a function that performs its own fault reset and restarts with pick-up. Set the number of retries, and the wait time (t_{RW}). If pick-up is not possible within the number of set times, an IO-4 fault will occur.
The errors that are targets of retry are power module (PA - n), overcurrent (OC - n), overvoltage (OU - n)[Note 3)], overload (OL - n), overheat (LOSH.), and ground fault (GF- d. n).



(1) Waiting after trip due to OC - n.
(2) (3) Retry with pick up.
(4) Successful pick-up, and completion of retry.

(Note 1) If C21-0=0, retry will not function.
(Note 2) The FA-FC relay output will stay open during retry, but will not function.
(Note 3) OVT retry may not function correctly if the DC voltage drop is slow.
(Note 4) If the run command turns OFF during retry, the retry will be canceled, and the FA-FC relay contact will turn ON.
(Note 5) The pickup operation is not carried out during vector control with IM sensor and PM motor control (C30-0 = 4, 5).

⚠ CAUTION

When a fault occurs on an extremely rare case, this function automatically resets the fault and restarts the operation.
If the fault occurs frequently, the inverter could be damaged, so first remove the cause of the fault.

C21-2 Pick-up wait time

The wait time t_{PW} after the output is cut off to when the pick-up operation is started is set.
Set the time to when the motor residual voltage is abated for this parameter. (The residual voltage is a voltage generated by the motor after the inverter output turns OFF, and will be abated in approx. 1 to 3 seconds. This abatement time will take longer if the motor capacity is large.)

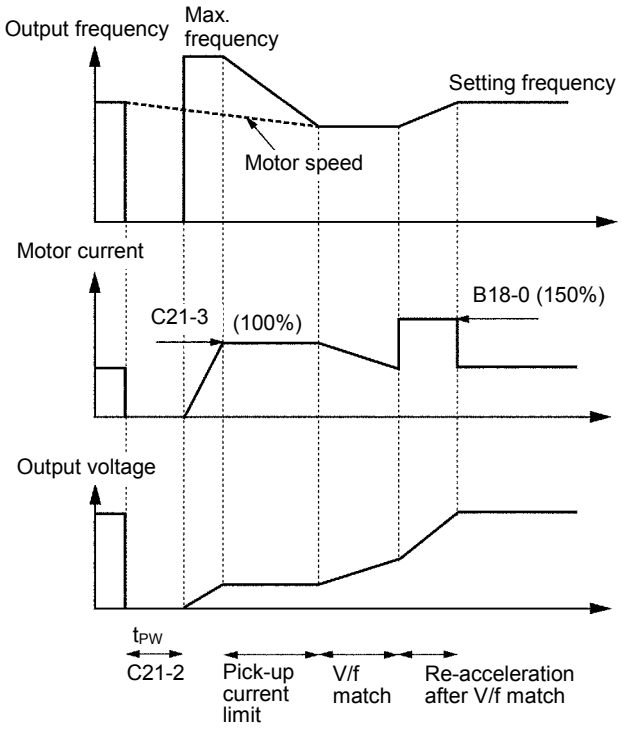
C21-3 Pick-up current limit value

The current limit value during pick-up is set. This setting value is applied only during pick-up.
Normally, set 100% and use.
Adjust within the following range only when the output torque at restart is to be limited.

C21-3 Setting value ≥ Applicable motor excitation current (%) +10%
(Normally 30 to 40%)

<Pick-up operation (When V/f control is selected)>

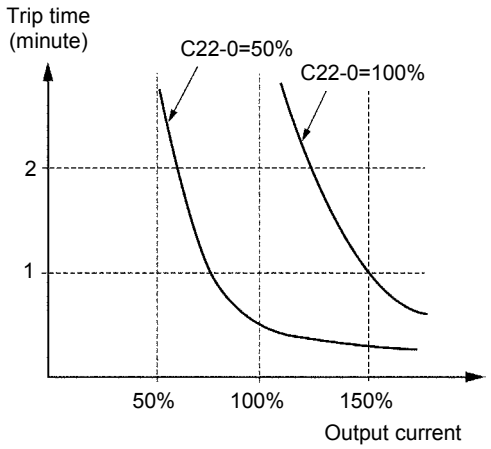
Pick-up starts when F.RUN or R.RUN is ON in the PICK ON state or when the power is turned on when auto start with pick-up is selected (C08-0=3).
The pick-up operation is carried out with the overcurrent limit function as shown below.



C22-0
C22-1
C22-2

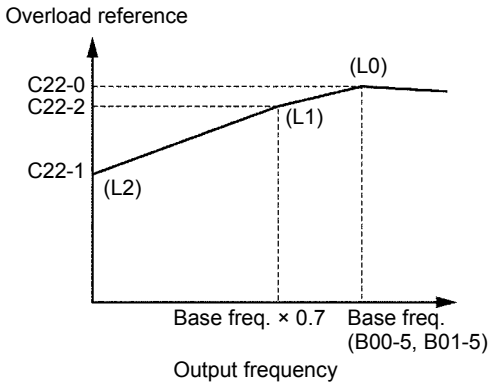
Overload setting (L0)
0Hz overload (L2)
0.7 Fbase freq. overload (L1)

The operation reference for overload (OLT) is set. The reverse time interval characteristics will change with the C22-0 setting as shown on the right.
The setting uses the motor rated current (B00-6, B01-6) as 100%.



(Note 1) Do not set a value that exceeds the inverter rated current.

When running a self-cooling type motor at a low speed, set C22-1 and C22-2 according to the motor characteristics. The characteristics will be as shown on the right.



(Note 2) At 1.0Hz or less, the inverter will trip at 75% of the inverter's rated current in one minute.

(Note 3) If the inverter output current exceeds 155%, the inverter will trip at 170% of the rated current in 2.5 seconds.

(Note 4) The above overload characteristics apply to when V/f control (constant torque load) is selected (C30-0 = 1), IM speed sensor-less vector control is selected (C30-0 = 3), IM vector control with sensor is selected (C30-0 = 4), and when PM motor control is selected (C30-0 = 5).
Refer to section 6-7 for the overload characteristics when V/f control (variable torque load) is selected (C30-0 = 2).

C22-4

Motor power loss braking setting

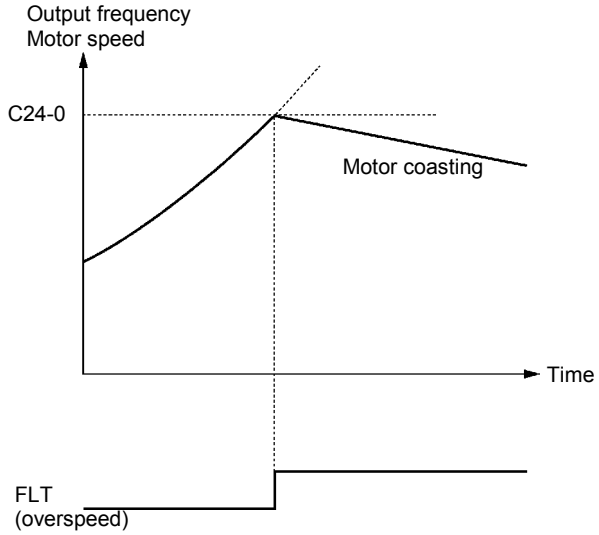
When the motor loss braking function is activated, set the voltage to increase with the base frequency as a percentage in respect to the rated output voltage (B00-3). Normally, 50% of the default value is set.
When the DC voltage attempts to rise due to deceleration operation or a regenerative load, the motor loss braking function raises the inverter output voltage and decreases the motor efficiency to prevent tripping by an overvoltage. This function is valid only when the motor loss braking is selected with the DBR option selection (C31-0 = 3, 4) in the V/f control mode (C30-0 = 1, 2).

(Note 1) Take care to motor heating.

(Note 2) If the normal V/f setting is inappropriate, the motor efficiency will increase when the voltage is increased and thus tripping by the overvoltage could occur easily.

C24-0 Overspeed protection level

Set the overspeed protection level. Set as a percentage in respect to the maximum frequency (B00-4) or maximum speed (B01-4). The output frequency or motor speed is the target for comparison.



C24-1 Control mode changeover during speed detection error

This is valid when vector control with IM sensor (C30-0=4) or PM motor control (C30-4=5) is selected.

= 1: The speed detection error is not monitored.

= 2: The speed detection error is monitored, and if an error occurs, a fault (FLT) is output. The motor then coasts to a stop.

= 3: The speed detection error is monitored, and if an error occurs, a minor fault (ALM) is output. The control changes from the vector control with IM speed sensor to the IM speed sensor-less vector control, and the operation is continued. When the speed detection returns to the normal state, the control changes again from the sensor-less vector control to the vector control with sensor, and the minor fault output is cleared. The presence of a minor fault due to a speed detection error can be confirmed with the minor fault monitor (D05-0). This is available only during vector control with IM sensor.

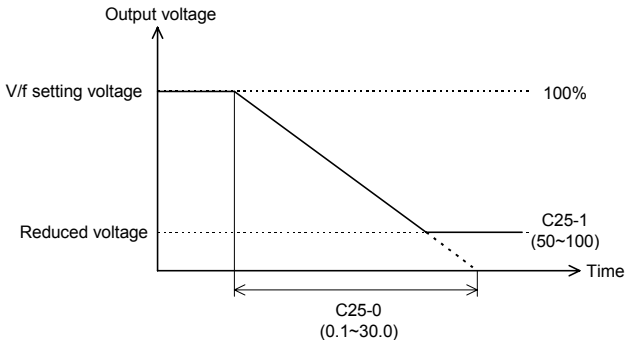
C24-2 Speed detection error level

C24-3 Speed detection error recovery level

This is valid when C24-1 = 3.
Set as a percentage in respect to the maximum speed (B01-4).
If the deflection of the speed detection value per 2ms increases above the value set with C24-2, it is judged as a speed detection error, and the control changes from the vector control with sensor to the sensor-less vector control. After changing, when the deflection of the speed estimated value for sensor-less vector control and the speed detection value drops to below the value set with C24-3, it will be judged that the speed detection has returned to the normal state. The control changes again from the sensor-less vector control to the vector control with sensor.

C25-0

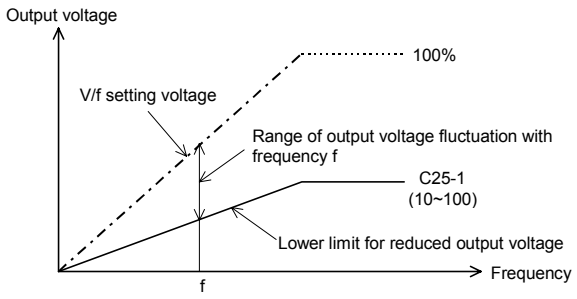
High-efficiency operation Voltage reduction time [sec]



This setting value is the time to reduce the output voltage from the V/f setting value to 0V after the output frequency reaches the set frequency.
Normally, the default value (10.0) is set. When using for loads with sudden torque fluctuations, and the output frequency drops remarkably with the overcurrent limit function, set an appropriately low value. If the rotation becomes unstable during the voltage reduction or recovery operations causing a trip, set an appropriately high value.
The high-efficiency operation function is valid when V/f control is selected (C30-0 = 1, 2) or auxiliary drive is selected.

C25-1

High-efficiency operation Voltage lower limit setting value [%]



Set a value between 50 and 99 while the inverter is stopped to select the high-efficiency operation function.
When not using the high-efficiency operation function, set 100 while the inverter is stopped.
This setting value is the lower limit of the output voltage reduced when the high-efficiency operation function is selected, and uses the V/f setting voltage (output voltage when not using high-efficiency operation) as the reference.
Normally, the minimum value (50) is set. When using for loads with sudden torque fluctuations, and the output frequency drops remarkably with the overcurrent limit function, set an appropriately high value.

<Operation of high-efficiency operation>

Normally for the V/f constant operation, the no-load loss is large with a light load, and the motor efficiency drops remarkably. Thus, according to the load, the output voltage is reduced using the C25-1 setting value as the lower limit in respect to the voltage set with V/f, and the motor efficiency is improved.

(Note) Slipping will increase during high-efficiency operation, so it is recommended to execute automatic tuning before operation and set the automatic torque boost selection to valid (A02-1 =2).

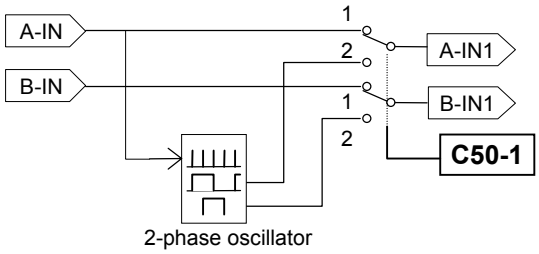
C31-0

DB option selection

Select the usage of the motor loss braking and DBR resistor (built-in or external).
Refer to the explanation on the motor loss braking setting (C22-4) for details on the motor loss braking function.
The motor loss braking function is valid when V/f control is selected (C30-0 = 1, 2) or auxiliary drive is selected.

C50-1 Encoder output pulse No. selection

The No. of encoder pulses (2-phase or 1-phase) is set.
The function to convert a 1-phase pulse signal from a proximity sensor, etc., into a 2-phase pulse is validated or invalidated.



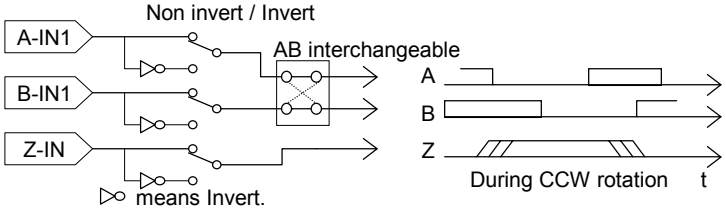
=1: This is set when using an encoder that outputs a 2-phase pulse having a 90° phase difference.
The rotation direction can be judged, and the speed can be stably controlled even at low speeds.
Set the No. of pulses for one phase in the No. of encoder pulses (B01-8).

=2: This is set when using an encoder that outputs a 1-phase pulse.
Connect the input pulse to only the A phase, and always leave the B phase disconnected.
With the 1-phase pulse mode, the rotation direction is recognized as the operating command direction. The forward run and reverse run directions are not judged.
A speed detection error could occur due to the effect of chattering in low speed areas, so use a 2-phase encoder when carrying out low-speed run or forward/reverse run.

(Note) The 1-phase pulse mode cannot be used with the PM control mode.

C50-2 Encoder ABZ pulse type selection

When using the 2-phase pulse, the rotation direction is judged by the advance and delay of the 2-phase pulse phase. With the VT230S, the encoder pulse is defined as shown below during forward run. (The Z-phase pulse is the zero point position detection and is used only for PM motor control.) When using an encoder with different signal specifications, use this setting to invert the signal or convert the signal using the interchange function.



Pulse conversion circuit **Definition of VT230S encoder**

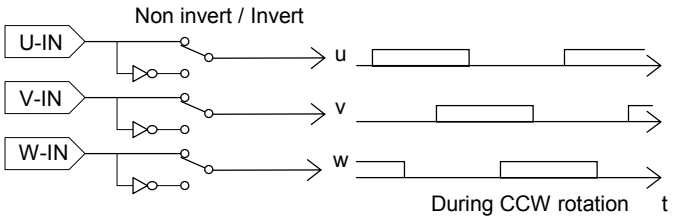
Following the set No., the signal conversion circuit functions with the following combination.

Setting No.	A-IN1 Non invert / Invert	B-IN1 Non invert / Invert	Z-IN Non invert / Invert	AB inter-change
0	–	–	–	No inter-change
1		–	–	
2	–	Invert	–	
3	Invert	Invert	–	
4	–	–	Invert	
5	Invert	–	Invert	
6	–	Invert	Invert	
7	Invert	Invert	Invert	
8	–	–	–	AB inter-change
9	Invert	–	–	
10	–	Invert	–	
11	Invert	Invert	–	
12	–	–	Invert	
13	Invert	–	Invert	
14	–	Invert	Invert	
15	Invert	Invert	Invert	

(Note) "–" means Non invert.

C51-0 Encoder UVW pulse type selection (PM motor control)

A position encoder which outputs a 180° rectangle wave for 3-phase as an electrical angle is used to initialize the PM motor position. The encoder polarity can be set individually for the three phases.
With the VT230S, the position detection signal is defined as shown below. If the polarity is different from this, apply the internal conversion function to match the VT230S specifications.



▷○ means Invert.

Setting No.	U-IN Non invert / Invert	V-IN Non invert / Invert	W-IN Non invert / Invert
0	–	–	–
1	Invert	–	–
2	–	Invert	–
3	Invert	Invert	–
4	–	–	Invert
5	Invert	–	Invert
6	–	Invert	Invert
7	Invert	Invert	Invert

(Note) "–" means Non invert.

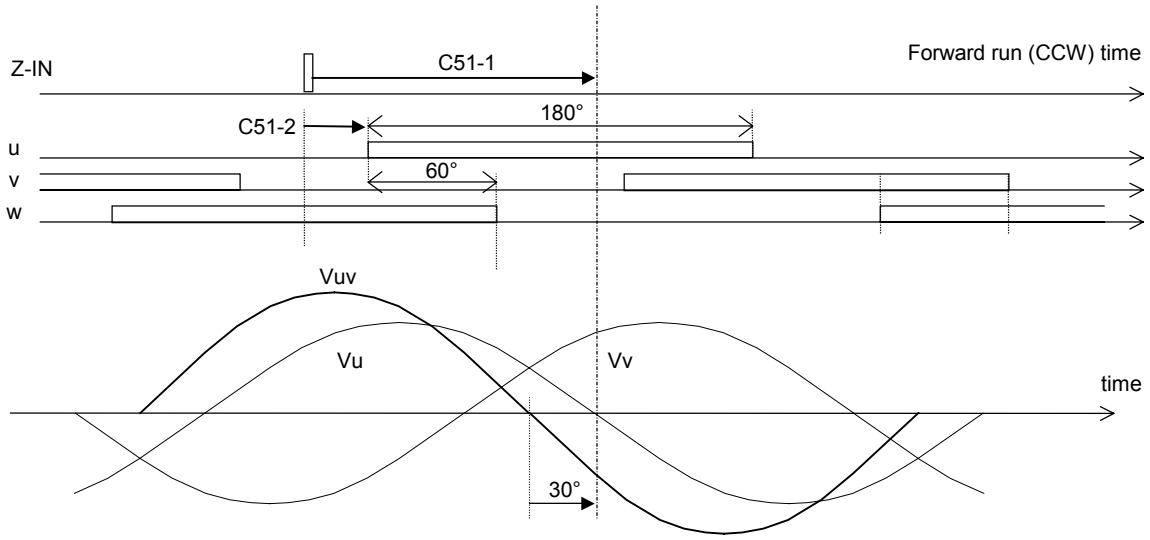
C51-1
C51-2

Z-IN → U phase winding phase angle (PM motor control)
Z-IN → u pulse angle (PM motor control)

The PM motor control requires position detection, so the following two types of encoder signals must be used.

(a) A phase and B phase 90° phase difference 2-phase pulse and Z phase zero point detection pulse signal
(b) U, V, W phase electrical 180° pulse 3-phase pulse

The PM motor magnetic pole position and the above (a),(b) of position relations are set in (C51-1) and (C51-2).
During forward direction rotation, observe the waveform between the lines of the encoder Z-IN pulse and motor terminal's UV voltage. Then, from the following relation obtain and set the (C51-1) phase angle (electrical angle) using the Z-IN pulse as a reference. For the phase angle of the Z-IN pulse and u pulse, set the phase difference using the Z-IN pulse as a reference in (C51-2).



Encoder phase angle adjustment (PM motor control)

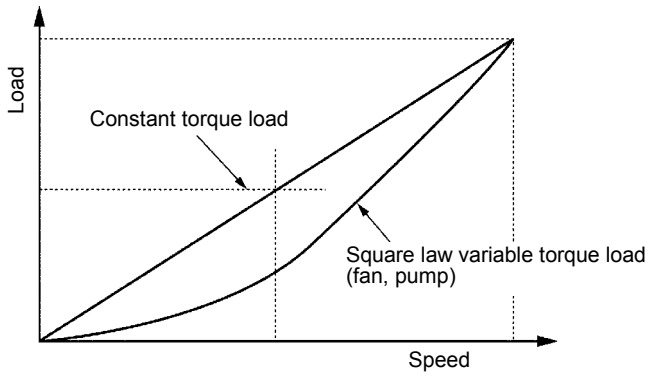
6-7 Application to square low variable torque load

6-7-1 Specifications for square low variable torque load

A load having characteristics in which the load torque variable with the reduction of the speed, etc., such as in a fan or pump, is called a square law variable torque load. The load curves of the constant torque load and square torque load are shown below.

CAUTION

The variable torque specifications must be applied to square variable loads such as fans and pumps.
The constant torque specifications must be applied for all other types of loads.



Load curve

The specifications for when the constant torque load and the square law variable torque load are applied are shown in Appendix 1.
Hereafter, the square law variable torque load characteristics will be called the variable torque.

6-7-2 Selection of load characteristics

Select the load characteristics by setting the following parameters.

Table ___

No.	Name	Default value	Min. value	Max. value	Unit	Function
C30 - Control mode selection						
0	Control mode selection	—	1.	4.	—	= 1 : V/f control (constant torque: overload characteristics 150% for one minute.) = 2 : V/f control (variable torque: overload characteristics 120% for one minute.) (Note 3)

(1) For the default setting, = 1: constant torque load characteristics is selected, so change the setting according to the application. When this parameter is selected, there are parameters with setting values and setting ranges that also fluctuate, so this parameter must be set before the other parameters.
(2) This parameter is not affected by C09-7: default value load.
If the default value is executed, the values set by the user will be held.
(3) The parameters with setting values and setting ranges that fluctuate when this parameter is selected are shown below.

Table ___

No.	Name	Default value	Min. value	Max. value	Unit	Function
A02 - Torque boost						
2	Manual torque boost setting	**(Note 1)**	0.0	20.0	%	Setting of torque boost at 0Hz.
A03 - DC brake						
2	DC braking voltage	**(Note 1)**	0.1	20.0	%	
B00 - Output rating						
6	Motor rated current Constant torque Variable torque	**(Note 2)** Inverter rating	Constant torque rated current × 0.3~1.0 Variable torque rated current × 0.3~1.0		A	Overcurrent limit OLT, current % display, meter output reference value
B18 - Overcurrent limit						
0	Over current limit Constant torque Variable torque	150. 105.	50. 50.	300. 120.	%	

(Note 1) The default value differs according to the inverter capacity and load characteristics selection.
(Note 2) For the inverter rating value, the constant torque rated current value and variable torque rated current values given in Appendix 1 will apply.
(Note 3) Up to CPU version 122.x and ROM version 123.x, this is
up to 037L, up to 045H: 120%
045L and above, 055H and above: 112%
CPU version 124.0 and ROM version 125.0 and above
All capacities: 120%

Table

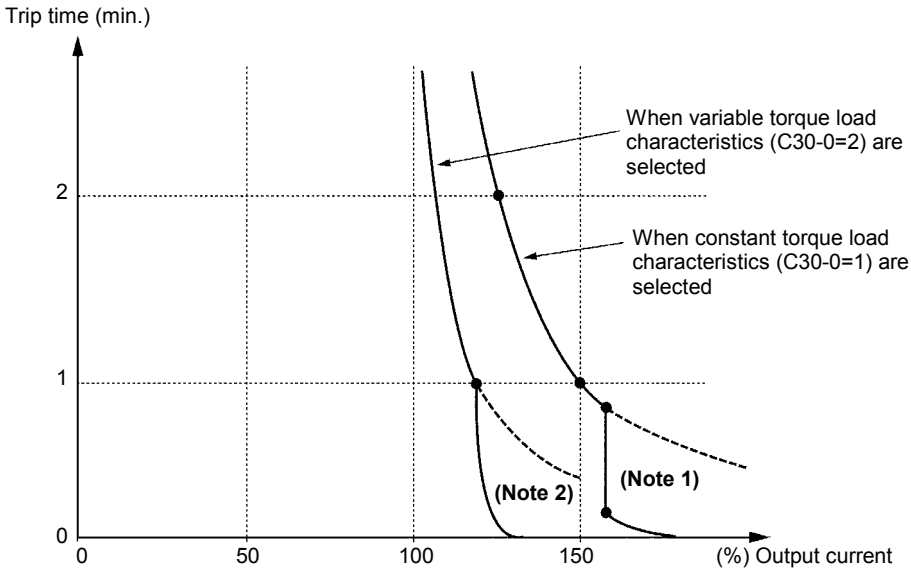
No.	Name	Default value	Min. value	Max. value	Unit	Function
C22 - Overload						
0	Overload setting				%	The C22-1, 2 data will be limited by this value when this value is changed.
	Constant torque	100.	50.	105.		
	Variable torque	100.	50.	105.		
1	0Hz overload				%	The max. value is the value of C22-2.
	Constant torque	100.	20.	105.		
	Variable torque	100.	20.	100.		
2	0.7 Base freq. overload				%	The max. value is the value of C22-1.
	Constant torque	100.	50.	105.		
	Variable torque	100.	50.	100.		

(Note 3) When the load characteristics are changed, the above parameters will be forcibly set to the default values, so reset them when necessary.

(Note 4) For parameters other than above, the default value and setting range will not change when the load characteristics are selected.

6-7-3 Overload Characteristics

The overload detection curve changes according to the load characteristics selection.
The overload characteristics for when the overload setting (C22-0) is 100% are shown below.
The motor rated current (B00-6) is the reference for the current value (%).



Overload characteristics

(Note 1) When the constant torque load characteristics are selected, the 150%, 60s inverse time characteristics apply.
Note that if 155% of the constant torque's rated current is exceeded, a trip will occur at the 160%, 10s, 170%, 2.5s inverter time characteristics. When 1.0Hz or less, a trip will occur at the constant torque rated current 75%, 60s inverse time characteristics.

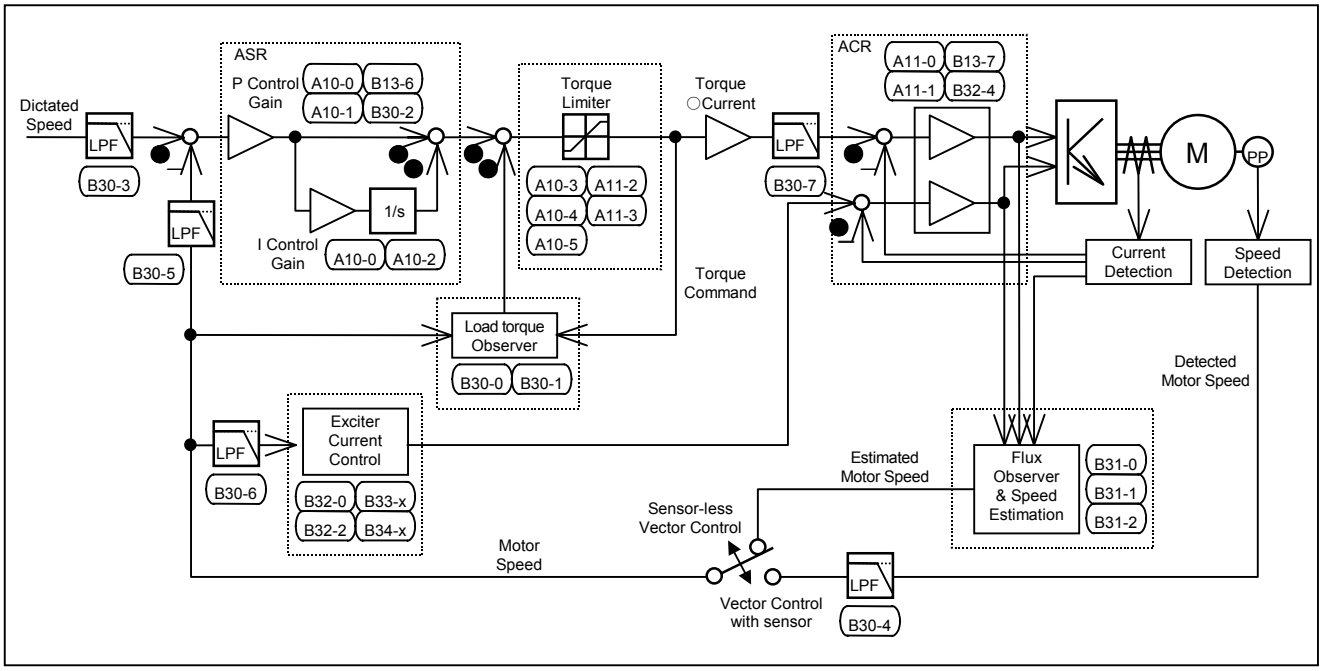
(Note 2) When the variable torque load characteristics are selected, the 120%, 60s inverse time characteristics apply.
Note that if 120% of the variable torque load characteristics are exceeded, a trip will occur at the 125%, 7.5s inverse time characteristics. When 1.0Hz or less, a trip will occur at the variable torque load characteristics 75%, 24s inverse time characteristics.
(Refer to Note 3 on the previous page.)

6-8 Adjusting the IM vector control speed control related parameters

With the VT230S, ASR operation is possible by executing automatic tuning and setting simple speed control parameters. However, when carrying out high-response or high-accuracy control, the parameters must be adjusted in detail. In this section, the configuration of the speed control system is explained, and the adjustment parameters that need to be adjusted are indicated.

6-8-1 Speed control system of IM vector control

The speed control system of IM vector control is configured of blocks as shown below. Automatic tuning is used for adjusting the exciting current control, current regulator, flux observer and speed estimation mechanism, so these parameters often do not need to be adjusted. However, the parameters related to the speed regulator, torque limiter, load torque observer, various low path filters, etc., must be adjusted according to the user's system. Thus, these cannot be simply adjusted with automatic tuning. The final user of the system must adjust these parameters to match the system. Adjustments are carried out while referring to the block diagram below.



IM speed control system block diagram

(Note) The related parameter Nos. are indicated in the above function blocks.

6-8-2 IM motor speed regulator

The IM motor speed regulator (ASR) is configured of PI control, and has the following parameters.

Parameter No.	Parameter	Function
A10-0	ASR response	The required ASR response radian frequency is set.
A10-1	Machine time constant 1	The time to accelerate the motor and load's torque inertia to the base speed at the rated torque is set.
A10-2	Integral time constant compensation coefficient	The compensation coefficient applied on the integral time constant of the speed regulator (ASR) is set.
B13-6	ASR gain compensation in constant power range	This sets the ASR P gain compensation value at the max. speed. By adjusting this parameter, the ASR P can be compensated in the constant power range. If ASR hunting occurs in the sensor-less control's constant output range, set a smaller value.
B30-2	ASR proportional item change rate limit	If the speed setting value or motor speed change suddenly, this will prevent the ASR's P item from suddenly changing.

6-8-3 IM motor torque limiter

The output torque is limited. Set an appropriate value for protecting the load side.

Drive torque limiter) Set this to a large value to increase the torque during driving. Note that the output torque is limited by the output current limiter (B18-0), so when set excessively, the set torque may not be attained.

Regenerative torque limiter) Set this to a large value to increase the torque during regeneration. Note that the output torque is limited by the output current limiter (B18-0), so when set excessively, the set torque may not be attained. If the DBR or PWM converter, etc., are not provided and an excessively large setting is made, an overvoltage trip could occur during regeneration. In this case, lower the regeneration torque limiter setting.

Parameter No.	Parameter	Function
A10-3	ASR drive torque limiter	The limit value for the ASR drive side is set.
A10-4	ASR regenerative torque limiter	The limit value for the ASR regenerative side is set.
A10-5	Emergency stop regenerative torque limiter	The ASR regenerative side limit value applied during the emergency stop mode is set.
A11-2	ACR drive torque limiter	The ACR drive side limit value is set.
A11-3	ACR regenerative torque limiter	The ACR regenerative side limit value is set.

6-8-4 IM motor exciting current control

The exciting current is controlled to establish the secondary flux. A current reduction process in the constant output range or during voltage saturation, and high-speed magnetizing control to raise the secondary flux at a high speed are also carried out.

Parameter No.	Parameter	Function
B32-0	Speed flux control gain (Note 1)	This is the control gain used for high-speed control of the secondary flux when starting operation. Use this to control the secondary flux at a high speed at the start of operation or during operation in a constant output range. High speed control is possible by increasing the gain, but if increased too high, the magnetizing current may hunt.
B32-2	Voltage saturation compensation selection	If the output voltage in control is larger than the voltage that can be output by the inverter, select this control to limit the exciting current to prevent the current or torque from hunting. Select this when raising the output voltage to near the input voltage, or when the input voltage changes. Note that if voltage saturation occurs, some torque ripple will occur. In this case, lower the B01-9 no-load voltage setting to avoid voltage saturation.
B33-x	Table reference speed	This is the reference speed for changing the compensation amount according to the operation speed. Set as shown below to operate to the constant output range.
B34-x	M fluctuation compensation	This compensates the exciting inductance fluctuation according to the B33 table reference speed. Set the compensation table so that the output voltage is constant during no-load operation through the entire operation range. * This is adjusted by the automatic tuning mode 4. (B19-0)

<Setting the table reference speed>

When all of B34 is set to the default value (=100%), B33 will be automatically set as shown below when adjusted with automatic tuning mode 4 (B19-0=4). (Note 2)
When set manually and the motor largely fluctuates immediately after M' enters the constant output range, the voltage error can be reduced by setting the base speed carefully.

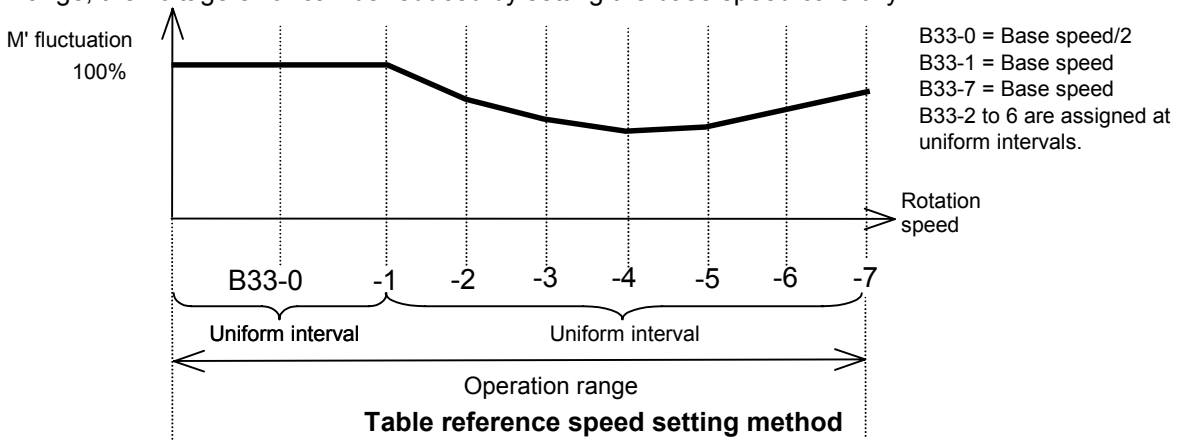


Table reference speed setting method

(Note 1) From CPU version 122.0 and ROM version 123.0 and above, this has been changed from selection to gain adjustment.
(Note 2) Automatic setting is available with CPU version 114.0 and ROM version 115.0 and above.

6-8-5 IM motor current regulator

The current regulator (ACR) is configured of PI control, and has the following parameters.

Parameter No.	Parameter	Function
A11-0	ACR response	The ACR response radian frequency is set. If the response is too low or too high, the current will become unstable, and the over current protection will function.
A11-1	ACR time constant	The ACR time constant is set. If the time constant is too long or too short, the current will become unstable, and the over current protection will function.
B13-7	ACR gain compensation in constant power range	This sets the ACR P gain compensation value at the max. speed.
B32-4	ACR voltage model FF selection	The voltage fluctuation caused by the leakage inductance is feed forward controlled. The current regulator (ACR) response speed will be increased. Select this if the current hunts in the high-speed operation range during sensor-less control.

6-8-6 IM motor flux observer and speed estimation mechanism

These are parameters used with speed sensor-less vector control.

Parameter No.	Parameter	Function
B31-0	Flux observer gain	This is the feedback gain for the flux observer. If hunting occurs at the estimated speed in the high-speed operation range, adjust within the range of 1.2 to 0.9.
B31-1	Speed estimated proportional gain	This is the proportional gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.
B31-2	Speed estimated integral gain	This is the integral gain for the adaptive speed estimation mechanism. To increase the speed estimation response, set a large value. Note that if the value is too high, the speed estimation value will hunt.

6-8-7 IM motor load torque observer

The disturbance load applied on the motor is calculated and the torque command is compensated.
To increase the response toward disturbance, use the load torque observer.
By setting the speed regulator (ASR) to P and using the load torque observer, overshooting can be suppressed.

Parameter No.	Parameter	Function
B30-0	Load torque observer gain	Set the observer gain for the load torque observer. To increase the responsiveness of the external disturbance response characteristics, set a large gain. Note that if the gain is set too high, the output torque could hunt. When set to zero, the load torque observer will not function.
B30-1	Model machine time constant	Set the model machine time constant used by the load torque observer.

6-8-8 IM motor various low path filters

The time constants of the low path filters used for speed detection, speed commands or torque current commands, etc., are set.
By adjusting these time constants, vibration caused by noise and overshooting can be suppressed.
Note that if an excessively high value is set, the control performance could drop.

Parameter No.	Parameter	Function
B30-3	Speed setting LPF time constant	Overshooting can be suppressed by setting this to the filter time constant equivalent to the speed response.
B30-4	Speed detection LPF time constant	The speed detection noise is cut.
B30-5	Speed detection LPF time constant for ASR	Set the low path filter time constant used for the speed detection value input into the speed regulator.
B30-6	Speed detection LPF time constant for compensation	Set the low path filter time constant used for the speed detection value for constant output range compensation or iron loss compensation, etc.
B30-7	Torque current command setting LPF time constant	Set the low path filter time constant used for the torque current command.
B30-8	LPF time constant for drooping	Set the low pass filter time constant applied on the dropping value input into the speed regulator.

6-9 Adjusting the PM motor control system parameters

With the VT230S, the PM motor can be controlled by using the position detection option dedicated for the PM motor. The PM motor control has basically the same torque control functions as the IM vector control with sensor, so either ASR operation or ACR operation is possible.
The differences with the IM vector control are listed below.

IM vector control with sensor	PM motor vector control
Only the speed detection is required.	Position detection is required. The 3-phase (U, V, W) signal for starting position detection and the A, B, Z phase for detailed position detection are required.
Operation with V/F control is also possible.	With the PM motor, which does not have a damper, operation with V/F control is not possible as the motor could easily pull out because of load disturbance.
By controlling the exciting current, the induced electromotive force can be controlled.	As the flux of the permanent magnets is always constant, the terminal voltage can be controlled only by the inductance voltage drop amount by passing the demagnetizing current. Thus, the constant output range is narrow compared to the induction motor control.
DC braking is possible. Even when rotating with the load external force, the machine will stop at the position after movement.	When exciting the direct current, rotational angle torque corresponding to the load torque will occur, and when the load is removed, the machine will return to the original phase position.
The 3-phase inductance is equivalent.	The d axis and q axis inductance differs.
During a no-load, the exciting current element current flows.	During a no-load, the current is also zero. (When the demagnetizing current control is not functioning.)
There is a time constant from the exciting current to the secondary flux generation, so the torque generation at starting is delayed.	The torque can be output simultaneously with the current generation at starting.
Even during the motor is running, the terminal voltage stays at zero even when the gate is cut off.	While the motor is rotating, an induced electromotive force is generated at the terminal even if the gate is cut off. When an overspeed is reached, a regenerative current is generated to the inverter and can cause an overvoltage.
When a speed detection error occurs, the operation can be switched to the speed sensor-less operation.	Speed sensor-less operation is not supported.

Precautions for using PM motor

(a) The current is approximately zero during the no-load. It cannot be determined that "the inverter is stopped because the ammeter reading is zero."

(b) Even if the inverter is stopped, an induced electromotive force is generated at the motor terminals while the motor is rotating. There is a risk of electric shock, so always carry out the wiring work after the motor has completed stopped. Even during free run, if the speed greatly exceeds the base speed, the motor's generated power will regenerate and cause the inverter DC voltage to rise and reach an overvoltage. This can lead to faults. In applications where the operation torque is applied from an external source, protective devices such as mechanical brakes must be installed.

6-9-1 Initializing the parameters

Refer to the PM motor data sheet and set the parameters required for the PM motor control from the panel. Other settings shall follow the vector control with sensor.

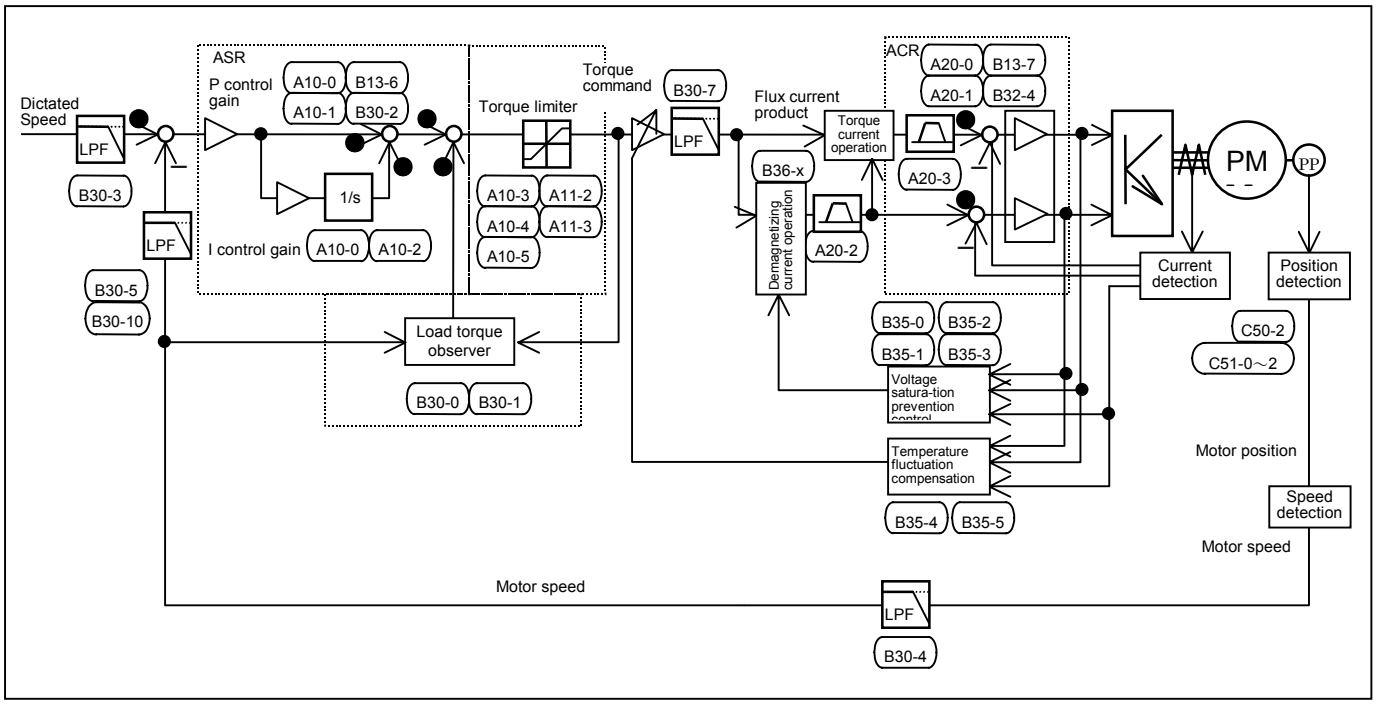
No.	Parameter	Unit
A20 – ACR control constant (PM)		
0	ACR response (PM)	rad/s
1	ACR time constant (PM)	ms
2	d axis current command ramp time	ms/I1
3	q axis current command ramp time	ms/I1
B01 – Motor rating		
1	Motor rated output	kW
2	No. of motor poles	Pole
3	Rated output voltage	V
4	Max. speed	min^{-1}
5	Base speed	min^{-1}
6	Motor rated current	A
7	Carrier frequency	
8	No. of encoder pulses	P/R
9	No-load output voltage	V
B03 – Motor circuit constant (PM)		
0	R1: PM motor primary resistance (Mantissa section)	mΩ
1	R1: PM motor primary resistance (Exponent section)	
2	Ld: PM motor d axis inductance (Mantissa section)	mH
3	Lq: PM motor q axis inductance (Mantissa section)	mH
4	Ld, Lq: PM motor inductance (Exponent section)	
B13 – Local setting		
7	ACR gain compensation in constant power range	%

No.	Parameter	Unit
B35 – Voltage control constant (PM)		
0	Demagnetizing control operation voltage allowance	%
1	Demagnetizing current limit value	%
2	Demagnetizing current control proportional gain	times
3	Demagnetizing current control integral time constant	ms
4	Flux temperature fluctuation compensation range	%
5	Flux temperature fluctuation compensation time constant	s
B36 – Demagnetizing current table (PM)		
0	Demagnetizing current table 0 (at torque command 25%)	%/I1
1	Demagnetizing current table 1 (at torque command 50%)	
2	Demagnetizing current table 2 (at torque command 75%)	
3	Demagnetizing current table 3 (at torque command 100%)	
4	Demagnetizing current table 4 (at torque command 150%)	
C50 – Encoder setting		
2	Encoder ABZ pulse type selection	
C51 – Encoder setting		
0	Encoder UVW pulse type selection	–
1	Z-IN → U-IN winding phase angle	deg
2	Z-IN → U-IN signal phase angle	deg

6-9-2 PM motor control speed control system

The PM motor control speed control system is configured of the following types of blocks. Of these blocks, the speed control system and Load torque observer section operate as the same functions as the IM vector control. The sections unique to the PM motor control are the demagnetizing current control and current control sections following the torque command. These are adjusted by setting the parameter sheet data enclosed with the motor from the panel.
Note that as with the IM, the parameters related to the speed regulator, torque limiter, load torque observer and various low path filters differ according to the user's system, and ultimately must be adjusted according to the system in use.

PM speed control system block



(Note) The numbers of the related parameters are indicated in the above function blocks.

6-9-3 Setting the PM motor circuit constants

The resistance and inductance elements are set as the PM motor circuit constants.

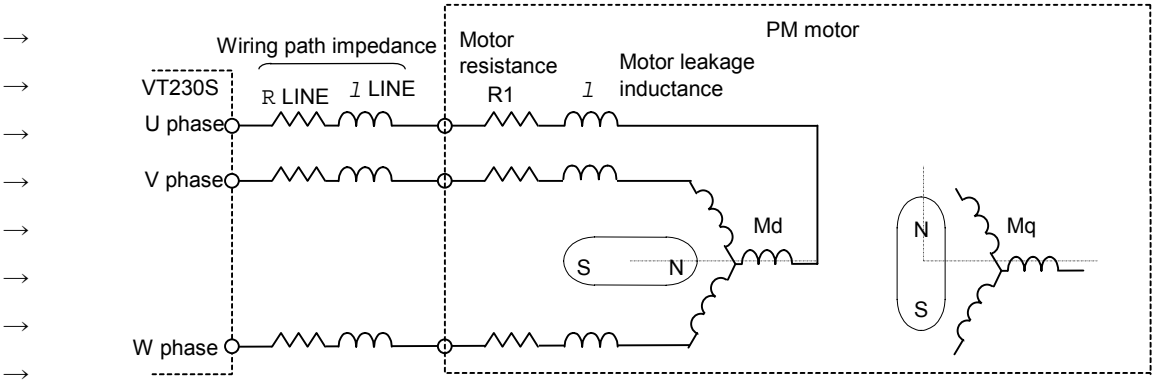
(1) Set the value of one phase converted into a 3-phase & Y connection.
(2) For the inductance element, set the value including the leakage inductance.
(3) If the wiring path is long, add the wiring path element to the motor constant.

In the following wiring example, the set constants are calculated with the following expressions.

(B03-0,1)→=→R LINE～+→R1

→ (B03-2,4)→=→*l* LINE～+→*l* a→+→Md→

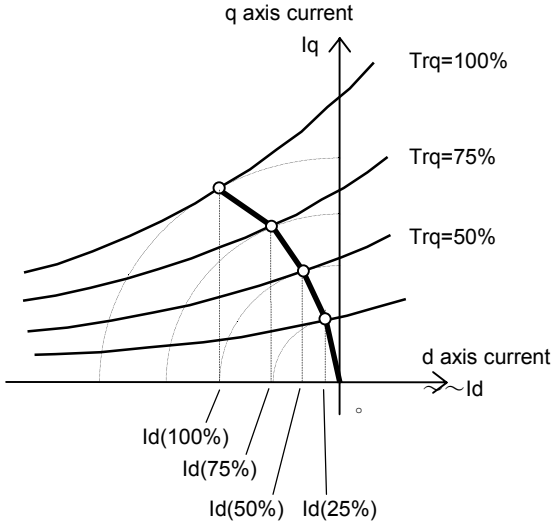
→ (B03-3,4)→=→*l* LINE～+→*l* a→+→Mq→



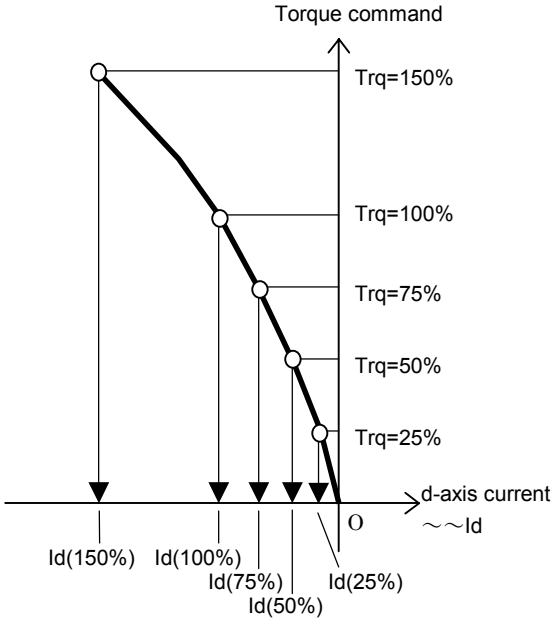
PM motor and wiring path circuit constants

6-9-4 Setting the PM motor demagnetizing current pattern

The permanent magnet's flux is generated in the d axis direction, so the torque can be generated by flowing a q axis current that intersects with this flux. However, with the PM motor, which is an IPM with permanent magnets embedded in the iron core, the inductance creates a reverse salient relation of Ld < Lq. Thus, by flowing a demagnetizing current (d axis negative direction current element), a reactance torque can be generated. By effectively using this reactance torque, more torque can be generated with less current.
The VT230S has a function to generate the demagnetizing current according to the torque command, and the characteristics can be set as table data (B36-0 to 4).
This setting value differs according to the motor design, so set a value that matches the motor. If the characteristics of the motor are unclear, set all to zero when driving the motor.
Set the demagnetizing current table from the panel with positive values. Even if the setting is a positive value, it will be internally converted into the d axis negative current command.
This table setting is valid only when the voltage saturation control is not functioning. During the voltage saturation, explained in the next section, the voltage control function activates to increase the demagnetizing current, so a demagnetizing current larger than these setting characteristics will be generated.



Relation of current vector and torque contour line



Demagnetizing table to be set

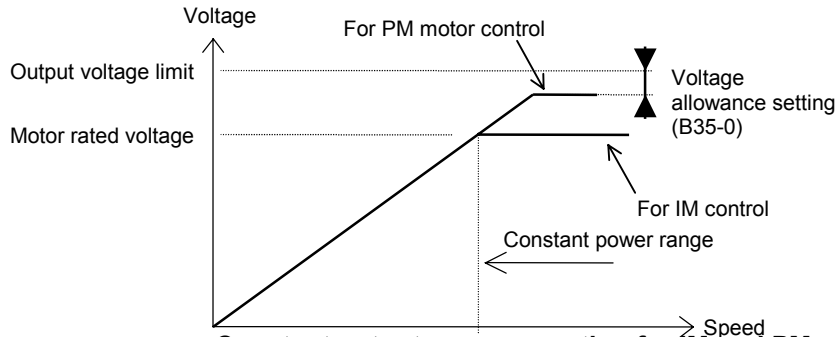
6-9-5 Differences of constant output range demagnetizing operation between IM motor and PM motor

When the PM motor's rotation speed is increased, the terminal voltage will rise and reach the inverter's maximum output voltage. This phenomenon is called voltage saturation, but when the voltage allowance is eliminated, the current cannot be controlled. Thus, the voltage saturation prevention function activates to suppress the terminal voltage by passing a demagnetizing current having the reverse polarity of the flux generated by the magnets.
The following settings are required to use this function effectively.

(B35-0) : Set the voltage allowance to the voltage saturation as a percentage of the rated voltage.
When the voltage rises and the voltage allowance drops to below this setting value, the demagnetizing current will flow.

(B35-1) : Set the maximum limit value of the demagnetizing current generated to suppress voltage saturation.
If the demagnetizing current is too large, the magnet could be demagnetized (non-reversibly demagnetized).
To prevent this, set a limit for the demagnetizing current.

(B35-2, 3) : Set the proportional gain and time constant of the demagnetizing current control.



Constant output range operation for IM and PM

6-9-6 Setting the PM motor flux temperature compensation

The permanent magnet used for the Pm motor will case a flux generation of approx. several percent due to an increase in the temperature.
By estimating the fluctuation amount during operation and compensating it, the torque precision can be maintained at a set level.

(B35-4) : Set the value to limit the fluctuation width for carrying out flux compensation. This value is normally set to 10% or less. If 0 is set (B35-4 = 0), the flux fluctuation compensation function will be invalidated.

(B35-5) : Normally, a time constant of one hour or more is provided as the motor's temperature characteristics. However, depending on the temperature, the flux fluctuation will fluctuate at a time constant approximate to this. This will cause the temperature compensation control and response to be delayed, so set a time constant equivalent to several seconds.

When the temperature changes, the amount of flux in the permanent magnet fluctuates. Thus, even if the same current is flowed, the generated torque will differ according to the temperature. The function that estimates the temperature fluctuation and improves the torque accuracy is the flux temperature compensation function. This control uses the output voltage information, so during low speed operation, the voltage element will be too small, and the function will stop. To reduce the effect of disturbances, such as voltage noise, set the control time constant (B35-5) to a long time (60S or more) which is approximately the same as the temperature time constant.
To prevent locking at an abnormal level because of malfunctioning, a limiter (B35-4) is provided for the compensation amount. In the normal usage state, the drift value by the temperature fluctuation is approximately 10%, so normally set 10% or more. The temperature compensation function can be turned OFF by setting this to 0.

6-9-7 Setting the PM motor encoder phase angle

The PM motor control requires position detection, so the following encoder pulses must be used.

(a) A phase and B phase 90° phase difference 2-phase pulse and Z phase zero point detection pulse.
(b) U, V, W phase electrical 180° pulse 3-phase pulse.

The signal specifications of this position sensor do not follow a unified standard, and will differ according to the maker or model. Thus, if the specifications differ from the signal specifications defined for the VT230S, the signal waveform must be compensated.
If the zero point position and winding phase relation are not set correctly, an error will occur in the torque control, so settings must also be made for the encoder signals.

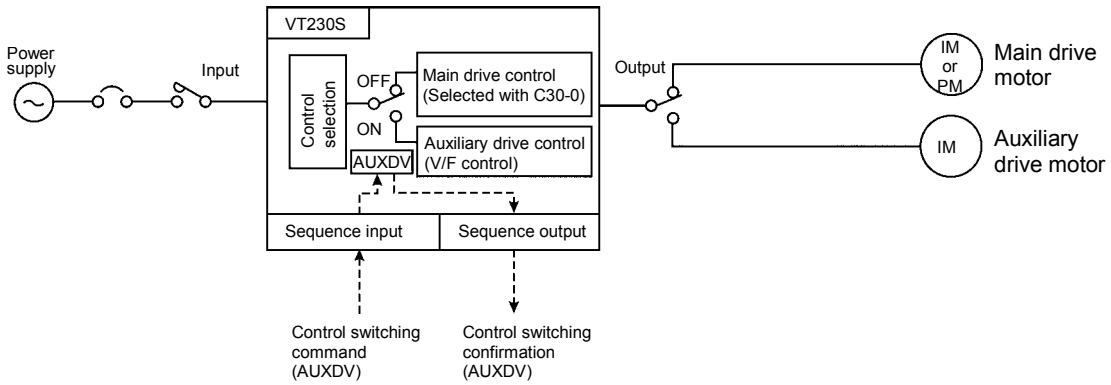
Refer to the parameters C50-0~2,C51-0~2 for details

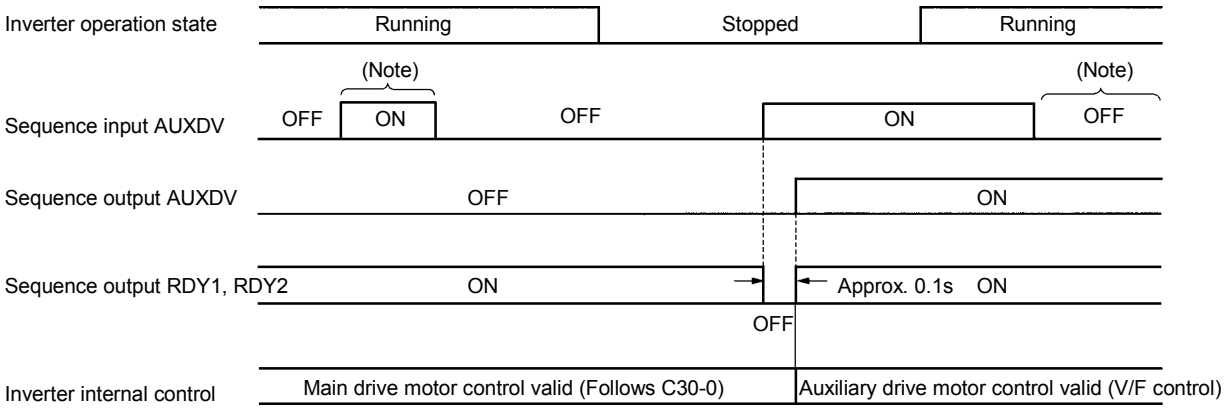
6-10 Operating the auxiliary drive motor

With the VT230S, by switching the internal control with the external sequence input AUXDV (auxiliary drive selection), the main motor operated with the parameter C30-0 control mode and an auxiliary drive motor operated with V/F control can be operated.

6-10-1 Switching the main and auxiliary drive motor control

The inverter's internal main drive motor control and auxiliary drive motor control is switched with the external sequence input AUXDV. However, the control must be switched while the motor is stopped. The switch will be invalid if carried out while the motor is running.
When switching the control, the sequence output RDY1 and RDY2 (READY) turn OFF, and the inverter operation is prohibited. The state of the inverter internal control switching can be confirmed with the sequence output AUXDV (auxiliary drive selection).





(Note) The main and auxiliary drive motor control cannot be switched while the inverter is running.

Switching of main drive motor control and auxiliary drive motor control

6-10-2 Auxiliary drive motor control related parameters

The dedicated parameters for auxiliary drive motor control are shown below. These differ from the V/F control (C30-0 = 1, 2) for the main drive motor control, and some functions cannot be used during auxiliary drive motor control.

Dedicated parameters for auxiliary drive motor

No.	Parameter
B20-0~5	Output rating
B21-0~1	Frequency setting
B22-0~3	Acceleration/deceleration time
B23-0~1	Torque boost
B24-0~1	DC brake
B25-0~2	Over current limit (The parameters B18-3~6 are shared with the main drive motor control)
C23-0~4	Start/stop frequency, overload

The below some functions can not be used during auxiliary drive motor control.

Functions, settings and sequence inputs that cannot be used during auxiliary drive motor control

Function and setting that cannot be used	Related parameter and sequence input
Automatic torque boost	A02-4~6
Frequency skip	B05-0~5
Ratio interlock	B06-0~3
V/F middle point	B17-0~3
Frequency increment/ decrement	C05-1~2 (Sequence input FUP/FDW)
Interlock ratio bias increment/decrement	C05-3~4 (Sequence input BUP/BDW)
Automatic tuning	B19-0
Primary resistance	B02-0~1 (Dedicated for main drive motor)
Control mode selection	C30-0 (Dedicated for main drive motor)
Serial/parallel speed setting	(Forcibly set to 0Hz during auxiliary drive operation)

Chapter 7 Options

7-1 Outline of options

The VT230S Series options include those shown below. This chapter will focus on the stand-alone options and main circuit wiring devices.

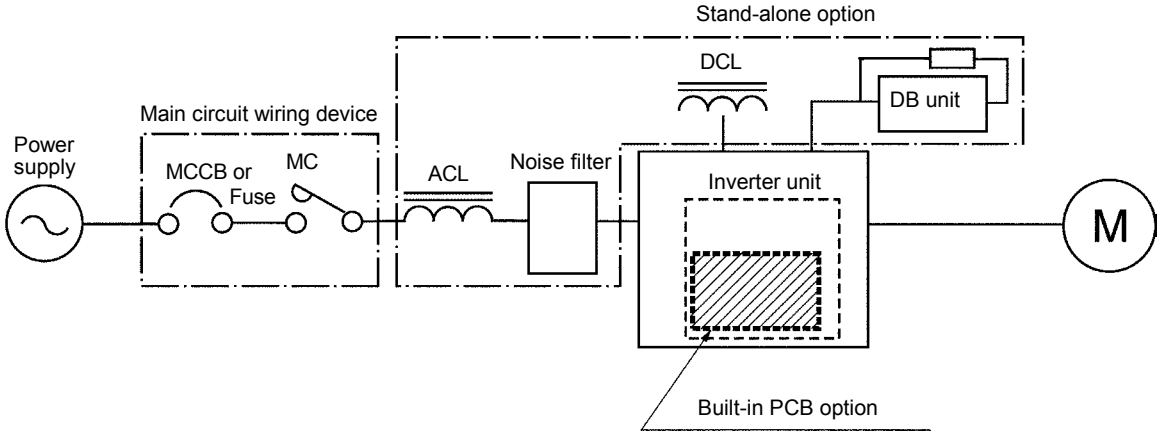


Fig. 7-1 Option configurations

Table 7-1

Item	Type	Function
Main circuit wiring devices		
Breaker for wiring (MCCB) or Fuse	Select a device that matches the inverter rating. (Refer to Table 7-2.)	Always install this device to protect the wiring of the inverter and peripheral devices.
Magnetic contactor (MC)	Select a device that matches the inverter rating. (Refer to Table 7-2.)	Install this device to provide an operation interlock. When using the DB unit, always install this device to protect the DBR. (Refer to Fig. 2-4.)
Stand-alone options		
ACL	V21-ACL-□□□□ (Refer to Table 7-2.)	If the capacity of the inverter's power supply transformer exceeds 10 times the inverter unit capacity, always install this device to protect the inverter. (Balance with power supply) This is also effective in improving the power factor of the inverter input and in suppressing the current high harmonics. The power factor will be approx. 0.9.
DCL	V21-DCL-□□□□ (Refer to Table 7-2.)	Install this device to improve the power factor of the inverter input. This is also effective in creating a balance with the power supply as the ACL. The power factor will be approx. 0.9.
Noise filter	RS□□□□-□□ (Refer to Table 9-2-1. to Table 9-2-3)	This device suppresses the electromagnetic noise generated by the inverter. The electromagnetic noise is the radiation of electromagnetic waves in the radio frequency bands and that conveyed to the power supply wires. Mounting of this device is recommended for creating a balance with the peripheral devices of the inverter.
DB unit	V23-DBU-□□ V21-DBU-□□ (Refer to Table 7-2.)	This is used when the motor is to be stopped with dynamic braking.

Table 7-1 (continued)

Built-in PCB options (These are built-in type options mounted on the basic PCB of the inverter.)

Item	Type (Instruction manual)	Function		Indication of rating nameplate (Note 1)
Speed detection 1 (complimentary compatible)	V23-DN1 (ST-3299)	This is a speed detection PCB for the IM vector control with speed sensor, and is compatible with the complimentary output type encoder. Response frequency: Change between 60±10kHz and 20kHz.	I	V
Speed detection 2 (line driver compatible)	V23-DN2 (ST-3300)	This is a speed detection PCB for the IM vector control with speed sensor, and is compatible with the line driver output type encoder. Response frequency: 250kHz (signal: A, B, Z phase)	I	W
Speed detection 3 (PM compatible)	V23-DN3 (ST-3301)	This is a speed (pole position) detection PCB for the PM drive control, and is compatible with the line driver output type encoder. Response frequency: 250kHz (signal: A, B, Z, U, V, W phase)	I	Y
Relay interface	V23-RY0 (ST-3302)	This is used to expand the contact input/output points. Relay input : 4 points (PSI6 to 9) 1c contact output : 2 points (PSO4, 5)	III	R
PC interface	V23-PI0 (ST-3303)	This is used to receive parallel settings from the PLC. Parallel data input : 16 bits Data length : 16, 12, 8 bits selective Format : Binary or BCD selective Open collector output : 2 points (PSO4, 5)	III	P
Serial interface	V23-SL0 (ST-3304)	This is used to make a connection with serial transmission to the personal computer, etc. Transmission : RS-232C, RS-422/485Multi-drop is possible for up to 32 units. Baud rate : 1200~9600 bps	III	S
Profibus interface	V23-SL6 (ST-3307)	This is used to make a connection with the network on the Profibus DP communication protocol. Baud rate : 12Mbps No. of stations : 126 stations (This P.C.B. is available from CPU version : Y114, ROM version Y115)	III	Q

(Note 1) "0" indicates that the optional PCB is not installed.

Table 7-2 Main circuit wiring device ratings and stand-alone option types

Inverter type		Fuse (Note 2)	MCCB trip current (A)	MC rated current (A)	ACL	DCL	DB unit (Refer to 7-3-1)
Constant torque	Variable torque						
0P4L	—	20	5	20	V21-ACL-LA4	Not applicable	The DB transmission is built in.
0P7L	0P4L	20	5	20	V21-ACL-LA4		
1P5L	0P7L	50	10	20	V21-ACL-LA8		
2P2L	1P5L	60	15	20	V21-ACL-LA12		
4P0L	2P2L	110	20	20	V21-ACL-LA18		
5P5L	4P0L	125	30	32	V21-ACL-LA27	V21-DCL-LA32	
7P5L	5P5L	225	40	50	V21-ACL-LA35	V21-DCL-LA45	
011L	7P5L	225	75	60	V21-ACL-LA55	V21-DCL-LA60	
015L	011L	250	75	80	V21-ACL-LA70	V21-DCL-LA80	V23-DBU-L1
018L	015L	400	100	100	V21-ACL-LA70	V21-DCL-LA100	
022L	018L	500	150	100	V21-ACL-LA90	V21-DCL-LA120	V23-DBU-L2
030L	022L	500	150	135	V21-ACL-LA140	V21-DCL-LA150	
037L	030L	600	200	200	V21-ACL-LA180	V21-DCL-LA180	V23-DBU-L3
045L	037L	600	200	200	V21-ACL-LA200	V21-DCL-LA220	
055L	045L	800	300	260	V21-ACL-LA260	V21-DCL-LA270	V21-DBU-L0
075L	055L	1000	400	350	V21-ACL-LA320	V21-DCL-LA350	
—	075L	1200	500	400	V21-ACL-LA400	V21-DCL-LA410	
0P4H	—	10	5	20	V21-ACL-HA3	Not applicable	The DB transmission is built in.
0P7H	0P4H	10	5	20	V21-ACL-HA3		
1P5H	0P7H	20	5	20	V21-ACL-HA4		
2P2H	1P5H	30	5	20	V21-ACL-HA6		
4P0H	2P2H	50	15	20	V21-ACL-HA10		
5P5H	4P0H	60	20	20	V21-ACL-HA14	V21-DCL-HA18	
7P5H	5P5H	90	30	20	V21-ACL-HA18	V21-DCL-HA25	
011H	7P5H	110	40	32	V21-ACL-HA27	V21-DCL-HA32	
015H	011H	125	40	50	V21-ACL-HA35	V21-DCL-HA40	V23-DBU-H1
018H	015H	175	50	50	V21-ACL-HA35	V21-DCL-HA50	
022H	018H	225	50	50	V21-ACL-HA45	V21-DCL-HA60	V23-DBU-H2
030H	022H	250	75	80	V21-ACL-HA70	V21-DCL-HA80	
037H	030H	300	100	100	V21-ACL-HA90	V21-DCL-HA90	V23-DBU-H3
045H	037H	400	100	135	V21-ACL-HA90	V21-DCL-HA110	
055H	045H	400	150	135	V21-ACL-HA110	V21-DCL-HA140	V23-DBU-H2 ×2 units
075H	055H	500	200	170	V21-ACL-HA150	V21-DCL-HA180	V21-DBU-H0
090H	075H	700	300	200	V21-ACL-HA180	V21-DCL-HA210	
110H	090H	800	300	260	V21-ACL-HA210	V21-DCL-HA270	
132H	110H	800	350	350	V21-ACL-HA300	V21-DCL-HA310	
160H	132H	1200	400	350	V21-ACL-HA360	V21-DCL-HA400	
200H	160H	1600	500	500	V21-ACL-HA460	V21-DCL-HA540	
250H	200H	2000	700	660	V21-ACL-HA520	V21-DCL-HA650	
315H	250H	2000	800	660	V21-ACL-HA580	V21-DCL-HA740	
—	315H	3000	900	800	V21-ACL-HA700	V21-DCL-HA820	

(Note 1) Device selection conditions

- The input current is calculated as follows: $I = (IMkW)/\eta IM/\eta INV/COS\phi/voltage/\sqrt{3}$

- The ηIM (motor efficiency) is 0.85 for 11kW or less, 0.9 for 15kW or more.
- The ηINV (inverter efficiency) is 0.95.
- COSø (input power factor) is 0.9.
- The power supply voltage is 220V/440V. (If the power supply voltage differs, recalculate and select.)

(Note 2) To comply with UL using the 400V Series, use a fuse. Use a Class J fuse.
(Note 3) When using with the IM sensor-less vector control , the IM vector control with sensor, or PM motor control, use the constant torque inverter type.
(Note 4) For noise filter, refer to section 9-10-2.

7-2 Built-in PCB option

This is a built-in type option mounted on the VT230S control PCB.
One type can be selected from option I, option II and option III. UP to three types of PCB options can be mounted at once.
These PCB options are connected to the connector on the VT230S control PCB, and can be easily mounted even after purchasing the VT230S.

* The PCB option cover is required when the PCB option is mounted.

Refer to each instruction manual for details on the PCB options.

7-2-1 Option classes

(1) Option I

This is a PCB option for speed detection during IM vector control with speed sensor and PM motor control. The mounting position is fixed.

* The PM drive control is applicable for the Meidensha standard PM motor.

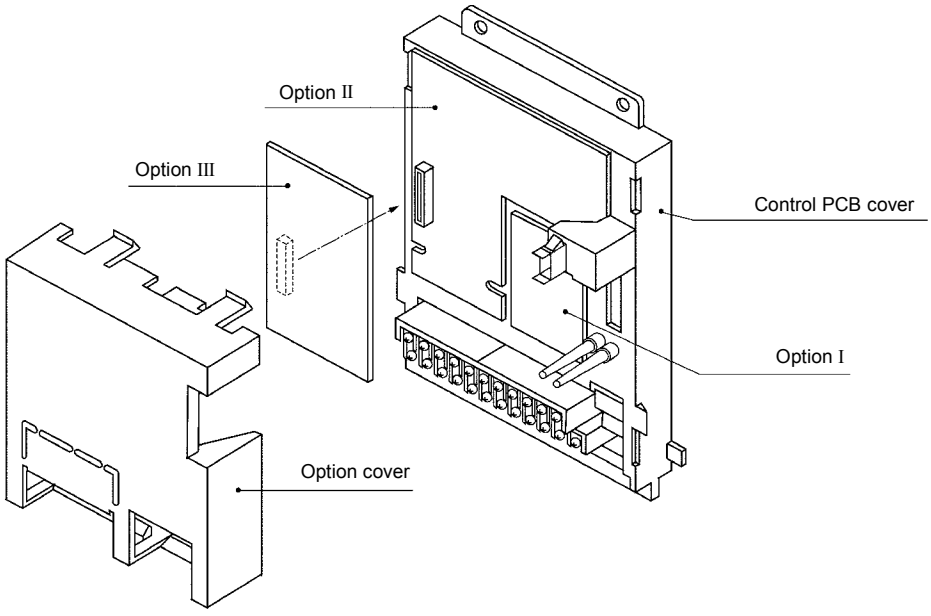
(2) Option II

This is the PCB option for an analog interface, etc. The mounting position is fixed.

(3) Option III

This is the PCB option for the relay interface, etc.

Refer to Table 7-1 for the detailed option classes.



Built-in PCB option mounting drawing

7-3 Dynamic braking (DB) option

The VT230S has a dynamic braking option.
Note) When Unit built-in DBR is used, set C22-3 : (DBR overload protection parameter) to less than the actual used %ED. When the external DB unit is used, set C22-3 to 0.0.

7-3-1 7P5H and smaller, and 7P5L and smaller

The DBR transistor is built in as a standard. Note that DB resistor is an option. The DB is required to use dynamic braking.
When using the DB, use at 10%ED or less as shown in Fig. 7-2.
When using the dynamic braking option, set parameter B18-1: Regenerative power limit and C31-1: DB option selection.

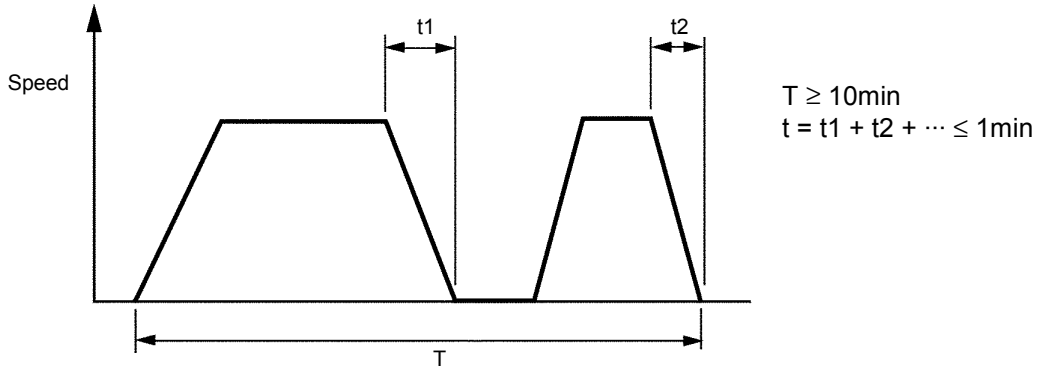


Fig. 7-2

(1) Unit built-in DBR

The DBR built into the unit is shown in Fig. 7-3. If these resistors are applied, use within t(sec) shown in Table 7-3. These resistors can be installed easily even after the unit is purchased. If designated when ordered, they will be built in.

Designation method

VT230S-7P5HB000X001

Main circuit option A: Standard (No DBR)
B: With DBR (The resistor shown in Table 7-3 is built in.)

Table 7-3

Device type	Resistance capacity (W)	Resistance value (Ω)	Braking torque (%)(Note 1)	Max. t (SEC)
0P4L	120	220	200	30
0P7L	120	220	110	30
1P5L	120	220	55	30
2P2L	120	180	45	20
4P0L	120	110	45	10
5P5L	120	91	35	10
7P5L	120	91	25	10

Device type	Resistance capacity (W)	Resistance value (Ω)	Braking torque (%)(Note 1)	Max. t (SEC)
0P4H	120	430	340	10
0P7H	120	430	220	10
1P5H	120	430	130	10
2P2H	120	430	75	10
4P0H	120	430	45	10
5P5H	120	430	30	10
7P5H	120	430	20	10

(Note 1) The case for the constant torque is shown. When using the square reduction torque, the control torque for one capacity higher will apply.

(2) External DB resistor

If the braking torque is insufficient with the above built-in resistor, provide an external DB resistor with a circuit as shown in Fig. 7-3. When using an external DB resistor, remove the built-in DB resistor. The resistance value and usable minimum resistance value to obtain a 100% braking torque is shown in Table 7-4.
When using the external DB resistor, use of a burning prevention circuit, including the thermal relay (76D) shown in Fig. 7-3 is recommended.

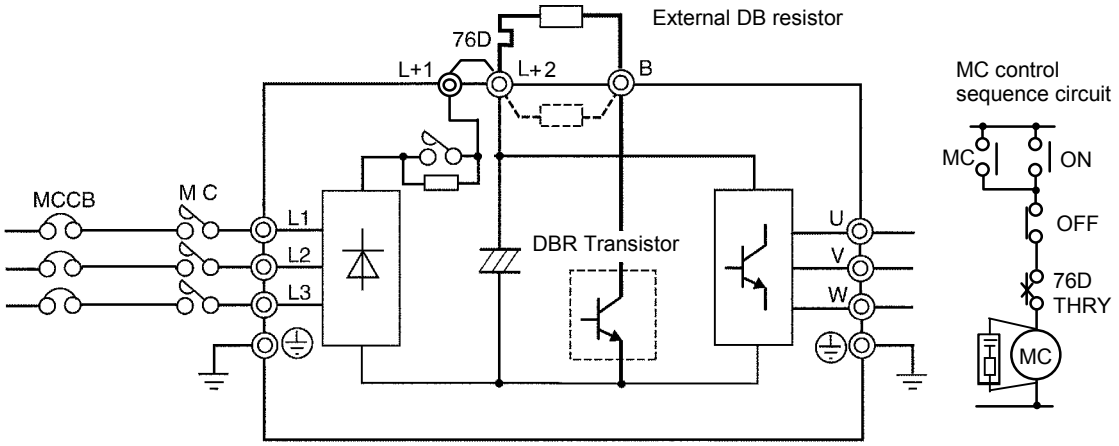


Fig. 7-3 DB circuit

7-3-2 011H and larger, and 011L and larger

When carrying out dynamic braking with the 011H and larger, and 011L and larger unit, use the DB unit.
Connect the DB unit as shown in Fig. 7-4. When carrying out dynamic braking with one DB unit, use at 10%ED or less as shown in Fig. 7-2. If the braking torque is insufficient with one unit, connect a DB unit in parallel. Refer to V23-DBU Instruction Manual (ST-3296) for details.

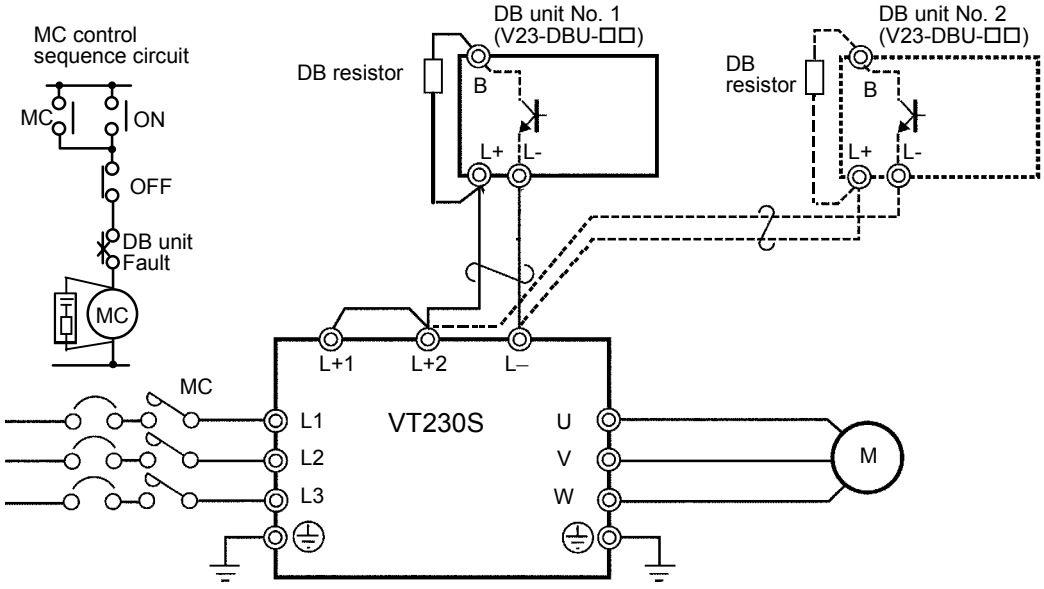


Fig. 7-4 DB connection

The resistance value and usable minimum resistance value to obtain a 100% braking torque is shown

in Table 7-4.

Table 7-4

Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 2)	Applicable wire size [mm^2]	Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 2)	Applicable wire size [mm^2]
011L	9.3	15.6	2.0	011H	37	62	2.0
015L	9.3	11.5	3.5	015H	37	46	2.0
018L	9.3	9.3	5.5	018H	37	37	2.0
022L	5.7	7.8	5.5	022H	23	31	3.5
030L	5.7	5.7	14.0	030H	23	23	5.5
037L	3.8	4.6	14.0	037H	15	18	14.0
				045H	15	15	14.0

(Note 2) The 100% braking resistance value (Ω) for the constant torque is shown. When using Variable torque, the 100% braking resistance value for one capacity higher will apply.

Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 1)	Applicable wire size [mm^2]	Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 1)	Applicable wire size [mm^2]
0P4L	145	450	2.0	0P4H	200	1830	2.0
0P7L	145	240	2.0	0P7H	200	970	2.0
1P5L	80	120	2.0	1P5H	200	480	2.0
2P2L	50	80	2.0	2P2H	200	330	2.0
4P0L	30	45	2.0	4P0H	120	195	2.0
5P5L	20	30	2.0	5P5H	60	130	2.0
7P5L	15	20	2.0	7P5H	60	95	2.0

(Note 1) The 100% braking resistance value (Ω) for the constant torque is shown. When using a square reduction torque, the 100% braking resistance value for one capacity higher will apply.

7-3-3 055H and larger, and 045L and larger

(1) When carrying out dynamic braking with the 055H and larger, and 045L and larger unit, use the V21-DBU unit. Connect the DB unit as shown in Fig. 7-5. When carrying out dynamic braking with one DB unit, use at 10%ED or less as shown in Fig. 7-2. If the braking torque is insufficient with one unit, connect a DB unit in parallel.
(2) Connect the inverter control terminal block RA and RC terminals with the DB unit control terminal TB2 so that the DBR unit will function only while the inverter is running.

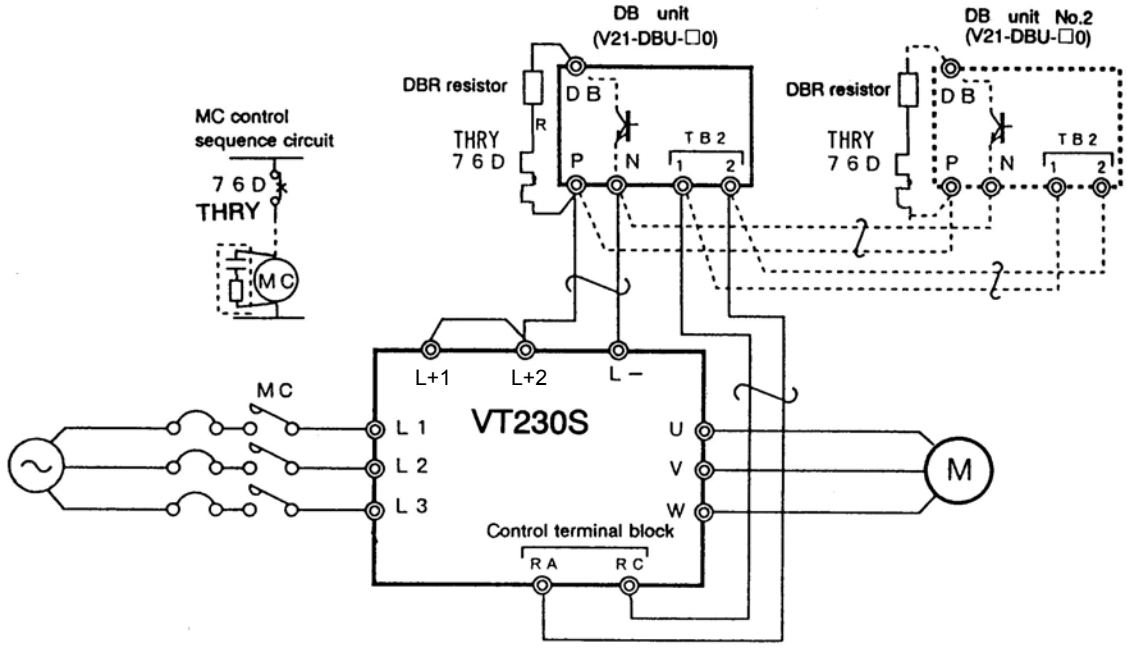


Fig. 7-5 DB connection

(3) Connect the thermal relay for DBR as shown in Fig. 7-6.
(4) Set the following parameters when using V21-DBU.

C31-0 = 2 ; Without motor power loss braking, With DB
= 4 ; With motor power loss braking, With DB
C13-2 = 0 ; RC-RA output parameters
B18-1 = 100% ; Regenerative current limit
B25-1 = 100% ; Regenerative current limit
(Auxiliary drive)
Set this to 10% when not using the DBR

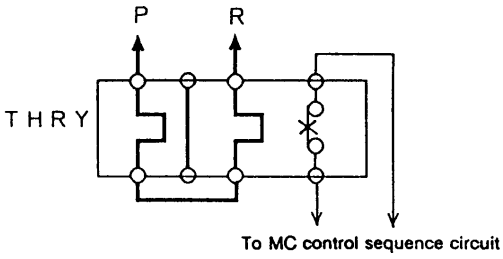


Fig. 7-6 THRY connection

When limiting the regenerative torque at the full speed range,
set the value obtained with the following expression.
B18-1 = Regenerative current limit * 1.1
B25-1 = Regenerative current limit * 1.1 (Auxiliary drive)
(5) Use this DB unit at 10% ED or less as shown in Fig. 7-2.
(6) Obtain the power generation capacity and DBR resistance value with the following expressions.

$$\text{Power generation capacity (kW)} = \frac{\text{Regenerative torque}}{\text{Motor rated torque}} \quad 0.8 \quad \text{Motor capacity (kW)}$$

$$\text{DBR resistance value} = \frac{K}{\text{Power generation capacity}}$$

Note that for the 200V Series, K = 148.2
For the 400V Series, K = 593

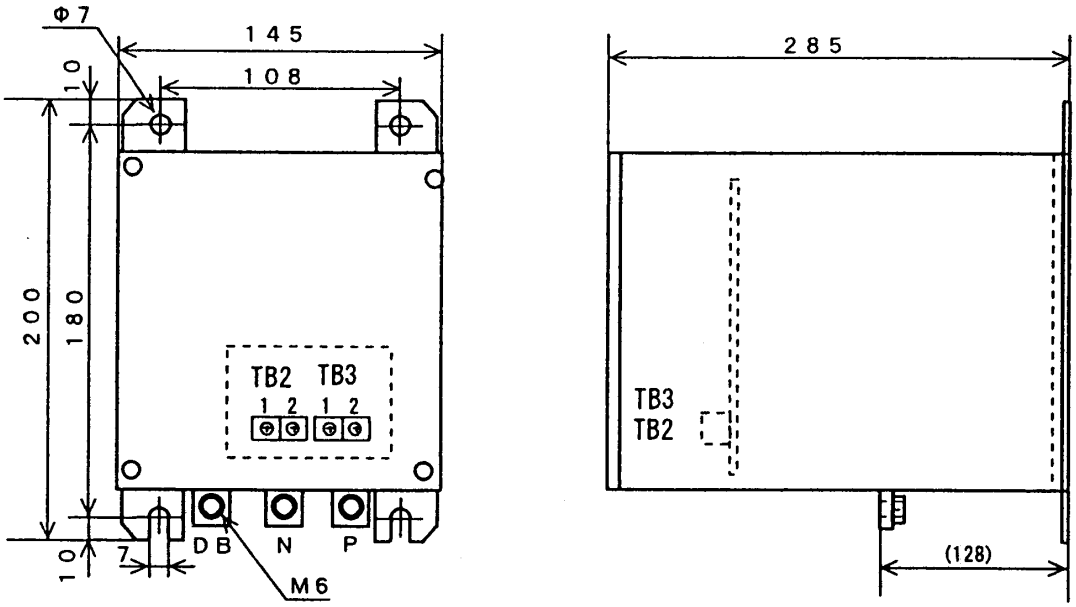


Fig. 7-7 Outline of DB unit

(7) The minimum resistance values of the resistors that can be connected to the DB unit are as listed below.
If the value is lower than this, increase the No. of DB units installed. (Parallel connection)

Min. resistance value of DBR for 200V Series is 1.5→
For 400V Series is 3.3→

The resistance value and usable minimum resistance value to obtain a 100% braking torque is shown in Table 7-5.

Table 7-5

Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 2)	Applicable wire size [mm^2]	Device type	Min. resistance value [Ω]	100% braking resistance value [Ω] (Note 2)	Applicable wire size [mm^2]
045L	1.5	4.1	14.0	055H	3.3	13	14.0
055L	1.5	3.4	14.0	075H	3.3	9.9	14.0
075L	1.5	2.5	14.0	090H	3.3	8.2	14.0
				110H	3.3	6.7	14.0
				132H	3.3	5.6	14.0
				160H	3.3	4.6	14.0
				200H	3.3	3.7	22.0
				250H	3.3	3.0	22.0
				315H	3.3	2.4	22.0

(Note 2) The 100% braking resistance value (Ω) for the constant torque is shown. When using Variable torque, the 100% braking resistance value for one capacity higher will apply.

7-4 ACL and DCL

Select the ACL and DCL according to the Table 7-2 inverter type. Refer to Table 7-6, Table 7-7 for the outline dimension. The ACL is equivalent to a 3% impedance of the inverter capacity.

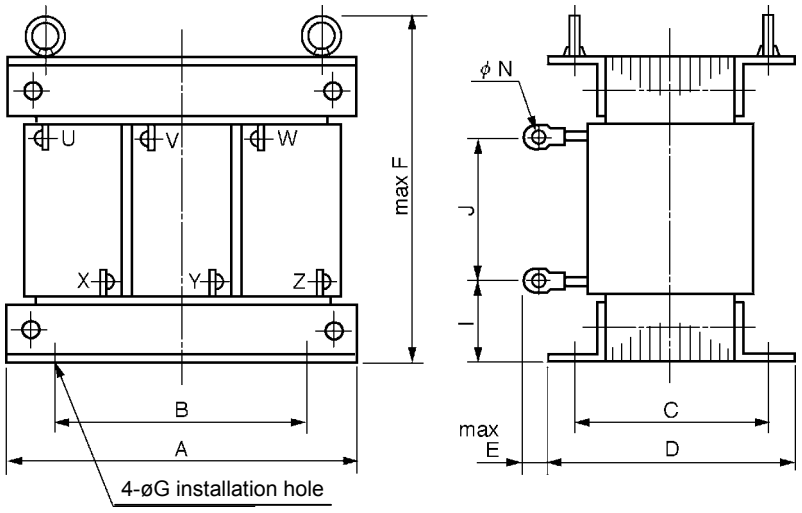


Fig. 7-8-1 Outline of ACL

Table 7-6 Outline dimensions of ACL (Outline : Fig. 7-8-1)

ACL type V21-ACL-□	Dimensions (mm)										Weight (kg)
	A	B	C	D	E	F	G	I	J	N	
LA4	170	100	70	85	45	100	8	55	–	4.3	4
LA8	170	100	70	85	45	100	8	65	–	4.3	4
LA12	170	100	70	85	45	110	8	70	–	4.3	5
LA18	170	100	70	85	45	110	8	35	35	4.3	5
LA27	170	100	70	85	50	130	8	35	60	5.3	6
LA35	170	100	70	85	50	130	8	35	60	6.4	6
LA55	190	100	75	105	60	155	8	40	70	6.4	10
LA70	190	100	75	105	80	180	8	40	80	6.4	11
LA70	190	100	75	105	80	180	8	40	80	6.4	11
LA90	220	150	90	115	80	180	8	50	80	8.4	13
LA140	220	150	90	115	80	210	8	50	100	10.5	18
LA180	270	200	110	150	80	240	11	50	100	10.5	25
LA200	270	200	110	150	100	260	11	50	110	10.5	28
LA260	270	200	110	150	100	270	11	60	120	10.5	30
LA320	300	200	140	180	120	290	11	60	120	13	45
LA400	300	200	140	180	120	300	11	60	120	13	46

ACL type V21-ACL-□	Dimensions (mm)										Weight (kg)
	A	B	C	D	E	F	G	I	J	N	
HA3	170	100	70	85	45	100	8	55	–	4.3	4
HA4	170	100	70	85	45	100	8	55	–	4.3	4
HA6	170	100	70	85	45	100	8	65	–	4.3	4
HA10	170	100	75	95	45	110	8	65	–	4.3	6
HA14	170	100	75	95	45	110	8	35	35	4.3	6
HA18	170	100	75	95	45	120	8	35	50	4.3	6
HA27	190	100	75	105	50	160	8	40	75	5.3	9
HA35	190	100	75	105	50	160	8	40	70	6.4	9
HA35	190	100	75	105	50	160	8	40	70	6.4	9
HA45	220	150	90	115	50	160	8	50	75	6.4	13
HA70	220	150	90	115	80	185	8	50	90	6.4	16
HA90	270	200	110	150	80	240	11	50	95	8.4	25
HA90	270	200	110	150	80	240	11	50	95	8.4	25
HA110	270	200	110	150	80	240	11	50	95	8.4	27
HA150	300	200	140	180	80	260	11	60	95	10.5	43
HA180	300	200	140	180	80	280	11	65	105	10.5	45
HA210	330	200	140	180	110	270	11	65	100	10.5	50
HA300	350	240	160	220	120	310	15	65	110	13	65
HA360	350	240	160	220	150	320	15	65	120	13	70
HA460	370	280	160	220	150	370	15	70	170	13	100
HA520	370	280	160	220	150	390	15	70	190	13	100
HA580	370	280	160	220	150	410	15	70	210	17	110

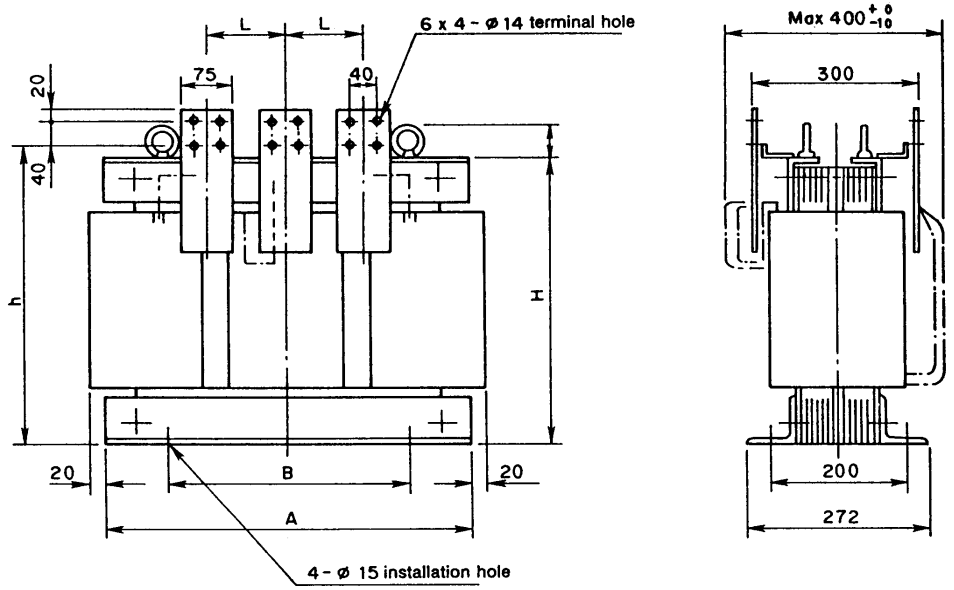


Fig. 7-8-2 Outline of ACL

(Outline : Fig. 7-8-2)

ACL type V21-ACL-□	Dimensions (mm)					Weight (kg)
	A	B	L	H	h	
HA700	500	350	150	440	470	180

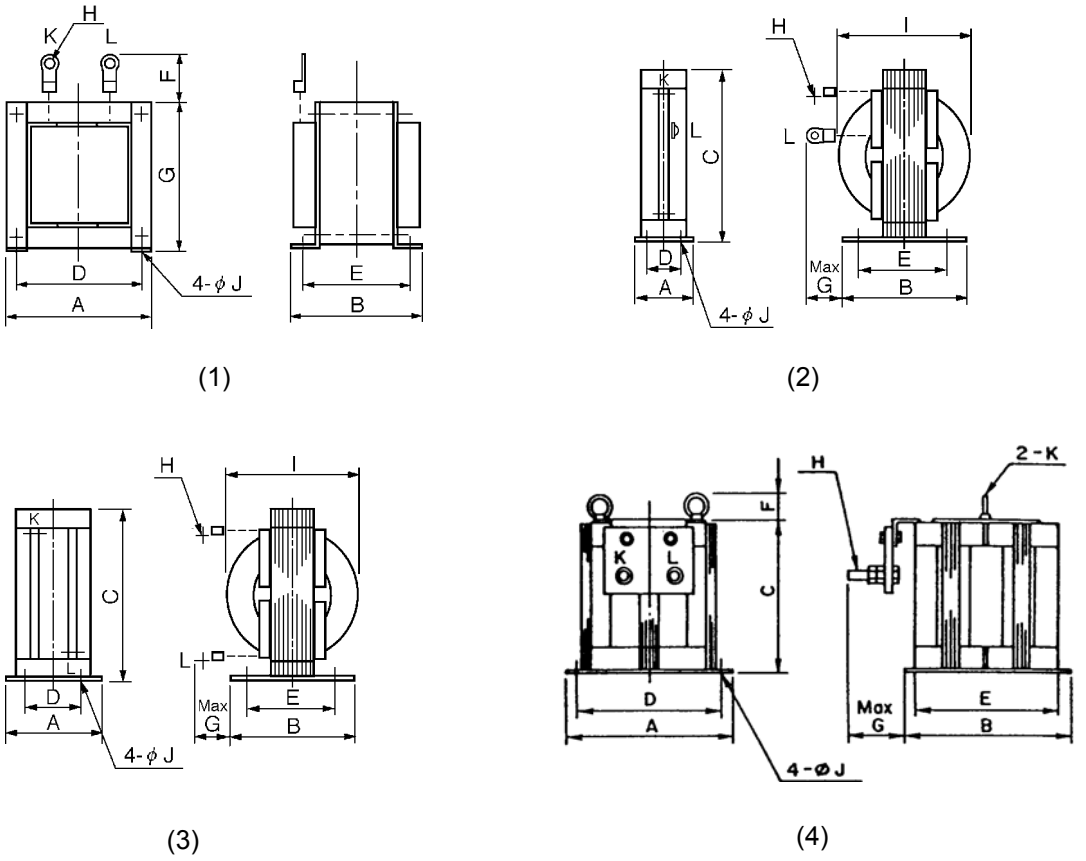


Fig. 7-9 Outline of DCL

Table 7-7 Outline dimensions of DCL

DCL type V21-DCL-□	Dimensions (mm)											Weight (kg)	Shape class
	A	B	C	D	E	F	G	H	I	J	K		
LA32	65	130	195	45	110	–	50	M6	150	6	–	4.5	(2)
LA45	65	130	220	45	110	–	50	M6	180	6	–	5.6	(2)
LA60	65	130	225	45	110	–	50	M6	180	6	–	6.1	(2)
LA80	120	140	220	100	120	–	60	M6	175	6	–	8.8	(3)
LA100	120	140	210	100	120	–	70	M8	205	6	–	9	(3)
LA120	120	140	220	100	120	–	60	M8	180	6	–	11	(3)
LA150	75	140	246	55	120	–	100	M8	203	7	–	9	(2)
LA180	75	140	247	55	120	–	120	M10	204	7	–	10	(2)
LA220	75	140	265	55	120	–	120	M10	222	7	–	11	(2)
LA270	75	140	307	55	120	–	120	M12	254	7	–	15	(2)
LA350	120	140	303	100	120	–	135	M12	240	7	–	21	(3)
LA410	120	140	300	100	120	–	150	M12	234	7	–	23	(3)

DCL type V21-DCL-□	Dimensions (mm)											Weight (kg)	Shape class
	A	B	C	D	E	F	G	H	I	J	K		
HA18	105	109	88	88	95	30	–	M6	–	7	–	3.7	(1)
HA25	65	130	232	45	110	–	50	M6	190	7	–	5.5	(2)
HA32	65	130	235	45	110	–	50	M6	191	7	–	6.4	(2)
HA40	65	130	250	45	110	–	65	M6	205	7	–	7.3	(2)
HA50	65	130	240	45	110	–	65	M6	196	7	–	7.5	(2)
HA60	65	130	255	45	110	–	70	M6	210	7	–	8.5	(2)
HA80	120	140	245	100	120	–	70	M6	200	7	–	12	(3)
HA90	65	130	249	45	110	–	90	M8	206	7	–	9	(2)
HA110	65	130	265	45	110	–	100	M8	222	7	–	10	(2)
HA140	75	140	289	55	120	–	100	M8	236	7	–	12	(2)
HA180	120	140	281	100	120	–	120	M10	228	7	–	18	(3)
HA210	120	140	299	100	120	–	120	M10	246	7	–	23	(3)
HA270	120	140	289	100	120	–	120	M12	236	7	–	23	(3)
HA310	120	140	333	100	120	–	135	M12	270	7	–	23	(3)
HA400	225	225	216	195	195	34	90	M12	–	10	M8	25	(4)
HA540	250	250	215	210	210	34	90	M16	–	10	M8	28	(4)
HA650	275	275	201	235	235	34	90	M16	–	10	M8	32	(4)
HA740	275	275	236	235	235	34	90	M16	–	10	M8	35	(4)
HA820	275	275	262	235	235	34	90	M16	–	10	M8	42	(4)

Chapter 8 Maintenance and Inspection

DANGER

- Always wait at least 20 minutes after turning the input power OFF before starting inspections.
  Wait at least 20 minutes after turning the input power OFF before starting work. Make sure that the displays on the operation panel have gone out before removing the front cover.
  Remove the front cover, and confirm that the "CHARGE" LED on the drive PCB or at the side of the control PCB has gone out. Also check that the voltage between terminals L+1 or L+2 and L– is 15V or less before starting the inspections.
  Failure to observe this could lead to electric shocks.
- Maintenance, inspections and part replacement must be done by a designated person.
  (Remove all metal accessories such as watches, bracelets, etc., before starting the work.)
  (Always use an insulation measure tool.)
  Failure to observe this could lead to electric shocks and injuries.
- Always turn the power OFF before inspecting the motor or machine. A potential is applied on the motor terminal even when the motor is stopped.
  Failure to do so could lead to electric shocks and injuries.
- Do not use parts other than those designated for the replacement parts.
  Contact your inverter dealer for replacement parts.
  Failure to observe this could lead to fires.

CAUTION

- Vacuum the inverter with a vacuum cleaner to clean it. Do not use water or organic solvents.
  Failure to observe this could lead to fires or damage.

8-1 Inspection items

The inspections must be carried out periodically according to the working environment and frequency of use. If there are any abnormalities, the cause must be inspected immediately and countermeasures taken.

(1) Daily inspections

Table 8-1

Inspection item	Inspection details and work
Temperature/humidity	Confirm that the ambient temperature is –10 to 50°C, and that the humidity is 95% or less with no dew condensation.
Oil mist and dust	Confirm that there is no oil mist or dust in the VT230S.
Abnormal noise and vibration	Confirm that there is no abnormal noise or vibration from the installation site or VT230S.
Input power source	Confirm that the input voltage and frequency are within the specifications range.
Cooling fan	Confirm that the cooling fan rotates normally and that no lint, etc. is stuck on it.
Indicator	Confirm that all lamps on the operation panel light properly.

(2) Periodic inspections

Table 8-2

Inspection item	Inspection details and work
VT230S appearance	Check the state of dirt and dust on the vent or heatsink, and clean if necessary.
VT230S interior	Check the state of dirt and dust on the PCB and inside the equipment, and clean if necessary.
Terminal block	Tighten the terminal block screws if loose.
Cooling fan	Replace the fan every three years.
Electrolytic capacitor	Confirm that there is no liquid leaking or sheath discoloration.
Insulation resistance inspection	Do not perform a megger test on the VT230S. When doing a megger test on the external circuit, disconnect all wires connected to the VT230S.
Encoder	Confirm that there is no looseness or play in the bearings or couplings. The bearings are durable parts. This is approx. 10,000 hours at 6000rpm, and approx. 30,000 hours at 3000rpm.They must be replaced periodically.

(3) Inspection of spare VT230S

The inspection shown in Table 8-2 must also be performed for spare VT230S that are left connected but are not used in normal operation. The operation of the VT230S must be checked every six months by turning the power on.

8-2 Measuring devices

As the voltage and current on the input and output sides include high harmonics, the measured value will differ according to the measuring device. When measuring with a device for commercial frequencies, measure with the following circuits and noted measuring devices.

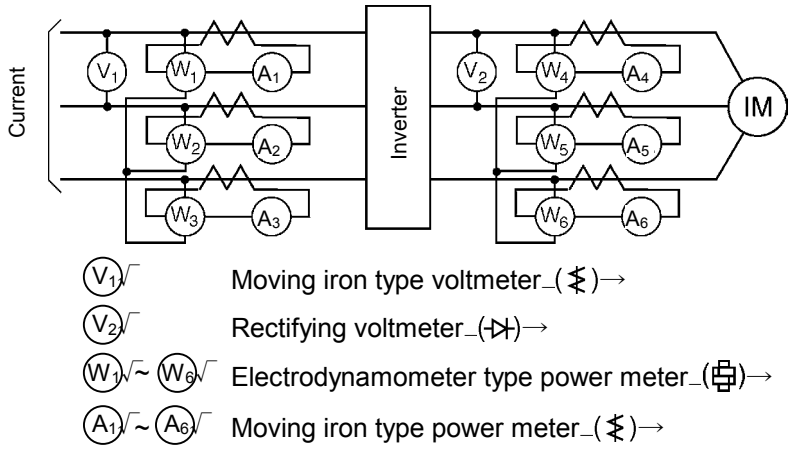


Fig. 8-1 Measurement circuit example

8-3 Protective functions

The VT230S has the protective functions shown in Table 8-3.

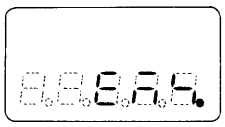
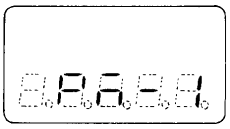
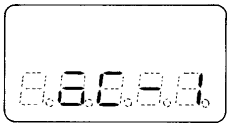
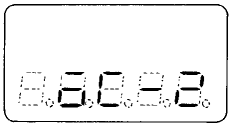
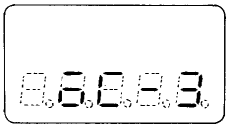
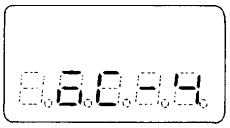
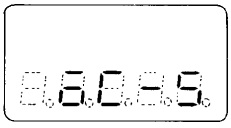
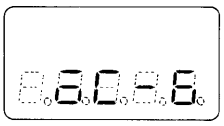
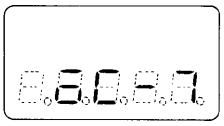
Table 8-3 Protective function

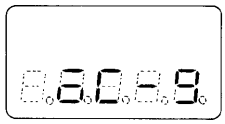
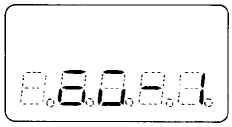
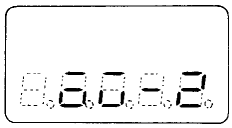
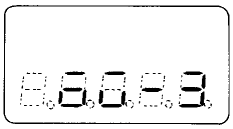
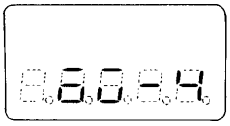
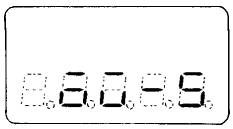
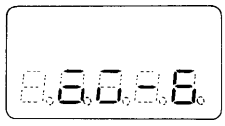
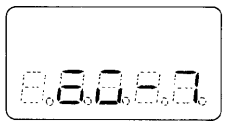
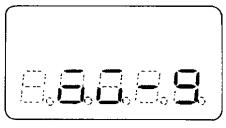
Name	Function
Overcurrent trip (OC-1 to 9)	The output is cut off and the inverter stops if the instantaneous value of the output current exceeds the preset value.
Overvoltage trip (OV-1 to 9)	The output is cut off and the inverter stops if the instantaneous value of the DC voltage in the main circuit exceeds the preset value.
Undervoltage trip (UV-1 to 9)	The output is cut off and the inverter stops if the DC voltage drops to approx. 65% or less due to a power failure or voltage drop during operation.
Overcurrent limit	If an overload occurs, the output frequency is automatically adjusted so that the output current is less than the overcurrent limit (150% as a standard) set with B18-0.
Overvoltage limit	If the output frequency is reduced suddenly, the DC voltage will rise in the main circuit due to the regenerative power. The output frequency will be automatically adjusted to prevent the DC voltage in the main circuit from exceeding the preset value.
Overload trip (OL-1)	The output will be cut off and the inverter will stop if the overload characteristics set with C22-0, 1 and 2 are exceeded. The setting (150% for 1 min. as a standard) can be changed according to the characteristics of the motor.
Overheat (UOH)	A thermistor is installed to detect temperature rises of the heatsink.
Self-diagnosis (IO, dER, CPU)	The built-in CPU, peripheral circuits and data are tested and monitored for abnormalities.
Grounding trip (Grd1 to 9)	The output will be cut off and the inverter will stop if a ground fault is detected.
Power module fault (PM-1 to 9)	The operation of the main circuit power module protection function is detected, and the inverter will stop if a fault is detected.
Phase failure (PHL)	The output will be cut off and the inverter will stop if a phase failure in the AC input power supply is detected.
Converter fan fault (CONV)	The output will be cut off and the inverter will stop if it is detected that the converter cooling fan has stopped due to trouble. (Only on parallel machines mounted with a converter fan.)

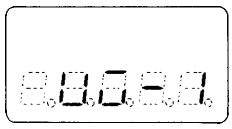
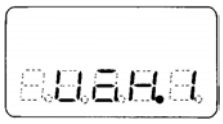
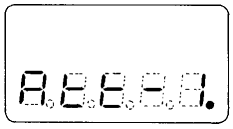
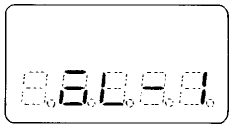
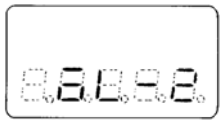
8-4 Troubleshooting with fault display

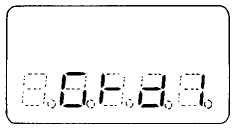
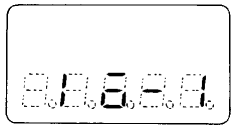
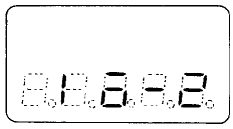
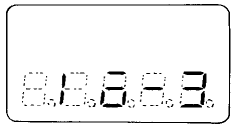
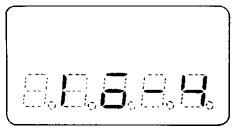
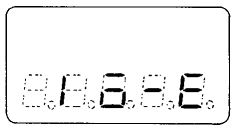
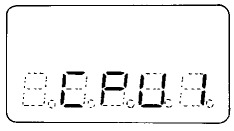
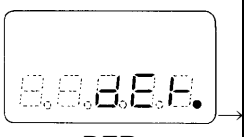
The countermeasures for when the inverter stops with a fault code display are shown in Table 8-4.

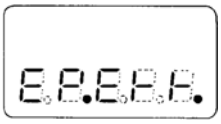
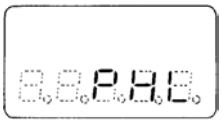
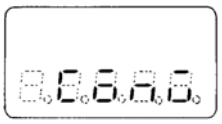
Table 8-4 Troubleshooting (1)

Display symbol	Name	Causes and countermeasures
 EMS.	Emergency stop	1. The sequence input EMS has been activated. Check the signal wiring. 2. This fault occurs when C00-4=2.
 PM-1~PM-9	Power module	1. Indicates that the short circuit protection circuit activated. 2. The sub-codes and causes and countermeasures are the same as for OC-1~9.
 OC-1	Overcurrent during stop	1. The power module in the main circuit may be broken.
 OC-2	Overcurrent during constant speed operation	1. A sudden change in the load or short circuit may have occurred. Reduce the load fluctuation.
 OC-3	Overcurrent during acceleration	1. Increase the acceleration time setting (A01-0). 2. Reduce the torque boost voltage (A02-2). 3. An excess GD^2, short circuit or rapid fluctuation of the load may have occurred.
 OC-4	Overcurrent during deceleration	1. Increase the deceleration time setting (A01-1). 2. A short circuit or rapid fluctuation of the load may have occurred.
 OC-5	Overcurrent during braking	1. Reduce the brake voltage setting (A03-0). 2. A short circuit in the load may have occurred.
 OC-6	Overcurrent during ACR	1. A short circuit in the load may have occurred.
 OC-7	Overcurrent during pre-excitation	

Display symbol	Name	Causes and countermeasures
 OC-9	Overcurrent during automatic tuning	1. Increase the acceleration time setting (A01-0). 2. Increase the deceleration time setting (A01-1). 3. A short circuit in the load may have occurred.
 OV-1	Overvoltage during stop	1. The power supply voltage may have risen. Reduce the voltage to within the specified range.
 OV-2	Overvoltage during constant speed operation	1. The power supply voltage may have risen. Reduce the voltage to within the specified range. 2. The speed may be fluctuating.
 OV-3	Overvoltage during acceleration	
 OV-4	Overvoltage during deceleration	1. The load GD^2 may be too large. Set the deceleration time (A01-1) according to the load GD^2. 2. The power supply voltage may have risen. Reduce the voltage to within the specified range.
 OV-5	Overvoltage during braking	1. The power supply voltage may have risen. Reduce the voltage to within the specified range.
 OV-6	Overvoltage during ACR	
 OV-7	Overvoltage during pre-excitation	
 OV-9	Overvoltage during automatic tuning	

Display symbol	Name	Causes and countermeasures
 UV-1~UV-9	Undervoltage	1. A drop in voltage, phase dropout or power supply failure may have occurred. Check the power supply system and correct if necessary.
 UOH.n	Overheat	1. A trouble may have occurred in the cooling fan. Replace if necessary. 2. The ambient temperature may have risen. Lower the ambient temperature. (50°C or less) 3. The vent or heatsink may be clogged. Clean the dirt and dust accumulated in the vent, etc. 4. The carrier frequency may be set too high. Confirm that the setting is within the range given in Appendix Table 1 (Note 5).
 ATT-n	Automatic tuning abnormal completion n: Step No.	1. n = 1 The motor may not be connected correctly. Check the connection. The B00 and B01 parameters may not be set correctly. Check the parameter settings. 2. n = 2 The B00 and B01 parameters may not be set correctly. Check the parameter settings. 3. n = 3 The load and machine may not be separated. Separate the load and machine. Increase the acceleration time (A01-0). Increase the deceleration time (A01-1). If the motor vibrates, increase the torque stabilizing gain (B18-2). 4. n = 4 The load and machine may not be separated. Separate the load and machine. If the motor vibrates, increase the torque stabilizing gain (B18-2). 5. n = 5 If the motor does not stop. Increase the acceleration/deceleration time (A01-0, A01-1). If the motor is stopped. The B00 and B01 parameters may not be set correctly. Check the parameter settings. 6. n = 6 The B00 and B01 parameters may not be set correctly. Check the parameter settings.
 OL-1	Overload	1. The motor may have overloaded. Reduce the load or increase the motor and inverter capacity. 2. If this occurs at a low speed, try lowering the boost (A02-2) or brake voltage (A03-0).
 OL-2	DBR overload	1. The regenerative power may be excessive. Increase the deceleration time, and reduce the regenerative power. 2. C22-3: DBR overload may not be set correctly. Set a value appropriate for DBR and the unit.

Display symbol	Name	Causes and countermeasures
 GRD.1~GRD.9	Grounding	1. A ground fault may have occurred in the output line or motor. Restore the grounded point.
 IO-1	I/O error (gate turn-off circuit error)	1. The VT230S may be malfunctioning due to external noise, etc. Look for the noise source and remove the cause. The control circuit may be faulty.
 IO-2	I/O error (A/D converter error)	
 IO-3	I/O error (current detection error)	1. The current detector connectors may be connected improperly. Properly connect these. 2. The current detection may be faulty.
 IO-4	I/O error (retry time-out)	1. Retry has failed. There are no countermeasures for this code, so reset the VT230S.
 IO-E	I/O error (thermistor error)	1. Securely connect the thermistor connector.
 IO-F	I/O error (speed detection error)	1. This indicates that there is an error in the speed detection operation results. Check the speed detection signal wiring, connection and the speed detector.
 CPU-1~CPU-8	CPU error	1. The unit may be malfunctioning due to external noise, etc. Look for the noise source and remove the cause. 2. The control circuit may be faulty. 3. For all sub-codes other than 8, turn the power off and on once.
 DER	EEPROM data error	The parameter setting value is incorrect. Correct the parameter setting value with the following procedure. (1) Select D20-2 with the monitor mode, and press the set key. The parameter for which an error occurred will display. (2) Set the correct parameter in this state. (3) Display the parameters in order with the knob.

Display symbol	Name	Causes and countermeasures
 EP.ERR.	Verify check data error	An error may have occurred when using verify check in the parameter copy function using the operation panel. Execute the parameter copy function again.
 PHL	Phase failure	1. There may be a phase failure in the AC input power supply. Investigate the AC input power supply, and eliminate the phase failure. 2. The AC input wiring may be disconnected. Check the tightening, etc., of the AC input wire.
 Conv	Converter fan fault	1. There may be an abnormality in the converter cooling fan. Replace the fan if there is an abnormality.

8-5 Troubleshooting with no fault display

The causes and countermeasures for errors with no fault display are shown in Table 8-5.

Table 8-5 Troubleshooting

Phenomenon	Causes and countermeasures
Motor does not run	1. The input/output wiring may be improper, or phase or power failure may have occurred. Inspect and correct the wiring. 2. The motor may be locked or the load excessively heavy. Reduce the load. 3. The reverse run interlock function (C09-3) may be set or the other parameters may be incorrect. Check the parameters. 4. The voltage may not be output to the VT230S output terminal. Measure the output voltage, and confirm that the three phases are balanced. 5. The local/remote setting may be incorrect. Set according to the required mode. 6. The encoder signal may not be input correctly. Check the encoder signal.
Motor runs in opposite direction	1. The output terminals U, V, and W sequence may be incorrect. Interchange the phase sequence. 2. The sequence input wires for forward/reverse run may not be connected to the specified terminals. Connect the wires as follows: Forward run: Short-circuit terminals RUN - RY0 Reverse run: Short-circuit terminals PSI1 - RY0 (When input terminal function setting is C03-0=1 (default value))
Motor runs but the speed does not vary	1. The load may be too heavy. Reduce the load. 2. The frequency setting signal level may be too low. Check the signal level and circuit.
Motor acceleration/ deceleration is not smooth	1. The motor acceleration/deceleration time setting (A01-0, 1) may be too low. Increase the acceleration/deceleration time.
Motor speed varies during constant speed operation	1. The load may be fluctuating excessively or the load is too heavy. Reduce the load or fluctuation. 2. The inverter-motor ratings may not match the load. Select an inverter-motor set that matches the load.
Motor speed is too high or low	1. The number of poles or voltage may be incorrect. Check the motor specifications. 2. The maximum frequency (speed) or base frequency [B00-4, 5 (B01-4, 5)] may be incorrect. 3. The motor terminal voltage may be low. Use a thicker output cable.

Chapter 9 EMC Instruction

9-1 Preface

This Instruction details how to meet the EMC directives (89/336/EEC) with VT230S. It is important to understand and before installation and operation of drive. The VT230S designed to meet the EMC directives and are suitable for use in the Industrial, Residential, Commercial and Light Industrial Environments. These drives have been tested with the power cables and control leads connected as shown in Fig. 9-1. If these drives are connected with fewer control leads than these examples, it may be possible to reduce installation costs by using ordinary cables rather than screened cables which are recommend in this manual. It is strongly advised however that a compliance test should be performed under the actual operating conditions to certify that the system complies with the relevant EMC requirements. If the drives are used with any of the optional cards, you must provide suitable extra measures and must certify through a test that the product, system or installation complies with the relevant EMC requirements.

This instruction also details how to use filters for installation: the installation where the drives are installed as stand-alone equipment without being fitted into any enclosure, and the installation where the drives are installed inside a metal enclosure.

VT230S is suitable for use in Industrial Environments and in this case need not necessarily be installed in metal cabinets for EMC compliance.

VT230S in size 7P5H and smaller, 7P5L and smaller can be used also in Residential, Commercial and light Industrial Environment if they are properly installed in metal cabinets. See 9-9 for details.

VT230S in size 011H ~ 045H, 011L ~ 037L can be used also in Residential, Commercial and light Industrial Environment with stand-alone.

VT230S in size 055H and larger, 045L and larger have been tested for use in the Industrial Environment only.

⚠ WARNING

1. This manual represents Meidensha's recommendations based on its understanding of the EMC regulations only and Meidensha cannot accept responsibility for any legal problems arising from or in connection with the use of its products.
2. Meidensha have made every effort to ensure that their products comply with the directives laid out in the certificate of conformity which is supplied with each drive. In the case of EMC, the testing has been carried out using the filters which are recommended for each product. As VT230S in size up to 7.5kW are designed to be built into metal cabinets, they are considered to be components. Therefore, the final responsibility for compliance rests with the system builder.

9-2 Installation environment

Installing VT230S in size 7P5H and smaller, 7P5L and smaller within a metal structure control cabinet and 011H ~ 045H, 011L ~ 037L with stand-alone is recommended to use in Residential, Commercial, and Light Industrial Environment, ensure that the drive is not installed adjacent to devices or equipment, for instance, measuring devices that are not CE marked.

For VT230S in size 055H and larger and 045L and larger that are not designed for use in the Residential, Commercial and Light Industrial Environments, ensure that no device or equipment is installed adjacent to the drive that is intended for the Residential, Commercial and Light Industrial Environments only, as interference with such equipment may occur.

9-3 Input filters and their connections

⚠ WARNING

1. Electrical shock hazards. The input filter terminals must be fully covered with appropriate insulation material to avoid electrical shocks.
2. Electrical shock hazards. The input filters must be fully earthed. Otherwise, there may be a risk of electrical shocks and the effectiveness of filters will be impaired.

In most cases, the input filter should be installed as closely to the drive as possible to ensure its effectiveness. The following table shows the maximum distance between the filter and the drive. This may be changed, if, for instance, a complete system is filtered in its entirety. In this case, the whole system would require testing to ensure EMC compliance.

Table 9-1 Max. distance between drive and filter

Sizes	Max. distance
0P4L ~7P5L , 0P4H ~7P5H	0.3 meter
011L ~075L , 011H~315H	0.5 meter

Ensure that the input filter is securely and effectively earthed. If the drive is installed on a metal plate, install the filter on the same plate and then earth the plate. This is effective to reduce EMI.

9-4 Choosing and installing power cables

9-4-1 Choosing power cables

The input cables to the drive via the filter must be selected from those specified in the drive's manual. The output cables from the drive must be screened or armoured cables (see Fig. 9-1) and should be selected from Table 2-1.

9-4-2 Installing power cables

The power cables comprises three sections: one on the primary side of the filter, one between the filter and the drive and one on the output of the drive. Ensure that these are not installed in parallel to each other and that these are laid down apart from each other by at least 0.3m. Please also ensure that the screen of the output cable is earthed at both ends with one end connected to the drive's earth terminal and the other end to that of the motor. Please arrange the termination at the drive's end inside the drive enclosure, and if this is not possible and the cable is terminated outside the drive enclosure, terminate the cables as closely to the drive's conduit hole as possible, i.e., within 0.1 m from it.
If the screened output cables are over 30 meters, this may cause a problem arising from a floating capacitance, such as undesirable surge voltage increase at the motor terminals, electrical noises from the cables when they discharge capacitance, or increase in leakage currents. In this case, Meidensha recommend the use of output chokes. Please contact your supplier for more information.

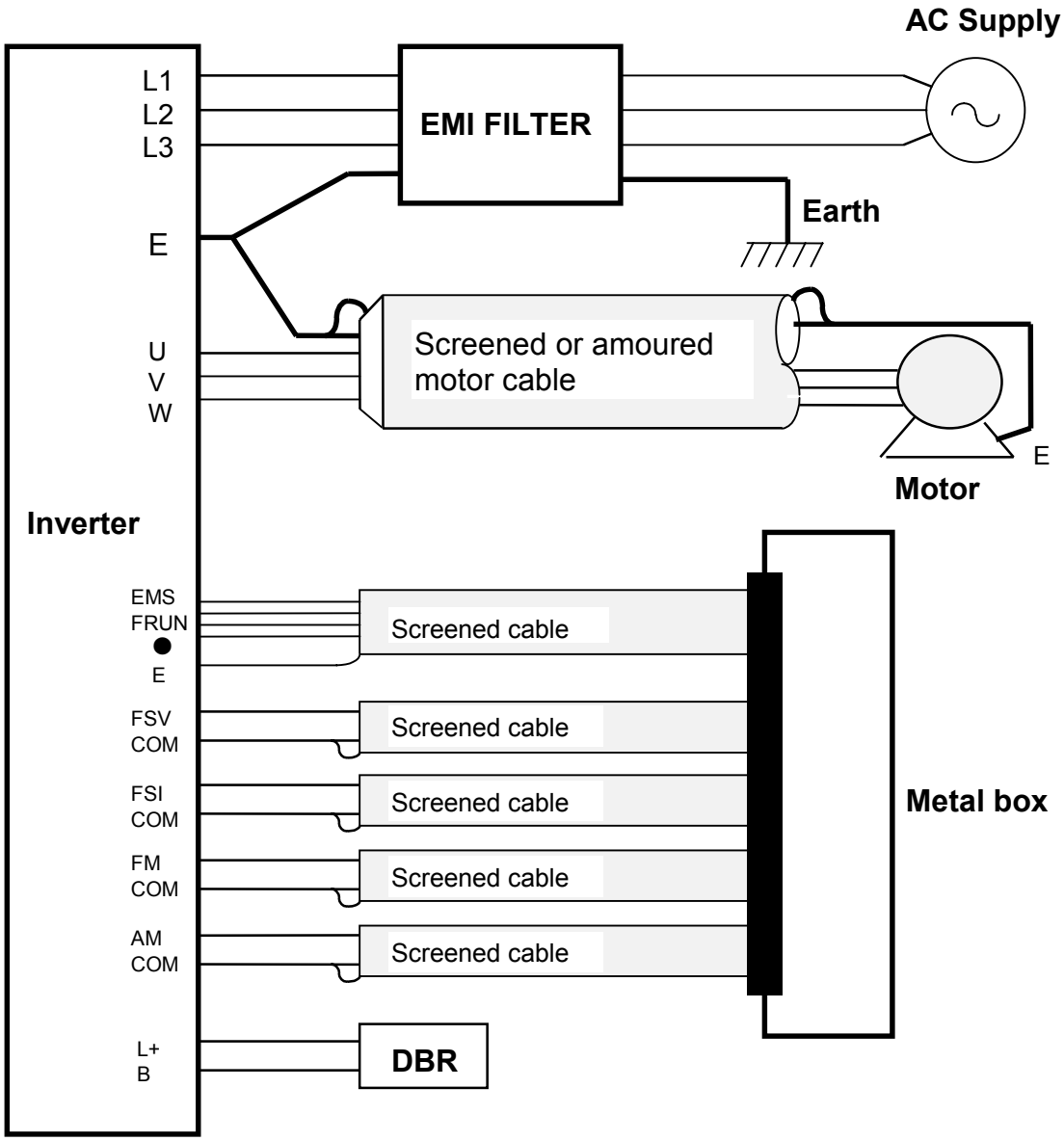


Fig.9-1 Installation (Stand-alone)

9-5 Choosing and connecting control leads

Control leads should be selected in accordance with the instructions in the drive's manual and should be screened if they are used for a speed setting circuitry, analogue signal circuitry for metering, or relay signal circuitry. The screen should be connected to the drive's earth or COM terminal only (refer to Fig.9-1) The control leads should be wired away from the power cables. If the control leads must run across the power cables, cross them at the right angle, and if they are laid down alongside each other, ensure to separate them by at least 0.3 m. When the section which runs along the power cables exceeds 10 m, separate them further more. The control leads should not share the same conduit hole of the drive with the power cables. Separate analogue control leads from relay control leads.
To reduce emission and to increase immunity, ensure that no control leads are connected that are not used. Also, ensure that control leads are wired in such manner that they are as short as possible.

The relay signal controller and analogue speed setting controller, analog signal meters should be put in a metal box together.

9-6 Earthing method

Earth the drive, motor and filter in such manner that the earthing cables are as short as possible. Select and install earthing cables in accordance with local requirements. It is recommendable to use low impedance earthing cables, i.e. those that can carry as much current as possible. If the motor does not share the same earth post with the drive and filter, do not connect the screen and earth lead of the drive's output cable to the motor.

9-7 EMI and EMS

The EMC directives set out immunity requirements for the electrical drive (ability to work properly without being affected by external electromagnetic disturbance), in addition to the previously enforced emission requirements (electromagnetic disturbance generated by the electrical drive).

In addition to the radiated noise directly generated from the drive and its connected cables, the emission requirement includes the conducted noise which is conducted outside the drive through the input cables.

Immunity is the ability of a drive to operate properly without being affected by an external disturbance.

The EMC compliance is only achieved when the drive's immunity level exceeds its emission level under its operating environment.

In addition to the immunity against a radiated and conducted disturbance, the EMC directives also requires of the drive the immunity against static electricity discharges and fast transients.

A human body can easily be charged with static electricity by merely walking on carpet and with a mere touch on the drive, this static electricity will be discharged through it. A discharging spark can be at such a magnitude that it can damage the drive.

A drive which is installed near cables connected to a switchable inductive load can often operate incorrectly due to a fast transient induced on its control leads at a switching of the inductive load.

These are just a few examples of disturbance to which the drive is exposed, and the drive is now required to operate correctly without being affected by such disturbance.

9-8 Considerations to measuring devices

All the cables and leads connected to the drive or filter should be regarded as active sources of electrical noise. For inspection or service, use measuring devices or equipment that are CE marked. If they require an external power supply, use one which is separate or well insulated from that of the drive system.

Even for a system that comprises CE marked equipment and devices only, an EMC compliance test may be required if the whole system is exported from one country to another. Ask the local government for details.

9-9 Installation into a metal cabinet

To clear the levels of the Residential, Commercial, Light Industrial Environments and the Industrial Environment for the drives up to 7.5kW, the following method of installation is required.

(1) To ensure compliance with international RF emission standards, the drive should be mounted in metal cabinets with the screens of the output power and the control cables attached to the cabinet
at the point of exit with 360 earth bonds.
When closing the metal cabinet, lock it so that it is completely sealed.

(2) The cabinet is preferably such that its door is connected to the main structure with shielded gaskets or conductive packing. When fitting these gaskets and packing, remove any paint from the face area where these materials fitted to the panels to ensure a minimum contact resistance between them. Use a thick and short cable to earth the door to the main cabinet structure.

(3) To ensure a better electrical contact, remove any point from the area of the cabinet panel where the filter is mounted.

(4) The controls assembly that attaches to the control cabling should be mounted in a cabinet panel where the unit with 360 earth bond to screened cable.

Installing the drive, filter, and other equipment in a metal structure control cabinet will reduce the emission level and will increase the immunity against external disturbance. It may be possible to use inferior filters to reduce installation costs and yet to meet the relevant EMC compliance.

Even within a control cabinet, install “High-noise cables” and “Low-noise cables” separately and ensure that they are all segregated.

High-noise cables: Any cables or leads connected to such equipment or devices which produces electrical noise, for example, ac variable speed drives, and un-suppressed contactor and relay coils.

Low-noise cables: Any cables or leads which are not connected to such equipment or devices that produces electrical noise, for example, ac variable speed drives, and un-suppressed contactor and relay coils.

Fig.9-2 shows an example of the installation where a foot-print filter is used.

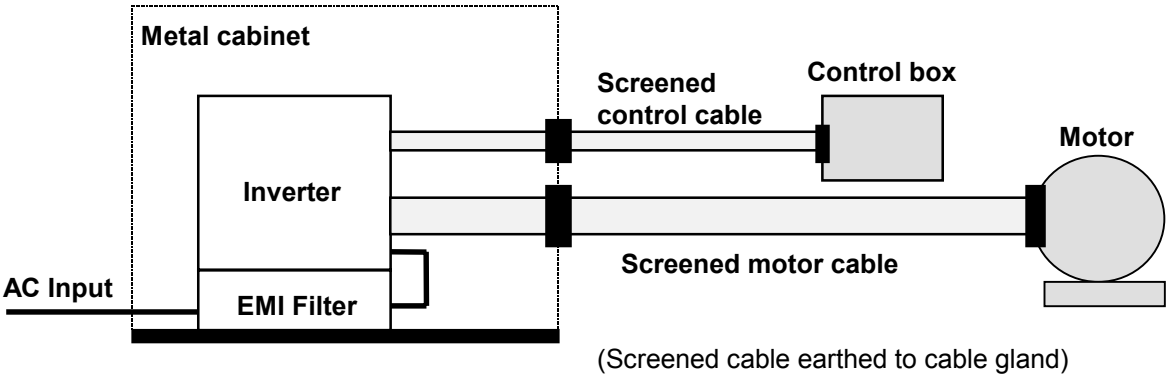


Fig. 9-2

9-10 Selecting and fitting of filters and ferrite cores for the installation

9-10-1 Selecting the filter

The following method of installation is required for compliance with the EMC Directives.

(1) The cables between the filter and the drive should be as short as possible.

(2) For the correct filters, see Table.9-2 and for correctly fitting them.

(3) Filters with current rating exceeding 100A are available for separate-mounting only.

9-10-2 Required input filters to achieve EMC compliance with VT230S

The following filters have been certified for EMC compliance for use with VT230S.

Table 9-2-1 Input filters for VT230S drives up to 045H

Series	Size	Output current (A)*1	Filter type	Series	Size	Output current (A)*1	Filter type
200V Series	0P4L	5.0	RS 3016-MD1	400V Series	0P4H	2.5	RS 3016-MD1
	0P7L	8.0			0P7H	3.6	
	1P5L	11.0			1P5H	5.5	
	2P2L	16.0	RS 3030-MD1		2P2H	8.6	
	4P0L	22.0			4P0H	13.0	
	5P5L	33.0	RS 3060-MD2		5P5H	17.0	RS 3032-MD2
	7P5L	42.0			7P5H	23.0	
	011L	61.0	RS 3094-MD3		011H	31.0	RS 3058-MD3
	015L	76.0			015H	37.0	
	018L	86.0	RS 3150-MDN		018H	44.0	
	022L	108.0			022H	60.0	RS 3096-MD4
	030L	134.0	RS 3280-MDN		030H	73.0	
	037L	161.0			037H	84.0	RS 3150-MDN
					045H	108.0	

*1 Data of Variable Torque

Table 9-2-2 Input filters for VT230S drives In size 045L or larger

Series	Size	Output current (A)	Filter type	Ferrite core type*2
200V Constant Torque	045L	173	RS3280-MDN/Std	OC/4√4 (1) OC/3 (3)
	055L	210	RS3330-MDN/Std	
	075L	286	RS3380-MDN/Std	F10080G√4 (1) OC/3 (3)
200V Variable Torque	045L	194	RS3280-MDN/Std	OC/4√4 (1) OC/3 (3)
	055L	270	RS3380-MDN/Std	
	075L	328	RS3660-MDN/Std	F10080G√4 (1) OC/3 (3)

*2 Top : Ferrite cores for output cables Bottom: Ferrite cores for Control cables
In ( ) : The number of turns required for cables to pass through the output core.

Table 9-2-3 Input filters for VT230S drives In size 055H or larger

Series	Size	Output current (A)	Filter type	Ferrite core type*2

400V Constant Torque	055H	108	RS3180-MDN/Std	OC/4 (2) OC/3 (3)
	075H	145	RS3280-MDN/Std	OC/4√4 (1) OC/3 (3)
	090H	173	RS3280-MDN/Std	
	110H	214	RS3330-MDN/Std	
	132H	245	RS3380-MDN/Std	
	160H	321	RS3450-MDN/Std	F10080G√4 (1) OC/3 (3)
	200H	428	RS3660-MDN/Std	
	250H	519	RS3750-MDN/Std	
	315H	590	RS3880-MDN/Std	
400V Variable Torque	055H	147	RS3280-MDN/Std	OC/4 (2) OC/3 (3)
	075H	179	RS3280-MDN/Std	O/C4√4 (1) OC/3 (3)
	090H	208	RS3330-MDN/Std	
	110H	242	RS3380-MDN/Std	
	132H	293	RS3450-MDN/Std	
	160H	365	RS3660-MDN/Std	F10080G√4 (1) OC/3 (3)
	200H	479	RS3750-MDN/Std	
	250H	581	RS3880-MDN/Std	
	315H	661	RS3990-MDN/Std	

9-10-3 Insulation test

⚠ CAUTION

If an insulation test is performed on a system incorporating VT230S and filters, do one of the following.

- Remove the input filters from the system during the test. (For precautions for the drive, see Chapter 2.)
- Perform the test at the maximum voltage of 1500VAC.

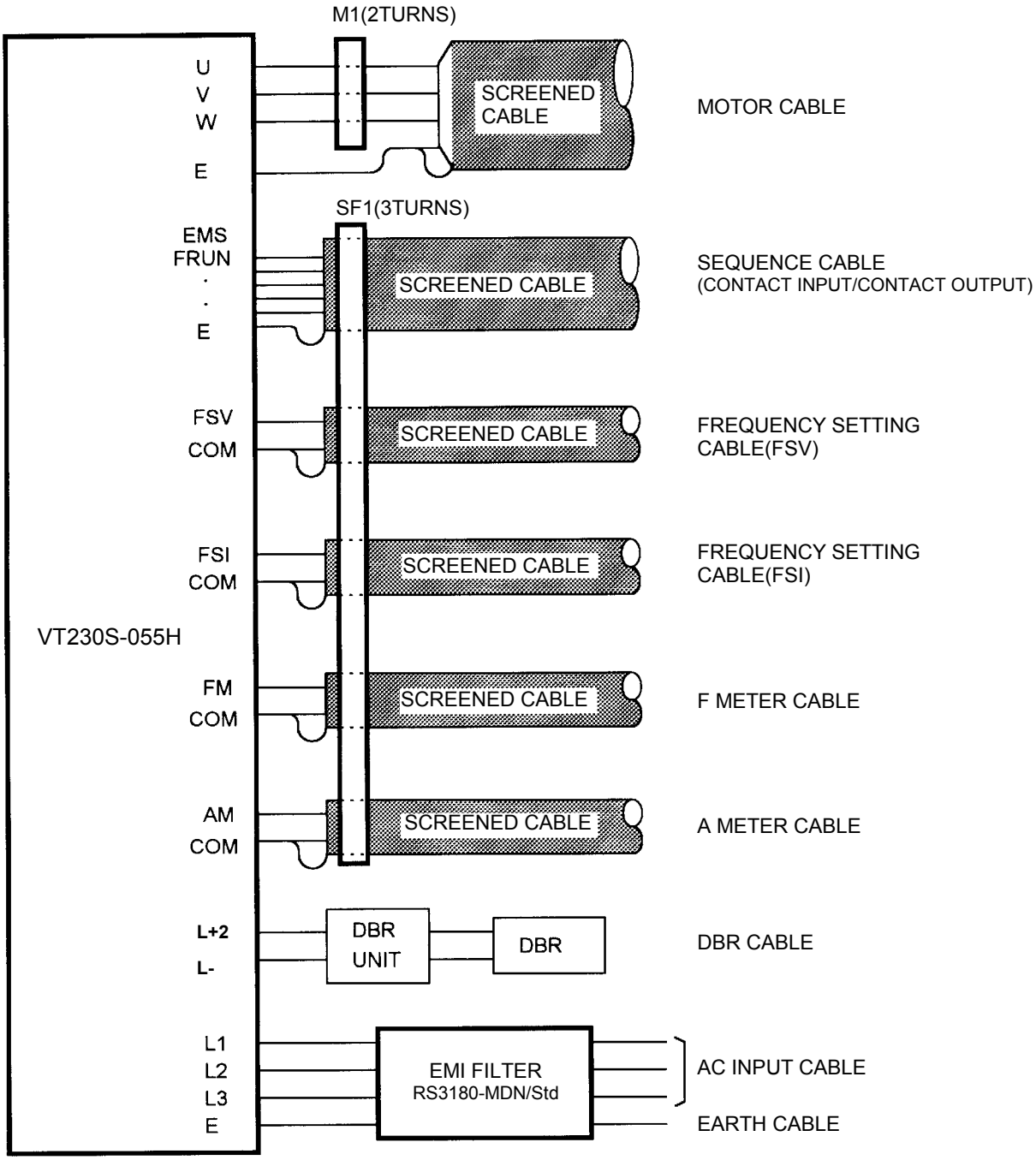
9-10-4 Fitting ferrite cores

For VT230S in size 055H and larger, 045L and larger, Figs.9.3 and 9.4 are examples where ferrite cores are fitted on the power cables and control leads. When using the filters listed in Tables 9-2-2, 9-2-3 use the ferrite cores as listed for each drive. VT230S drives are designed to meet the EMC requirements with these ferrite cores properly fitted. Select the best suitable ferrite cores from the Figs. or equivalent. The ferrite cores should be closely to the drives as possible.

If VT230S is operated with Operation Panel using extension cable (See Table.9-4), fitting 2 ferrite cores (TDK: ZCAT1518-0730) on the cable is required.

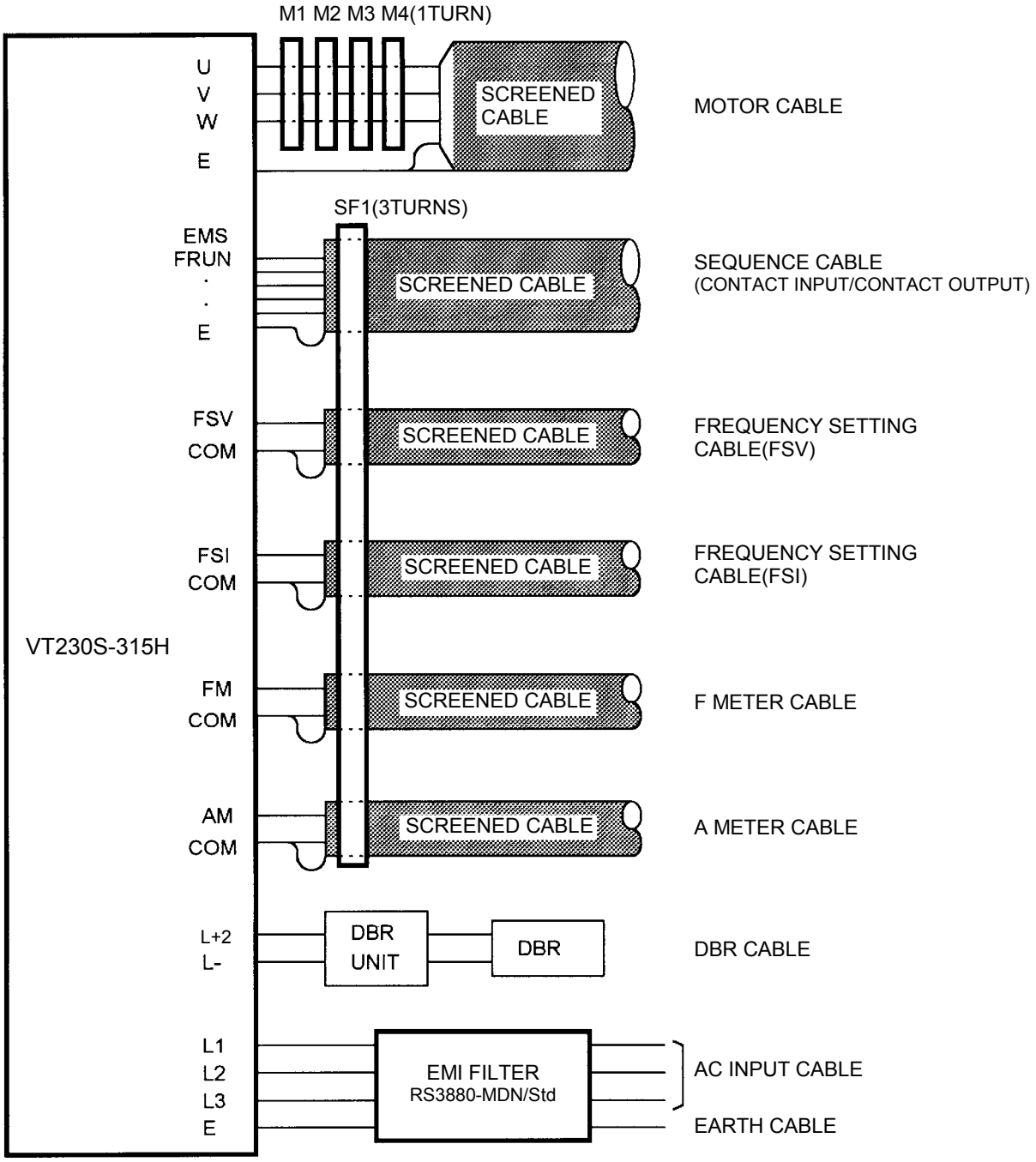
Table.9-4 Extension cable

Type	Length (m)
V23-W10-1	1
V23-W10-2	2
V23-W10-3	3



Ferrite Core	Type	Manufacturer
M1	OC/4	Rasmi Electronics
SF1	OC/3	Rasmi Electronics

Fig. 9.3



Ferrite Core	Type	Manufacturer
M1, M2, M3, M4	F140100	Hitachi Ferrite Electronics
SF1	OC/3	Rasmi Electronics

Fig. 9.4

Chapter 10 UL Instruction

VT230S-0P4HA to 045HA and -0P4HB to 7P5HB comply with UL508C and CSA C22.2 No. 14-M91.
(Note 1) UL compliant parts have been shipped as a standard from June 2001. When using the product as a UL compatible product, refer to section 10-2, and always check the attached rating nameplate to confirm that the product complies with UL.

10-1 Registration format

UL registration is indicated in the following manner.
The types for UL Approval are Model VT230S , followed by 0P4, 0P7, 1P5, 2P2, 4P0, 5P5, 7P5, 011, 015, 018, 022, 030, 037 or 045; followed by H; followed by A or B; followed by any one to seven letters, numbers or blank.

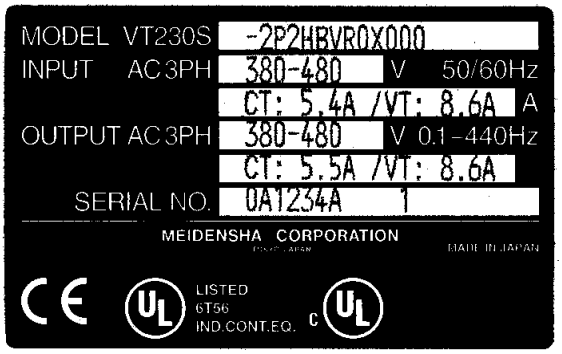
Example of type indication

VT230S-2P2 H A RV0 X000

- 2P2: Capacity. 0P4 045 are types of UL certificated.
- H: H indicates a type of UL certificated and 400V system.
- A: Indicates main circuit options. A : Standard (no options) B : With dynamic braking resistor (Applied only ~7P5)
- RV0: Indicates the control PCB option.
- X000: Meidensha control No.

10-2 Indication

The UL and cUL marks are indicated on the rating nameplate for UL compliant parts.



10-3 Matters to observe

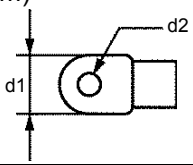
Always observe the following matters when using the product as a UL Instruction compliant part.

1) Use a "65/75ºC CU Class 1" wire with "voltage rating of 600V or more" for the main circuit wire connected to the inverter.
2) Use the closed-loop crimp terminals indicated in Table 10-1 when wiring the main circuit. Select a "UL Listed and CSA Certified closed-loop terminal" having a size matching the wire diameter. Use a maker tool when crimping.

3) When wiring the main circuit, tighten with the torque indicated in Table 10-1.

Table 10-1 Applicable wires and terminals

Wiring to power supply and motor (L1, L2,L3,U,V,W)

	400V Series	4P0H	5P5H 7P5H	011H	015H	018H	022H	030H	037H 045H
Applicable wire	mm^2	5.5	5.5	14	14	14	22	38	60
	AWG	10	10	6	6	6	4	2	1/0
Max. ring terminal (mm) 	d1	8.5	9.5	12			16.5	22	
	d2	4.3		5.3			6.4	8.4	
Terminal screw		M4		M5			M6	M8	
Tightening bolt [N•m]		1.2		2			4.5	9	

→

4) The short-circuit current of the connected power supply must be 10,000A or less and the voltage must be 480V or less. When connecting to the power supply, use a Class J fuse with the rated current shown in Table 10-2.

Table 10-2 The ratios of fuse

Type	0P4H	0P7H	1P5H	2P2H	4P0H	5P5H	7P5H
Class J fuse (A)	10	10	20	30	50	60	90
Type	011H	015H	018H	022H	030H	037H	045H
Class J fuse (A)	110	125	175	225	250	300	400

5) The inverter must be installed as "open type equipment".
6) The installation environment must have a "pollution degree 2".
7) The inverter has a motor overload protection function. Refer to Chapter 6 and correctly set parameters C22-0 to 2.
8) The following fuse (device: EFC1) is used for the VT230S-045HA. Use the same part when replacing the fuse.
   Fuse type: ATQR1, holder type: 30321R, maker: FERRAZ and SHAMUT
9) Use the control terminals RA/RC, FA/FB/FC at 30VAC/DC or less.

Appendix 1 Type Description System

■ Standard specifications

■ 200V Series VT230S-0P4L→037L

Item			Specifications											
System			200V Series											
Type (VT230S-□□□□)			0P4L	0P7L	1P5L	2P2L	4P0L	5P5L	7P5L	011L	015L	018L	022L	030L	037L
Inverter rating	Constant torque (Note 8)	Rated capacity [kVA] (Note 1)	1.0	1.7	2.7	3.8	5.5	8.3	11.4	15.9	21.1	26.3	31.8	41.0	50.0
		Max. continuous rated current [A] (Note 2)	3.0	5.0	8.0	11	16	24	33	46	61	76	92	118	144
		Max. applicable motor [kW] (Note 3)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
		Working ambient temperature	−10 to 50°C												
		Carrier frequency (Note 5)	Mono sound standard 10kHz, variable between 1 and 15kHz												Mono sound standard 4kHz, variable between 1 and 15kHz
		Overload current rating	150% for 1min.												
	Variable torque	Rated capacity [kVA] (Note 1)	1.2	2.1	3.0	5.1	7.6	10.0	14.5	19.3	24.2	29.7	37.4	45.0	55.0
		Max. continuous rated current [A] (Note 2)	5.0	8.0	11	16	22	33	42	61	76	86	108	134	161
		Max. applicable motor [kW] (Note 3)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
		Working ambient temperature	−10 to 40°C (Note 4)							−10 to 50°C					
		Carrier frequency (Note 5)	Mono sound standard 4kHz, variable between 1 and 15kHz												
		Overload current rating	120% for 1min.												
Power supply		Rated input AC voltage: rated input frequency	200~230V ± 10% 50/60Hz ± 5%				200~220V ± 10%/50Hz±5% 200~230V ±10%/60Hz±5%								
Output (Note 9)		Rated output voltage	200~230V (Max.) (Note 7)												
		Output frequency	0.1~440Hz												
Const-ruction		Structure	Wall-mounted												
		Enclosure	IP20									IP00			
		Approx. weight (kg)	3.5					6		13		26		35	40
		Cooling method	Self-cooling	Forced air cooling											
		Paint color	Munsell N4.0												
Working environment			Indoors, Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.												

■ 400V Series VT230S-0P4H→045H

Item			Specifications												
System			400V Series												
Type (VT230S-□□□□)			0P4H	0P7H	1P5H	2P2H	4P0H	5P5H	7P5H	011H	015H	018H	022H	030H	037H	045H
Inverter rating	Constant torque (Note 8)	Rated capacity [kVA] (Note 1)	1.0	1.7	2.5	3.8	5.9	9.0	11.7	15.9	21.4	25.6	30.4	41.5	50.0	60.0
		Max. continuous rated current [A] (Note 2)	1.5	2.5	3.6	5.5	8.6	13	17	23	31	37	44	60	72	87
		Max. applicable motor [kW] (Note 3)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
		Working ambient temperature	−10 to 50°C													
		Carrier frequency (Note 5)	Mono sound standard 10kHz, variable between 1 and 15kHz												Mono sound standard 4kHz variable between 1 and 15kHz	
		Overload current rating	150% for 1min.													
	Variable torque	Rated capacity [kVA] (Note 1)	1.7	2.5	3.8	5.9	9.0	11.7	15.9	21.4	25.6	30.4	41.5	50.5	55.0	75.0
		Max. continuous rated current [A] (Note 2)	2.5	3.6	5.5	8.6	13	17	23	31	37	44	60	73	84	108
		Max. applicable motor [kW] (Note 3)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
		Working ambient temperature	−10 to 50°C													
		Carrier frequency (Note 5)	Mono sound standard 4kHz, variable between 1 and 15kHz													
		Overload current rating	120% for 1min.													
Power supply		Rated input AC voltage: rated input frequency (Note 6)	380~460V ± 10%, 50/60Hz±5% 480V − 10%, +5% 50/60Hz±5%													
Output (Note 9)		Rated output voltage	380~480V (Max.) (Note 7)													
		Output frequency	0.1~440Hz													
Const-ruction		Structure	Wall-mounted													
		Enclosure	IP20										IP00			
		Approx. weight (kg)	3.5						6		13		26		35	
		Cooling method	Self-cooling	Forced air cooling												
		Paint color	Munsell N4.0													
Working environment			Indoors, Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.													

200V/400V Series VT230S-045L→075L＜-055H→315H

Item			Specifications										
System			200V Series			400V Series							
Type (VT230S-□□□□)			045L	055L	075L	055H	075H	090H	110H	132H	160H	200H	250H	315H
Inverter rating	Constant torque (Note 8)	Rated capacity [kVA] (Note 1)	60	73	100	75	100	120	150	170	220	300	360	400
		Max. continuous rated current [A] (Note 2)	173	210	286	108	145	173	214	245	321	428	519	590
		Max. applicable motor [kW] (Note 3)	45	55	75	55	75	90	110	132	160	200	250	315
		Working ambient temperature	−10 to 50°C											
		Carrier frequency (Note 5)	Mono sound standard 4kHz, variable between 1 and 8kHz											
		Overload current rating	150% for 1min.											
	Variable torque	Rated capacity [kVA] (Note 1)	65	90	110	100	120	140	170	200	250	330	400	460
		Max. continuous rated current [A] (Note 2)	194	270	328	147	179	208	242	293	365	479	581	661
		Max. applicable motor [kW] (Note 3)	55	75	90	75	90	110	132	160	200	250	315	370
		Working ambient temperature	−10 to 50°C											
		Carrier frequency (Note 5)	Mono sound standard 4kHz, variable between 1 and 8kHz											
		Overload current rating (Note 10)	120% for 1min.											
Power supply		Rated input AC voltage: rated input frequency	200~230V ± 10%, 50/60Hz±5%			380~460V ± 10%, 50/60Hz±5% (Note 6)								
Output (Note 9)		Rated output voltage (Note 7)	200~230V (Max.)			380~460V (Max.)								
		Output frequency	0.1~440Hz											
Const-ruction		Structure	Wall-mounted											
		Enclosure	IP00											
		Approx. weight (kg)	60	80	100	55	60	65	70	90	100	210	300	
		Cooling method	Forced air cooling											
		Paint color	Munsell 5Y7/1											
Working environment			Indoors, Relative humidity: 95%RH or below (no dew condensation), Altitude: 1000m or less, Vibration: 4.9m/s^2 or less Freedom from corrosive or explosive gases, steam, dust, oil mist or cotton lint.											

Note 1) The output voltage indicates the output capacity [kVA] at 200V for the 200V series, and 400V for the 400V series.

Note 2) Indicates the total effective value including the higher harmonics.

Note 3) Indicates the case for the MEIDENSHA standard 4-pole squirrel cage motor.

Note 4) When 40°C is exceeded, derate the output current by 2% for each 1°C. (Refer to Fig. 1-1.)

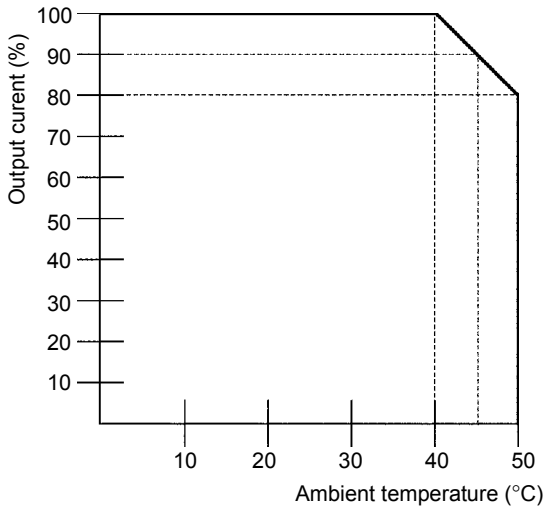


Fig. 1-1 Derating according to ambient temperature

Note 5) The soft sound mode is set as a default. Set as follows to use the mono sound mode.

＞030H and smaller and 022L and smaller
If the carrier frequency is set to higher than 4kHz on variable torque, derate the output current by (variable torque rated current - constant torque rated current)/6[A] per 1kHz. Furthermore, when picking up the 10kHz and using, set 7% of the constant torque's rated current per 1kHz as the reduced rating. (refer to Fig. 1-2)

＞037H→045H and 030L→037L
If 4kHz is exceeded, derate the output current by 7% of the constant torque's rated current per 1kHz as the reduced rating. (refer to Fig. 1-3)

＞055H and larger and 045L and larger
If 4kHz is exceeded, derate the output current by 5% of the constant torque's rated current per 1kHz as the reduced rating. (refer to Fig. 1-4)

If the heat sink temperature 70°C is exceeded and the output current exceeds 90%, the carrier frequency will automatically change to 4kHz.

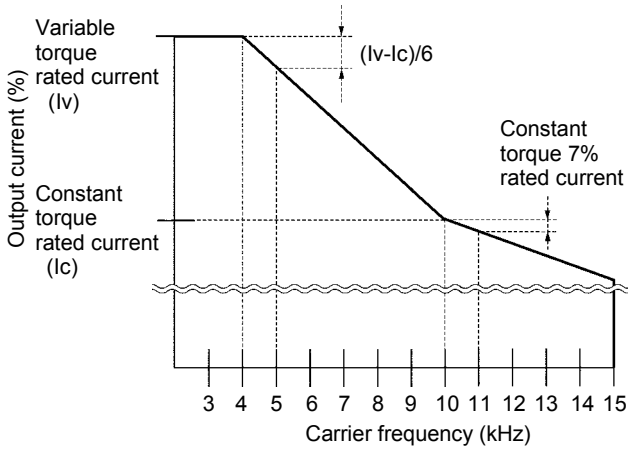


Fig. 1-2 Derating according to carrier frequency for 030H and smaller and 022L and smaller

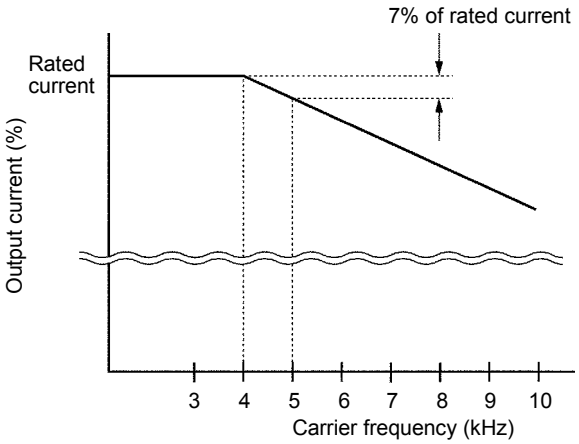


Fig. 1-3 Derating according to carrier frequency for 037H→045H and 030L→037L

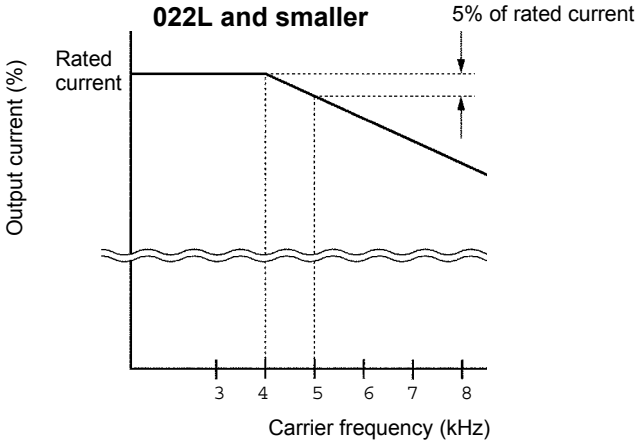


Fig. 1-4 Derating according to carrier frequency for 055H and larger and 045L and larger

(Note) When changing the carrier frequency, take care to the motor's temperature rise.

Note 6) This inverter is subject to the EC Low Voltage Directives. The rated input voltage will be 380 to 415V to comply to the EC Low Voltage Directives.

Note 7) An output voltage exceeding the input voltage cannot be attained.

Note 8) When using the IM speed sensor-less vector control , the IM vector control with speed sensor, or the PM motor control, select the applicable motor from the max. continuous rated current [A] of the constant torque.

Note 9) The rated output voltage for the IM speed sensor-less vector control , the IM vector control with speed sensor, or the PM motor control is as follows.

200V series : 160V/180V/185V respectively in respect to the input voltage 200V/220V, 230V.
400V series : 300V/320V/360V/370V respectively in respect to the input voltage 380V/400V/440V/460V. The output frequency range will be 0 to 120Hz ($7200min^{-1}$).

Note 10) This is 112% per minute for up to CPU version 122.x and ROM version 123.x, and 120% per minute for CPU version 124.0 and ROM version 125.0 and above.

■ Control specifications table

		V/f control (constant torque)	V/f control (variable torque)	Speed sensor-less vector control	Vector control with speed sensor (Note 1)	PM motor control (Note 2)
Frequency control	Control method	All digital control Sine wave approximation PWM				
	Transfer frequency	Mono-sound mode : 1 to 15KHz (0.1kHz increments) (1 to 8kHz for 055H√, 045L√) Soft sound mode : Average frequency 2.1 to 5kHz Frequency modulation method (3 tone modulation, 4 tone modulation)				
	Output frequency resolution	0.01Hz				
	Frequency setting resolution	0.01Hz (digital) 0.025% (analog) In respect to maximum frequency				
	Frequency accuracy	±0.01% (digital) at 25±10°C ±0.1% (analog) at 25±10°C				
Control specifications	Voltage/frequency characteristics	Select randomly from constant torque, constant output and reduction torque 3 to 440Hz range.		Select randomly from constant torque and constant output 150 to 7200min^{-1} (210Hz) range.		
	Torque boost	Manual/automatic selective		—		
	Max. torque boost	Max. torque for applicable motor is output when used with automatic tuning.		—		
	Automatic tuning	Automatic measurement of motor constants Automatic measurement of various parameters (Measurement time approx. 2 minutes)				—
	Starting frequency	Set between 0.1 and 60.0Hz		—		
	Starting torque	200% or more **(Note 3)** (Time to reach using Meidensha standard motor at 150%A: approx. 3 seconds)		—		
	Acceleration/ deceleration time	0.01 to 60000sec Acceleration/deceleration time × 2, jogging dedicated × 1, program cushion × 8				
	Acceleration/ deceleration mode	Linear/S-character selective				
	Operation method	3 modes selective • Forward run/reverse run • Run stop/forward run reverse run • Forward run pulse/reverse run pulse/stop				

(Note 1) The IM speed detection option PCB is required.
(Note 2) This is for the Meidensha standard PM motor. The PM speed detection option PCB is required.
(Note 3) It depends on the motor capacity. For 45kW and larger, Starting torque is Approx. 150%.
(Note 4) This is 150Hz for up to CPU version 114.x and ROM version 115.x, and 210Hz for CPU version 122.0 and ROM version 123.0 and above.

		V/f control (constant torque)	V/f control (variable torque)	Speed sensor-less vector control	Vector control with speed sensor	PM motor control
Control specifications	Stop method	Deceleration stop in respect to run, emergency stop and inching, coast to stop selective				
	DC braking	Braking start frequency, randomly set between 0.1 and 60.0Hz Braking voltage, randomly set between 0.1 and 20.0%		Braking speed, randomly set between 0.00 and 50.00% Braking start ,randomly set between 50 and 150%.		
		Braking time, randomly set between 0.0 and 20.0 seconds				
	Output frequency	0 to 440Hz		0 to 120Hz		0 to 210Hz (Note 1)
	ASR	—	Control range	1 : 100	1 : 1000	1 : 100
			Constant output range	Up to 1 : 2	Up to 1 : 4	Up to 1 : 1.2
			Control accuracy (At Fmax ≥ 50Hz)	±0.5%	±0.01%	±0.01%
			Control response	5Hz	30Hz	—
Setting	Multi-step frequency setting	8 steps Acceleration/deceleration time as changeable 5-bit non-encode mode				
	Ratio interlock setting	During remote setting mode y = Ax + B + C y: Operation results x: Operation input A: 0.000 to ±10.000 B: 0.00 to ±440Hz C: Auxiliary input With output upper/lower limit		During remote setting mode y = Ax + B + C y: Operation results x: Operation input A: 0.000 to ±10.000 B: 0 to ±7200min^{-1} (120Hz) C: Auxiliary input With output upper/lower limit		
	Frequency jump	Three places can be set Width can be varied between 0.0 and 10Hz		—		
	Slip compensation	Operation/non selective Slip compensation gain: 0.0 to 20.0		—		
	Automatic run function	10-step automatic run function Synchronous/asynchronous selective				
	Others	PID control Pick-up Automatic start Restart after instantaneous power failure Reverse run prevention Traverse pattern		Pick-up Automatic start Restart after instantaneous power failure Reverse run prevention Traverse pattern	Automatic start Restart after instantaneous power failure Reverse run prevention Traverse pattern	
Control input/output	Standard panel	Display: 7-segment LED × 5 digits and sign Status/unit display LED: 8 points Operation: Operate with knob and set keys Local/remote changeover operation, forward run/reverse run direct run operation, all parameter reference/change, others Unit installation possible (extension cable max. 3m)				
	Sequence input	Fixed: 3 points Programmable: 5 points Sink/source changeable				
	Sequence output	Relay 1c contact: 1 point (fault) Relay 1a contact: 1 point (programmable) Open collector: 3 points (programmable) The programmable details can be changed between speed detection, pre-charging complete, reverse run, speed reached, direction operation, current reached, speed reached, acceleration, deceleration and fault code				
	Frequency setting	FSV: 0 to 10V/0 to 5V/1 to 5V FSI: 4 to 20mA/0 to 20mA AUX: 0 to ±10V/0 to ±5V/1 to 5V (Used for the ratio interlock, operation or PID feedback)				

(Note 1) This is 150Hz for up to CPU version 114.x and ROM version 115.x, and 210Hz for CPU version 122.0 and ROM version 123.0 and above.

		V/f control (constant torque)	V/f control (variable torque)	Speed sensor-less vector control	Vector control with speed sensor	PM motor control
Control	Meter output	0 to 10VDC, 1mA (programmable) : 2 points Change between output frequency, output voltage, output current, DC voltage, etc.				
Protection	Preventive	Overcurrent limit (drive regeneration limit variable), overvoltage limit, overload warning contact				
	Shut-off	Overcurrent, overvoltage, undervoltage, IGBT fault, overload, temperature rise, ground fault, other self-diagnosis				
	Fault history	Past four faults are saved. Saved details: Primary cause, secondary cause, output current and output frequency before shut-off.				
	Overload withstand level	Except variable torque 150% for 1 minute, 170% for 2.5 seconds (75% for 1minute in case 1Hz and less) Inverse time characteristics Variable torque (Note 1) 120% for 1 minute, 125% for 7.5 seconds (75% for 24 seconds in case 1Hz and less) Inverse time characteristics				
	Retry	Randomly set between 0 and 10 times				

(Note 1) For up to CPU version 122.x and ROM version 123.x, this is up to 037L, up to 045H: 120%; 045L and above, 055H and above: 112%
For CPU version 124.0 and ROM version 125.0 and above, this is 120% for all capacities.

Appendix 2 Outline Dimension Drawings

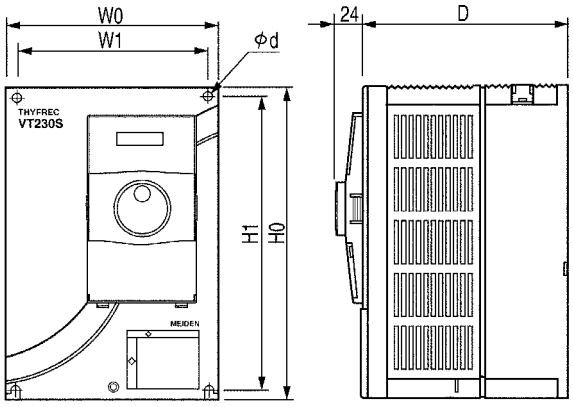


Fig.1

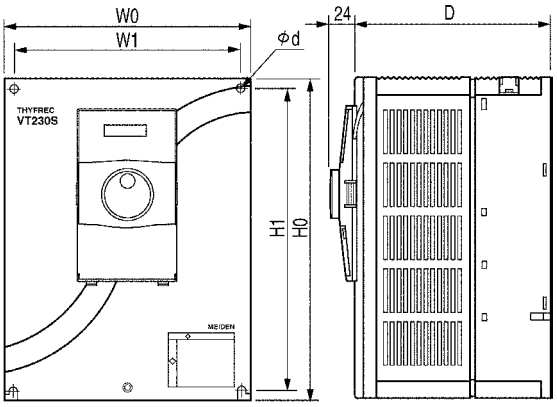


Fig.2

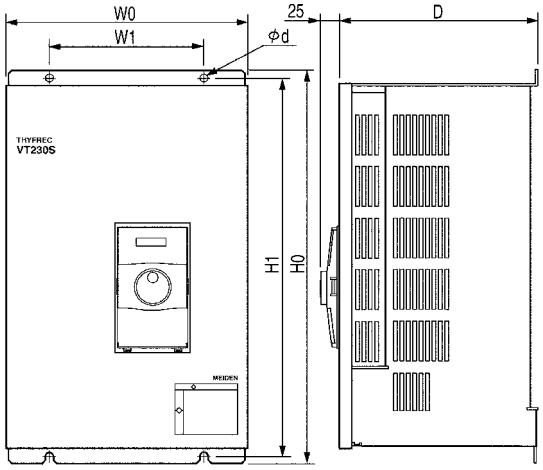


Fig.3

Type		Dimensions (mm)						Main circuit terminal	Weight (kg)	Fig.
200V Series	400V Series	W0	W1	H0	H1	D	ød			
0P4L 0P7L 1P5L 2P2L 4P0L	0P4H 0P7H 1P5H 2P2H 4P0H	170	155	243	228	162	6	M4	3.5	Fig. 1
	5P5H 7P5H	216	201	275	260	169	7		6	Fig. 2
5P5L 7P5L								M5		
	011H 015H 018H	265	245	360	340	228			13	
011L 015L								M6		
	022H	310	200	500	480	253	10		26	Fig. 3
018L 022L	030H							M8		
030L	037H 045H	342	200	590	570	307			35	
037L								M10	40	

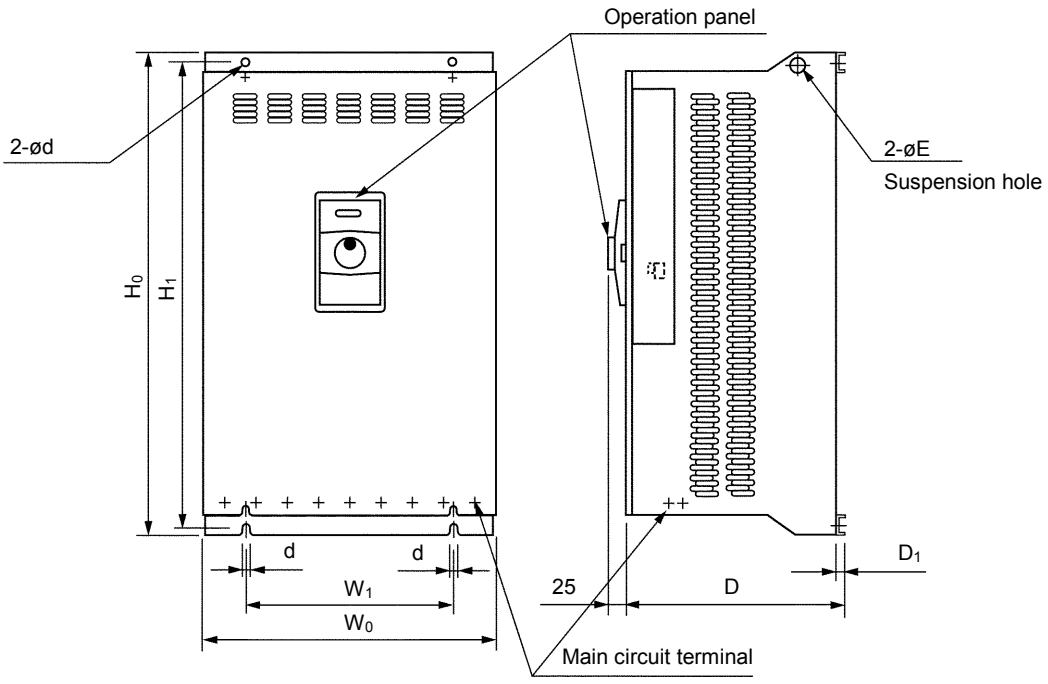


Fig.4

Type		Dimensions (mm)								Main circuit terminal	Weight (kg)	Fig.
200V Series	400V Series	W0	W1	H0	H1	D	D1	ød	øE			
	055H	420	300	690	666	309	12	10	20	M10	55	Fig.4
045L	075H										60	
	090H	480	400	740	714	352					65	
	110H										70	
055L											80	
	132H	488	320	980	956	358		13	23		90	
075L	160H										100	
	200H	680	500	1100	1070	379	20	15	23	M16	210	
	250H 315H	870	600	1300	1270						300	

Appendix 3 Fault Codes

Code	Display	Fault	Description	Retry
0	— — —	No fault	No fault recorded.	×
1	EA. (EmS)	Emergency stop	Indicates that sequence signal EMS has been input in C00-4 = 2 (fault output at emergency stop) mode.	×
2	PA-n (PM-n)	Power Module	Power module fault n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during pre-extension 9: during automatic tuning	○
3	oC-n (OC-n)	Over current	The output has risen to or beyond 300%. n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during pre-extension 9: during automatic tuning	○
4	oU-n (OV-n)	Over voltage	The DC voltage has risen to or beyond the preset level. (Vdc ≥ 800 or 400V) n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during pre-extension 9: during automatic tuning	○
5	UU-n (UV-n)	Under voltage	While the drive is running, the DC voltage has lowered to or beyond the preset level (65% of the rating). n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during pre-extension 9: during automatic tuning At C08-0 = 2, 3 (automatic start), only the symbol displays, so the FLT LED and terminal block FA, FB and FC contacts will not operate. EC0 to 3 will operate.	×
6	PHL (PHL)	Phase failure	This indicates that there is a phase failure in the AC input power supply. (Note. 1)	×
7	UoHn (UOHn)	Overheat	The heatsink temperature has risen. n: sub-code 1: Detected with thermistor (95ºC and above) 2: Detected with thermostat (90ºC and above)	○
8	oSP (OSP)	Overspeed	Indicates that the motor speed exceeded the overspeed setting value (C24-0).	×
9	ConU (CONV)	Converter fan fault	This indicates that trouble has occurred in the converter cooling fan. (Only on parallel machines mounted with a converter fan.) (Note 1)	
A	Att-n (ATT-n)	Automatic tuning abnormal completion	This indicates that the automatic tuning did not complete normally. n: sub-code (Automatic tuning step) 1: Setting error 2: Calculation operation error 3: Operation error 4: Load error 5: End process error 6: Convergence operation error	×
B	oL-n (OL-n)	Overload	Indicate that the output current exceeded the thermal operation time having inverse time characteristics. The standard characteristics are 150% for one minute in respect to the motor rated current. At 155% or more in respect to the inverter rated current, this will be 170% for 2.5 seconds. n: sub-code 1: Drive output overload	○
C	Grd. n (GRD. n)	Ground	The Drive has sensed a grounded conditions on the output. n: sub-code 1: during stop 2: during operation at the set speed 3: during acceleration 4: during deceleration 5: during braking 6: during ACR 7: during pre-extension 9: during automatic tuning	○

(Note 1) Added with CPU version 114.0 and ROM version 115.0 and above.

	Display	Fault	Description	Retry
D	 (IO-n)	I/O Error	There has been an error in communications through the I/O port. n: sub-code 1: Gate Shutdown Circuit error. A feedback signal has disagreed to a Gate Shutdown command. 2: A/D Convertor error. The A/D Convertor has been jammed. 3: Current Detector Offset. The offset of the Current Detector has increased to or beyond 0.5V. 4: Retry time out. Indicates that the operation was not successful within the No. of retries set in C21-0. 7: This indicates that the PROFIBUS interface option cannot be started up. 8: This indicates that a watch dog error occurred in the PROFIBUS interface option. (Indicates that an operation delay occurred in the PROFIBUS interface option.) E: Thermistor fault F: Speed (pole position) detection fault	×
E	 (CPU-n)	CPU Error	There has been an error while the CPU, RAM or ROM is in the self-diagnosis mode at power-up. n: sub-code 1: Watch-dog error, indicating that the CPU has been jammed. This fault may appear during at-speed operation. 2: CPU calculation error. 3: CPU RAM error. 4: External RAM error. 6: E^2PROM check-sum error. 7: E^2PROM read error. 8: E^2PROM write error. This error is only displayed, and the gate will not shut down and FLT will not be output. 9: Illegal combination of software version and CPU.	×
F	 (dEr)	E^2PROM Data Error	Indicates that there is an error in the various data stored in the E^2PROM. For details, enter the monitor mode: D20-2, and correct the data. **Caution)** If this appears when starting up, the details will not be stored internally. Thus, after starting up normally, these details cannot be read with the fault history (D20-0).	×
-	(EP.ERR)	Verify check data error	This indicates that an error occurred during the verify check in the parameter copy function using the operation panel.	

Appendix 4 7-segment LED Display

(1) Numeric

Display										
Numerics	0	1	2	3	4	5	6	7	8	9

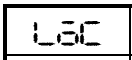
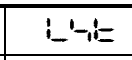
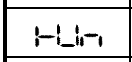
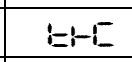
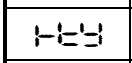
(2) Alphabet

Display										
Alphabet	A	B (b)	C	D (d)	E	F	G	H	I	J

Display										
Alphabet	L	M (m)	N (n)	O	P	Q (q)	R (r)	S	T (t)	U

Display					
Alphabet	V (v)	Y	–	:	⌋ **(Brackets)**

(3) Message

	LOC	LOCK		Lst	LIST
	rUn	RUN		trC	TRACE
	rty	RETRY		d.Err	Data ERROR
	Err	ERROR		d.End	Data END
	rmt	REMOTE		d.CHG	Data CHANGE

Revision history				
Revision	Page	Revision details	CPU version	ROM version
A	-	Not use	-	-
B	-	Add for PM motor control. Add for software option. Add for hardware option. Add Chapter 9	94.0	95.3
C	3-7~8,3-11, 3-13,7-6~7	Indications of Automatic tuning operation were revised. MC control sequence circuit was revised. Table 7-4 was revised.	Ditto	Ditto
D	Chapter 2, 7 Appendix	Add for large size drives.	114.0	115.0
	Chapter 4, 5, 6	Add parameters. (B19-1, 2 C22-3 C25-2 C35 U00)		
	Chapter 3	Add for Automatic tuning functions.		
E	Chapter 1, 10	UL Instructions added	124.0	125.2
	6-1,-23	Random scale parameter added		
	8-3, -8, A-11	Protection function added		
	A-3	Overload resistance value for variable torque 045L and above, 055H and above changed		
	-	Mistakes corrected, explanations added		

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