High Performance Vector Control Inverter

VVVF Inverter

SAMCO-svc06

Instruction Manual

SANKEN ELECTRIC CO., LTD.

Thank you for purchasing the Sanken High Performance Vector Control Inverter SAMCO-SVC06.

This inverter is designed to drive an induction motor at a variable speed. The inverter has a built-in microprocessor providing a wide range of functions and easy operability. To ensure many years of trouble-free operation and maintain optimum performance, be sure to read through this manual before using the product.

[For Safe Use]

- Safety instructions are given in this manual and on the product for safe use. Read the instructions thoroughly and use it correctly before using this product.
- After reading, keep this manual near to the machines for convenient reference.

Expressions and meanings of safety notes

Make sure the [safety notes] are fully read and correctly used prior to installation, operation, maintenance inspection. Critical safety instructions are marked “Danger” or “Caution” as follows.

⚠	**Danger**	This symbol indicates a hazard that could lead to death or serious injury if the warning is ignored and the product is handled incorrectly.
⚠	**Caution**	This symbol indicates a hazard that could lead to injury or damage to property if the warning is ignored and the product is handled incorrectly.

Even ignoring an instruction marked ⚠ “Caution” can have serious consequences under some circumstances. Be sure to abide by all instructions in this manual, irrespective of the degree of danger.

Meanings of symbols

This symbol indicates a potential danger.
The specific content of danger is indicated within △. (This example indicates a general danger.)

General danger **Electric shock danger** **Fire danger**

This symbol indicates the need for caution.
The specific content of caution is indicated within △. (This example indicates a general caution.)

General caution Caution: risk of electric shock Caution: risk of rotating objects

This symbol indicates a prohibition (strictly prohibited).
The specific content of prohibition is indicated within ⃠. (This example indicates a general prohibition.)

General prohibition **Disassembly is prohibited** **The use of open fire is prohibited.**

This symbol indicates an action that must be performed (the project that must be performed).
The specific content is indicated within ●. (This example indicates a general compulsory item.)

General compulsory item **Must be grounded**

CONTENTS

1. Safety Notes

1-1 Important notes

Danger

- **Caution: risk of electric shock**
  It is absolutely prohibited to remove the cover
  The risk of casualties exists because there are high-voltage circuits inside, accidental touch of which would cause electric shock.

- **Caution: Fire Hazard!**
  Immediately stop the device when peculiar smell, abnormal noise, smoke or sparks, etc. are found in the device (turn the power switch to "off" position), and then set the input side circuit breaker which is set outside to OFF. And contact the sale store or business office of the Company where the device is purchased.
  In case of a fire, please use extinguisher for electrical fire (dry powder), but do not use water for fire fighting.

1-2 Notes on use

Caution

- **Before starting the inverter, confirm the safety status of the load first, and then start running operation following the instruction manual.**
  Arbitrary power-on has the risk of accidents such as electric shock etc.

- **Do not smoke or use fireworks around the inverter.**
  As the explosions and damage may result in personal injury and fire.

- **Do not keep containers which contain water such as vase etc. above the equipment.**
  In case the vase is overturned, the water flowing out will penetrate inside the device and cause fire.

- **Do not sit or stand on top of the equipment, and do not lean on it or treat it as a footboard.**
  Otherwise, personal injury may be caused by overturn of the equipment..

- **Do not insert sticks, fingers etc. into the fan.**
  Because the rotating fan would cause personal injury.

- **During operation, do not short-circuit the input terminal and output terminal.**
  As the current return will result in electric arc, the arc light can cause personal burns and visual impairment.

- Its use in the following applications is absolutely prohibited.
  a) Medical equipment which are directly related to life.
  b) Trolley buses which may lead to personal injury.
  c) Important computer systems for the community, public utilities.
  d) Equipment with these as standards.
  When used in the above-mentioned load equipment, please consult the Company in advance. For equipment which have significant impact on personal safety and the maintenance of public functions, special measures are required on the use, maintenance and management, such as multiple of the system, setting up generating equipment for emergency use etc..

1-3 Notes on Installation

Caution	
	■ **It is absolutely prohibited to store or use the inverter under the environmental conditions described below.** Failure to observe this warning may result in a fault, damage, or deterioration, which could lead to fire. • Very hot, cold, or humid locations, of which the environmental conditions are beyond that of sample or that are recorded in the instruction manual. • In direct sunlight. • Near a heater or other heat source. • In a location subject to vibration or physical shock. • Near machinery that generates sparks • In a location subject to dust, corrosive or inflammable gases, salt, and water droplets. • Outdoors. • Higher than 3000 meters above sea level. • Other similar environments.
	■ **Mount the inverter on a metal surface or other non-flammable surface.** Failure to observe this warning may result in a fire.
	■ **Install the inverter in a location that can bear its weight.** Failure to observe this warning may result in injury if the inverter falls down.
	■ **Do not plug up the air inlet/exhaust. (Refer to “Installation” in the instruction manual for implementation).** If the air inlet/exhaust is blocked, a fire may be resulted due to internal temperature rise of the equipment.
	■ **Do not place the inverter near flammable materials.** Failure to observe this warning may result in a fire.
	■ **Do not allow foreign objects into the inverter or attach to the cooling fans.** Failure to observe this warning may result in a fire or an accident.
	■ **Do not operate an inverter which is damaged, lacking parts or dented.** Failure to observe this warning may result in an electric shock, injury, fire or accident.

1-4 Notes on Handling and Moving

Caution	
	■ **During handling and moving, do not tilt the equipment.** Otherwise, personal injury may be resulted due to falling down of equipment.
	■ **Prior to handling and movement, confirm the weight marking attached to the equipment first, if necessary, please prepare alternative handling machine for work.** Failure to observe this warning may result in personal injury.

1-5 Notes on wiring

Danger

- **Wiring must be performed by qualified personnel.**
  Failure to observe this warning may result in an electric shock or fire due to incorrect wiring.
- **Do not connect AC power to an output terminal (U, V, or W).**
  Failure to observe this warning may result in personal injury or fire.
- **Do not use if rated voltage is exceeded.**
  Failure to observe this warning may result in personal injury or fire.
- **Do not connect a resistor directly to the DC terminals (P and X).**
  Failure to observe this warning may result in a fire.
- **Connection between the ground terminals must be reliable.**
  Failure to observe this warning may result in electric shock if ungrounded.
  For the thickness of grounding wires, please refer to the wire sizes specified in the instruction manual.
- **Please tighten the terminal block screws according to specified tightening torques.**
  Failure to observe this warning may result in a fire.
- **Check that the AC power supply voltage is equal to the rated voltage of the inverter.**
  Failure to observe this warning may result in personal injury or fire.
- **For cable types and diameters, please use the cables specified in the instruction manual.**
  Failure to observe this warning may result in heating or a fire if the diameters of wires are too small.
- **Secure the inverter before wiring.**
  Failure to observe this warning may result in electric shock or personal injury.

Caution

- **The inverter, motor or wiring may cause interference. Please note misoperation of peripheral devices.**
  Failure to observe this warning may result in accidents.
- **If the input and output are terminal blocks, the wire heads must be connected with crimp terminals.**
  Failure to observe this warning may result in electric shock or fire.

1-6 Notes on Operation

Danger	
	■ **Attach the front cover before (**Turning the power on) **And, do not remove the front cover when the power is on.** Failure to observe this warning may result in electric shock.
	■ **Do not touch any switch with wet hands.** Failure to observe this warning may result in electric shock.
	■ **Do not touch any inverter terminal when the inverter is energized even if the motor is not operating.** Failure to observe this warning may result in electric shock.
	■ **Do not get close to the machinery driven by the inverter after an alarm stop because it will restart suddenly if the restart function is selected. (Design the system to ensure personal safety at restart.)** Failure to observe this warning may result in personal injury.
	■ **Provide a separate emergency stop switch.** Failure to observe this warning may result in personal injury.
	■ **If alarm reset is done in the operation signal status, the equipment will restart suddenly. Therefore, please cut off the operation signal before releasing an alarm.** Failure to observe this warning may result in personal injury.

Caution	
	■ **Do not touch the radiator fins or DC reactor because they become very hot.** Failure to observe this warning may result in burns.
	■ **It is easy to set the inverter drive speed from low to high, so be sure to confirm the operating range of the motor and machinery driven by the inverter before making such settings.** Failure to observe this warning may result in personal injury.
	■ **Please set separate brake if it is required to keep brake.** Failure to observe this warning may result in personal injury.
	■ **Do not start or stop the inverter by turning the main circuit ON or OFF.** Failure to observe this warning may result in equipment faults.

1-7 Notes on Maintenance and Inspection

Caution	
	■ **Works such as maintenance, inspection and replacement of parts etc. can only be carried out by professional electricians.** [Take off any metal item (such as watch, bracelet, etc.) before working on the equipment.] [Use insulated tools.] Failure to observe this warning may result in electric shock or burns.
	■ **Turn off the input power for maintenance or inspection. After the CHARGE lamp goes out, check that the voltage between DC terminals P and X is less than 30 VDC.** Failure to observe this warning may result in electric shock or personal injury.

1-8 Disposal

Caution	
	■ **When disposing this product, please entrust a specialized industrial waste disposal service (*) to handle.** If not handled by professionals, personal injury may be caused by capacitor explosion or harmful gases produced in explosion. （*）So-called professional waste disposal service refers to the [Industrial Waste Recycling and Carrying Body] and [Industrial Waste Disposal Body]. Those who carry out recycling, handling and disposal of industrial waste without prior approval will be subject to legal action. ([Subject to laws regarding disposal and cleaning of industrial products])

1-9 Others

Danger	
	■ **Reformation of the product without authorization is strictly prohibited.** Failure to observe this warning may result in an electric shock, personal injury, fault, damage or fire.
	■ **This product is designed for operation of a three-phase induction motor. Therefore it can not be used for single-phase motor or other purposes.** Failure to observe this warning may result in a fire or an accident.
	■ **Do not use this product for life-support equipment, or other purposes directly related to dangers to people.** Failure to observe this warning may result in an accident.
	■ **Install a safety device when this product is applied to facilities where the failure of this product may cause a serious accident or damage.** Failure to observe this warning may result in an accident.

2. Checking the Product and Precautions on Use

2-1 Checking the Product

After unpacking the product, check the following:
Check that the product has not been damaged during delivery, such as depression of casing etc..
If such problems are found, please contact the retailer.

Danger		
(prohibition symbol)	■	**Do not use if rated voltage is exceeded.** Failure to observe this warning may result in personal injury or fire.
(mandatory symbol)	■	**Check that the AC power supply voltage is equal to the rated voltage of the inverter.** Failure to observe this warning may result in personal injury or fire.

Product body

Figure 2-1 Outside View

Instruction Manual

this manual

2-2 The contents of the model

The model on the nameplate

SVC06 — ００１５ － Ｌ Ｆ ４

〔Series Name〕 SVC06

〔Capacity〕 0015

0015：1.5kW-150% / 2.2kW-120%
0022：2.2kW-150% / 4.0kW-120%
0040：4.0kW-150% / 5.5kW-120%
0055：5.5kW-150% / 7.5kW-120%
0075：7.5kW-150% / 11kW-120%
0110：11kW-150% / 15kW-120%
0150：15kW-150% / 18.5kW-120%

〔LCD panel〕
L:Configuration
N:no

〔EMC filter〕
F:Configuration
N:no

〔Voltage Class〕
4:3φ-400V series

2-3 Precautions on Use

1. **Use the product in a location satisfying the standard environmental specifications (temperature, humidity, vibration, dust, water drop, and toxic gases etc.).**

2. **Before starting up the product for the first time, carefully check the wiring. Make sure that the power cable (input) and motor cable (output) are connected correctly. Otherwise, the inverter will be damaged.**

3. **Since the ambient temperature of the installation location greatly affects the life of the inverter, it is recommended to lower the ambient temperature before operation.**

4. **When installing the product in an enclosure, check the closure size and ensure sufficient ventilation.**

5. **Capacitors and surge suppressors used for improving the inverter's output power factor may be heated or even damaged because of high-order harmonic components output by the inverter. In addition, when current overload occurs in the inverter, over-current protection action will be automatically executed. Therefore, please do not connect capacitors and surge suppressors at the output side of the inverter. To improve power factor, install the DC reactor at the DC side or AC reactor at the primary side (i.e. input end) of the inverter.**

6. **When implementing a megger test, follow the method given in this instruction manual (10-4 “Megger Test.”).**

7. **When using leakage circuit breaker protection switch, select a product for corresponding high-order harmonic and surge.**

8. **Avoid inserting a magnetic contactor between the inverter and the motor. If the magnetic contactor is turned on and off while the inverter is operating, an excess current will be generated.**

9. **Select larger capacity since the operating characteristics of full electromagnetic-type MCCB changes with higher harmonic current.**

2-4 Names of Parts

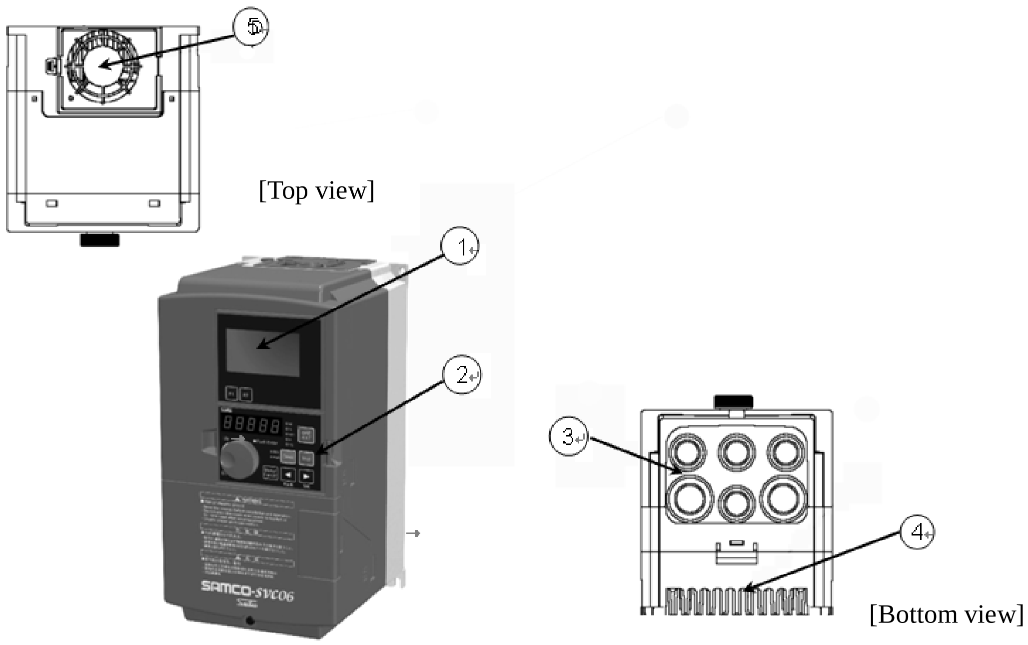


Figure 2-2 Names of Parts

Table 2-1 Names of Parts

No.	Name	Function
1	LCD display part	Refer to [Chapter 5 Operation Panel]
2	Operation Panel	Refer to [Chapter 5 Operation Panel]
3	Wiring Hole	Refer to [Chapter 4 Wiring]
4	Air Inlet	Cooling air suction hole
5	Exhaust hole (fan)	Cooling air exhaust hole

3. Installation

3-1 Installation Location and Storage

This equipment is an electronic control device. Please pay full attention to environment of the device before it is used.

Caution

- **Mount the inverter on a metal surface or other non-flammable surface.**
  Failure to observe this warning may result in a fire.

- **Do not plug up the air inlet / exhaust hole.**
  If the air inlet/exhaust is blocked, a fire may be resulted due to internal temperature rise of the device.

- **Do not place the device near flammable materials.**
  Failure to observe this warning may result in a fire.

- **Do not install the device where larger vibration exists.**
  Otherwise, personal injury may be caused due to falling of the mainframe.

- It is absolutely prohibited to store or use the inverter under the environmental conditions described below.
  Failure to observe this warning may result in a fault, damage, or deterioration, which could lead to fire.
  - In direct sunlight.
  - Near a heater or other heat source.
  - In a location subject to vibration or physical shock.
  - Near machinery that generates sparks
  - In a location subject to dust, corrosive or inflammable gases, salt, and water droplets.
  - Outdoors.
  - Higher than 3000 meters above sea level.
  - Other similar environments.

Table 3-1 Work Environment Parameters

Ambient temperature	Mode A(150% 1min)	-10℃-50℃
	Mode B(120% 1min)	-10℃-40℃
Relative humidity	Below 95%RH （no frost）	
Vibration	Below 5.9m/s2 (0.6G)	
Working environment	Below 3000m above sea level (When above 1000m, the current will be reduced for use)	
Working place	Indoor (free from corrosive and flammable gases, oil mist, and dust)	

Table 3-2 (1) Capacity Modes

Capacity	Mode A	Mode B
0015	1.5kW (150%)	2.2kW (120%)
0022	2.2kW (150%)	4.0kW (120%)
0040	4.0kW (150%)	5.5kW (120%)
0055	5.5kW (150%)	7.5kW (120%)
0075	7.5kW (150%)	11kW (120%)
0110	11kW (150%)	15kW (120%)
0150	15kW (150%)	18.5kW (120%)
0185	18.5kW (150%)	22kW (120%)
0220	22kW (150%)	30kW (120%)
0300	30kW (150%)	37kW (120%)
0370	37kW (150%)	45kW (120%)
0450	45kW (150%)	55kW (120%)
0550	55kW (150%)	75kW (120%)
0750	75kW (150%)	90kW (120%)

Table 3-2 (1) Capacity Modes

Capacity	Mode A	Mode B
0900	90kW (150%)	110kW (120%)
1100	110kW (150%)	132kW (120%)
1320	132kW (150%)	160kW (120%)
1600	160kW (150%)	200kW (120%)
1850	185kW (150%)	220kW (120%)
2000	200kW (150%)	250kW (120%)
2200	220kW (150%)	280kW (120%)
2500	250kW (150%)	315kW (120%)

Table 3-3 Storage Environment

Storage temperature	-20℃-+65℃ This temperature is for short periods, such as during transportation. Ambient temperature must be 30°C or lower for more than 3 months of storage in consideration of the deterioration of the electrolytic capacitor.
Relative humidity	Below 95%RH (no frost)
Storage environment	Places free of direct sunlight, corrosive or inflammable gases, oil mist, dust, steam, water droplet, vibration, or high salinity.

Table 3-4 Main body mounting screws

Capacity	Screws	Recommended Screw Tightening Torque
SVC06-0015-**4	M4	1.5N•m (1-1.9N•m)
SVC06-0020-**4		
SVC06-0040-**4		
SVC06-0055-**4	M5	2.9N•m (1.6-3.5N•m)
SVC06-0075-**4		
SVC06-0110-**4		
SVC06-0150-**4		
SVC06-0185-**4	M5	2.9N•m (1.6-3.5N•m)
SVC06-0220-**4		
SVC06-0300-**4		
SVC06-0370-**4	M6	4.3N•m (2.3-5.6N•m)
SVC06-0450-**4		
SVC06-0550-**4	M8	10.8N•m (5.4-13.8N•m)
SVC06-0750-**4		
SVC06-0900-**4	M12	42N•m (35-50N•m)
SVC06-1100-**4		
SVC06-1320-**4		
SVC06-1600-**4		
SVC06-1850-**4		
SVC06-2000-**4		
SVC06-2200-**4		
SVC06-2500-**4		

3-2 Installation Direction and Space

(1) This inverter is of the wall mounting type.

(2) Install the inverter vertically on a flat mounting surface.

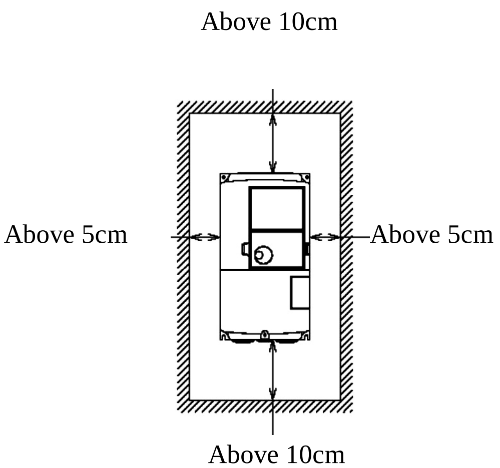
(3) Since the inverter generates heat, provide adequate space around it to ensure good heat dissipation conditions.

(4) When installing the inverter in a control cabinet, provide a ventilation fan to keep the ambient temperature below 40°C.

(5) When installing the inverter in a control cabinet, mounting the radiator fins outside the control cabinet will help to reduce the internal temperature of the cabinet.

(6) This inverter is of IP20 structure.

Please select according to intended use.



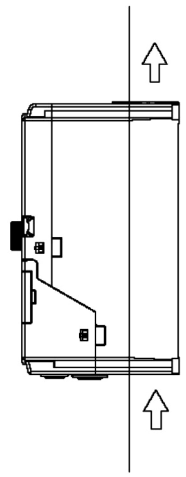


Figure 3-1 Surrounding Space **Figure 3-2 Arranging method of radiator fins outside the cabinet**

> **When several inverters are set in a control cabinet, be sure to locate the ventilation fans properly to allow free air circulation.**
> **If the ventilation fans are located improperly, the ambient temperature will rise and affect the cooling of the inverter.**

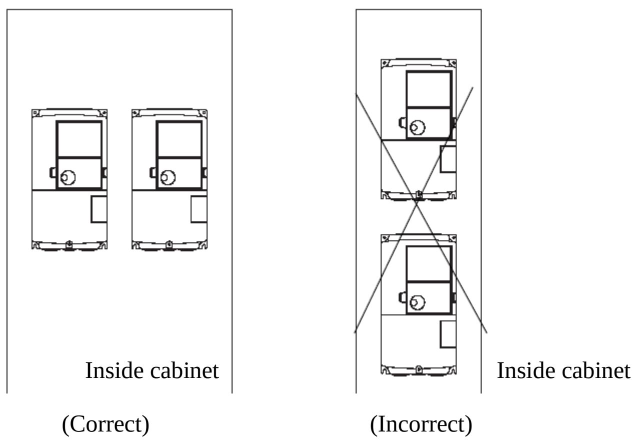


Figure 3-3 Arranging method inside the cabinet

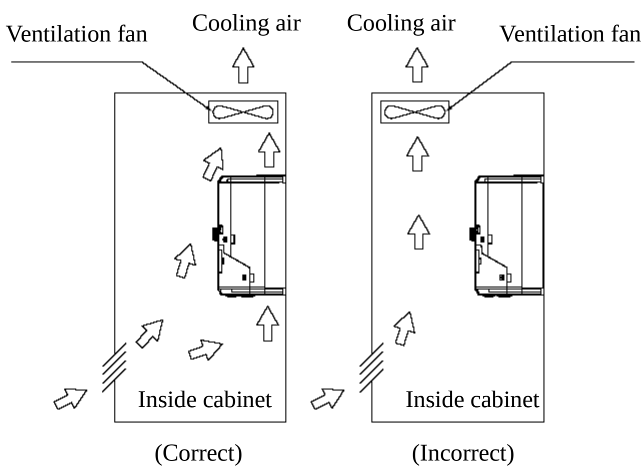


Figure 3-4 Ventilation fan position in cabinet

3-3 Removal and Installation of the Front Cover

3-3-1 Small-capacity model (below SVC06-0150)

(1) Removal of front cover (lower)

Unscrew the M4 screws, and pull the cover toward you while pressing the Dent portion on both sides of the front cover (lower).

- Please carry out this work during the main circuit wiring, control circuit wiring, and SW1 switching.

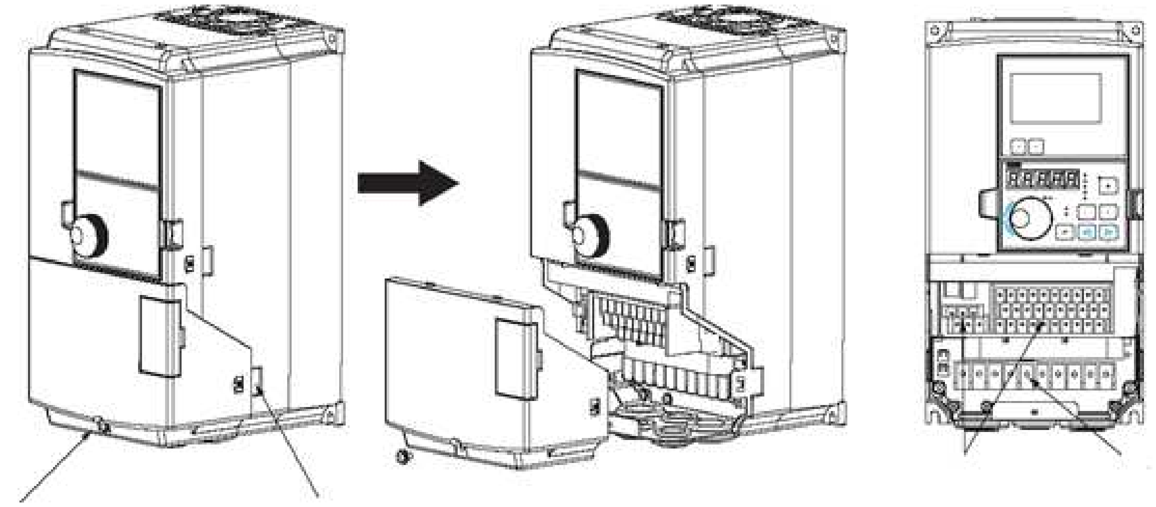


Figure 3-5 Removal of front cover (lower)

(2) Removal of front cover (upper)

After the front cover (lower) has been removed, pull the cover toward you while pressing the Dent portion on both sides of the front cover (upper).

- Please carry out this work during the control circuit wiring (RX and TX), installation and removal of optional boards, and SW2 switching.

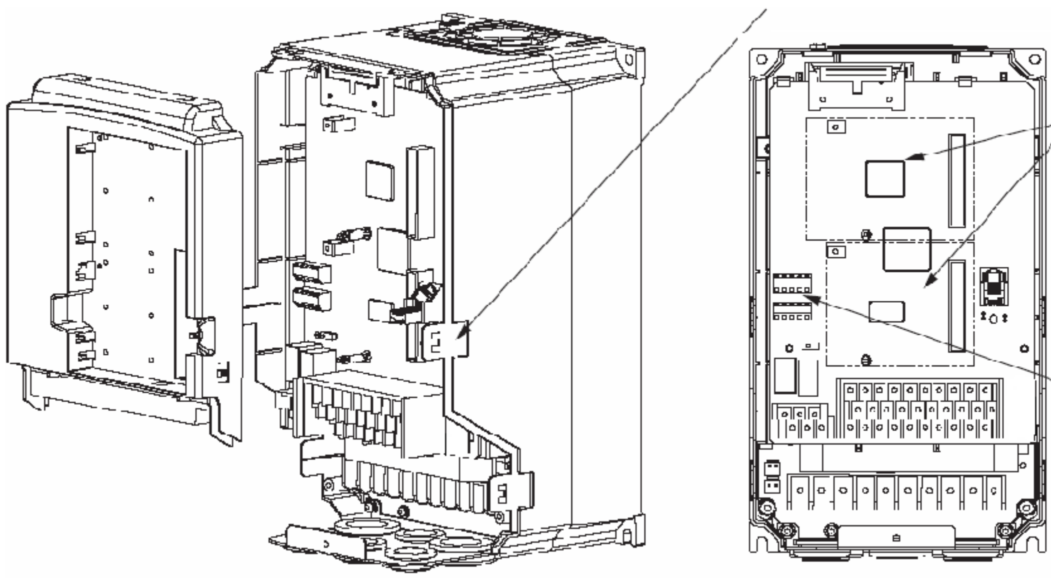


Figure 3-6 Removal of front cover (upper)

(3) Installation

When installing, work in reverse order.

3-3-2 Middle- or large-capacity model（SVC06-0185 - 0750）

(1) Removal of front cover (lower) and internal sealing plate (iron)

Unscrew the M4 screw on the front cover (lower) and pull down gently, and then the front cover (lower) will be removed. Then, unscrew 4 M4 screws and remove the sealing plate.

- Please carry out this work during the main circuit wiring, control circuit wiring, and SW1 switching.

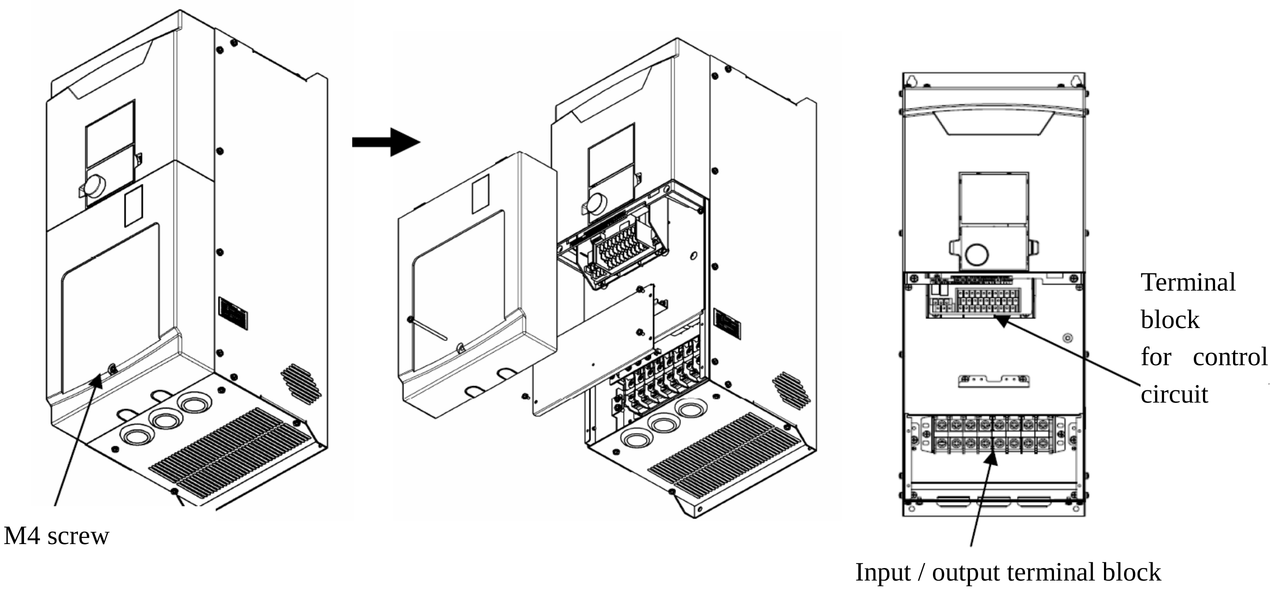


Figure 3-5 Removal of front cover (lower) and internal sealing plate (iron)

(2) Removal of front cover (upper)

After the front cover (lower) has been removed, unscrew 2 M4 screws on the front cover (upper), and gently push up front cover (upper), it will be removed.

- Please carry out this work during the control circuit wiring (RX and TX), installation and removal of options, and SW2 switching.

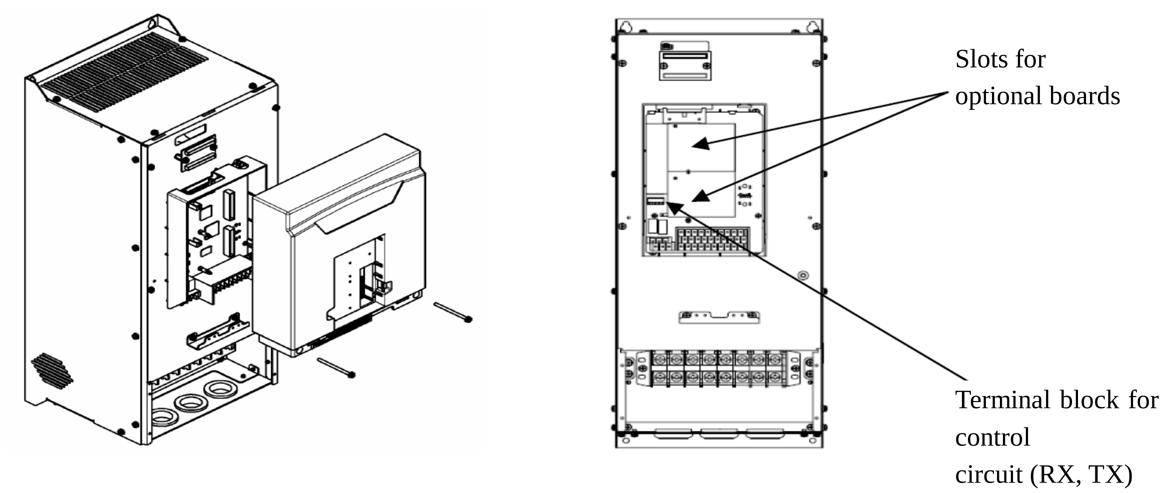


Figure 3-6 Removal of front cover (upper)

(3) Installation

When installing, work in reverse order.

3-3-3 Middle- or large-capacity model（above SVC06-0900）

(1) Removal of front cover (lower)

Unscrew the M4 screw, gently lift up and take off the cover.

- Please carry out this work during the main circuit wiring, control circuit wiring, and SW1 switching.

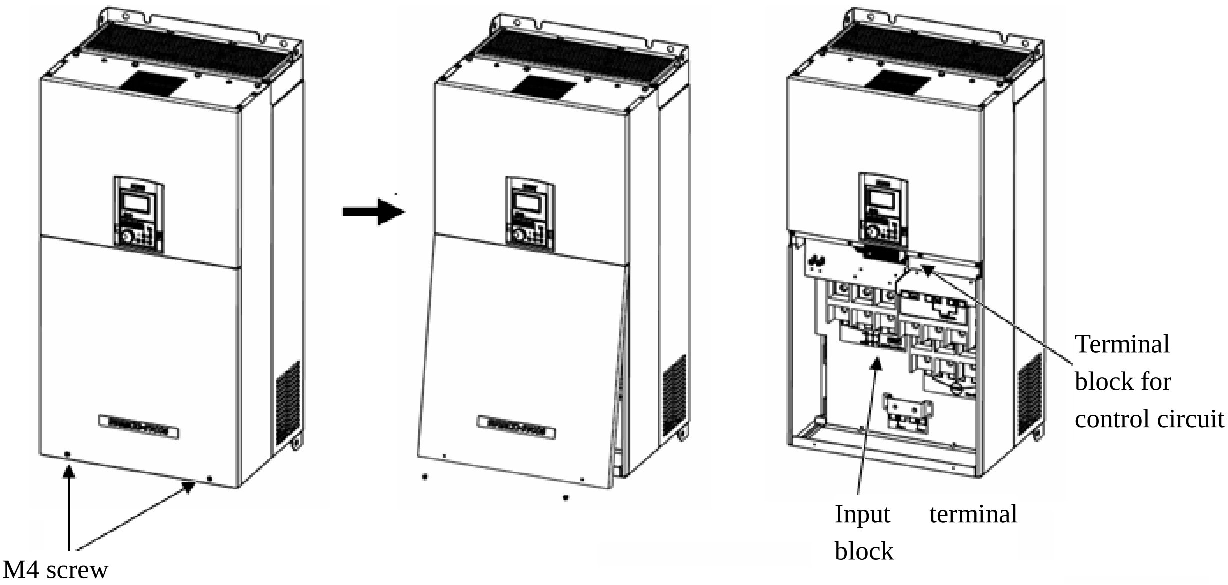


Figure 3-7 Removal of front cover (lower)

(2) Removal of front cover (upper)

After the front cover (lower) has been removed, unscrew M4 screws (4) on the front cover (upper), gently lift up and take off the front cover.

- Please carry out this work during the control circuit wiring (RX and TX), installation and removal of options, and SW2 switching.

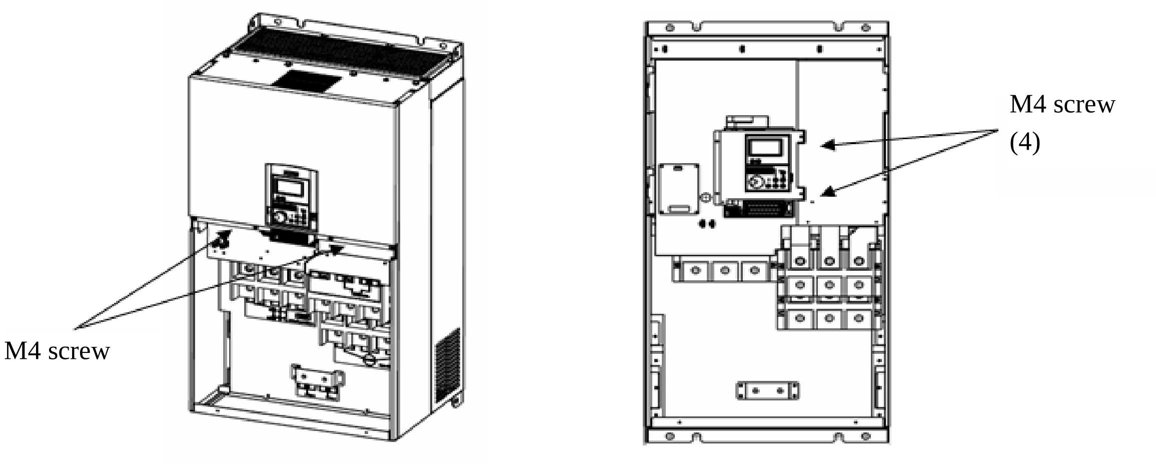


Figure 3-8 (1) Removal of front cover (upper) Figure 3.8 (2) During wiring, installation and removal of options

(3) Installation

When installing, work in reverse order.

3-4 Removal and Installation of the Operation Panel

3-4-1 Removal of Operation Panel

Hook □ and □ on the cover with your fingers, and take off the panel, pull it toward you while pressing the jack catch on □ side.

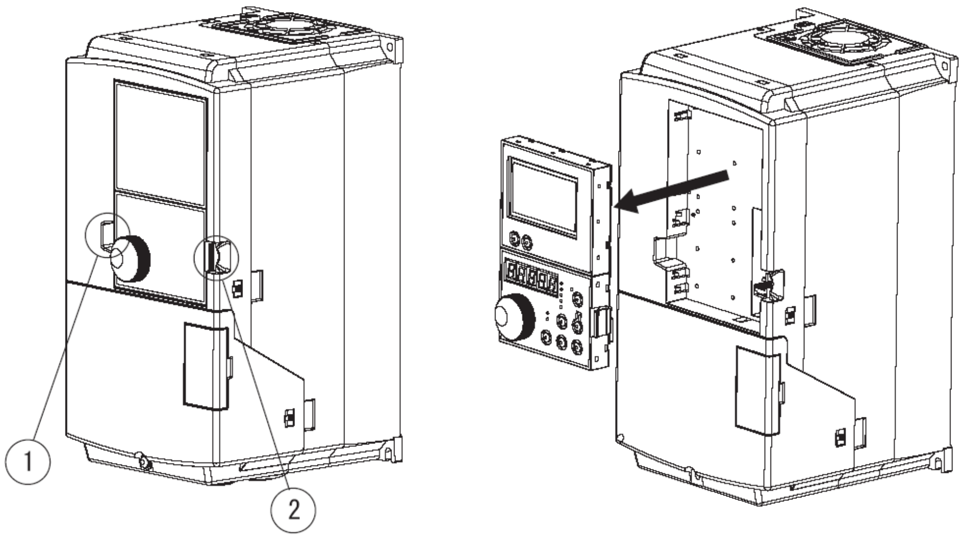


Figure 3-9 Removal of Operation Panel

3-4-2 Installation of Operation Panel

When installing, simply insert the operation panel straightly.
At this point, check from front cover, if the operation panel is not protruding, it is fully installed.
Otherwise, protruding operation panel may result in unreliable contact of connector.

- If the removed operation panel is installed outside the control cabinet, please use a 8-pin direct plug-in combination cable (both ends of RJ45 type) which is shielded within 5m and available from market for connection.

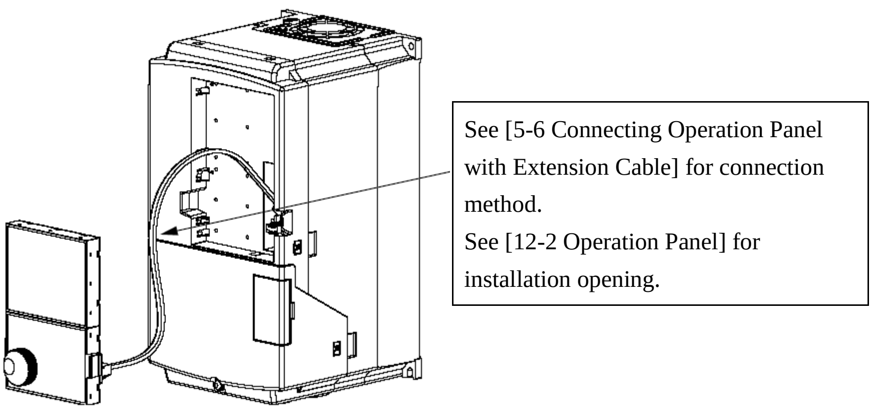


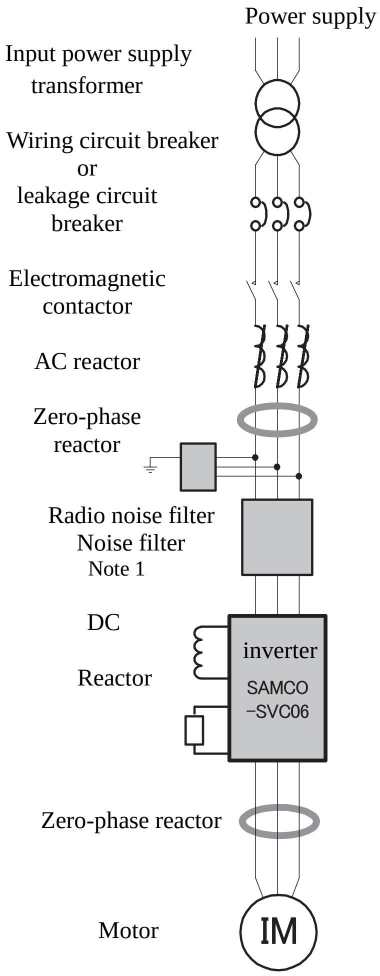
Figure 3-10 Installation of Operation Panel outside Cabinet

4. Wiring

■ **Read the Notes on Wiring (1-5) before wiring.**
Failure to observe this warning may result in personal injury or fire.

4-1 Connection with peripheral devices

Name	Purposes and Detailed Description
Input power supply transformer	When there is need for matching the system power supply voltage with rated inverter input voltage, please provide the input power supply transformer. When several inverters are used, please provide the input power supply transformer to reduce the impact of high-order harmonic on other load devices.
Wiring circuit breaker or leakage circuit breaker	Please connect wiring circuit breaker or leakage circuit breaker in the overload protection circuit during protection and wiring of the power supply system. When using leakage circuit breaker, select a product for corresponding high-order harmonic.
Electromagnetic contactor	The coil must be provided with a surge absorber.
Surge absorber	Please install the surge absorber for suppression of surge generated on opening and closing of electromagnetic contactors and control relays.
AC reactor DC reactor	To achieve the following objectives, please install the reactor ·Improve the inverter's input power factor ·Reduce the impact on inverter due to unbalance between phases of power supply voltage · Prevent tripping of inverter due to action of phase lead compensation capacitors in the system · When the capacity of power supply is large (above 500 kVA)
Zero-phase reactor Line noise filter	Reduce the interferences coming into input power supply system of the inverter and generated by wiring. It is recommended that elements such as zero-phase reactor etc. be inserted as close to inverter as possible.
Radio noise filter	Used to suppress the radio noise radiating to power supply side of the inverter.
Noise filter	Reduce the interferences coming into input power supply system of the inverter and generated by wiring. It is recommended that noise filter be installed as close to inverter as possible.



Note 1: For SVC06 series inverter with built-in EMC filter, please place the EMC filter selector switch to "ON".
Note 2: See model selection samples of options of Sanken Inverter for related options.

4-2 About Wiring

Before carrying out wiring work, turn the inverter's input power supply to "OFF" (disconnected) first, and then check with a circuit tester that no applied voltage is present. Check also that the CHARGE lamp is not lit.

(1) Be sure to connect a MCCB (circuit breaker) between the power supply and the input power supply terminals (R, S, T). (Use a leakage circuit breaker specific to high-order harmonic when necessary.)
In addition, to ensure the system safety, connect a MC (magnetic contactor) between the MCCB and the input power terminals (R, S, T).

(2) The phase order does not need to be considered when wiring the input power terminals (R, S, and T).

(3) Connect the motor to the output terminals (U, V, W) correctly.

The harmonic component leakage current increases by stray capacitance of wiring and causes adverse affects on the inverter itself and peripheral mechanical equipment when the total length of wiring between inverter and motor is too long.

The total length of wiring between inverter and motor shall not exceed the values described in Table 4-1.

Table 4.1 Length of wiring between the inverter and the motor

Length of wiring between the inverter and the motor	50m	100m	200m
Carrier frequency (Specified by F1009)	F1009=130 or less	F1009=90 or less	F1009=40 or less

- When driving several motors at the same time, the total length of wiring to motors shall not exceed the values described in Table 4-1. However, for vector control, the maximum wiring length shall be controlled within 100m. (For length of more than 30m, please implement autotuning mode2)
- The surge voltage generated by the inverter element switching is superimposed and terminal voltage of the motor is impressed. The following measures should be considered to prevent deterioration of motor isolation especially for 400V class motors when the length of wiring between the inverter and the motor is long.
  ① Use reinforced motor isolation.
  ② Length of wiring between the inverter and the motor should be as short as possible (Generally about 10 - 20m) .

(4) See 4-5-4 for capacity of MCCB and MC and wire sizes.
Use sleeved crimp terminals for the power and motor cables.

(5) Use shielded or twisted-pair wires for wiring to the control circuit terminals. Keep the wires well away from the main and high-voltage circuits (including logic circuit of 200 V relay).

(6) Use a micro-signal contact or two-contact relay for the control circuit terminal to prevent poor contact.

(7) Ground the ground terminal (⏚) securely.
In addition, use the ground terminal of the inverter for grounding. (Do not use the casing or the chassis.)

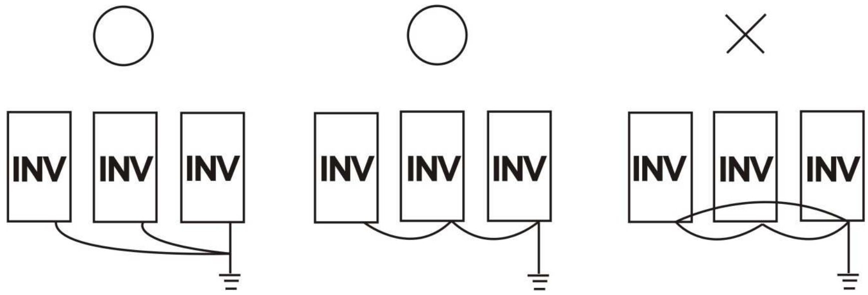
According to technical standards for electrical equipment, 200 V series shall be connected to the grounding electrode for type D grounding; while 400 V series connected to the grounding electrode for type C grounding.

Table 4-2 Types of grounding

Voltage	Types of grounding	Grounding resistance
200V series	Type D grounding	100Ω or less
400V series	Type C grounding	10Ω or less

- Do not share the grounding wire with the welding machine or the power equipment.
- Use the grounding wire prescribed in the technical standards for electrical equipment, and shorten wiring length as much as possible.

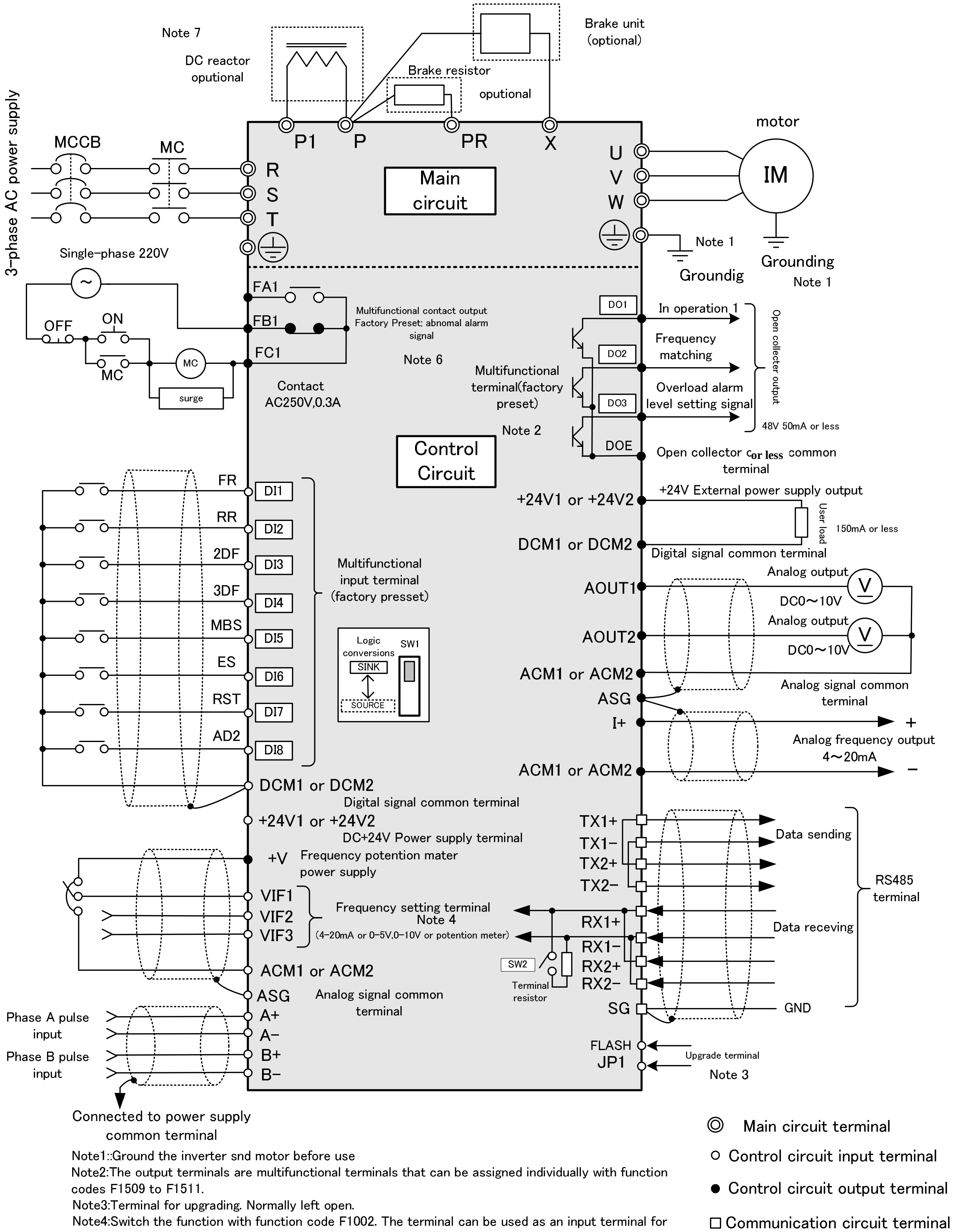
- Be careful not to loop the grounding wire when using multiple inverters.



(a) Correct (b) Correct (c) Incorrect

(8) During wiring, please note that the inside of inverter shall be free from chips of wires.

4-3 Terminal connection diagram



Note1::Ground the inverter snd motor before use

Note2:The output terminals are multifunctional terminals that can be assigned individually with function codes F1509 to F1511.

Note3:Terminal for upgrading. Normally left open.

Note4:Switch the function with function code F1002. The terminal can be used as an input terminal for various feedback signals.

Note5:The input terminals are multifunctional terminals that can be assigned individually with function codes F1414 to F1421.

Note6:Multifunctional contact output terminals is also a maltifunctional terminal that can be assigned individually with function code F1513 to F1514.

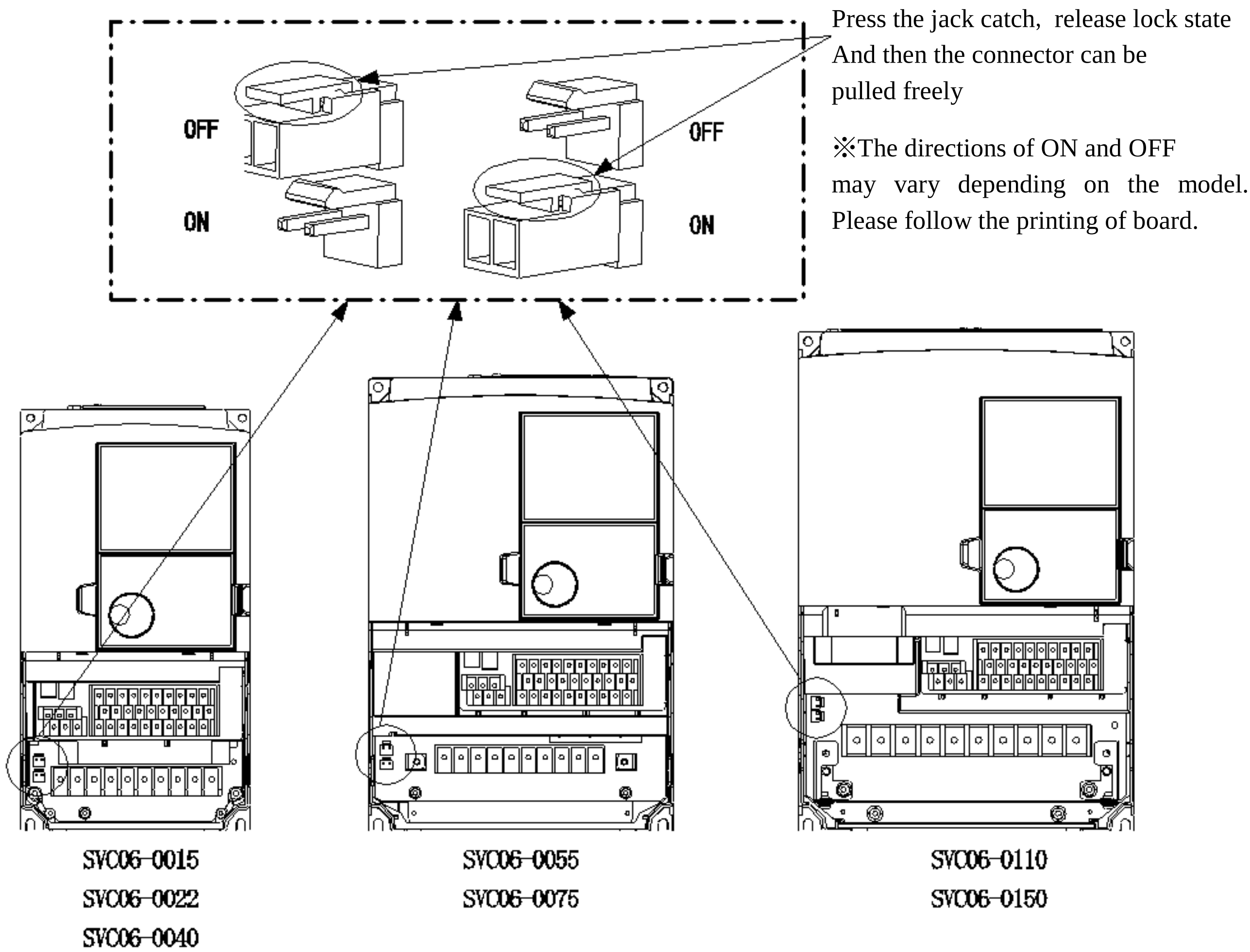
Note7:18.5k or above standard DC reactor

4-3 Terminal connection diagram

- Please use shielded wires for analog input and output wires, contact input wire (digital multi-function input terminals). (The set values of functional terminals are factory preset values.)
- In order to prevent misoperation due to interference, during wiring, signal lines and power lines should be separated as much as possible (about more than 10cm).
- When using operation panel to operate the inverter, it can be realized simply through the main circuit wiring. (Without the need to operate from the outside or to input frequency instructions).
- Please connect MCCB (circuit breaker) etc. between the power supply and input terminal for circuit protection.
- When inverter protection function starts or other accident occurs, in order to cut off the inverter power supply to prevent further expansion of a fault or accident, please connect a MC (magnetic contactor) between the MCCB and the input terminal. And the MC connection location, if possible, shall be close to the inverter.

4-4 About EMC filter

This inverter can be provided with built-in EMC filter (order requirement).
Although the EMC filter can effectively reduce the interference transfer, it will increase the leakage current.
ON or OFF of the EMC filter can be selected as follows through the on / off of the connector.



Before carrying out make-break of the connector, turn the inverter’s input power supply to “OFF” (disconnected) first, and then check with a circuit tester that no applied voltage is present, and also that the CHARGE lamp is not lit.

When pulling the connector, pull out the connector while pressing the jack catch of the connector, but do not pull cable. When inserting it, check if the jack catch has been secured. Please install the connector at “ON” or “OFF”.

The EMC filter is set to open (OFF) state at factory.

***When the EMC filter is set to ON, the leakage current will increase.**
*** Models above 18.5k are provided with only built-in capacitors.**

4-5 Composition of Main Circuit Terminals

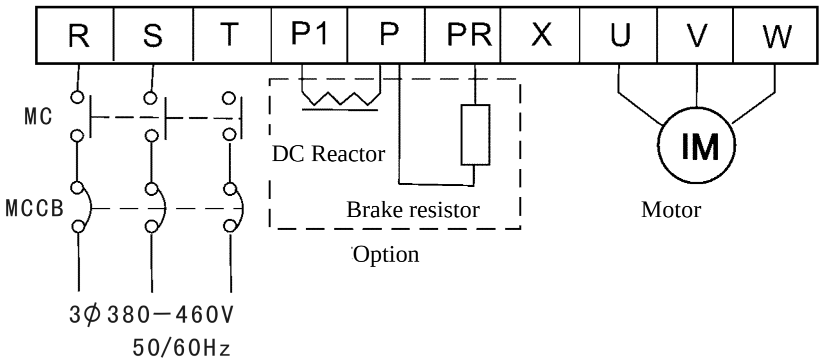
4-5-1 Description of Main Circuit Terminals

Terminal Symbol	Name	Description
R,S,T	Input power supply terminals	Terminals connected to a three-phase commercial power supply
U,V,W	Inverter output terminals	Terminals connected to a three-phase induction motor
P,P1	DC reactor connection terminals	Terminals connected to a DC reactor *1
P,PR	Brake resistor connection terminals	Terminals connected to a brake resistor between P-PR
P,X	DC side voltage terminals	Terminals connected to a brake unit P is the DC positive terminal, X the DC negative terminal
⏚	Ground terminal	Terminal for grounding of inverter casing

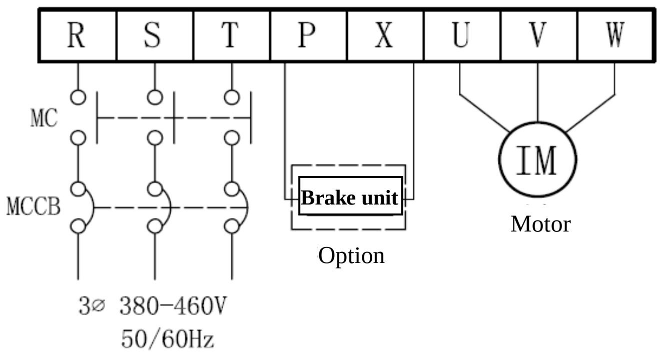
***1 When connecting the reactor, please remove the jumper between P1 and P.**

4-5-2 Connection Diagram of Main Circuit Terminals

(1) SVC06-0015 - 0150

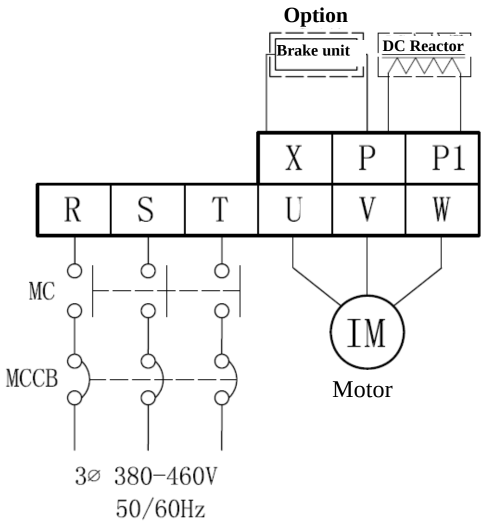


(2) SVC06-0185 - 0750

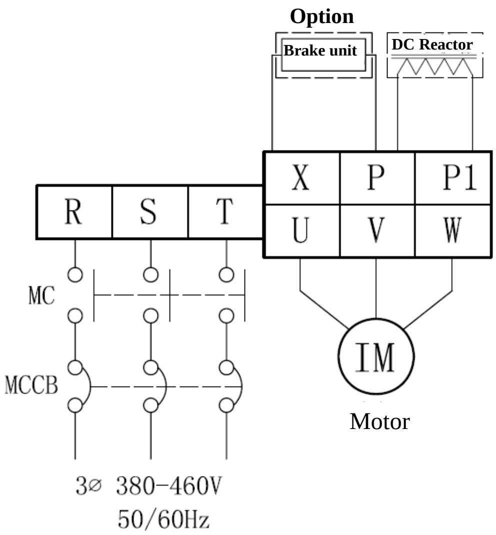


Chpater 4

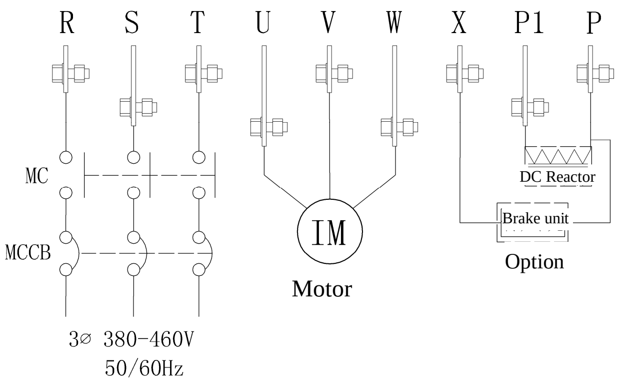
(3) SVC06-0900 - 2500



SVC06-0900 - 1100



SVC06-1320 - 1850



SVC06-2000 - 2500

4-5-3 External brake resistor selection example

Model	External brake resistor (recommended)		External brake resistor (limit value)	
	Resistance	Capacity □1	Resistance	Capacity □1
SVC06-0015-**4	320Ω or more	200W	190Ω or more	300W
SVC06-0022-**4	160Ω or more	400W	130Ω or more	500W
SVC06-0040-**4	120Ω or more	600W	80Ω or more	800W
SVC06-0055-**4	80Ω or more	800W	52Ω or more	1100W
SVC06-0075-**4	60Ω or more	1000W	38Ω or more	1500W
SVC06-0110-**4	40Ω or more	1500W	32Ω or more	1800W
SVC06-0150-**4	40Ω or more	1500W	32Ω or more	1800W

***1 In this example, the maximum duty cycle of the brake resistor is assumed to be 10% ED.**

As shown in the example, to protect the brake resistor, F1115 (utilization rate of brake resistor) shall be set at 10% ED or less. When % ED needs to be set above 10 %, brake resistor capacity should be increased proportionally.

Example) When setting 20 % ED, the capacity should be doubled.

4-5-4 Capacities of MCCB and MC and Wire Size

Model	MCCB (Leakage circuit breaker) [A]	MC (Electromagnetic contactor)		Main circuit						
				Recommended wire size [mm^2]						
		Rated current	Rated making current [A]	Input wire	P and P1 wires	Output wire	grounding wire	Screw diameter	Tightening torque [N•m]	Max. wire size [mm^2]
SVC06-0015-**4	15	7	20	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	5.5	M4	1.2	5.5
SVC06-0022-**4	20	7	20	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	5.5			
SVC06-0040-**4	30	7	20	3.5 (2.0)	3.5 (2.0)	2.0 (2.0)	5.5			
SVC06-0055-**4	30	17	32	5.5 (2.0)	5.5 (2.0)	3.5 (2.0)	5.5			
SVC06-0075-**4	50	25	50	5.5 (2.0)	5.5 (2.0)	5.5 (2.0)	5.5			
SVC06-0110-**4	60	25	50	8.0 (3.5)	8.0 (3.5)	8.0 (3.5)	14	M5	2.0	14
SVC06-0150-**4	70	32	60	14 (5.5)	14 (5.5)	8.0 (3.5)	14			
SVC06-0185-**4	75	48	80	14（5.5）		8.0（5.5）	14	M6	2.03	22
SVC06-0220-**4	100	65	100	22（14）		8.0（5.5）	14			
SVC06-0300-**4	125	75	135	38（14）		14（5.5）	14			
SVC06-0370-**4	150	75	135	22×2（22）		22（8）	22	M6	4.52	60
SVC06-0450-**4	175	150	200	60（38）		22（14）	22			
SVC06-0550-**4	225	150	200	60（38）		38（14）	22	M8	4.52	60
SVC06-0750-**4	250	150	200	60（38）		60（22）	22			
SVC06-0900-**4	250	180	260	100（60）	150（60）	100（60）	38	M10	18.0	150
SVC06-1100-**4	300	180	260	150（60）	150（100）	150（60）	38			
SVC06-1320-**4	350	265	350	150（100）	200（100）	150（100）	38	M16	80.0	325
SVC06-1600-**4	450	400	420	200（150）	325（150）	200（100）	38			
SVC06-1850-**4	500	600	660	250（150）	325（200）	250（150）	38			
SVC06-2000-**4	600	600	660	325（150）	150×2（200）	325（150）	60		100.0	-
SVC06-2200-**4	600	600	660	150×2（200）	250×2（200）	150×2（200）	60			
SVC06-2500-**4	700	600	660	200×2（200）	250×2（200）	200×2（200）	60			

Note 1: The values for wires in the main circuit are for 600 V IV PVC-insulated wires (60ºC) when the inverter ambient temperature is 40ºC. The values in parentheses are for 600 V bridged-polyethylene insulated wires (90ºC).

Note 2: The maximum wire size indicates the maximum wire cross-sectional area that can be used with the terminal block.

Note 3: If possible, use thick and short conductors for grounding wire.

Chapter 4

4-6 Composition of Control Circuit Terminals

4-6-1 Wire size and terminal arrangement

Terminal screw diameter: M3
Recommended wire size 0.75 [mm^2]
Tightening torque: 0.5[N•m]

The arrangement of control circuit terminals is as shown in the following.

+24V1	DI1	DI2	DI3	DCM2	+24V2	ACM2	VIF1	VIF2	ASG
DI4	DI5	DI6	DI7	DI8	AOUT1	AOUT2	+V	VIF3	ACM1
DCM1	DO1	DO2	DO3	DOE	A+	A−	B+	B−	I+

FA1	FB1	FC1

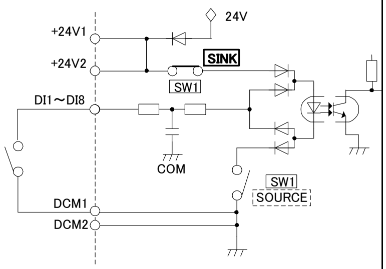
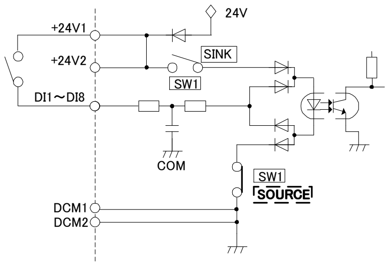
- The common end of control circuit terminals shall not be grounded to the earth. In addition, DCM1/DCM2 shall not be in common use with ACM1/ACM2. (Because they are insulated with each other).

- Use shielded wires for wiring connected to the control circuit terminals, and connect one end of the shielding to each common terminal or dedicated terminal, and leave the other end open. (refer to 4-3 Terminal connection diagram).

- Do not input the voltage to multifunctional terminals (DI1-DI8).

4-6-2 Functions of Control Circuit Terminals

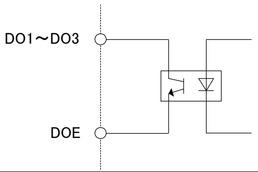
Table 4-3 Description of Control Circuit Terminals

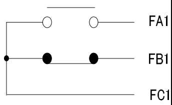
Type	Terminal Symbol	Terminal Name	Function Description	Rated Specification	Notes
Contact input	DCM1 DCM2	Digital signal common terminals	Common terminals for digital input and output signals and for +24V1 and +24V2 power supplies	Total current consumed: 100mA or less	
	DI1 DI2 DI3 DI4 DI5 DI6 DI7 DI8	Digital multifunctional input terminals	(1) The functions selected can be set through function codes F1414-F1421. (2) Input mode and SINK/SOURCE can be switched through SW1. <SINK connection>  <SINK connection> 	Input resistor: about 6.6 kΩ When short-circuited: about DC3-5mA <For SINK connection> (1) Signal input “on” by short-circuiting either DCM1 or DCM2. (2) Signal input “off” by opening either DCM1 or DCM2. <For SOURCE onnection> (1) Signal input “on” by short-circuiting either +24V1 or +24V2. (2) Signal input “off” by opening either +24V1 or +24V2.	
Analog input	ACM1 ACM2	Analog signal common terminals	Common terminals for analog input and output signals	Total current consumed: 100mA or less	
	ASG	Analog signal shield common terminals	Shielding layer connected to analog signal wire		ACM1 is interconnected with ACM2 internally.
	+V	Analog input potentiometer wiring terminal	Connected to a potentiometer of 5kΩ 0.3W of above (It can not be connected to any element other than the potentiometer)	DC10-14V	Unable to provide power supply

<table>
<tr><td></td><td>VIF1
VIF2
VIF3</td><td>Analog input terminals</td><td>(1) By selecting a function code corresponding to each function, current / voltage of the 3 channels can be switched separately.
(2) When the frequency setting is selected, the current / voltage input can be determined by setting the contents of F1002.
(3) When carrying out frequency setting through voltage input, set the gain frequency corresponding to 5V or 10V with voltage input. When “External analog forward / reverse run” is selected, set the gain frequency corresponding to 10V (5+5V) or 0V (5-5V) with external analog value.
(4) When carrying out frequency setting through current input, set the gain frequency corresponding to 20mA.</td><td>For voltage input:
input resistor: about 34 kΩ
Maximum allowable voltage: DC12V

For current input:
input resistor: about 250 kΩ
Maximum allowable current: 30mA</td><td></td></tr>
<tr><td rowspan="4">Pulse input</td><td rowspan="2">A+
A-</td><td>Pulse power supply input + side</td><td rowspan="2">PG’s pulse input signal
Open collector / push-pull input phase A</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>Pulse phase A input - side</td></tr>
<tr><td rowspan="2">B+
B-</td><td>Pulse phase B input + side</td><td rowspan="2">PG’s pulse input signal (+ side and – side)
Open collector / push-pull input phase B</td></tr>
<tr><td>Pulse phase B input - side</td></tr>
</table>

4-6 Composition of Control Circuit Terminals

Type	Terminal Symbol	Terminal Name	Function Description	Rated Specification	Notes
power supply	+24V1 +24V2	Power supply output	(1) Supply DC24V power to the user (2) The common terminal is DCM1 or DCM2 (+24V1 and +24V2 are the same power supply)	Power supply voltage: DC48V Maximum allowable overload current: 150 mA in total	Please pay full attention to the short-circuit of power supply, etc..
Digital output	DOE	Multifunctional output common terminal	This terminal is DO1 - DO3 shared common terminal	Allowable load: DC48V,50mA	The so-called power-on state means that the open collector output transistor is ON (conducting state).
	DO1 DO2 DO3	Multifunctional output terminals	(1) Open collector output (2) Send signals through functions selected by function codes 		
Analog output	AOUT1 AOUT2	Analog output terminals	(1) Select a output item from F1501 (AOUT1) or F1504 (AOUT2) or analog output. (2) The signal output can be adjusted by F1502 (AOUT1) or F1505 (AOUT2), and the output coefficient varies from 0 - 20. (3) This common terminal is shared by ACM1 and ACM2.	Signal output: DC0-10V Maximum allowable current: 15mA	If the output current increases, the output voltage will decrease. In this case, the signal output can be adjusted using output coefficient.
Current output	I+ ACM1	Current output terminals	(1) The current proportional to output frequency of the inverter passes through between I+, ACM1 or ACM2 terminals. (4-20mA) (2) The current output coefficient is adjustable between 0-20 through F1515.	Current output range: 4-20mA Load resistance: 500Ω or less	(1) Adjust F1515 so that the current output under maximum output frequency is 20mA or below. (2) Please select load resistance of 500Ω or below.
Communication terminal	TX1+ TX1- TX2+ TX2-	RS485 inverter signal sending terminals	The terminals are used for sending communication signals by inverter. • TX1+ and TX2+ are terminals with the same function, and so are TX1- and TX2-. When communicating with several inverters, they can be used as other connection terminals of a inverter.	Communication speed for RS485 full-duplex communication mode: 1200-57600bps Total length: 500m □ If switch SW2 is connected, then the terminating resistor 100Ω will be connected.	(1) TX1+ is interconnected with TX2+ internally. (2) TX1- is interconnected with TX2- internally.
	RX1+ RX1-	RS485 inverter signal receiving	The terminals are used for receiving communication		(1) RX1+ is interconnected with RX2+ internally.

	RX2+ RX2-	terminals	signals by inverter. • RX1+ and RX2+ are terminals with the same function, and so are RX1- and RX2-. When communicating with several inverters, they can be used as other connection terminals of a inverter.		(2) RX1- is interconnected with RX2- internally.
	SG	RS485 communication common terminal	This is a RS485 communication common terminal. Connected to SG terminal of each communication device.		There is a terminal in each of TX and RX terminals
Contact output	FA1 FB1 FC1	Abnormal alarm signal output and multifunctional contact output 	(1) These contact output terminals indicate that the protective function has stopped the inverter. (2) F1513: multifunctional contact outputs according to the relay 1 contact output setting.	Contact capacity AC250V/0.3A Alarm contact setting: FA1,2-FC1,2 open Abnormal: FA1,2-FC1,2 closed	
	JP1	Upgrade jumper	Do not connect anything to this terminal except when upgrading.		

4-6-3 Multifunctional Input / Output

The so-called multifunctional input / output means freely assigning various functions to multifunctional input / output terminals through the data selection of function codes.

The multifunctional input / output is divided into the input terminal of contact input and output terminal of open collector.

(1) Multifunctional input terminals

Digital multifunctional input terminals DI1 - DI8 can be set to any one of the functions by using the function codes F1414 - F1421 corresponding to various functions.

In addition, a multiplexed terminal may have several functions.

When the function code is set to F1414=13, for example, jog operation can be enabled simply by turning the DI1 terminal on.

Table 4-4 Multifunctional input codes

Function code No.	Input terminal name	Data range	Initial value (symbol)
F1414	DI1	0-255	1 (FR）
F1415	DI2		2 (RR)
F1416	DI3		3 (2DF)
F1417	DI4		4 (3DF)
F1418	DI5		5 (MBS)
F1419	DI6		6 (ES)
F1420	DI7		7 (RST)
F1421	DI8		8 (AD2)

- See description of selection functions of the input terminals DI1 - DI8 for details.

(2) Multifunctional output terminals

Digital multifunctional output terminals DO1-DO3 can be set as the open collector outputs of any one of the functions by using the function codes F1509 - F1511 corresponding to various functions.

Table 4-5 Multifunctional output codes

Function code No.	**Input terminal name**	**Data range**	**Initial value (function)**
F1509	DO1	0-99	1 (In operation 1)
F1510	DO2		5 (Frequency matching)
F1511	DO3		8 (Overload alarm level setting)

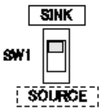
- See description of selection functions of D01 - D03 for details.

4-6-4 Control logic switching

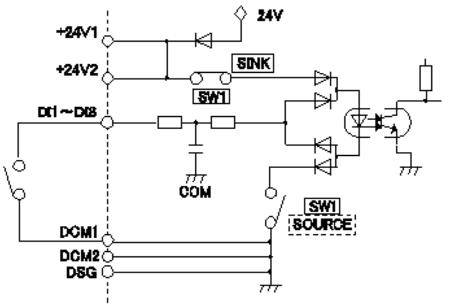
Through the switching of switches on the main control board, multifunctional input terminals DI1 - DI8 can be switched between SINK and SOURCE. When switching, use switch SW1 on the main control board.

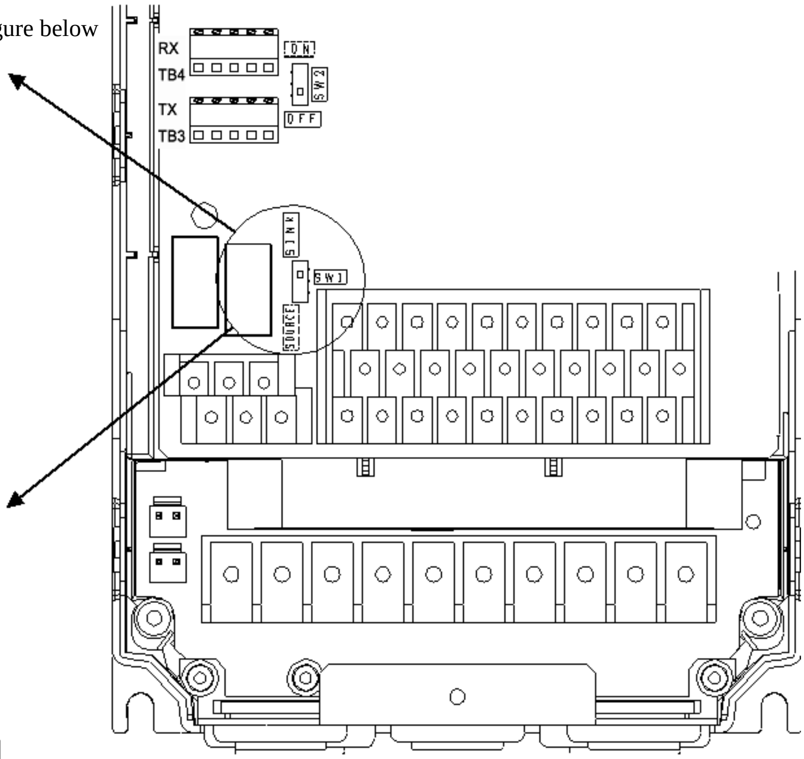
- The so-called SINK connection refers to the logic that when curren flows from the signal input terminal, the signal will be ON (connected).
  For contact input signal, DCM1/DCM2 is a common terminal.
- The so-called SOURCE connection refers to the logic that when current flows into the signal input terminal, the signal will be ON (connected).
  For contact input signal, +24V1/+24V2 is a common terminal.

● **SINK connection (initial state)**

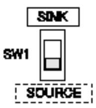


Wiring connection as shown in the figure below

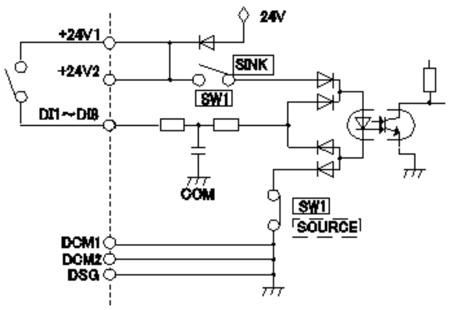




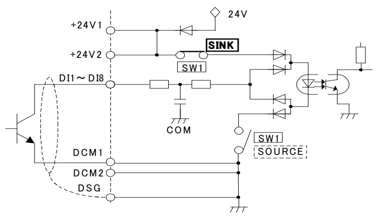
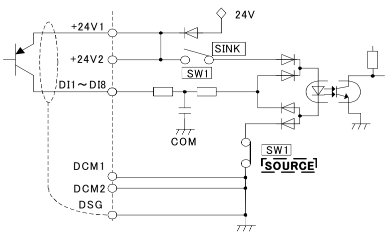
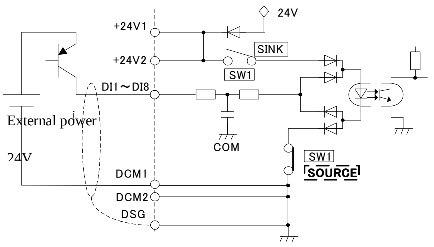
● **SOURCE connection**



Wiring connection as shown in the figure below



- **When the transistor is used for external control signals, please set and wire transistors of different types as shown in the following table.**

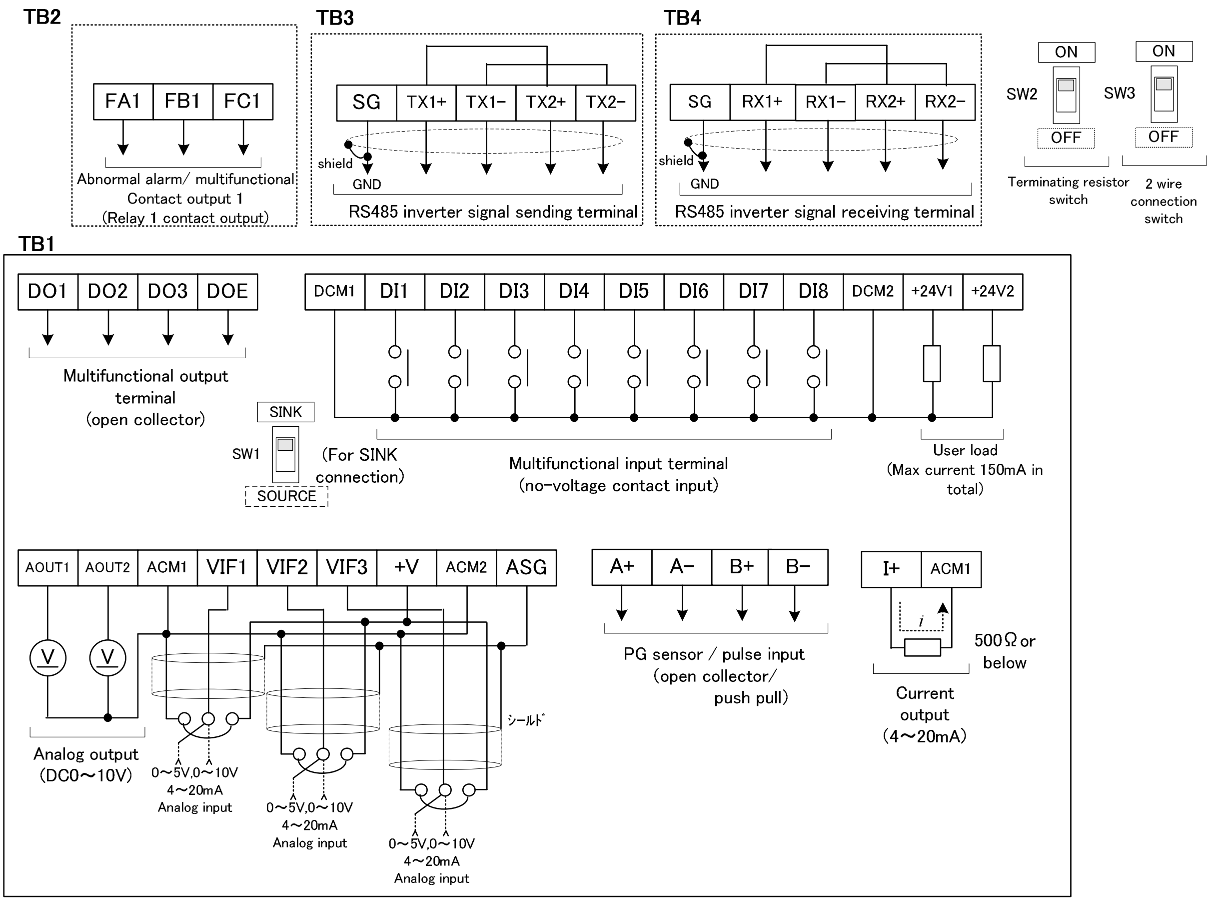
Transistor	Using internal power supply of the inverter	Using external 24V power supply (□)
NPN Type	Set SW1 as SINK 	Unable to connect
PNP Type	Set SW1 as SOURCE 	Set SW1 as SOURCE 

***Please do not connect the inverter's power supply (+24V1 or +24V2) to the external power supply**.

Note: Do not switch the switches in power-on state.

4-6-5 Connection of Control Circuit Terminals

Figure 4-1 Connection Diagram of Control Circuit Terminals



1) Potentiometer for frequency setting

- Please install a 5kΩpotentiometer of 0.3w or above, set the 1st speed frequency and select the frequency settings of current and voltage by selecting function code F1002.
- Please use shielded wires for wiring, please connect one end of the control terminal shield to the shield terminal ASG, while leave the other end open.
- They can be connected to the potentiometer respectively, the power supply terminal of the potentiometer is the + V common terminal.

  The + V terminal can not provide power to the external as it is not a terminal used for supplying power. It is a dedicated terminal used for connecting the specified potentiometer.

2) Multifunctional output (open collector output)

- The figure below shows an example of using multifunctional output terminals D01 to D03.

  ***When using a relay, be sure to install a surge suppressor (reverse-parallel connected diode).**

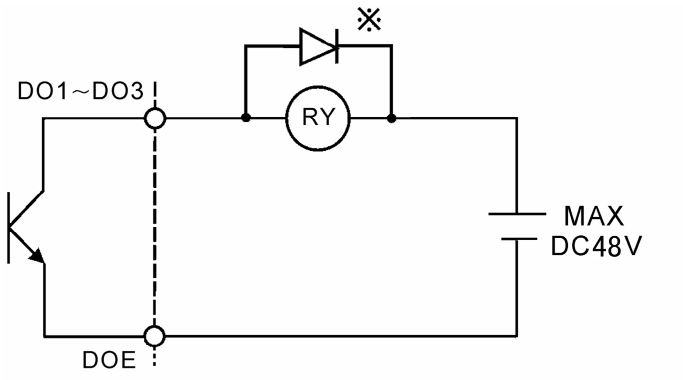


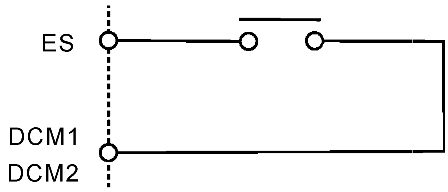
Figure 4-2 Example of using multifunctional output (open collector output)

Note: The maximum output current of the multifunctional output is 50 mA.

3) Signal mode switching for emergency stop (multifunctional input ES terminal)

- The figure below shows an example of signal switching when the multifunctional input terminal is set for the external emergency stop (ES) command.
- A signal action is selected using the function code F1413: ES input terminal function.

● When the "normally open" signal is input: F1413=1



● When the "normally closed" signal is input: F1413=2

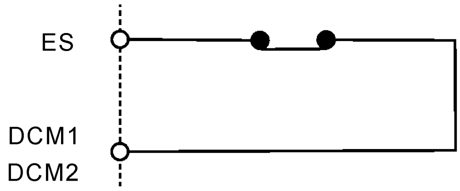
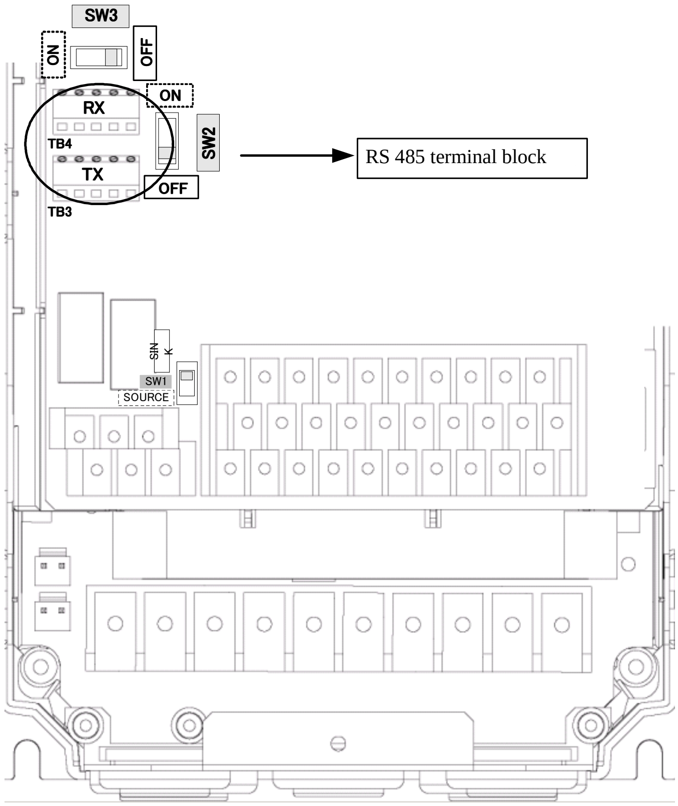


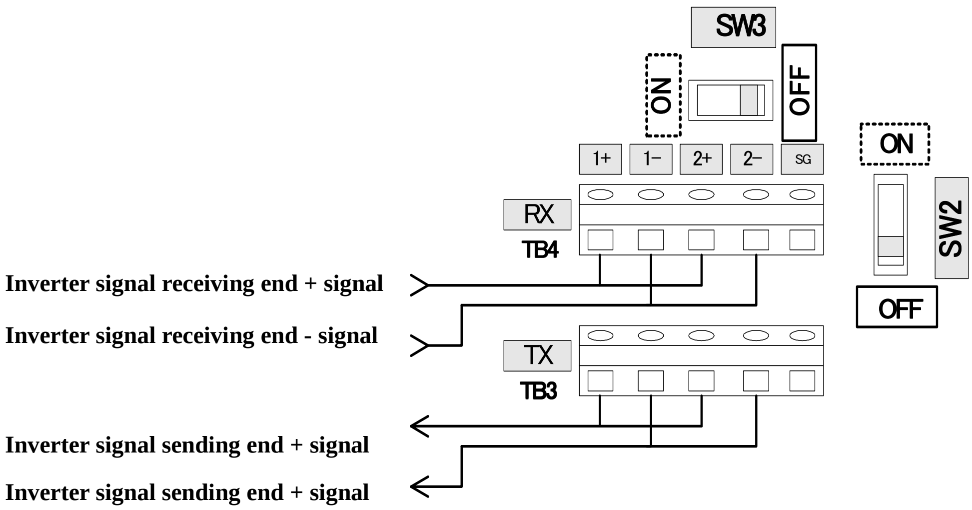
Figure 4-3 ES terminal signal mode switching

4-6-6 Communication function terminal



1) RS485 communication

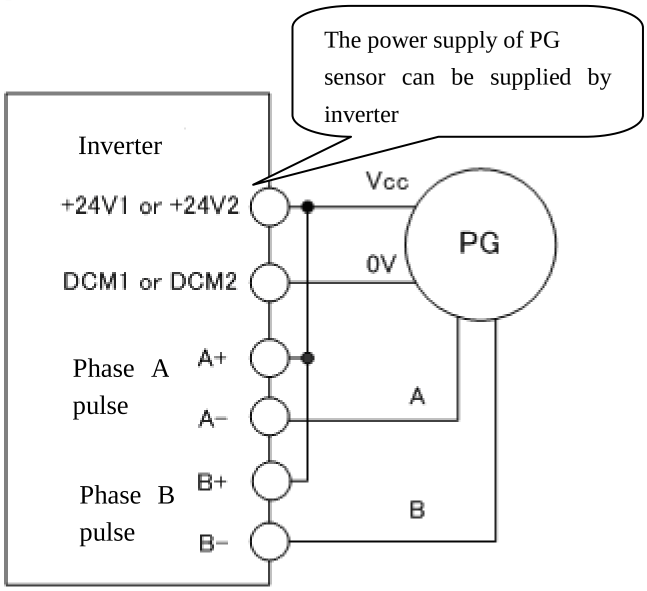
- The communication control with peripheral devices can be realized by using RS485 communication terminal block on the following main control board.
- SW2 is a switch for turning ON / OFF the terminating resistor. Please set only the farthest terminating resistor switch of the inverter to ON. (Factory preset= OFF: terminating resistor OPEN).



Note: Please refer to Description of Communication Functions for details of the communication functions.

4-6-7 Connection of PG sensor

1) Connection example when the control terminal of main control board is used (open-collector mode)

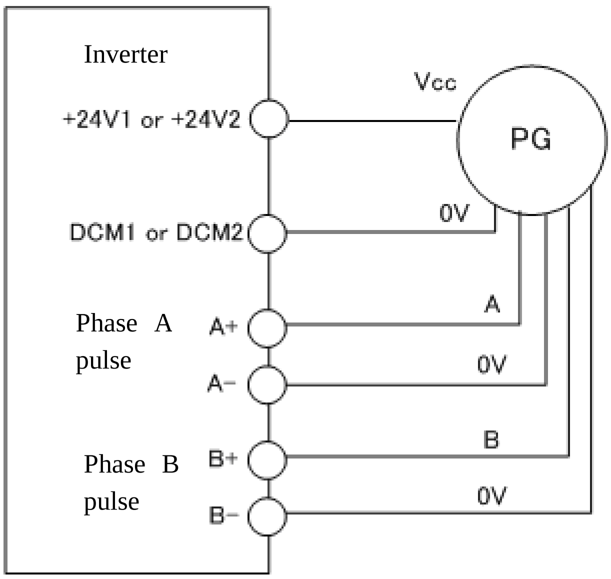


*1: Set function code F8109 (PG: PG switching) to 1.

*2: Both phase A pulse and phase B pulse can be input.

*3: Please use as shown in the example above when the power supply of PG sensor is 24V. And, as shown in the connection diagram, using the inverter to provide 24V power supply eliminates the need for an external power supply.

2） Connection example when the control terminal of main control board is used (push-pull mode)



*1: When the power supply of PG sensor is 24V, the inverter can be used for supplying 24V power to the user.

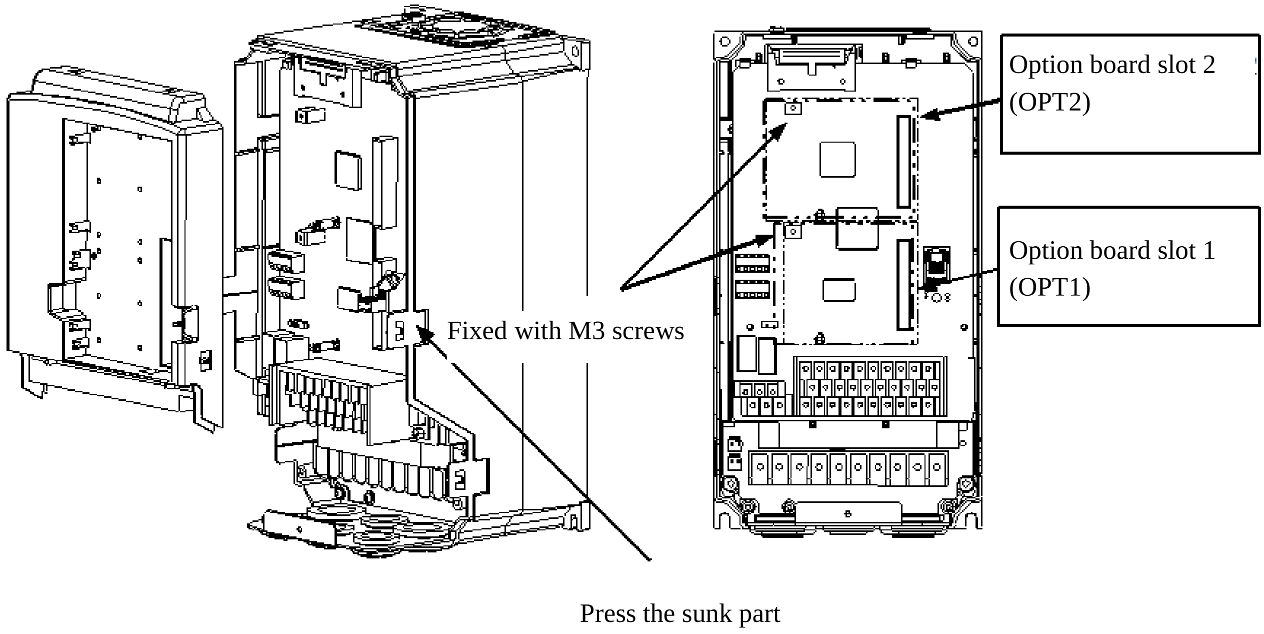
4-7 Installation and Wiring of Option Board

4-7-1 Overview of Option Board

- 2 option boards can be installed on one inverter at the same time.
  2 slots are provided in the inverter, but the shape of option board may vary between different option boards.
  Insert each option board to the specified slot.
  And sometimes, combination state of the option board may also have impacts on installation and functions.
  See the instruction manual of each option board for detailed functions of each option board.

4-7-2 Installation method of Option Board

Remove the front cover (upper) before installing or removing an option board.
After the front cover (lower) has been removed, pull the cover toward you while pressing the sunk parts on both sides of the front cover (upper), and the front cover (upper) will be removed.



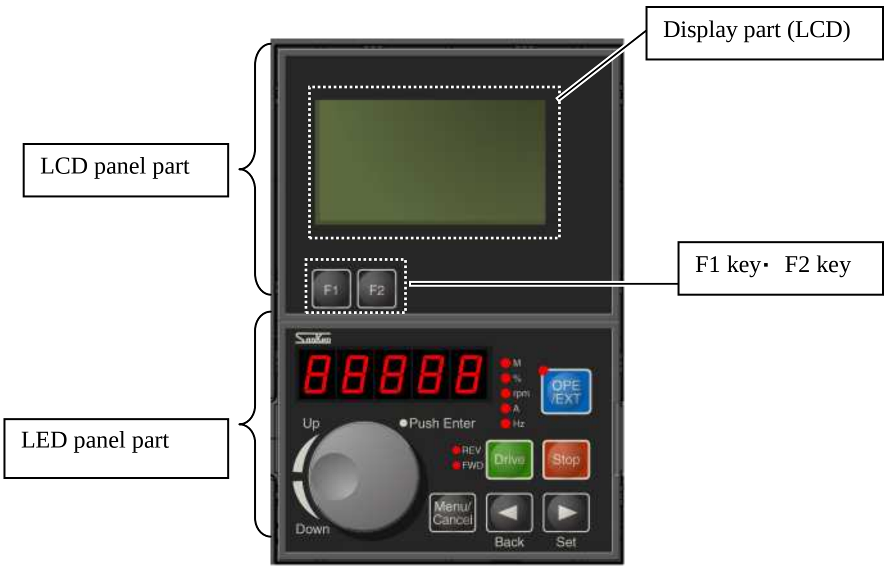
When inserting an option board into the slot, check if the connection of mainframe side connector with the option board side connector is firm and reliable.
After the option board has been installed, fix the option board with attached screws (M3).
Shielded wires shall be used for wiring connected to terminals, with each common terminal connected to the shield.
Wiring shall be carried out according to the instruction manual of each option board.

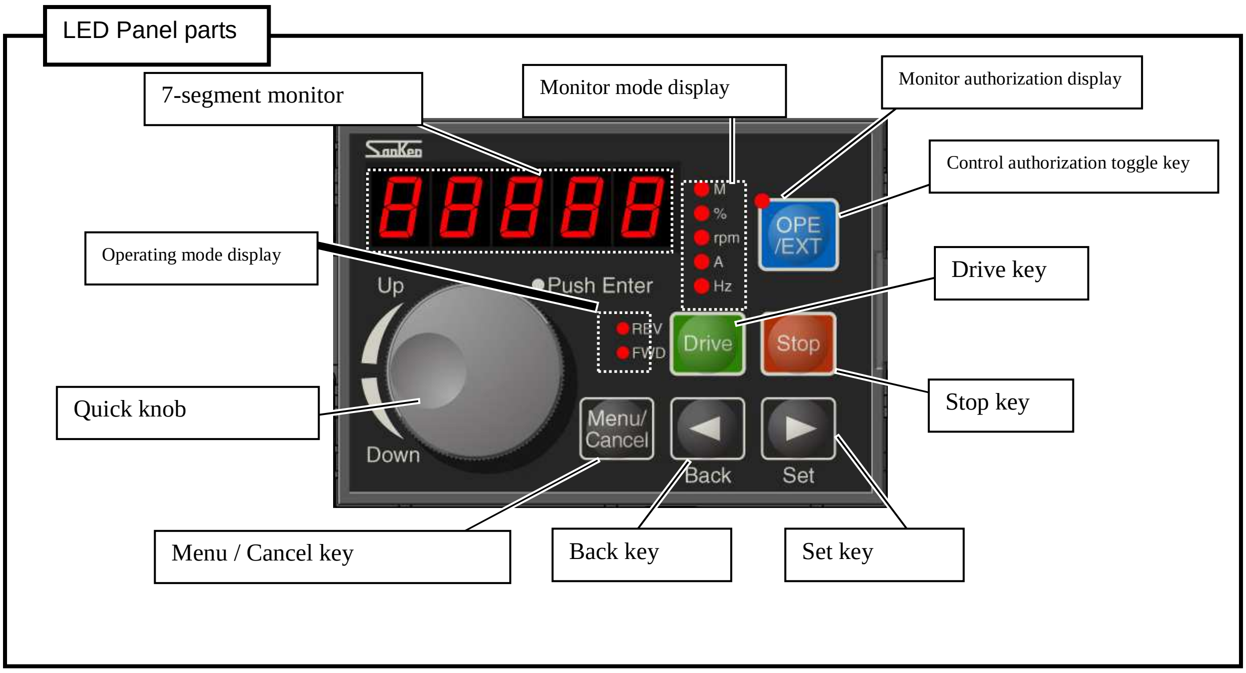
4-7-3 Auxiliary Power Supply Option

Auxiliary power supplies (control circuit power supply) can be used as factory option configuration for SVC06-0900 and above models. With the auxiliary power supply board, the control power supply can be separately supplied, alarm display contents can be confirmed even if the main circuit power supply fails.

5. Operation Panel

5-1 Names and Functions of Parts of the Operation Panel





*The LCD panel may have different configurations depending on varieties of the inverter.

5-1-1 LCD display part of the operation panel

The LCD display is a part of the LCD monitor. In conjunction with 7-segment monitor, the operation status and the function code settings etc. can be indicated. See 5-2-2 for display contents.

5-1-2 LCD operation part

Key Name	Key mark	Function Summary
F1 key	F1	Switch the LCD display interface to the previous page.
F2 key	F2	Switch the LCD display interface to the next page.

*Depending on display contents, sometimes the interface can not be switched.

*Sometimes the interface displayed automatically returns to the initial interface due to operation on the operation panel or alarm.

5-1-3 LED display part

Display	Display contents
7-segment monitor	Frequency, output current, speed, load factor monitoring display, alarm contents, warning contents, operation error, function code number, function code settings and so on.
Monitor mode display	The unit of numerical values displayed by the 7-segment monitor.
Operation mode display	The operation status of inverter (forward running, reverse running, stop, frequency lock).
Control authorization display	Whether the operation command sent from the operation panel is active or not.

5-1-4 LED operation part

(1) Key operation

Key Name	Key Mark	Function Summary
Drive key	Drive	● Starts forward or reverse running operation.
Stop key	Stop	● Stops operation. ● Can be used for releasing alarm signal in alarm condition.
Menu / Cancel key	Menu/Cancel	● In Status Display mode, changes the Status Display mode to Function Code Display mode.
		● In Function Code Display mode, returns to the menu state of previous page.
Set key	Set	● In Status Display mode, changes contents displayed on the 7-segment monitor.
		● In Function Code Display mode, confirms the value input.
Back key	Back	● In Status Display mode, changes display contents of the 7-segment monitor.
		● In Function Code Display mode, returns to the menu state of previous page.
Control authorization toggle key	OPE/EXT	● Toggles the operation control authorization.

(2) Quick knob operation

Operation Name	Operation Indication	Function Summary
Turning (clockwise)		The value displayed by 7-segment monitor increases.
Turning (counter-clockwise)		The value displayed by 7-segment monitor decreases.
Pressing	(press)	Confirm the value displayed by 7-segment monitor.

5-2 Switching of Statuses

The operation panel has two display modes: [Status display mode] and [function code display mode], and the modes can be toggled by pressing the key Menu/Cancel.

Table 5-1 7-segment monitor display modes

Display Mode	Display Contents
Status Display	• The inverter status during operation • stop (such as frequency, output current, speed, load factor, monitoring display, alarm and warning contents)
Function Code Display	Function code No. and data

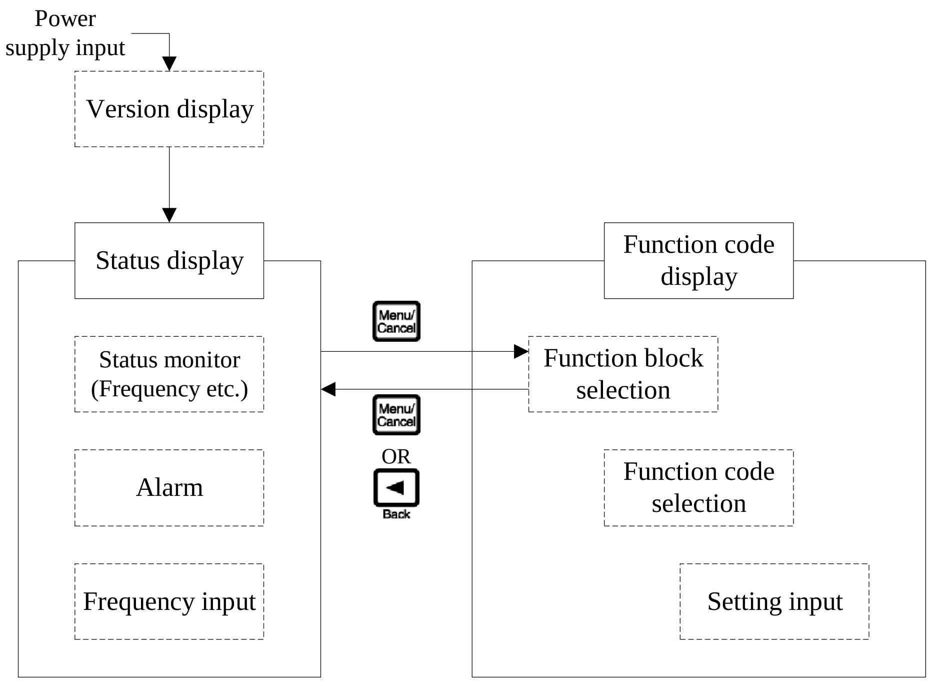
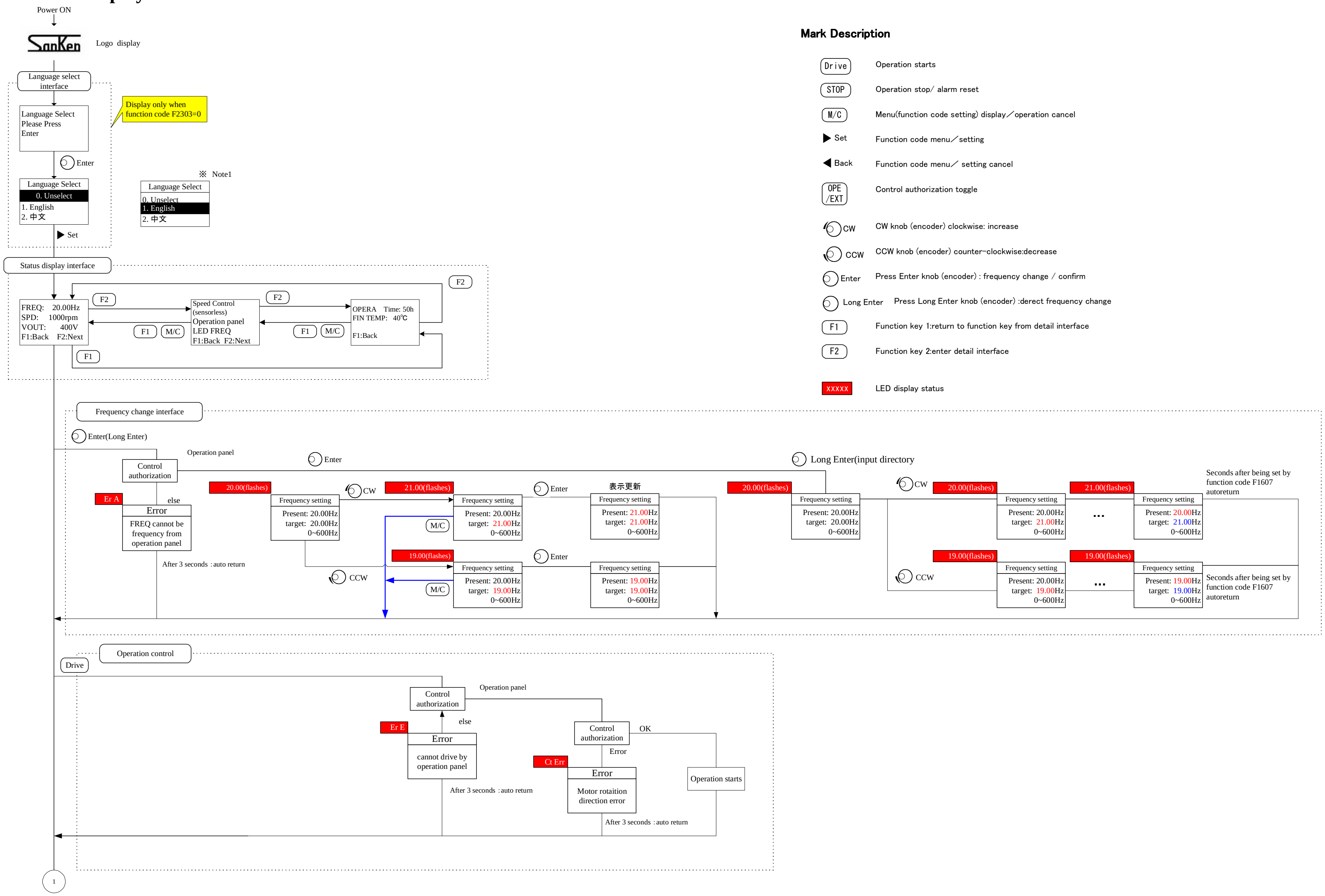


Figure 5-1 Status transition diagram (summary)

5-2-1 Status Switching diagram

1. Status display

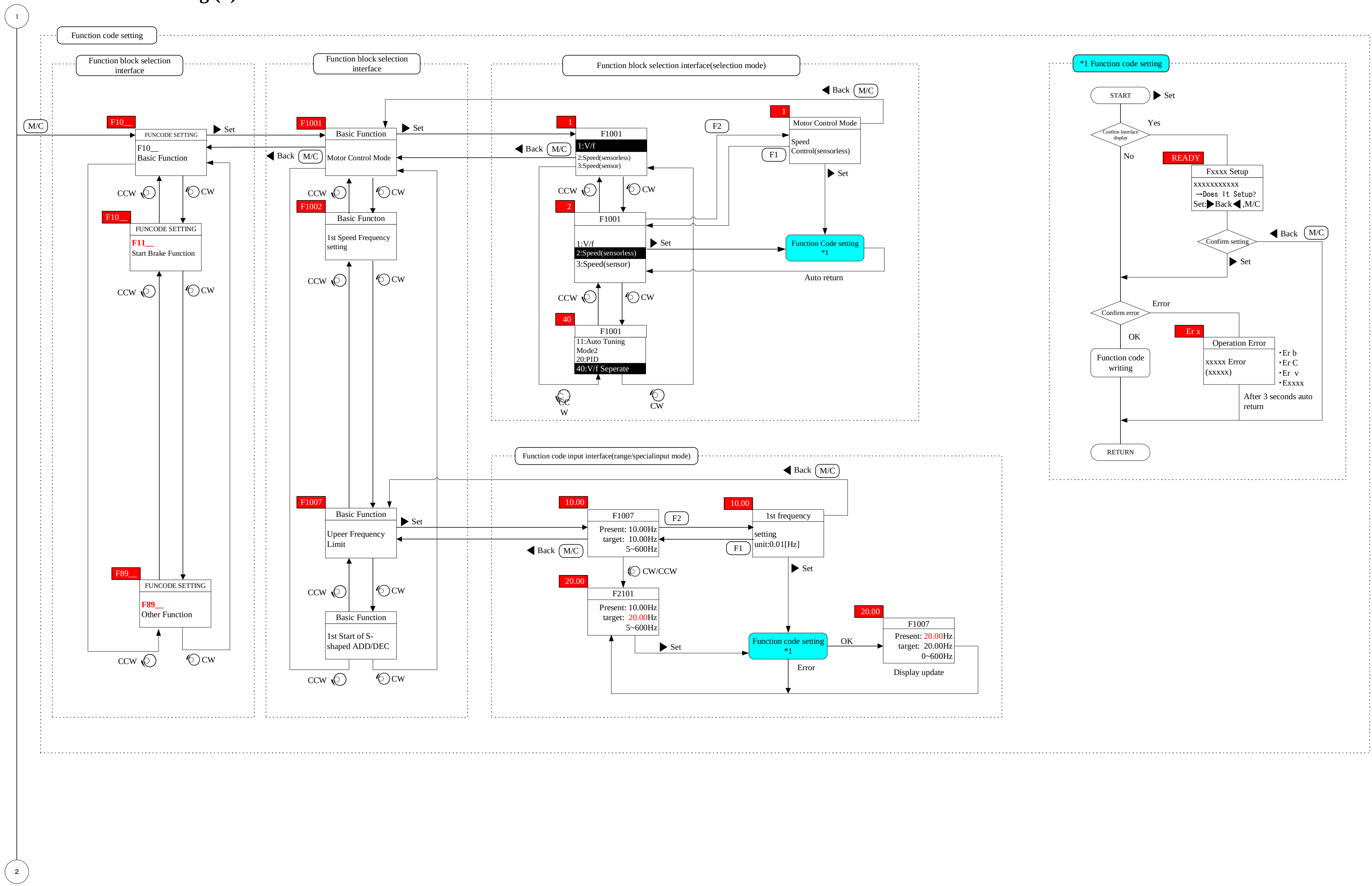


Mark Description

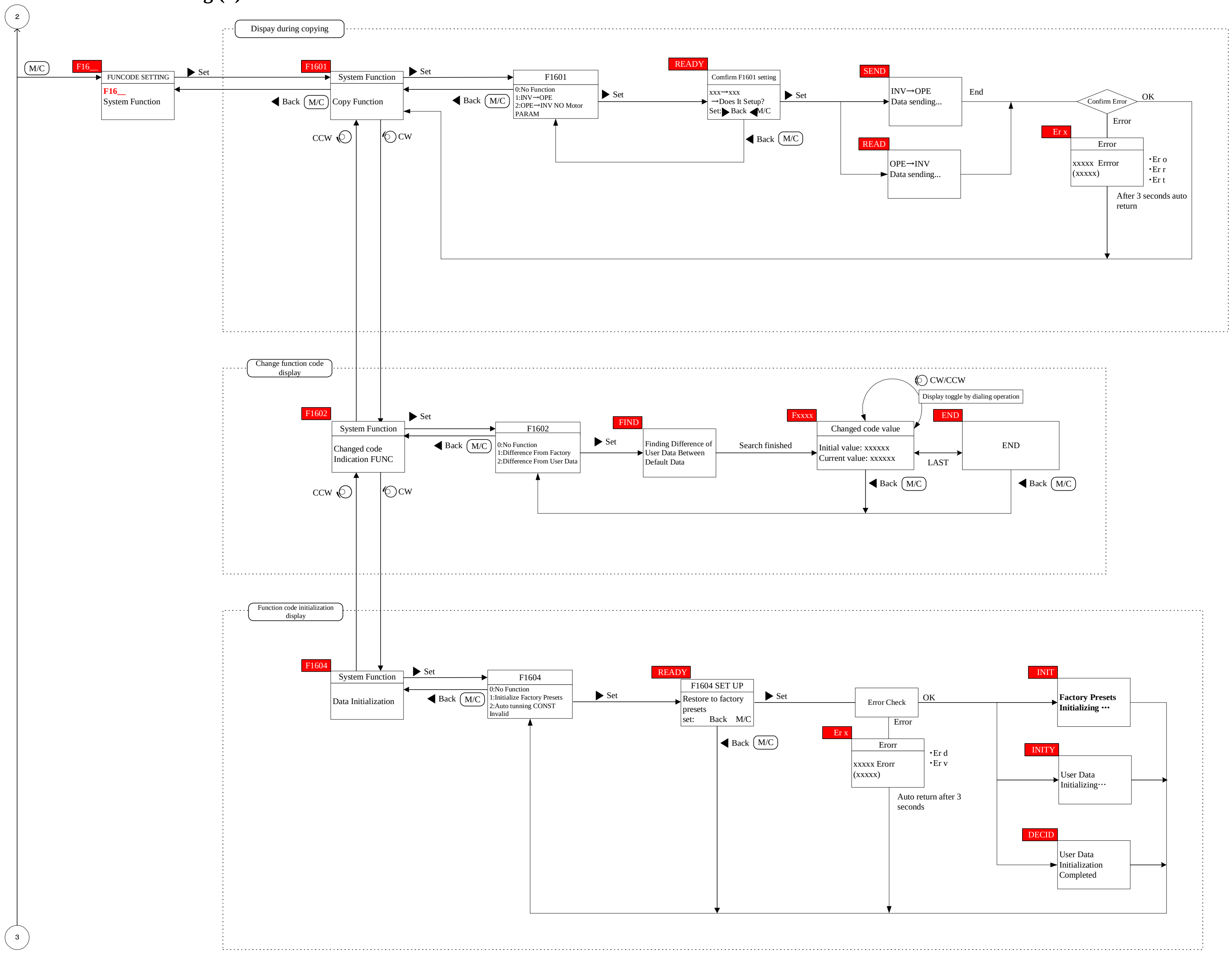
- Drive — Operation starts
- STOP — Operation stop/ alarm reset
- M/C — Menu(function code setting) display／operation cancel
- ▶ Set — Function code menu／setting
- ◀ Back — Function code menu／ setting cancel
- OPE/EXT — Control authorization toggle
- CW — CW knob (encoder) clockwise: increase
- CCW — CCW knob (encoder) counter-clockwise:decrease
- Enter — Press Enter knob (encoder) : frequency change / confirm
- Long Enter — Press Long Enter knob (encoder) :derect frequency change
- F1 — Function key 1:return to function key from detail interface
- F2 — Function key 2:enter detail interface
- xxxxx — LED display status

Note 1: When choosing Chinese version, change to this interface and press the Set key

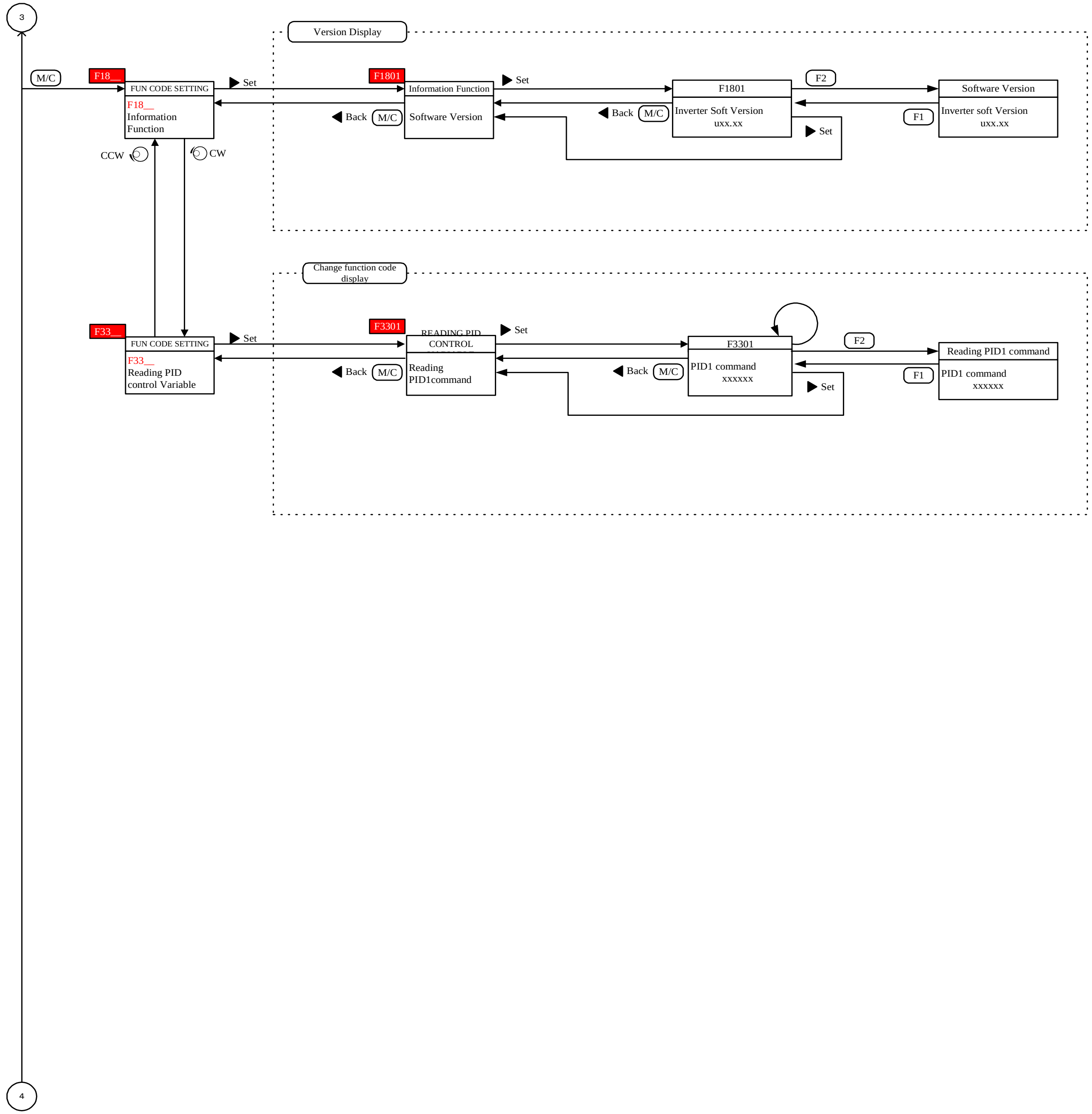
2. Function code setting (1)



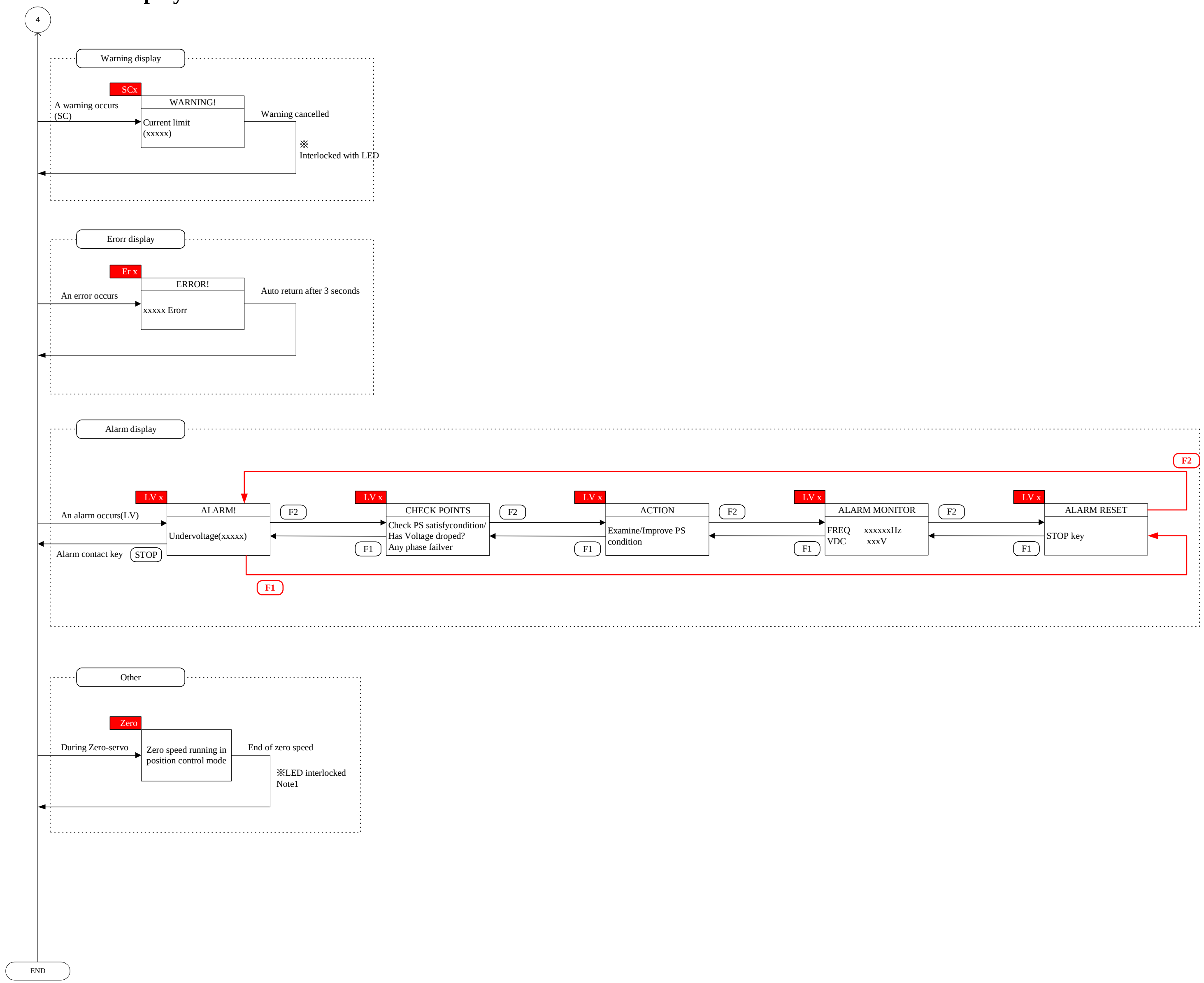
3. Function code setting (2)



4. Function code reading



5. Alarm display and others



 Note 1: The display during zero speed operation in position control mode or zero servo mode.

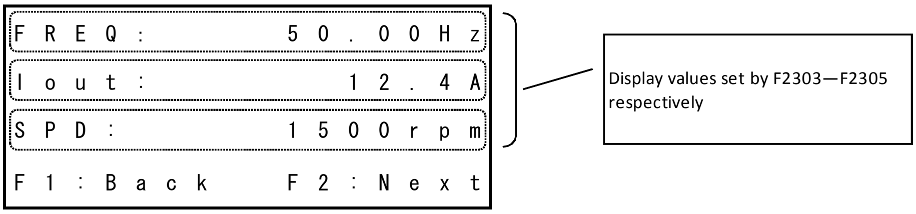
5-2-2 LCD display under various statuses

<u>**An Example of LCD Interface in Status Display Mode**</u>

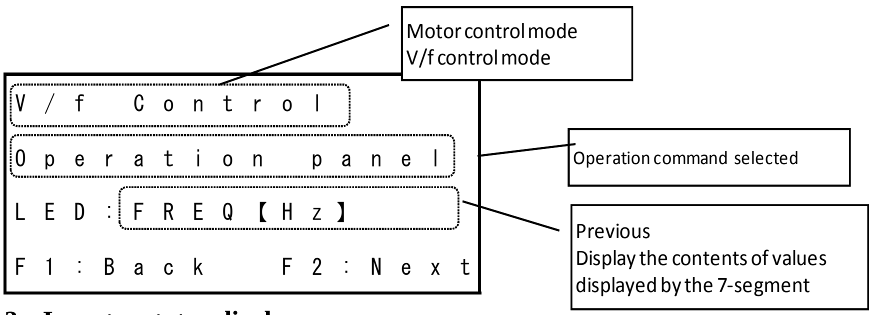
Status Display Interface

This interface shows the LCD conditions in the status display of operation panel.
This interface has 3 pages of screen which can be switched by F1 and F2 function keys.
Specific operation method is introduced by the contents on the bottom line.

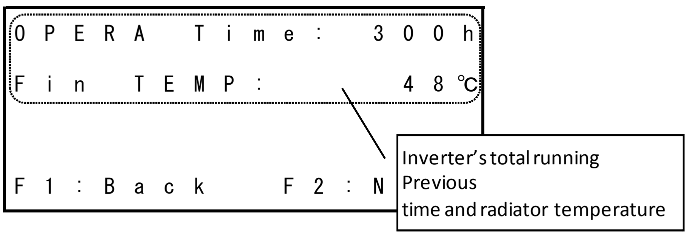
1. Monitor display



2. Control mode / control authorization display

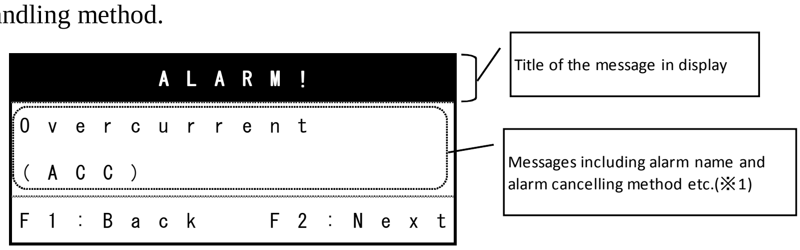


3. Inverter status display



Alarm interface (e.g. OCA alarm)

After the alarm of inverter has stopped, the alarm name is displayed on the 7-segment monitor, and LCD interface also shows the alarm contents at the same time, that is, the alarm interface.
The interface can be switched by function keys F1 and F2, and can also be switched to the display interface of alarm handling method.



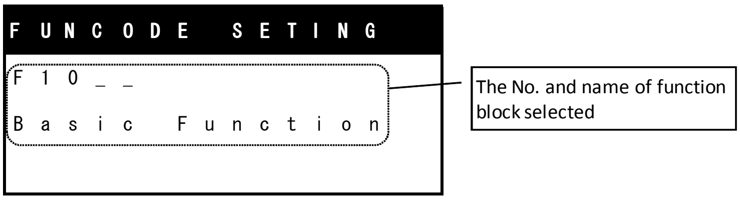
※1: These messages can be freely switched through F1 and F2.

The display contents are shown in the table below

Message title	Message Display Contents
ALARM!	Alarm name
Check items	Check items for cancelling alarm
Countermeasures indicated	Example handled
Key parameters at alarm status	The inverter's status when an alarm occurs
Alarm cancelling method	Alarm releasing method

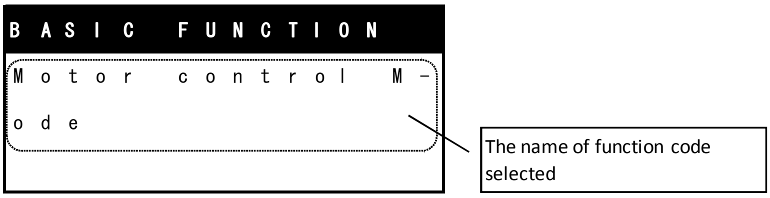
An Example of LCD Interface in Function Code Display Mode

Function block selection interface



□: The function block No. is displayed in 7-segment monitor.

Function Code Selection Interface (selection mode: e.g. F1001)



*The function code No. is displayed in 7-segment monitor.

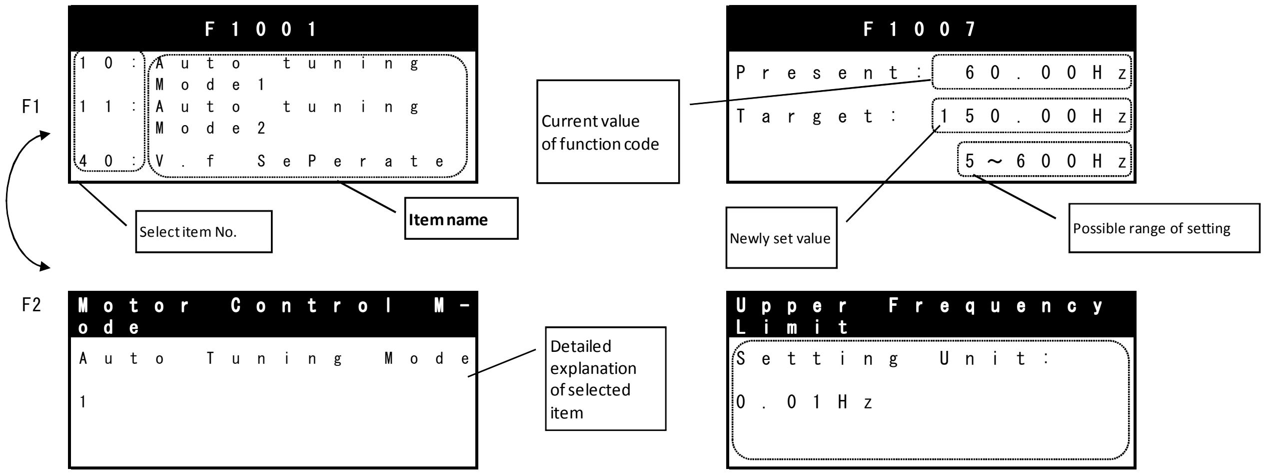
Function code setting

Selection mode (display set value)

* The value set is displayed in 7-segment monitor.

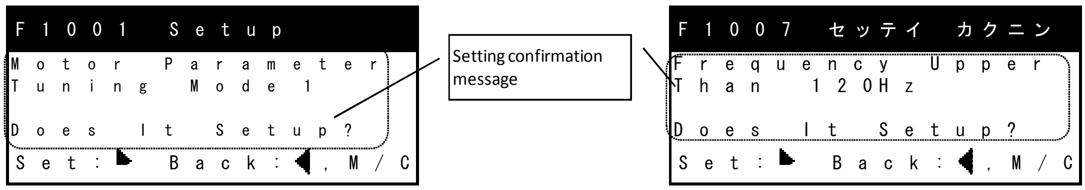
Range mode (display set value)

*The value set is displayed in 7-segment monitor.



*: For use in applications where the title occupies 2 lines or above through function code.

Confirming the settings



For use in applications where confirmation image displays when confirming through function code and the set value.
*The confirmation message may vary depending on the function code.

5-3 Status Display Mode

In status display mode, inverter status monitoring, alarm display, setting of output frequency and operations such as running and stop of inverter can be implemented.

5-3-1 Version display

Shortly after the power-on of the equipment, the software version of inverter will be displayed on 7-segment monitor. The following is: display example for software version: VER 1.00.

u0 100

If, for some reason, the host can not communicate with the operation panel when connected to the power, the 7-segment monitor will display the software version of the operation panel. Now the monitor displays PXXXX

5-3-2 Inverter status mode

The inverter status mode will be displayed.

In the operation mode display, various operation and stop states of the inverter are displayed.

Table 5-2 Display contents of operation mode

Operation Status	Display Contents
Stopped	● REV ● FWD
Forward running	● REV ○ FWD
Deceleration to stop from forward run Forward run waiting DC braking (forward)	● REV ◐ FWD
Reverse running	○ REV ● FWD
Deceleration to stop from reverse run Reverse run waiting DC braking (reverse)	◐ REV ● FWD
Frequency locking	○ REV ○ FWD
Position control running (Zero-servo running)	◐ REV ◐ FWD

○ Lit ◐ Flashing ● Unlit

Monitor mode display refers to the contents displayed on the 7-segment monitor

Table 5-3 Display contents of monitor mode

Display Contents	Unit	Display Contents	Display of 7-segment Monitor
Frequency	Hz	○Hz ●A ●rpm ●% ●M	Running: the lit lamp indicates output frequency Stopped: the flashing lamp indicates set frequency
Output current	A	●Hz ○A ●rpm ●% ●M	Running: the lit lamp indicates output current Stopped: the flashing lamp indicates 0.0
Speed	rpm	●Hz ●A ○rpm ●% ●M	Running: the lit lamp indicates speed (*1) Stopped: the flashing lamp indicates speed (*1)
Load factor	%	●Hz ●A ●rpm ○% ●M	Running: the lit lamp indicates load factor Stopped: the flashing lamp indicates 0.0
Status monitor display (No unit)	-	●Hz ●A ●rpm ●% ○M	Running: the lit lamp indicates the value selected by F1202 Stopped: the flashing lamp indicates the value selected by F1202

○ Lit ◐ Flashing ● Unlit

*1 Depending on the motor control modes, the display contents may be somewhat different. The display contents are as shown in Table 5-4

Table 5-4 Display contents of speed

Motor control mode	Running	Stopped
Sensorless vector control	Estimated speed of motor	0
Others （V/f, vector etc.）	Detecting speed of PG sensor	Detecting speed of PG sensor

During the inverter’s status monitoring display, display contents of 7-segment monitor are shifted every time when the ◄ Back (Back) key or ► Set (Set) key is pressed. Display contents of 7-segment monitor can also be shifted through function codes. See the function code F1201 in [7-3 Description of Functions] for details.

Key	Switch action
◄ Back	Display in order of: frequency → output current → speed → load factor → status monitor display → frequency → …
► Set	Display in order of: frequency → status monitor display → load factor → speed → output current → frequency → …

During selection of an operation command from an external terminal or from communication through the function code, as the OPE/EXT key is pressed, running operation can be carried out instantly by the operation panel.
Each time the OPE/EXT key is pressed, the [operation command from the operation panel] and the [operation command from an external terminal or communication] will be interchanged.
Control authorization is indicated by a lit lamp where the running operation is controlled by operation panel.

Table 5-5 Control authorization displays

Operation Command	Control authorization display
Operation Panel	○
External terminal / communication	●

○ Lit ◐ Flashing ● Unlit

*See the function code F1101 in [7-3 Description of Functions] for details of the operation command from an external terminal / operation command from communication.
*Sometimes this function is not available if set through the inverter's function code.

5-3-3 Alarm display

When the alarm has stopped, the type of alarm will be displayed on the 7-segment monitor of the inverter. At this point, the monitor mode displays that all the LEDs are flashing. See [8-4 Alarm Status] for the details of alarm display.

Display Contents	Monitor mode display	7-segment Monitor Displays
Alarm display	◐Hz ◐A ◐rpm ◐% ◐M	The type of an alarm is indicated by the lit lamp

○ Lit ◐ Flashing ● Unlit

*During alarm display, the display on 7-segment monitor can not be switched even by pressing ◄ Back key or ► Set key.
*During alarm display, pressing Menu/Cancel key can switch current display to function code display mode.

5-3-4 Frequency input

The frequency setting of the inverter can be input by using the quick knob with one of the following two methods.

(1) Frequency setting A

Turn the quick knob, and press when the required frequency is obtained, thus the frequency is changed. This is the method of frequency setting A.

- This is an effective method for setting a desired frequency.
- Cancellation can be made during frequency setting.
- In status monitor display, the method of frequency setting A can be used either during in running or stopping stopped state of the equipment.
- This method can not be used during alarm display.

Operation example: changing from 5 Hz to 50 Hz

Operation	Display	Description
	500 or 500	Display of status monitor (frequency display)
(press)	500	Press the quick knob, and the current set frequency will be displayed
	500 ⇒ 501 ⇒ 502 ⇒…	Turn the quick knob, and the value displayed will increase or decrease.
	502 ⇒ 602 ⇒ 702 ⇒…	Quickly turn the knob, and the displayed digit number of increase or decrease will be changed.
	5000	The frequency desired will be displayed.（□1）
or (press)	5000 or 5000	Press the key or quick knob, then the set value will be stored as a new frequency value. And the interface will return to status monitor display mode. If this is done during running operation, then the output frequency will start to change to the newly set value.

5000 **:Lit** 5000 **:Brightness periodically changes** 5000 **: Flashing**

*1 If it is not necessary to set frequency, press key or key to return to the status monitor display mode.

(2) Frequency setting B

Frequency setting B is a method for changing frequency by dialing the quick knob each time.

- This is an effective method for fine-tuning of the set frequency during observation of the load conditions.
- In status monitor display, this method can be used either in running or stopped state of the equipment.
- This method can not be used during alarm display.

Operation example: changing the frequency from 5 Hz to 50 Hz

Operation	Display	Description
	500 or 500	Display of status monitor (frequency display)
(long press)	500	Press the quick knob, and the current set frequency will be displayed
	500 ⇒ 501 ⇒ 502 ⇒…	Turn the quick knob, and the value displayed will increase or decrease. The frequency changed by turning the quick knob will be stored immediately as a new frequency value. If this is done during running operation, then the output frequency will start to change to the newly set value.
	502 ⇒ 602 ⇒ 702 ⇒…	Quickly turn the knob, and the displayed digit number of increase or decrease will be changed.
	5000	The frequency desired is reached.
Set or (press)	5000 or 5000	Press the Set key or quick knob, then the display screen will return to status monitor display. Also, the display screen will return to the status monitor display if the quick knob is not operated in seconds (* 1). （*2）

5000 :Lit 5000 : Brightness periodically changes 5000 : Flashing

*1 Under no-operation condition, the time before the display screen returns to status display can be changed through function codes, see the contents of function code F1607 in [7-3 Description of Functions].

*2 Although the display can be switched back to the status monitor display through Back (Back) key or Menu/Cancel key, the set frequency is still active.

5-4 Function code display mode

Function code display mode can be used to set various functions of inverter.

5-4-1 Status transition diagram

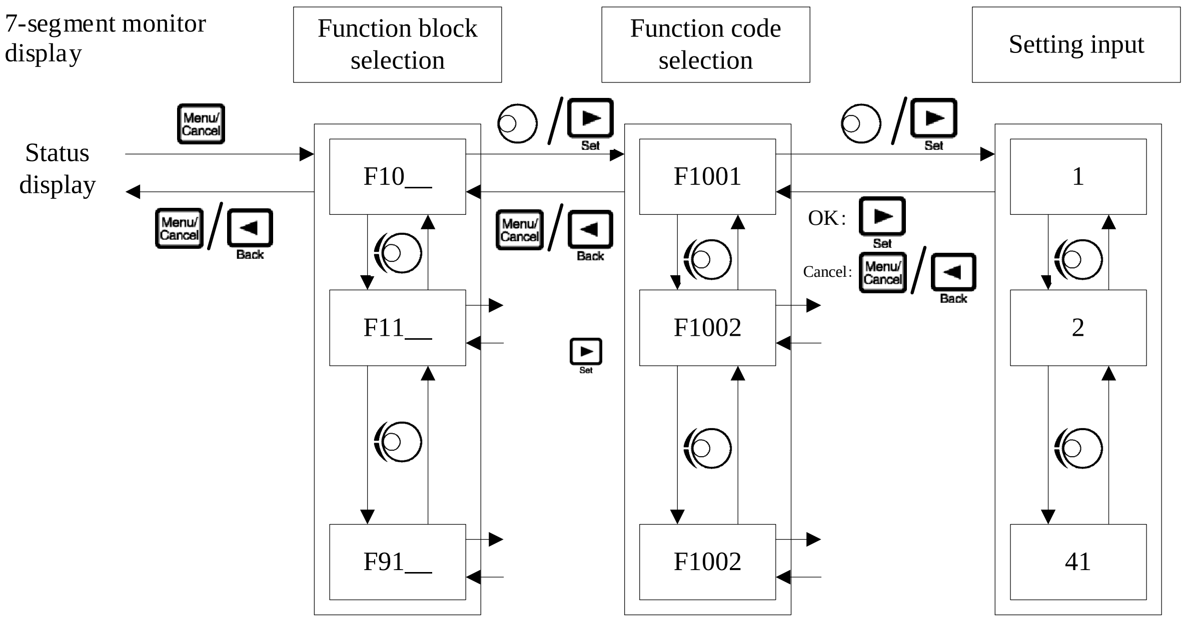


Figure 5-2 Function code display mode transition diagram

5-4-2 Basic operation

The basic operation is used for changing the value of a function code.

Operation example: setting F1414=10

Operation	Display	Description
	50.00 or 50.00	Display of status monitor (frequency display)
Menu/Cancel	F 10_ _	Pressing the Menu/Cancel key shows the function block selection
	F 10_ _⇒F 11_ _⇒F 12_ _⇒…	Turn the quick knob, then the function block number will change accordingly.
	F 14_ _	Select the target function module.
Set or （press）	F 1401	Press the Set（Set）key or quick knob, then the selected function code will be displayed
	F 1414	By turning the quick knob, you can select the target function code.
Set or （press）	1	Press the Set（Set）key or quick knob, and the set value of function code will be displayed.
	10	Turn the quick knob, and select the new settings
Set	F 1414	Press the Set（Set）key to confirm the new setting, and the display screen will return to function code selection.（□1）
Back or Menu/Cancel	F 14_ _	Press the Set（Set）key or Menu/Cancel key, and the display screen will return to function code selection.
Back or Menu/Cancel	50.00 or 50.00	Press the Back（Set）key or Menu/Cancel key, and the display screen will return to status monitor mode.

*1 If a new value is not required, the display can be switched back to the function code selection interface through Back (Back) key or Menu/Cancel key.

5-4-3 Confirming operation

For some function codes, operation needs to be re-confirmed to prevent data rewriting due to misoperation.

Operation example: setting F1001=10

Operation	Display	Description
	50.00 or 50.00	Display of status monitor (frequency display)
Menu/Cancel	F 10_ _	Press the Menu/Cancel key, the screen will display function block selection
	F 10_ _	By turning the quick knob, you can select the target function module.
Set or (press)	F 1001	Press Set (Set) key or quick knob, then the function code will be displayed on display screen.
	F 1001	Turn the quick knob to select the target function code.
Set or (press)	1	Press the Set (Set) key or quick knob, then the set value of function code will be displayed on display screen.
	10	Turn the quick knob to select the new setting
Set	10 rEAdy	Pressed the Set (set) key, then the set value and rEAdy will be alternately displayed, suggesting that the setting is being confirmed (□ 1)
Set	F 1001	Press the Back (Set) key again to confirm the new setting, and the display will return to function code selection interface. (□1)
Back or Menu/Cancel	F 10_ _	Press the Back (Back) key or Menu/Cancel key, and the display will return to function block selection interface.
Back or Menu/Cancel	50.00 or 50.00	Press the Back (Back) key or Menu/Cancel key, and the display will return to status monitor mode interface.

*1 During alternate display period, if it is desired to interrupt input as any mistake in operation is found, operate the (Back) key Back or key Menu/Cancel to return the display to the function code selection state.

5-4-4 Signed operation

For some function codes, they can be set with values containing signs (polarity).

Operation example: setting F1503=-5.0

Operation	Display	Description
	50.00 or 50.00	Display of status monitor (frequency display)
Menu/Cancel	F 10_ _	Press Menu/Cancel key, then the screen will display function block selection interface
	F 15_ _	Turn the quick knob to select the target function module.
Set or (press)	F 1501	Press the Set (Set) key or quick knob, then the function code selection will be displayed.
	F 1503	Turn the quick knob to select the target function code.
Set or (press)	0.0	Press the Set (Set) key or quick knob, then the set value of function code will be displayed.
	-5.0	Turn the quick knob to select the new setting, and the sign will be displayed only when it is negative. (If the value is + 5.0, it will be displayed as 5.0)
Set	F 1503	Press the Set (Set) key to confirm the new setting, and the display will return to function code selection interface. (*1)
Back or Menu/Cancel	F 15_ _	Press the Back (Back) key or Menu/Cancel key, and the display will return to function block selection interface.
Back or Menu/Cancel	50.00 or 50.00	Press the Back (Back) key or Menu/Cancel key again, and the display will return to status monitor mode interface.

* 1 Please press Back or Menu/Cancel key to return to the function code selection interface.

5-5 Special functions

5-5-1 Copy function operation

The so-called copy function is the function which transfers the function code data to other inverters after transferring the function code data from one inverter side to the operation panel.

The copy function is an effective function where several inverters need to be set with the same function code data.

Only 1 inverter is set, while other inverters can also receive the same function code data, thus the same function code setting can be easily implemented.

□ The copy function can be implemented only when the inverter stops working. Therefore, this operation shall be carried out after the inverter has been stopped.

Operation example: copying from the inverter to the operation panel

Operation	Display	Description
	F 1601	Select function code F1610 (copy function)
or (press)	0	Press （Set）key or quick knob, then the set value of function code will be displayed.
	1	Turn the quick knob to select 1 When F1601 = 1, the current value of the function code data will be transferred to the operation panel (□ 1)
	SEnd	Press the (Set) key to start transferring data. And a flashing SEnd is displayed on 7-segment monitor.
After transfer is completed	F 1601	When data transfer is completed, the display will return to function code selection interface.

*1: When the value is set to 2 or 3, then the saved contents of the operation panel will be transferred to the inverter.
And then, a flashing rEAd will be displayed on 7-segment monitor.

See the contents of function code F1601 in [7-3 Description of Functions] for detailed description of the function and its operation method.

5-5-2 Changed code display operation

Considering current function code data may be different from the factory presets of product or the user's initial value, the function for displaying a changed function code and its data.

This is an effective function for inquiring the difference between current function code and product's factory preset or the user initial value.

Confirmation of maintenance and other function codes can be easily achieved by this function.

Operation example: displaying difference with product's factory preset data

Operation	Display	Description
	F 1602	Select function code F1602 (changed code display function)
or (press)	0	Press (Set) key or quick knob, then the set value of function code will be displayed.
	1	Turn the quick knob to select 1 If F1602 = 1, the current function code data will be compared with the factory preset function code data.
	Find	Press the (Set) key to start searching the number of a function code which has been changed and is different from the factory preset function code data. While the function is searching, a flashing Find will be displayed on 7-segment monitor.
After searching	FXXXX or End	After searching, the changed function code starts flashing on display screen. If there is no changed function code, a flashing End will be displayed on screen.
	FXXXX or End	If there are more than one changed function codes, they can be switched by adjusting the quick knob.
Or (press)	XXXXX	Press the (Set) key or quick knob, then the set value of function code will be displayed flashing.
or	FXXXX	Press the (Set) key or key to return to the changed function code (flashing display state).
or	F 1602	Press the (Set) key or key to return to function code selection interface.

See the contents of function code F1602 in [7-3 Description of Functions] for detailed description of the function and its operation method.

5-5-3 Function code initialization operation

The inverter’s function code settings can be returned to factory presets through this function.

Inverter’s initial value can be set to the factory preset or the data determined by the user (i.e. user’s initial value). Also, the initial value can be selected between the factory presets and the user’s initial value. By setting the user’s initial value, the function code data can be initialized to the user’s initial value even if it is overwritten for some reason, allowing for resetting the function code within a minimum range.

Operation example: recovering to the factory presets

Operation	Display	Description
	F 1604	Select function code F1604 (data initialization)
or (press)	0	Press the (Set) key or quick knob, then the set value of function code will be displayed.
	1	Turn the quick knob to select 1 If F1604 = 1, all the function code data will recover to the factory presets
	1 rEAdy	Pressed the (Set) key, then the set value and rEAdy will be alternately displayed, suggesting that the settings is being confirmed (∗ 1)
	init	Press the (Set) key to start initialization of the function code. During initialization, a flashing init will be displayed on 7-segment monitor.
After initialization	F 1604	When initialization is completed, the interface will return to function code selection.

*1: In the alternate display, if an operation error occurs and it is hoped to interrupt input, then the interface can be returned to the function code selection state by pressing the (Back) key or key.

See the contents of function code F1604 in [7-3 Description of Functions] for detailed description of the function and its operation method.

5-5-4 Alarm contents reading operation

Alarm history record display is a function for displaying alarms occurred in the past.

The latest 5 alarms will be recorded. If a new alarm occurs, then the first alarm will be deleted.

Operation example: reading alarm contents

Operation	Display	Description
	F 1805	Select function code F1805 (alarm contents reading)
▶ Set or (press)	0	Press the ▶ Set (Set) key or quick knob, then the set value of function code will be displayed.
	1	Turn the quick knob to select 1, then if F1805 = 1, the alarm contents will be read.
▶ Set	1 XXXXX or End	Press the ▶ Set (Set) key to execute the alarm reading function. Alarm history record number and alarm contents XXXXX are alternately displayed, and End will be displayed if there is no alarm record.
	2. XXXXX or End	Turn the quick knob, the alarm displayed will be shifted continually. In alarm history record, the alarm with the smallest number is the latest alarm.
◀ Back or Menu/Cancel	0	Press the (Set) key ◀ Back or Menu/Cancel key, then the interface will return to function code value setting.
◀ Back or Menu/Cancel	F 1805	Press the (Set) key ◀ Back or Menu/Cancel key to return to function code selection interface.

When the set function code F1805 = 9, then the alarm history record can be deleted.

5-5-5 Alarm status confirmation operation

Alarm status confirmation is a function for displaying the inverter’s status when an alarm occurs.

It can be used to confirm the latest 5 alarm statuses through function codes F1806 - F1810. If a new alarm occurs, then the first alarm will be deleted. F1806 is the latest alarm, while the F1810 is the first alarm.

Operation example: Confirming the inverter status when the latest alarm occurs

Operation	Display	Description
	F 1806	Select function code F1806 (alarm status confirmation)
► Set	ALtyP YYYYY or End	Press ► Set (Set) key, then the alarm name YYYYY and ALtyP indicating display of [alarm name] will be displayed alternately. The End will be displayed if the alarm status is not recorded.
(knob)	XXXXX YYYYY or End	After the alarm has been stored, turn the quick knob to switch the contents displayed. Now, the detonation XXXXX (□1) and the value YYYYY (□2) when alarm occurred will be displayed
◄ Back or Menu/Cancel	0	Press ◄ Back (Set) key or Menu/Cancel key, then the interface will return to function code setting.
◄ Back or Menu/Cancel	F 1806	Press the ◄ Back (Set) key or Menu/Cancel key to return to function code selection interface.

If the function code is set to F1805 = 9, alarm records will be eliminated. At this time, all the alarm records from F1806 to F1810 will be deleted.

*1: The denotations are shown in the table below

Denotation	Meaning	Unit
ALtyP	Alarm name	-
FrE	Output frequency	Hz
ioUt	Output current	A
uoUt	Output voltage	V
udC	DC voltage	V
P	Output power	kW
t	Radiator temperature	□

*2: The value displayed indicates the inverter status before occurrence of an alarm. Therefore, if an alarm is caused by transient over-current or over-voltage, the stored value is somewhat different from the current value or voltage value at the occurrence of the alarm (factors causing alarm).

5-5-6 7-segment monitor display list

Monitor display	Description
in it	During initialization, the data is displayed flashing.
in itY	During initialization of user data, the data is displayed flashing.
dEC id	During confirmation of user data, the data is displayed flashing.
rEAdY	The detonation indicates the need for reconfirmation operation using function code
F ind	It is displayed flashing during search of the function code, of which the user data is discrepant from default settings.
SEnd	It is displayed flashing during transfer of the host function code data to operation panel.
rEAd	It is displayed flashing during transfer of the operation panel function code data to host.
End	It is displayed flashing when the desired data can not be found through the function code search and alarm history record.
tUnE	Indicates auto tuning
2Ero	Indicates zero speed running (in position control mode or zero-servo running).

* In addition to the above, alarms, warnings, errors etc. are also displayed on 7-segment monitor. See Chapter 8 for details of these contents.

5-6 Connecting operation panel with extension cable

If the operation panel is connected to inverter with the extension cable, then the operation panel can be installed in other instrument frame. (See Chapter 12: outside view of 12-2 Operation Panel for installation opening drawing).
The extension cable length shall not be more than 5m. And use a standard 8-pin direct plug-in cable (both ends of RJ45 type) which is shielded and available from market for connection.

Note: Please do not connect devices other than operation panel, such as the computer network cable etc.. Connecting to other devices may lead to damage to inverter or the connected device.

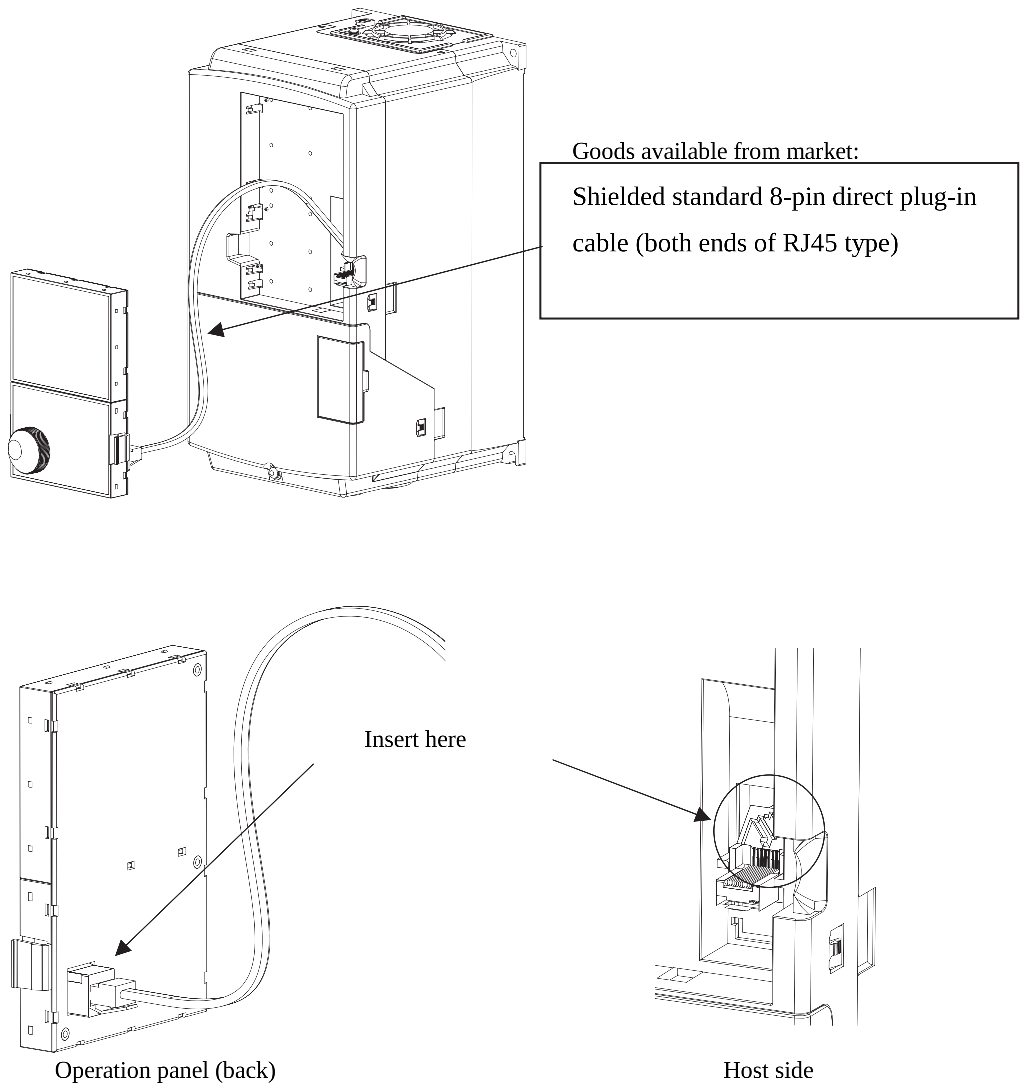


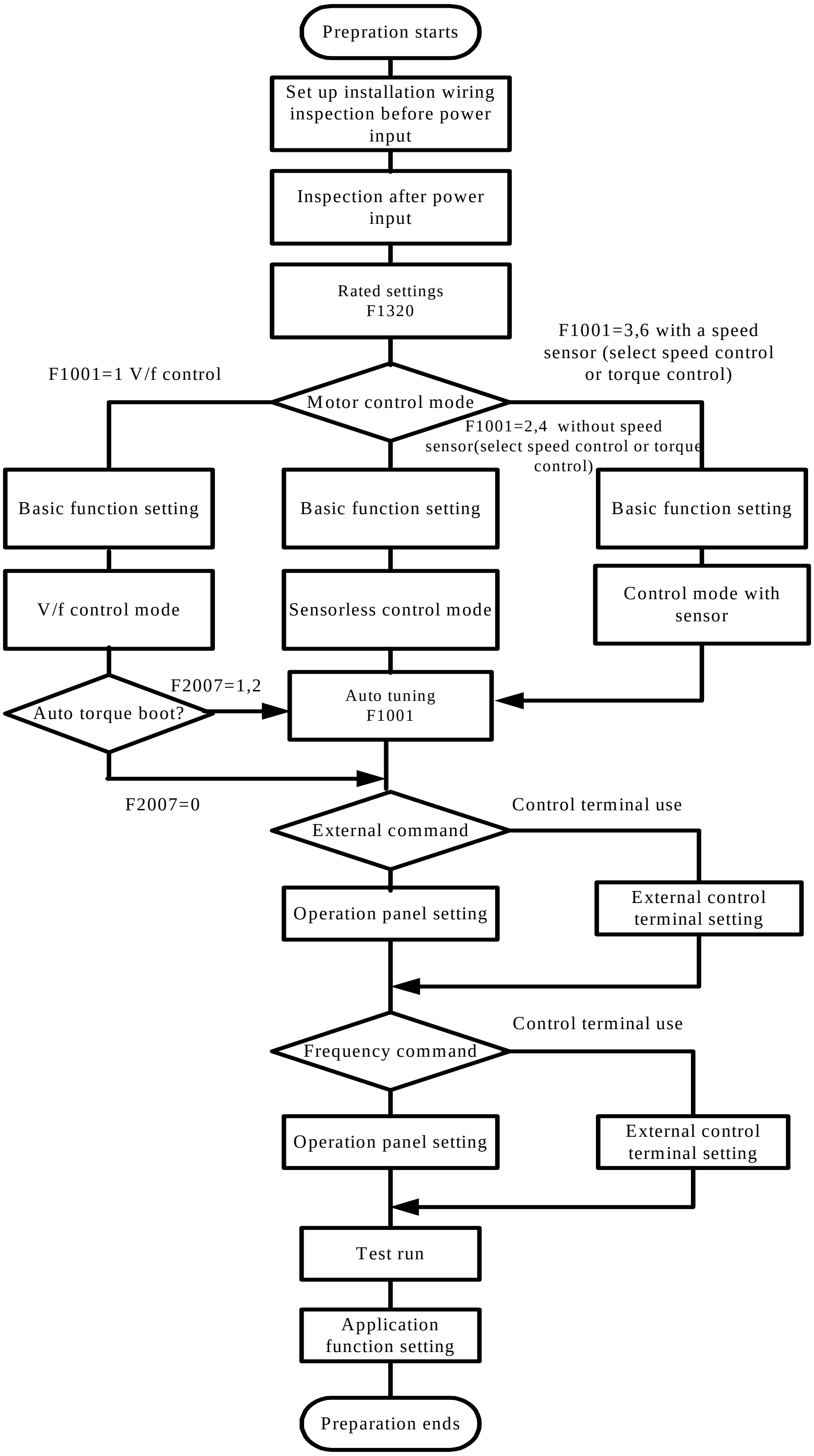
Figure 5-3 Usage of extension cable

6. Operation

- **Wiring shall not be made after connecting to power supply.**
  Failure to observe this warning may result in personal injury, fire or electric shock.
- **Before undertaking the work, safety notes must be checked.**
  Failure to observe this warning may result in personal injury or fire.
- **Grounding of the inverter and motor must be carefully implemented.**
  Failure to observe this warning may result in electric shock or fire.
- **Please install the cover of the inverter before connecting the power.**
  Do not remove the cover when it is powered on.
- **Works such as maintenance inspection and replacement of parts etc. can only be carried out by professional maintenance personnel.**
  Failure to observe this warning may result in electric shock or personal injury.

6-1 Operation steps

The following flowchart shows all the operation steps before and after operation of the inverter.
Please follow the following flow chart to carry out test run.



6-2-1 Confirmation before power input

6-2-2 Confirmation after power input

6-2-3 Basic setting (1)

6-2-4 Motor control mode

6-2-5 Basic setting (2)

6-2-6 Motor parameter auto tuning

6-2-7 Basic setting (3)

6-2-8 Operation confirmation

Figure 6-1 Operation step flow

6-2 Test run

6-2-1 Confirmation before power input

● Please check the following items after installation wiring and other works and before power-on.

Table 6-1 Confirmation items before power input

Item	Content
Power supply voltage confirmation	● If the power supply voltage coincides with the inverter's capacity and voltage.
Main wiring confirmation	● If the connection of input wirings R, S and T is correct. ● If the connection of output wirings U, V and W with the motor's U, V and W is correct. ● If grounding of the ground terminals of inverter and motor is reliable. ● If there is any place where short-circuit is caused by wiring debris. ● If there is any loose screw or connection terminal. ● If there is any short-circuit or grounding place in output end or sequence circuit.
Control wiring confirmation	● If wiring of control terminals is correct. ● If the control signal is in OFF (disconnected) state.

6-2-2 Confirmation after power input

● If it is confirmed that there is no problem before the power supply input, connect to the power supply. And then check the following:

Table 6-2 Confirmation items after power input

Item	Content
Status of operation panel	After the display of software version, check if the operation panel status is as shown in the figure below.（*1）  When the LED panel displays "" stopped state, and 7-segment monitor shows all the digits represent of numerical values are flashing, indicating the equipment is stopped.
Fan drive status	If the cooling fan at the top of inverter host is in stopped state. (Note) Do not drive the fan immediately after power input. Because it is subject to temperature control, if the designated temperature is exceeded, the fan will run. * Setting the function code F1318 (Fan ON / OFF) =1 will make the fan ON all the time, i.e., the fan will fun all the time.

*1: In a LCD application, display indicates language selection.

If the quick knob is pressed, the language list will be displayed. Therefore use the quick knob to choose and press key to confirm.

6-2-3 Basic setting (1)

Carry out setting after the basic operation settings have been confirmed.
The selection of rated values can be made by switching through the following function code.

Table 6-3 Basic function (1)

Function code	Name		Overload capacity	Maximum frequency	Remarks
F1320	Rating selection	1: Mode A (Heavy overload)	150%1min	600Hz	Used for setting the rated values of inverter
		2: Mode B (Light overload)	120%1 min	240Hz	

If the function code is set to 2, but the overload capacity is reduced even though the value has increased by one, .See Standard Specifications in Chapter 11 for details.

6-2-4 Motor control setting

Please refer to the function code F1001 to set the desired motor control mode as the inverter has all the motor control modes shown in the following table.

Table 6-4 Motor control mode

Function code F1001	Control mode	Speed sensor Yes / No	Basic control mode	Remarks
1	V/f control	No	V/f control	Torque boost
2	Speed control		Vector control	
4	Torque control		Vector control	
40	V • f separation control		V/f control	
3	Speed control	Yes	Vector control	
5	Torque control		Vector control	
6	Position control		Vector control	Some are optional functions

Table 6-5 Auto torque boost

Function code	Name	Settings	Remarks
F2007	Auto torque boost	0: No 1: Voltage compensation 2: Slip compensation	

(1) V/f control
The set V (voltage) / f (frequency) is a constant control output for making the motor operate.

(2) Sensorless control (speed, torque)
The so-called speed sensorless control mode, is a mode that controls always at a constant speed no matter what the state of the load is, and also a control mode that can generate high torque at a low frequency range.

(3) V．f separation control
A function which can set the inverter’s output voltage independently. This control mode is also a V / f control mode. According to V • f separation selection, its separation mode can be divided into two modes: complete separation and V • f Separate control.

(4) Sensor control (speed, torque and position)
By feeding back the pulse signal sent by pulse generator (PG) from the motor to inverter, the motor’s

position and speed can be measured. This enables high-precision speed control, torque control and position control.

(5) Auto torque boost control

The inverter is provided with voltage compensation function and slip compensation function. The former is used for auto-regulating the inverter output voltage, while the latter is used for slip frequency compensation based on the load.

Use F2007 to select the above functions.

6-2-5 Basic setting (2)

Please follow the operation steps to set the following function codes.

Table 6-6 Basic function (2)

Function Code	Name	Content	Remarks
F1005	Base voltage	200V Series 0: no AVR, 50-240V	Please check the rated voltage
		400V Series 0: no AVR, 50-460V	
F1006	Reference frequency	0.1-600Hz	
F1007	Upper frequency limit	5-600Hz	
F1009	Carrier frequency	0-130	
F1101	Operation command selection	1. Operation Panel 2. External terminal 3. Communication	
F1110	Motor rotation direction	1: Forward, 2: Reverse	
F1701	Output current limiting function	Mode A (heavy load) 0: no function 50—200 Mode B (light load) 0: no function 50—150	
F1702	Electric thermistor	0: No function 20-105%	

※ Please confirm the factory presets which can be set again only when the need for change really exists.

6-2-6 Motor parameter auto tuning

The so-called auto tuning mode is a function which automatically measures the parameters of the connected motor which will be stored to the inverter’s memory.

This function is a useful function when it is hoped to implement vector control and auto torque control with the motor parameters not fully known. It is also a useful function when it is hoped to implement speed control and torque control if the distance between the inverter and motor is more than 30m.

<For F1001=10, 11 (Motor parameter auto tuning)>

- The auto tuning function has two modes for selection.

Table 6-7 Auto tuning mode

Function Code F1001	Function	Motor Parameters	Remarks
10	Auto tuning mode 1: Measure when the motor shaft is fixed	Primary resistance R1 Secondary resistance R2 Leakage inductance I Excitation inductance M	For cases where the motor can not operate
11	Auto tuning mode 2: Measure when the motor is operating	Primary resistance R1 Secondary resistance R2 Self-inductance L Excitation current I.	For cases where the motor can operate

Chapter 6

Before setting the above auto tuning, set the following function codes in order.

Table 6-8 Auto tuning setting

Function Code	Content	Settings	Remarks
F5001	Motor poles, voltage, and capacity	XYZZZ X: Polarity, Y : Rated voltage Z: Motor capacity	See the following description for details. *1
F5002	Motor current rating	30 — 110% of the inverter current rating (0.1A stepping)	
F5003	Motor frequency rating	10 — 600 Hz	
F5004	Motor speed rating	0 -24000 rpm (1rpm stepping)	
F5005	Motor insulation type	1: Type A 2: Type E 3: Type B 4: Type F 5: Type H	
F5006	The motor's rated voltage during auto tuning of motor parameters	0: Use function code F 5001 Selected voltage 100 -460 (the voltage of F 5001 is inactive)	
F5007	Rated motor slip	0-50%	

*If motor parameters are known, please enter the parameters into the following function codes.

F 5009 Motor's primary resistance (Ω or m Ω)

F 5010 Motor's secondary resistance (Ω or m Ω)

F 5011 Motor's primary inductance (mH)

F 5012 Motor's secondary inductance (mH)

F 5013 Motor's mutual inductance (mH)

F 5014 Motor's excitation current (A)

F 5015 Motor inertia (kgm^2)

F 5016 Load inertia ratio

[Motor parameter auto tuning steps]

(1) Setting of motor ratings

Set all the motor ratings into function codes F5001 — F5005 correctly.

- Press key to display function codes
- Turn the quick knob to select F5001
- Press (Set) key to input numerical values.
- After input, press the (Set) key again to confirm.
  Set function codes F5002 — F5005 in order in the same way.

① F5001 Motor poles, voltage, and capacity

- The configurable values and contents denoted are as follows.

1) Number of poles: 2 — 8 (4 types).

2	4	6	8

2) Rated voltage: the setting range of rated voltage is denoted by serial numbers. Unit: [V].

No.	1	2	3	4	5	6	7	8
Corresponding rated voltage	200	220	230	380	400	415	440	460

3) Motor capacitor: the setting range of motor capacitor is denoted as follows. Unit: [kW].

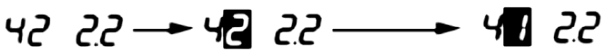
0.37	□0.4	0.55	0.75	□1.1	□1.5	□2.2
□3.0	□3.7	□4.0	□5.5	□7.5	11.0	15.0
18.5	22.0	30.0	37.0	45.0	55.0	75.0
90.0	110	132	160	185	200	220
250	280	315	355			

The symbol □ indicates a space.

Example) When using a motor of 4 poles, 220V, 2.2KW, the 7-segment monitor displays the following:

42 22

Operation example) in case where a motor of 4 poles, 200V, 2.2KW is used, operation for changing the rated voltage is as follows:



Note: During vector control and auto torque boost control, standard values of various control constants necessary for inverter control need to be obtained from the settings of the function code, thus please make correct setting according to the motor used.

In addition, the basic range of configurable value for vector control is shown as follows. Please consult separately about use of other specifications for vector control.

Number of poles: 2, 4, and 6

Rated voltage: No. 3 or below for 200V series inverters

No. 4 or above for 400V series inverters

Motor capacity: If the motor does not have a capacity equal to or one level lower than the inverter, Exxxx or Er···E· may be displayed.

Chapter 6

② Setting of F5001 — F5005

- Set rated current, frequency, speed and insulation type of the connected motor.
  Under normal circumstances, please set according to the motor ratings. If the value set is incorrect, the motor parameters auto tuning results and the control characteristics of torque control will become adverse.

Note 1): The settings are interdependent with the settings of motor poles, voltage, capacity (F5001). Therefore, if F5001 is changed, then function codes F5002 — F5005, F5009 — F5015 which are associated with the motor parameters will be automatically set with the settings of F5001 as the standard values.

Note 2): These settings can not be used in V / f control mode.

Note 3): The special motors shall be set according to F5006 Special Motor Voltage Rating.

(2) The setting of motor parameter auto tuning mode

Set the auto tuning modes 1 and 2 through F1001 (F1001 = 10 and F1001 = 11). (Check the status of mechanical system).

- Press [Menu/Cancel] key to display function codes
- Press the quick knob to select F1001
- Press the [▶ Set] (Set) key, and key in number, and then press the [▶ Set] (Set) value to confirm.

(3) Auto tuning starts

Auto tuning will begin if the operation signal is input, and the operation panel displays "TUNE" during this process and returns to “Stopped” display upon completion of the process. In addition, in auto tuning mode 2, operation starts in the rotation direction of operation signals until the motor frequency rating (F5003) is reached, and then operation will continue within 50% of the motor frequency rating.

Press [Drive] key to start the auto tuning.

(4) Motor parameter auto tuning ends

If the auto tuning goes smoothly, then the operation panel will return to the initial interface.

After completion of auto tuning, the parameters obtained through auto tuning will be set into the function code.

(5) Auto tuning error

□ If the auto tuning fails, then "Er S." will be displayed on the operation panel.

During auto tuning, please confirm the contents displayed on operation panel. If a "Er S is displayed, please confirm the following contents and conduct auto tuning again.

- Reconfirm the settings of F5001 — F5005
- When using special motors, change the range of F5008 if auto tuning is out of range.

Note 1): Enlarging auto tuning range of F5008 will make the error of auto tuning become bigger, therefore please set appropriate auto tuning range.

□ When using PG sensors, if the detected rotation is in the opposite direction, a “PGnG” will be displayed.

Please confirm the phase of PG pulse. Use operation panel to cancel the “PGnG”warning.

Note 1) Turning up the auto tuning range of F5008 may result in bigger error of auto tuning. Therefore, please set the auto tuning range.

(6) Forced ending of auto tuning

The auto tuning mode can be forcibly ended according to stop signal.

Pressing [Stop] key can also realize forced ending.

[Note: Notes on carrying out motor parameter auto tuning mode]

① Before carrying out auto tuning mode 2, be sure to disengage the load shaft of motor. If the load is not disengaged (for example, one-piece brake motor), then the auto tuning mode 2 can not carry out correct auto tuning.

② If F5001 — F5008 are not correctly set, then the right auto tuning can not be implemented.

③ Please carry out the auto tuning under normal temperature of the motor. As other test run items have been conducted, the motor may be overheated. And correct auto tuning can not be achieved in this condition.

④ The actions of auto tuning mode are executed based on normal operation steps, therefore sometimes it does not act according to the settings of function codes. In this case, please confirm if there is any conflict between data settings of function codes as in normal operation.

Example) If the frequency setting is lower than operation start frequency, the operation can not be started. Although the frequency setting is inactive in auto tuning mode action, it is active as an operation start condition.

Example) The auto tuning mode will not act if the frequency setting is higher than the upper frequency limit or lower than the lower frequency limit.

⑤ Performance of the auto-tuning with small motor in the extreme compared with the capacity of the inverter may possibly burn out the motor. Please make sure to choose appropriate motor that is equivalent to 2 levels lower than the capacity of the inverter.

⑥ During action of auto tuning mode 2, if the operation signal is input again during deceleration, then the motor will rerun at the frequency of F5003. Therefore do not enter operation command before the auto tuning is fully completed.

⑦ During auto tuning, when this function is stopped or temporarily stopped because of alarm, please return back to the auto tuning mode.

⑧ During action of auto tuning mode 2, if it enters the idling state temporarily because of MBS signals input by multifunctional input terminals, after that, correct auto tuning can not be achieved by continuing auto tuning action even if the signal is released.

⑨ The acceleration / deceleration time of auto tuning mode 2 acts with the 1st acceleration / deceleration time as standard.

⑩ Depending on the results of parameter auto tuning for motor with shaft fixed, auto tuning with shaft fixed may be reconducted.

6-2-7 Basic setting (3)

Please set the function codes used for setting the operation command and frequency command.

Table 6-9 Basic function (2)

Function code	Name	Content	Remarks
F1002	1st speed frequency selection	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—5V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—5V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 11: External analog VIF1 voltage +VIF2 voltage 12: External analog VIF1 voltage +VIF3 voltage 13: External analog VIF2 voltage +VIF3 voltage 14: External analog VIF1 voltage -VIF2 voltage 15: External analog VIF2 voltage –VIF1 voltage 16: External analog VIF1 voltage-VIF3 voltage 17: External analog VIF3 voltage –VIF1 voltage 18: External analog VIF1 voltage +VIF2 current 19: External analog VIF1 voltage -VIF2 current 20: External analog VIF1 current -VIF2 voltage 21: Terminal block stepping 22:Communication 25:Pulse train input 26:External analog VIF1 forward / reverse operation (0 — 10V, 5V reference) 27: External analog VIF2 forward / reverse operation (0 — 10V, 5V reference) 28:External analog VIF3 forward / reverse operation (0 — 10V, 5V reference)	Please set the setting to values other than 1 when using control terminals.
F1101	Operation command selection	1: Operation panel 2: External terminal 3: Communication	

Note 1) During test run, confirm the factory presets through the operation panel without additional configuration.
Note 2) Before setting external operation signals, check that the control terminals are in OFF (disconnected) state.

Frequency command selection can be switched using the status of multifunctional input terminals. Depending on the status of multifunctional input 1DFA or 1DFB, the frequency command shall be determined according to the method set by F1002, or F1034 — F1036. See F1034—F1036 in Chapter 7-3 for details.

1DFA terminal	1DFB terminal	1st speed frequency action
OFF	OFF	The method selected by F1002
ON	OFF	The method selected by F1034
OFF	ON	The method selected by F1035
ON	ON	The method selected by F1036

Operation command values can be changed using the status of multifunctional input terminals. According to the status of multifunctional input ROPE or RCOM, the operation commands as shown in the table below can be selected. See F1101 in Chapter 7-3 for details.

ROPE terminal	RCOM terminal	Operation Command
OFF	OFF	The method selected by F1101
ON	OFF	Operation Panel
OFF	ON	Communication
ON	ON	Terminal block (FR terminal or RR terminal)

6-2-8 Operation confirmation

After setting has been made by following the steps for test run, the operation shall be confirmed as follows.
Once the inverter or motor is in abnormal conditions, please stop operating immediately. See [Chapter 9 Fault Analysis] for details.

(1) Test run steps

Please refer to the operation methods of operation panel for implementation of 5Hz operation.

Table 6-10 Test run steps

	Operation	Display
1	Power supply input	0.00
2	press → → press	5.00 → 5.00
3	Drive	5.00
4	Stop	5.00

*The state where F1101 (operation command selection) is set to 1 (operation by operation panel)

① After power input, check that the frequency "0.00" displayed on the operation panel is flashing.

② Set the frequency to a low frequency of about 5Hz through the quick knob . (Check that the set frequency displayed on LED monitor is flashing)

③ Press Drive (Drive) key to start forward running operation.(Check that the set frequency displayed on LED monitor is flashing)

④ Press Stop (Stop) key to stop operation of the equipment.

(2) Confirmation items during test run

Please confirm the contents listed in the table below

Table 6-11 Confirmation items during test run

	Item	Result
1	Motor rotation direction	Is it the specified rotation direction?
2	Motor operation 1	Are the acceleration and deceleration smooth?
3	Motor operation 2	Is there any abnormal sound or vibration?
4	Inverter fan operation	Is the fan running?
5	Inverter display and others	Are the display on operation panel and equipment normal?

*When it is confirmed that there is no problem, please increase the set frequency before operation. Similarly, for the operation with increased frequency, the above confirmation items shall also be checked.

(3) Operation preparation

After confirmation of test run and normal operation confirmation of motor, please implement the connection with the mechanical system.

1 Please set the function codes related to machine action.
2 Check the interface matched with peripheral mechanical equipment.

(4) Operation confirmation

Before delivery, various functions of the inverter have been set up as shown in the function code list.
If change of settings of operation command is required, please refer to [5-6 Basic Operation] for implementation.

(5) Operation methods besides commands from operation panel

■Operation by commands from external signals

1 When controlling operation / stop according to external signals, please set the function code F1101 to 2, that is, F1101 = 2.
2 When carrying out frequency setting by external potentiometer, 4 — 20mA, 0 — 10V etc., please set the function code F1002 = 2 — 20.
3 Please refer to [4-6 Connection Diagram of Control Circuit Terminals] for correct use of external signals.

Note 1: If both input signals FR (Forward) and RR (Reverse) are input at the same time, then the inverter will not operate. And if both signals are simultaneously input during operation, then [Output Frequency Lock] will act. If this is done during accelerating or decelerating, the change of output frequency will also be locked. And when the output frequency is locked, the FWD and REV on the operation panel will be lit.

Note 2: If the operation signal is turned off and a signal to drive the motor in the opposite direction from the present direction of rotation is input before the inverter stops, the inverter operates according to the value of F1001 (motor control mode selection).

• F1001 = 1 (V / f control mode) and F1309 = 0

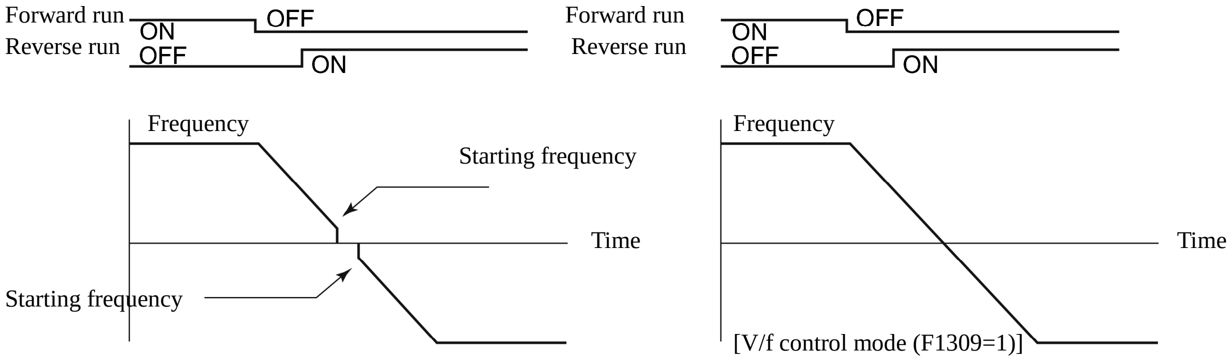
The inverter operates according to the function code settings when starting and stopping. Consequently, the change in output frequency around 0 Hz may not follow a straight line, depending on settings such as the starting frequency. Since DC braking does not work when reversing the direction of rotation, set the DC braking start frequency low.

• F1001 = 1 (V / f control mode) and F1309 = 1

A process of continuous deceleration to acceleration in the opposite direction, which has nothing to do with the relevant function codes for starting and stopping.

F1001 = 2 (Speed sensorless control mode), 3 (speed sensor control mode): Braking excitation or starting excitation is not applied when switching the direction of rotation. This allows “forward and reverse run” in a continuous operation.

Note 3: During torque control, the direction of motor rotation depends on the load side, therefore, both FR (Forward run) and RR (Reverse run) signals are provided with the function of setting ON / OFF of torque control. Because this function has nothing to do with the direction of rotation, please only use one of FR and RR during torque control.



[V/f control mode (F1309=0)]   [V/f control mode (F1309=1)] [Speed sensorless or speed sensor control mode]

Figure 6-2 External operation command action

6-3 Special functions

6-3-1 JOG operation

(1) Short-circuiting the multifunctional terminal JOG with DCM1, 2 forms a JOG operation mode.

(2) For JOG operation, please set the F1101 = 2, and then short-circuit the multifunctional terminal FR or RR with DCM1, 2 after short-circuiting the multifunctional terminal JOG with DCM1, 2. (JOG operating is active only in operation by external signal command.)

(3) Use F1021 to set frequency, and F1020 to set the acceleration / deceleration time.

(4) During operation, the JOG signal will not work even if it is input. The JOG signal must be input at the same time or in advance. Also, during JOG operation, the jog operation will still continue even if the short circuit between JOG and DCM1, 2 is disconnected. (To stop, set the operation signal to OFF.).

(5) In JOG operation mode, the setting of F1102 = 2 (Flying start) becomes inactive, and the setting of F1102 = 1 (Starting frequency) is active. Other actions shall be made according to settings of corresponding function codes.

(6) Once the JOG operation is started, it will continue until the inverter stops. Therefore, during slowdown of JOG operation, if acceleration is started again before the inverter stops, it is still in JOG operation regardless of status of the JOG terminal.

For normal operation after stopping the inverter, please turn the operation command ON (connected) only after the inverter has fully stopped and the JOG terminal is OFF (disconnected).

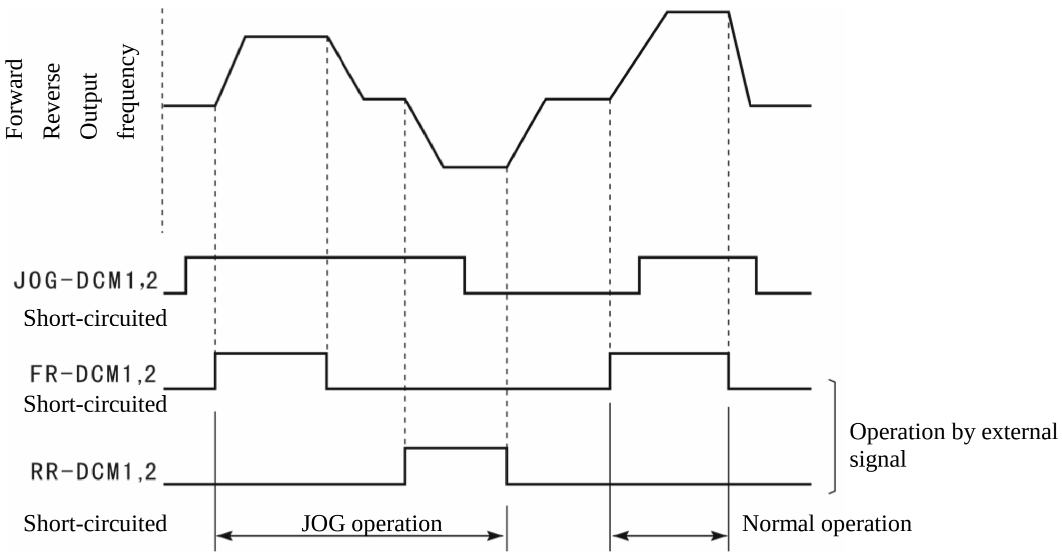


Figure 6-3 JOG action

6-3-2 Hold operation.

(1) To use a push-button switch or other momentary contact to control operation, wire the circuit as shown in Figure 6-1 and set the appropriate function codes (codes related to the multifunctional input terminals and F1101 = 2).

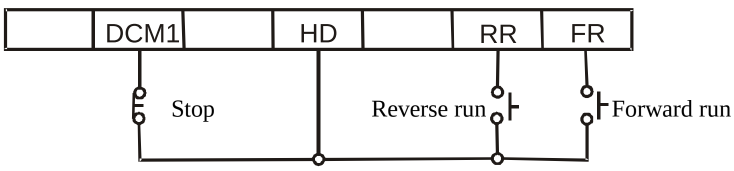


Figure 6-4 Operation signal hold circuit

(2) When the external signal terminals are used to operate and stop the inverter, and you do not want the motor to automatically restart after recovery from a power failure, use the above circuit and set F1108=0.

(3) When operating with the hold function, the inverter does not restart after recovery from the following conditions.

① Recovery from free run stop with MBS multifunctional input terminal

② Recovery from alarm stop with the auto alarm recovery function

③ Recovery from a momentary power failure by the “restart after momentary power failure” function

6-3-3 Notes on free run stop terminal (MBS)

The free run stop terminal is provided for systems in which mechanical braking is used to stop the motor. When setting the motor to the free run status using this terminal, be sure to turn OFF any operation signal.

If the free run stop signal is released with an operation signal on, the inverter restarts according to normal operating procedure and the function code settings. Therefore, depending on the free run speed of the motor, an unexpected over current or overvoltage may occur and result in an alarm stop.

For example: if flying start is not set as the starting method and the free run stop signal is released when the motor is still slowly rotating, the inverter will restart from the starting frequency or after DC braking depending on the starting method.

6-4 Definition of Technical Terms

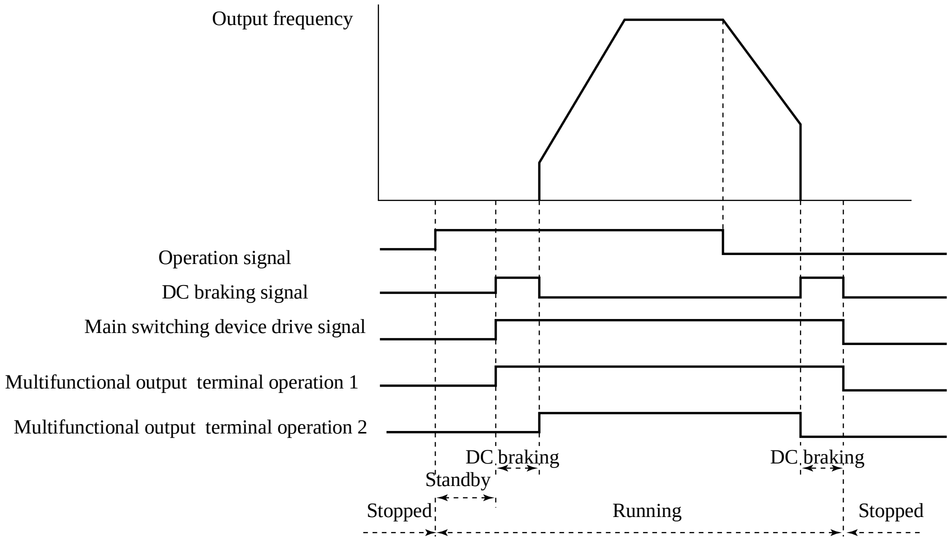


Figure 6-5 Operation action

Table 6-12 Explanation of Terms

Term	Definition
Operation	General term describing both “forward run” and “reverse run” implying that the inverter is in operation.
Operation signal	Signal requesting inverter operation, which is input by pressing the Drive (drive) key on the operation panel or using signals input through multifunctional control input terminals FR and RR.
In operation (operating)	Condition where the operation signal is being input or a drive signal is being output to the main switching device. In the stop status, the operation signal is OFF, but the main switching device operates until DC braking, etc. is completed.
In constant speed (operation)	Condition when the inverter is in operation at the frequency setting value.
Stopped	Condition where the operation signal is not being input and the drive signal is not being output to the main switching device. Even when the operation signal input is on, the input to the multifunctional control input terminal MBS disables the drive signal output to the main switching device.
Standby	Condition where the operation signal is being input but there is no output for some reason, for example, while waiting for the start delay time to expire or when the set frequency is lower than the operation start frequency.
DC braking	Condition where DC braking is applied when starting and stopping.
Frequency setting value or set frequency	Frequency set on F2101-F2116 and F1021. Frequency value corresponding to an external signal when setting F1002=2-21 and 25-28 with external signals for frequency setting.
Output frequency or frequency output value	Actual inverter output frequency. ・ V/f mode When the load is stable, the output frequency normally coincides with the frequency setting value. ・ When used in vector control mode or for slip compensation in V/f mode, even if the load is stable, the output frequency does not coincide with the frequency setting value but keeps changing.
Command frequency	Frequency value used by the inverter. As a command value frequency, its change in frequency setting value not only depends on the results of controls such as the acceleration/deceleration function and the current limiting function but also the actual output frequency. The command frequency normally coincides with the set frequency at the end of acceleration/deceleration. ・ V/f mode: If there is feedback operation such as PID control mode, the command frequency equals the output frequency. ・ When used in vector control mode or for slip compensation in V/f mode, the command frequency and the output frequency may not match in this mode because the synchronous speed specified by the number of motor poles and the command frequency is used as the speed command.

7. Function Code

7-1 Representation and Description of Function Codes

By changing the function code, the inverter action can be changed.
Function codes are functionally classified into "function blocks." To change the function code, first select the function block, and then select the serial number of the function code to be changed.
A function code can be set through operation panel (see sections 5-4 and 5-5), or communication (see section 7-4).

Function	Function Block	Function Block Name
Basic operation functions	F10XX	Basic functions
	F11XX	Starting • braking function
	F12XX	LED display function
	F13XX	Auxiliary functions
Input/output-related function	F14XX	Input function
	F15XX	Output function
System-related functions	F16XX	System functions
	F17XX	Protection function
	F18XX	Information function
Special functions	F19XX	Energy-saving function
	F20XX	V/f characteristics
Scheduled operation function	F21XX	Multi-speed function
	F22XX	Scheduled operation function
LCD display function	F23XX	LCD display function
PID function	F30XX	Basic PID1 functions
	F31XX	Basic PID2 functions
	F32XX	Combined function of PID1 and PID2
	F33XX	PID control parameter reading
Communication function	F40XX	Serial communication function
	F41XX	MODBUS communication function
Motor Parameters	F5XXX	Motor Parameters
Vector control	F60XX	Vector control function
Torque control	F61XX	Torque control function
Extended functions	F81XX	PG function
	F89XX	Other functions (for factory-adjustment)

7-2 Function Code List

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
Basic operation functions					
1001	Motor control mode selection	1: V/f control mode 2: Speed control (speed sensorless vector control) 3: Speed control (speed sensor vector control) 4: Torque control (speed sensorless vector control) 5: Torque control (speed sensor vector control) 6: Position control (speed sensor vector control) 10: Auto tuning mode 1 11: Auto tuning mode 2 40: V ・ f separation control	1	1	
1002	1st speed frequency setting selection	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 11: External analog VIF1 voltage +VIF2 voltage 12: External analog VIF1 voltage +VIF3 voltage 13: External analog VIF2 voltage +VIF3 voltage 14: External analog VIF1 voltage -VIF2 voltage 15: External analog VIF2 voltage –VIF1 voltage 16: External analog VIF1 voltage-VIF3 voltage 17: External analog VIF3 voltage –VIF1 voltage 18: External analog VIF1 voltage +VIF2 current 19: External analog VIF1 voltage -VIF2 current 20: External analog VIF1 current -VIF2 voltage 21: Terminal block stepping 22: Communication 25: Pulse train input 26: External analog VIF1 forward / reverse run operation (0 — 10V, 5V reference) 27: External analog VIF2 forward / reverse run operation (0 — 10V, 5V reference) 28: External analog VIF3 forward / reverse run operation (0 — 10V, 5V reference)	1	1	
1003	V/f pattern selection	1: Linear pattern 2: Square-law decreasing pattern (weak) 3: Square-law decreasing pattern (strong)	1	1	
1004	Torque boost	0-20%（maximum voltage ratio）	0.1%	□1	
1005	Base voltage	200V series: 0: No AVR 50-240V 400V series: 0: No AVR 50-460V	1V	□1	
1006	Base frequency	0.1-600Hz	0.01Hz	□1	

The setting values can not be changed during operation.

※ **1: The representative parameters that are suitable for various models have been input.**

Chapter 7

7-2 Function Code List - Basic Operation Functions

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1007	Upper frequency limit	5-600Hz	0.01Hz	60	
1008	Lower frequency limit	0.05-200Hz	0.01Hz	0.05	
1009	Carrier frequency adjustment	0-130	1	□1	
1010	Acceleration/deceleration curve	1: Linear 2: S-shaped 3: Reduction of acceleration/deceleration	1	1	
1011	Reference frequency for acceleration/deceleration	1-120Hz	0.01Hz	□1	
1012	1st acceleration time	0-6,500 sec.	0.1 s	□2—1	
1013	2nd acceleration time	0-6,500 sec.	0.1 s	□2—2	
1014	3rd acceleration time	0-6,500 sec.	0.1 s	□2—3	
1015	4th acceleration time	0-6,500 sec.	0.1 s	□2—4	
1016	1st deceleration time	0-6,500 sec.	0.1 s	□2—5	
1017	2nd deceleration time	0-6,500 sec.	0.1 s	□2—6	
1018	3rd deceleration time	0-6,500 sec.	0.1 s	□2—7	
1019	4th deceleration time	0-6,500 sec.	0.1 s	□2—8	
1020	JOG acceleration/deceleration time	0-20 sec.	0.1 s	0.1	
1021	JOG frequency	0-60Hz	0.01Hz	5	
1022	1st Start of S-shaped acceleration	0-200%	1%	50	
1023	1st End of S-shaped acceleration	0-200%	1%	50	
1024	Gradient of middle of 1st S-shaped Acceleration	0-100%	1%	0	
1025	1st Start of S-shaped deceleration	0-200%	1%	50	
1026	1st End of S-shaped deceleration	0-200%	1%	50	
1027	Gradient of middle of 1st S-shaped Deceleration	0-100%	1%	0	
1028	2nd Start of S-shaped acceleration	0-200%	1%	50	
1029	2nd End of S-shaped acceleration	0-200%	1%	50	
1030	2nd S-shaped Acceleration Middle Gradient Gradient of middle of 2nd t S-shaped Acceleration	0-100%	1%	0	
1031	2nd Start of S-shaped deceleration	0-200%	1%	50	
1032	2nd End of S-shaped deceleration	0-200%	1%	50	
1033	Gradient of middle of 2nd S-shaped Deceleration	0-100%	1%	0	
1034 1035 1036	1st speed frequency selection A 1st speed frequency selection B 1st speed frequency selection C	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 21: Terminal block stepping 22: Communication 25:Pulse train input 26:External analog VIF1 forward / reverse run operation (0 — 10V, 5V reference) 27:External analog VIF2 forward / reverse run operation (0 — 10V, 5V reference) 28:External analog VIF3 forward / reverse run operation (0 — 10V, 5V reference)	1	1 1 1 1	
1101	Operation command selection	1: Operation panel 2: External terminal 3: Communication	1	1	
1102	Starting method	1: Starting frequency 2: Flying start 3: Starting frequency after DC braking	1	1	
1103	Starting frequency	0.05-60Hz	0.01Hz	1	
1104	Operation start frequency	0-20Hz	0.01Hz	0	
1105	Start delay time	0-5 sec.	0.1 s	0	
1106	Start standby time	0-120 sec.	0.1 s	0	
1107	Start standby frequency	0.05-60Hz	0.01Hz	5	
1108	Restart after momentary power failure	0: Do not restart 1: Restart 2: Compensation for momentary power failure	1	0	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1109	Direction of rotation of motor	1: Forward and reverse run 2: Forward run only 3: Reverse run only	1	1	
1110	Direction of rotation of motor	1: Forward run 2: Reverse run	1	1	
1111	Braking method	1: Deceleration to stop 2: Deceleration to stop + DC braking 3: Free run stop	1	1	
1112	DC braking start frequency	0.05-20Hz	0.01Hz	0.5	
1113	DC braking time	0.1 -10 sec.	0.1 s	2	
1114	DC braking force	1-10	1	5	
1115	Duty cycle of brake resistor	0: No brake resistor 2-25%ED 98: No discharge resistor protection (with discharge) 99: External brake unit	1%ED	□1	
1116	Discharge resistor on signal output time	0.01 -10.00 sec.	0.01 s	0.1	
1201	Monitor display selection	1: Frequency [Hz] 2: Output current (A) 3: Speed of rotation [rpm] 4: Load factor [%] 5: No unit display	1	1	
1202	State display selection	1: No units (multiple of F1203) 2: Output voltage [V] 3: DC voltage [V] 4: Active power [kW] 5: Apparent power [kVA] 6: Radiator temperature [□] 7: Command speed [rpm] 8: PID1 feedback value [Hz] 9: PID2 feedback value [Hz] 10: VIF1 analog input value [Hz] 11: VIF2 analog input value [Hz] 12: VIF3 analog input value [Hz] 13: Output torque [%] 14: Partial excitation current [A] 15: Partial torque current [A] 16: Detecting position [mm] 29: Command frequency [Hz] 30: Command torque [%]	1	1	
1203	Multiple for no-units display	0-100 (multiple of the output frequency)	0.01	1	
1301	1st jump bottom frequency	0-600 [Hz]	0.01 [Hz]	0	
1302	1st jump top frequency	0-600 [Hz]	0.01 [Hz]	0	
1303	2nd jump bottom frequency	0-600 [Hz]	0.01 [Hz]	0	
1304	2nd jump top frequency	0-600 [Hz]	0.01 [Hz]	0	
1305	3rd jump bottom frequency	0-600 [Hz]	0.01 [Hz]	0	
1306	3rd jump top frequency	0-600 [Hz]	0.01 [Hz]	0	
1307	Auto alarm recovery	0: No auto reset function 1: Auto reset function	1	0	
1308	Instability elimination	0-20	1	0	
1309	Operation direction switching in V / f control mode	0: Start from the direction opposite to current direction after a stop 1: Continuous operation	1	0	
1315	Shortest operation time function	0 -99.99 sec.	0.01 s	0	
1316	2nd Upper frequency limit	5-600 [Hz]	0.01 [Hz]	60	
1317	3rd Upper frequency limit	5-600 [Hz]	0.01 [Hz]	60	
1318	Cooling fan ON/OFF control	0: ON/OFF control 1: Normally ON	1	0	
1319	Functions corresponding to high altitude areas	1: 1,000m or below 2: 1,000m-1,500m or below 3: 1,500m-2,000m or below 4: 2,000m-2,500m or below 5:2,500m-3,000m	1	1	
1320	Rating selection	1: Mode A (heavy load mode) 150% 1 minute 2: Mode B (light load mode) 120% 1 minute	1	1	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
Input/output-related function					
1401	Bias frequency (VIF1)	0-±600 [Hz] (frequency at 0V or 4mA)	0.1 [Hz]	0	
1402	Gain frequency (VIF1)	0-±600 [Hz] (frequency at 5V or 10V or 20mA)	0.1 [Hz]	60	
1403	Bias frequency (VIF2)	0-±600 [Hz] (frequency at 0V or 4mA)	0.1 [Hz]	0	
1404	Gain frequency (VIF2)	0-±600 [Hz] (frequency at 5V or 10V or 20mA)	0.1 [Hz]	60	
1405	Bias frequency (VIF3)	0-±600 [Hz] (frequency at 0V or 4mA)	0.1 [Hz]	0	
1406	Gain frequency (VIF3)	0-±600 [Hz] (frequency at 5V or 10V or 20mA)	0.1 [Hz]	60	
1407	External analog input filter time constant (VIF1)	1-500（set value 1=10ms）.	1	10	
1408	External analog input filter time constant (VIF2)	1-500（set value 1=10ms）.	1	10	
1409	External analog input filter time constant (VIF3)	1-500（set value 1=10ms）.	1	10	
1410	Set frequency gain	0-100	1	0	
1411	Analog input switching for set frequency gain	0: No analog input 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10 V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10 V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA)	1	0	
1412	MBS terminal input mode	1: Level triggered 2: Edge triggered	1	1	
1413	ES input terminal function	1: NO external thermistor signal 2: NC external thermistor signal	1	1	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1414 1415 1416 1417 1418 1419 1420 1421	Selection of input terminal DI1 Selection of input terminal DI2 Selection of input terminal DI3 Selection of input terminal DI4 Selection of input terminal DI5 Selection of input terminal DI6 Selection of input terminal DI7 Selection of input terminal DI8	0: Unused 2:RR， 4:3DF 6:ES， 8:AD2， 10:JOG， 12:9DF， 14:RR+JOG， 16:RR+AD2， 18:RR+AD3， 20:RR+2DF， 22:RR+3DF， 24:RR+2DF+3DF， 26:RR+AD2+2DF， 28:RR+AD2+3DF， 29:FR+AD2+2DF+3DF， 30:RR+AD2+2DF+3DF， 31:FR+AD3+2DF， 33:FR+AD3+3DF， 35:FR+AD3+2DF+3DF， 36:RR+AD3+2DF+3DF， 37:PTR， 40:HD， 46:CCL， 57:P0， 59:FR+RCCL， 65:RR+MBS， 68:2DF+AD3， 70:3DF+AD3， 71:A×10（Optional）， 72:A×100（Optional）， 75:3MAX， 77:PIDLCK， 84:S2， 86:PIDH， 88:PID1EX， 91:IHOLD， 109:RCCL， 115:1DFB， 117:ROPE， 119:ROPE+RCOM, 121:1DFB+RCOM, 122:1DFA+1DFB+ROPE+RCOM， 253-255:For factory adjustment 1:FR， 3:2DF， 5:MBS， 7:RST， 9:AD3 11:5DF， 13:FR+JOG， 15:FR+AD2， 17:FR+AD3， 19:FR+2DF， 21:FR+3DF， 23:FR+2DF+3DF， 25:FR+AD2+2DF， 27:FR+AD2+3DF， 32:RR+AD3+2DF， 34:RR+AD3+3DF， 39:FR+5DF， 45:CP（Optional）， 47:PC， 58:FR+CCL， 64:FR+MBS， 67:2DF+AD2， 69:3DF+AD2， 74:2MAX， 76:VFPID， 83:For factory adjustment 85:PIDL， 87:RPID1， 89:PID2EX， 92:ICLEAR 114:1DFA， 116:1DFA+1DFB， 118:RCOM, 120:1DFA+ROPE,		1 2 3 4 5 6 7 8	
1422	Reference frequency for pulse input	1000-60000 Hz	1 Hz	1000	
1423	Effective number of bits for VIF1 detection	8-12bit	1bit	12	
1424	Effective number of bits for VIF2 detection	8-12bit	1bit	12	
1425	Effective number of bits for VIF3 detection	8-12bit	1bit	12	

7-2 Function Code List – Input/Output-Related Functions

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1501	Internal analog output function 1	0: No function 1: Set frequency (Hz) 2: Output frequency [Hz] 3: PID1 feedback value [Hz] 4: PID2 feedback value [Hz] 5: Output current (A) 6: Output voltage [V] 7: DC voltage [V] 8: Radiator temperature [□] 9: Load factor [%] (electric thermistor integrated value) 10: Load factor [%] (ratio to rated current) 11: VIF1 analog input value [V] 12: VIF2 analog input value [V] 13: VIF3 analog input value [V] 14: Speed [rpm] 15: Active power [kW] 16: Apparent power [kVA] 17: PID1 command value [Hz] 18: PID1 input deviation value [Hz] 19: PID2 command value [Hz] 20: PID2 input deviation value [Hz] 21: For factory adjustment 22: For factory adjustment 23: For factory adjustment 24: External PID1 output value [Hz] 25: External PID2 output value [Hz] 26: For factory adjustment 35: Command frequency (Hz) 36: Command torque [%] 99: For factory adjustment	1	0	
1502	Internal analog output coefficient 1	0-20	0.01	1	
1503	Internal analog output bias 1	0-±10.0V	0.1V	0	
1504	Internal analog output function 2	0: No function 1: Set frequency (Hz) 2: Output frequency [Hz] 3: PID1 feedback value [Hz] 4: PID2 feedback value [Hz] 5: Output current (A) 6: Output voltage [V] 7: DC voltage [V] 8: Radiator temperature [□] 9: Load factor [%] (accumulated value of the electric thermistor) 10: Load factor [%] (ratio to rated current) 11: VIF1 analog input value [V] 12: VIF2 analog input value [V] 13: VIF3 analog input value [V] 14: Speed [rpm] 15: Active power [kW] 16: Apparent power [kVA] 17: PID1 command value [Hz] 18: PID1 input deviation value [Hz] 19: PID2 command value [Hz] 20: PID2 input deviation value [Hz] 21: For factory adjustment 22: For factory adjustment 23: For factory adjustment 24: External PID1 output deviation value [Hz] 25: External PID2 output value [Hz] 26: For factory adjustment 35: Command frequency (Hz) 36: Command torque [%] 99: For factory adjustment	1	0	
1505	Internal analog output coefficient 2	0-20	0.01	1	
1506	Internal analog output bias 2	0-±10.0V	0.1V	0	
1507	Approach frequency	0-600Hz	0.01Hz	10	
1508	Frequency matching range	0-10Hz	0.01Hz	0	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1509 1510 1511	Selection of output terminal DO1 Selection of output terminal DO2 Selection of output terminal DO3	0: Unused 1: In operation 1 2: Undervoltage, 3: End of simple scheduled operation 4: In operation 2, 5: Frequency matching (1st speed frequency) 6: Frequency matching (1st to 16th speed frequencies) 7: Frequency approach 8: Overload alarm level setting signal (the value of F1704) 9: Electric thermistor pre-alarm signal (80% of electric thermistor) 10: Radiator overheat pre-alarm signal， 13: Excitation and DC braking signals 14: Lower frequency limit matching signal， 15: Upper frequency limit matching signal， 16: Servo on ready signal (option), 17: Zero servo completion signal (option), 18: FR signal, 19: RR signal, 20: 2DF signal, 21: 3DF signal, 22: 5DF signal, 23: 9DF signal, 24: AD2 signal, 25: AD3 signal, 26: JOG signal, 27: MBS signal, 28: ES signal, 29: RST signal, 31: Positioning completion signal (option) , 32: Discharge resistor on signal, 34: Frequency counter (output frequency), 35: Frequency counter (command frequency), 36: Overload alarm level setting signal (Including when in acceleration/deceleration), 42: Torque matching signal， 43: Low speed detection signal 47: Motor speed counter 48: Forward run detection signal 49: Reverse run detection signal		1 5 8	
1512	Counter output multiple	1-100	1	1	
1513	Relay 1 contact output selection	0: Alarm contact 1: In operation 1, 2: Undervoltage, 3: End of simple scheduled operation 4: In operation 2, 5: Frequency matching (1st speed frequency) 6: Frequency matching (1st to 16th speed frequencies) 7: Frequency approach 8: Overload alarm level setting signal (the value of F1704) 9: Electric thermistor pre-alarm signal (80% of electric thermistor) 10: Radiator overheat pre-alarm signal， 13: Excitation and DC braking signals 14: Lower frequency limit matching signal， 15: Upper frequency limit matching signal， 16: Servo on ready signal 17: Zero servo completion signal, 18: FR signal, 19: RR signal, 20: 2DF signal, 21: 3DF signal, 22: 5DF signal, 23: 9DF signal, 24: AD2 signal, 25: AD3 signal, 26: JOG signal, 27: MBS signal, 28: ES signal, 29: RST signal, 31: Positioning completion signal, 32: Discharge resistor on signal, 36: Overload alarm level setting signal (Including when in acceleration/deceleration), 42: Torque matching signal， 43: Low speed detection signal 48: Forward run detection signal 49: Reverse run detection signal	1	0	
1514	Relay 2 contact output selection	Reserved			
1515	Current output multiple	0-20	0.01	0	
1516	Torque matching level	0-±200%	0.1 %	100	
1517	Torque matching range	0-50%	0.1 %	25	
1518	Low speed matching level	0-2,000rpm	1rpm	100	
1519	Low speed matching range	0-100rpm	1rpm	10	

Chapter 7

Code No.	Function Name	Data Content		Setting Resolution	Factory Presets	User Setting Value
System-related functions						
1601	Copy function	0: No function 1: Transfer the current code data to the operation panel 2: Transfer the contents stored by operation panel to the inverter (Excluding motor parameters measured) 3: Transfer the contents stored by operation panel to the inverter (Including motor parameters measured)		1	0	
1602	Changed code display function	0: No function 1: Display differences from factory preset 2: Display differences from user's initial value		1	0	
1603	Function lock	0: Code data changeable (No lock function) 1: Code data unchangeable (except F1603) 2: Code data (except frequency setting-related) unchangeable (except F1603, F1021, F2101 — F2116) 3: Code data unchangeable (except F1603 and function codes using communication)		1	0	
1604	Data initialization	0: No function 1: Initialize factory presets 2: Invalid parameter by auto tuning 3: Initialize user's data 99: Set user's initial value		1	0	
1605	Quick knob long-pressing cancel selection	0: Long-pressing cancel disabled 1: Long-pressing cancel enabled		1	0	
1606	Function code setting key selection	1: "Set" key only 2: "Quick knob" only 3: Both quick knob and Set key		1	1	
1607	Target frequency setting time-out	0: Timeout disabled 1 — 60: Timeout (sec.)		1	5	
1701	Output current limiting function	Mode A	0: No function 50-200%	1%	150	
		Mode B	0: No function 50-150%		120	
1702	Electric thermal setting	0: No function 20-105%		1%	100	
1703	Output current limiting at constant speed	0: No function 1: Yes, V/F mode, (Currently selected acceleration/deceleration time) 2: Yes, V/F mode, (1st acceleration/deceleration time) 3: Yes, V/F mode, (2nd acceleration/deceleration time) 4: Yes, V/F mode, (3rd acceleration/deceleration time) 5: Yes, V/F mode, (4th acceleration/deceleration time) 6: Yes, V/f mode and speed vector control mode (1st acceleration/deceleration time) 7: Yes, V/f mode and speed vector control mode (2nd acceleration/deceleration time) 8: Yes, V/f mode and speed vector control mode (3rd acceleration/deceleration time) 9: Yes, V/f mode and speed vector control mode (4th acceleration/deceleration time)		1	0	
1704	Overload alarm level setting value	Mode A	20-200%	1%	150	
		Mode B	20-150%		120	
1705	Motor type	1: General-purpose motor 2: Exclusive motor for the inverter		1	1	
1706	Function to switch between "OV" and "LV" alarms when stopped	0: "OV" enabled, "LV" disabled when stopped 1: "OV" disabled, "LV" enabled when stopped 2: "OV" disabled, "LV" disabled when stopped 3: "OV" enabled, "LV" enabled when stopped		1	0	
1707	Missing Phase detection function	0: No input phase loss, no output phase loss 1: Input phase loss, no output phase loss 2: No input phase loss, output phase loss 3: Input phase loss, output phase loss		1	3	
1708	Overvoltage stalling prevention function	0: No overvoltage stalling prevention function. 1: Overvoltage stalling prevention function.		1	1	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
1709	Feedback signal disconnection detection time	0: Only warning 0.01 -119.99 sec. 120: No detection	0.01 s	5	
1710	Carrier frequency variable by lowering temperature (Active when only mode A is selected)	0: Disabled 1: Enabled	1	0	
1801	Inverter host software version query	Read only		Version	
1802	Memory Version query	Read only		Version	
1803	Operation panel software version query	Read only		Version	
1804	Operation time display	Read only	1 hour	---	
1805	Reading alarm data	0: No function 1: Read start 9: Record erase	1	0	
1806	Alarm status confirmation 1	Read only	1	---	
1807	Alarm status confirmation 2	Read only	1	---	
1808	Alarm status confirmation 3	Read only	1	---	
1809	Alarm status confirmation 4	Read only	1	---	
1810	Alarm status confirmation 5	Read only	1	---	
Special functions					
1901	Energy-saving mode selection	0: No function 1: Simple energy-saving mode (V/f mode) 2: Auto energy-saving mode	1	0	
1902	Simple energy saving rate	0-50%	1%	0	
1903	Simple energy saving time	0 -65,000 sec.	1 s	10	
2001	V•f separation function selection	1: V · f proportional separation 2: Complete separation	1	1	
2002	V•f separation command voltage	0: Disabled (command is given by VIF1) 0.01-10.00V	0.01V	0	
2003	Arbitrary V/f pattern intermediate voltage 1	0-460V	1V	0	
2004	Arbitrary V/f pattern intermediate voltage 2	0-460V	1V	0	
2005	Arbitrary V/f pattern intermediate frequency 1	0.05-600Hz	0.01Hz	20	
2006	Arbitrary V/f pattern intermediate frequency 2	0.05-600Hz	0.01Hz	40	
2007	Automatic torque boost selection	0: No automatic torque boost 1: Voltage compensation function 2: Slip frequency compensation	1	0	
2008	Slip compensation response time constant	0-1000（set value 1=10ms）.	1	10	
2009	Slip compensation multiple	0.01-2	0.01	1	
Graph operation function					
2101	1st speed frequency	0-600Hz	0.01Hz	0	
2102	2nd speed frequency	0-600Hz	0.01Hz	10	
2103	3rd speed frequency	0-600Hz	0.01Hz	20	
2104	4th speed frequency	0-600Hz	0.01Hz	30	
2105	5th speed frequency	0-600Hz	0.01Hz	40	
2106	6th speed frequency	0-600Hz	0.01Hz	50	
2107	7th speed frequency	0-600Hz	0.01Hz	60	
2108	8th speed frequency	0-600Hz	0.01Hz	0	
2109	9th speed frequency	0-600Hz	0.01Hz	0	
2110	10th speed frequency	0-600Hz	0.01Hz	5	
2111	11th speed frequency	0-600Hz	0.01Hz	15	
2112	12th speed frequency	0-600Hz	0.01Hz	25	
2113	13th speed frequency	0-600Hz	0.01Hz	35	
2114	14th speed frequency	0-600Hz	0.01Hz	45	
2115	15th speed frequency	0-600Hz	0.01Hz	55	
2116	16th speed frequency	0-600Hz	0.01Hz	0	
2201	Selection of Scheduled operation	0: Normal operation 1: Simple scheduled operation 2: Disturbed operation	1	0	
2202	Simple scheduled operation repetitions	0: Continuous 1-250: Repetition count	1	1	
2203	Operation timer T1	0 -65,000 sec.	1 s	10	
2204	Operation timer T2	0 -65,000 sec.	1 s	10	
2205	Operation timer T3	0 -65,000 sec.	1 s	10	

7-2 Function Code List – Graph Operation Functions / Display Function

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
2206	Operation timer T4	0 -65,000 sec.	1 s	10	
2207	Operation timer T5	0 -65,000 sec.	1 s	10	
2208	Operation timer T6	0 -65,000 sec.	1 s	10	
2209	Operation timer T7	0 -65,000 sec.	1 s	10	
2210	Operation timer T8	0 -65,000 sec.	1 s	10	
2211	Operation timer T9	0 -65,000 sec.	1 s	10	
2212	Operation timer T10	0 -65,000 sec.	1 s	10	
2213	Operation timer T11	0 -65,000 sec.	1 s	10	
2214	Operation timer T12	0 -65,000 sec.	1 s	10	
2215	Operation timer T13	0 -65,000 sec.	1 s	10	
2216	Operation timer T14	0 -65,000 sec.	1 s	10	
2217	Operation timer T15	0 -65,000 sec.	1 s	10	
2218	Operation stop time T0	0 -65,000 sec.	1 s	10	
2219	Midway stop deceleration time	1: 1st deceleration time (value of F1016) 2: 2nd deceleration time (value of F1017) 3: 3rd deceleration time (value of F1018) 4: 4th deceleration time (value of F1019)	1	1	
2220	Midway start acceleration time	1: 1st acceleration time (value of F1012) 2: 2nd acceleration time (value of F1013) 3: 3rd acceleration time (value of F1014) 4: 4th acceleration time (value of F1015)	1	1	
2221	Forward/reverse and acceleration/deceleration in T1	X Y X 1: Forward run 2: Reverse run Y 1 - 4: Acceleration/deceleration time specified	---	11	
2222	Forward/reverse and acceleration/deceleration in T2		---	11	
2223	Forward/reverse and acceleration/deceleration in T3		---	11	
2224	Forward/reverse and acceleration/deceleration in T4		---	11	
2225	Forward/reverse and acceleration/deceleration in T5		---	21	
2226	Forward/reverse and acceleration/deceleration in T6		---	21	
2227	Forward/reverse and acceleration/deceleration in T7		---	21	
2228	Forward/reverse and acceleration/deceleration in T8		---	11	
2229	Forward/reverse and acceleration/deceleration in T9		---	11	
2230	Forward/reverse and acceleration/deceleration in T10		---	11	
2231	Forward/reverse and acceleration/deceleration in T11		---	11	
2232	Forward/reverse and acceleration/deceleration in T12		---	21	
2233	Forward/reverse and acceleration/deceleration in T13		---	21	
2234	Forward/reverse and acceleration/deceleration in T14		---	21	
2235	Forward/reverse and acceleration/deceleration in T15		---	21	
2236	Disturb modulation analog input switching	0: No analog input 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA)	1	0	
2237	Disturb modulation rate	0-50%	1%	0	
Display Function					
2301	LCD contrast adjustment	1-63	1	48	
2302	Language selection of LCD	0: Startup options (English display) 1: English 2: Chinese 3: Japanese	1	0	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
2303 2304 2305	LCD’s 1st display parameter setting LCD’s 2nd display parameter setting LCD’s 3rd display parameter setting	0: No display 1: Frequency (Hz) 2: Output current (A) 3: Speed [rpm] 4: Load factor [%] 5: Output voltage [V] 6: DC voltage [V] 7: Active power [kW] 8: Apparent power [kVA] 9: Radiator temperature [□] 10: Command speed [rpm] 11: PID1 feedback value [Hz] 12: PID2 feedback value [Hz] 13: VIF1 analog input value 14: VIF2 analog input value 15: VIF3 analog input value 16: Output torque [%] 17: Partial excitation current [A] 18: Partial torque current [A] 19: Detecting position [mm] 32: Command frequency (Hz) 33: Command torque [%]	1	1 2 4	
2306	LCD backlight out time	0: Off 1— 600 minutes: the time until it goes off 999: Normally on	1 minute	10	
PID function					
3001	PID1 command value input switching	1: Frequency 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 11: Function code setting (F3017) 99: Pulse train input	1	1	
3002	PID1 feedback input switching	0: No input 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA) 10: Communication mode 99: PG feedback PID	1	0	
3003	PID1 control proportional gain	0-100	0.01	0.1	
3004	PID1 control integral time	0.01 -100 sec.	0.01 s	0.1	
3005	PID1 control differential time	0 -100 sec.	0.01 s	0	
3006	PID1 control integral separation judgment value	5 — 100% (upper frequency limit reference)	0.1%	20	
3007	PID1 feedback signal input filter time constant	1-500（set value 1=10ms）.	1	10	
3008	Indirect PID1 input reference	5 — 100% (target value reference)	0.1%	20	
3009	PID1 deviation limit value	0: No limit 1 — 100% (upper frequency limit reference)	0.1%	100	
3010	PID1 output limit value	0: No limit 1 — 100% (upper frequency limit reference)	0.1%	100	
3011	PID1 operation polarity switching	1: Command value – feedback value 2: Feedback value – command value	1	1	
3012	PID1 gain polarity switching	1: The positive or negative deviation indicates the same gain 2: The positive or negative deviation indicates different gains	1	1	
3013	PID1 command value gain	0-50	0.01	1	

7-2 Function Code List – PID Function

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
3014	PID1 feedback value gain	0-50	0.01	1	
3015	PID1 control proportional gain (negative: F3012=2)	0-100	0.01	0.1	
3016	PID1 control integral time (negative: F3012=2)	0.01 -100 sec.	0.01 s	0.1	
3017	PID1 control command value	0-6,000	0.1	0	
3018	PID1 control feedback value (communication function)	0-6,000	0.1	0	
3019	Frequency corresponding to PID1 control maximum command value	0-600Hz	0.01Hz	60	
3101	PID2 command value input switching	1: Frequency 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 11: Function code setting (F3117) 99 :Pulse train input	1	0	
3102	PID2 feedback input switching	0: No input 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA) 10: Communication mode 99: PG feedback PID	1	0	
3103	PID2 control proportional gain	0-100	0.01	0.1	
3104	PID2 control integral time	0.01 -100 sec.	0.01 s	0.1	
3105	PID2 control differential time	0 -100 sec.	0.01 s	0	
3106	PID2 control integral separation judgment value	5 — 100% (upper frequency limit reference)	0.1%	20	
3107	PID2 feedback signal input filter time constant	1-500（set value 1=10ms）.	1	10	
3108	Indirect PID2 input reference	5 — 100% (target value reference)	0.1%	20	
3109	PID2 deviation limit value	0: No limit 1 — 100% (upper frequency limit reference)	0.1%	100	
3110	PID2 output limit value	0: No limit 1 — 100% (upper frequency limit reference)	0.1%	100	
3111	PID2 operation polarity switching	1: Command value – feedback value 2: Feedback value – command value	1	1	
3112	PID2 gain polarity switching	1: The plus or minus deviation indicates the same gain 2: The plus or minus deviation indicates different gains	1	1	
3113	PID2 command value gain	0-50	0.01	1	
3114	PID2 feedback value gain	0-50	0.01	1	
3115	PID2 control proportional gain (negative: F3012=2)	0-100	0.01	0.1	
3116	PID2 control integral time (negative: F3012=2)	0.01 -100 sec.	0.01 s	0.1	
3117	PID2 control command value	0-6,000	0.1	0	
3118	PID2 control feedback value (communication function)	0-6,000	0.1	0	
3119	Frequency corresponding to PID2 control maximum command value	0-600Hz	0.01Hz	60	
3123	PID start mode selection	1: Direct input mode 2: Condition input mode	1	1	
3124	PID end mode selection	1: Direct end mode 2: Condition end mode	1	2	
3125	PID end setting value	1 — 100% (upper frequency limit standard)	0.1%	20	
3127	For factory adjustment				
3201	PID control action selection	0: Open loop control 1: PID1 control 2: PID2 control 3: For factory adjustment 4: External terminal switching PID control 5: Timing switch PID control	1	0	
3202	For factory adjustment				

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
3203	External PID control selection	0: No external PID control 1: External control PID1 2: External control PID2 3: For factory adjustment 4: external controls PID1 and PID2 5: For factory adjustment 6: For factory adjustment	1	0	
3204	External PID operation mode selection	1: Operation interlocked with inverter operation 2: PID output after power input 3: PID output controlled by external terminals	1	1	
3205	PID constitution selection	0: Without command value addition calculation 1: With command value addition calculation	1	0	
3206	Command value addition calculation PID control gain	0.01-100	0.01	1	
3207	PID1/PID2 switching time	0.1 -6,000 minutes	0.1 minute	0.1	
3301	Reading PID1 command value	Read only	1	---	
3302	Reading PID1 feedback value	Read only	1	---	
3303	Reading PID1 input deviation	Read only	1	---	
3304	Reading PID1 output value	Read only	1	---	
3305	Reading PID2 command value	Read only	1	---	
3306	Reading PID2 feedback value	Read only	1	---	
3307	Reading PID2 input deviation	Read only	1	---	
3308	Reading PID2 output value	Read only	1	---	
3309	For factory adjustment				
3310	For factory adjustment				
3311	For factory adjustment				
3312	For factory adjustment				
Communication function					
4001	Message checksum	0: No 1: Yes	1	1	
4003	Pull-up/down function	0: No 1: Yes	1	0	
4004	Communication response time	10-6000ms	1ms	10	
4005	Serial communication function	0:No function 1: Dedicated protocol communication function 2: ModBus communication function	1	0	
4006	Inverter No.	0—254; for ModBus only (0—32; for RS485 communication)	1	1	
4007	Communication speed	1: 1,200bps 2: 2,400bps 3: 4,800bps 4: 9,600bps 5: 19,200bps 6: 38,400bps 7: 57,600bps	1	4	
4008	Parity bit	0: No 1: Odd 2: Even	1	1	
4009	Stop bit	1: 1 bit 2: 2 bits	1	1	
4010	End bit	0: CR+LF 1: CR	1	0	
4011	Inverter’s response to specified commands	0: Sent 1: Not sent (Error response sent) 2: Not sent (No error response sent)	1	0	
4101	ModBus communication timeout setting	0: No function 0.01 -600 sec.	0.01 s	0	
4102	ModBus communication timeout action	0: Keep the status 1: Stop alarm	1	0	

7-2 Function Code List – Motor Parameters / Vector Control

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
Motor Parameters					
5001	Motor poles voltage· capacity	X Y ZZZ X: Poles Y: Rated voltage Z: Motor capacity	—	□ 1	
5002	Motor current rating	0.1-999.9A About 30 — 110% of the inverter current rating	0.1A	□ 1	
5003	Motor frequency rating	10—600Hz	1Hz	□ 1	
5004	Motor speed rating	0-24,000 rpm	1rpm	□ 1	
5005	Motor insulation type	1: Type A 2: Type E 3: Type B 4: Type F 5: Type H	1	□1	
5006	The motor's rated voltage during auto tuning of motor parameters	0: The voltage selected by F5001 100-460V	1V	0	
5007	Rated motor slip ratio	0-50%	0.1%	2	
5008	The setting of motor parameter auto tuning range	0: No range 50-300%	0.1%	200	
5009	Motor stator resistance	55kW or below: 0.001-65Ω	0.001Ω	□1	
		75kW or above: 0.01-650mΩ	0.01mΩ		
5010	Motor rotator resistance	55kW or below: 0.001-65Ω	0.001Ω	□1	
		75kW or above: 0.01-650mΩ	0.01mΩ		
5011	Motor stator inductance	55kW or below: 0.1-6,000mH	0.1mH	□1	
		75kW or above: 0.01-600mH	0.01mH		
5012	Motor rotator inductance	55kW or below: 0.1-6,000mH	0.1mH	□1	
		75kW or above: 0.01-600mH	0.01mH		
5013	Motor's mutual inductance	55kW or below: 0.1-6000mH	0.1mH	□1	
		75kW or above: 0.01-600mH	0.01mH		
5014	Motor excitation current	0.01-650A	0.01A	□1	
5015	Motor's moment of inertia	0-65kgm^2	0.001kgm^2	□1	
5016	Load's inertia moment ratio	1-200	0.01	1	
Vector control					
6001	Torque limiter (power running)	Mode A: 0-200%	0.1%	150	
		Mode B: 0-150%	0.1%	120	
6002	Torque limiter analog input function (power running)	0: F6001 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA)	1	0	
6003	Torque limiter (regeneration)	Mode A: 0-200% Mode B: 0-150%	0.1%	100	
6004	Torque limiter analog input function (regeneration)	0:F6003 1: External analog VIF1 voltage (0—5 V) 2: External analog VIF1 voltage (0—10 V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0—10V or potentiometer) 5: External analog VIF3 voltage (0—5 V) 6: External analog VIF3 voltage (0—10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4—20mA)	1	0	
6005	Multiple for starting excitation current	0.1—2 (for applicable motor)	0.01	1	
6006	Starting excitation time	0: No starting excitation 0.1 -10 sec.	0.1 s	□1	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
6007	Multiple for braking excitation current	0.1—2 (for applicable motor)	0.01	1	
6008	Braking excitation time	0: No braking excitation 0.1 -10 sec.	0.1 s	1	
6009	Current control gain compensation	0.5-1.5	0.01	1	
6010	Speed control ASR proportional gain	0.01-150%	0.01%	□1	
6011	Speed control ASR integral time	0 -20 sec.	0.001 s	□1	
6012	Speed detection filter cut-off frequency	0: No function 0.01-500Hz	0.01Hz	0	
6013	Torque detection filter cut-off frequency	0: No function 0.1-5,000Hz	0.1Hz	0	
6014	Motor vibration reduction rate	0: No function 1: 75% 2: 50% 3: 25%	1	0	
6015	Lower frequency limit for motor vibration reduction function	0-240Hz	0.01Hz	0	
6016	Upper frequency limit for motor vibration reduction function	0-240Hz	0.01Hz	0	
6017	Starting torque	0-100%	0.1%	30	
6018	Starting torque duration time	0 -6500 sec.	0.1 s	1	
6019	Variable 2nd gain for speed control	0: No variable gain function 0.01-150%	0.01%	15	
6020	Frequency bottom of variable gain for speed control	0-240Hz	0.01Hz	10	
6021	Frequency top of variable gain for speed control	0-240Hz	0.01Hz	30	
Torque control					
6101	Torque command selection	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or capacity) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10 V or capacity) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10 V or capacity) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA)	1	1	
6102	Torque command	Mode A 0-±200.0% Mode B 0-±150.0%	0.1%	10	
6103	Positive upper value of Torque command	20.0-200.0%	0.1%	100	
6104	Positive lower value of torque command	0-20.0%	0.1%	5	
6105	Negative upper value of torque command	20.0-200.0%	0.1%	100	
6106	Negative lower value of torque command	0-20.0%	0.1%	5	
6107	Bias torque command (VIF1)	0-±200.0%（torque command of 0V or 4mA）	0.1%	0	
6108	Gain torque command (VIF1)	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100	
6109	Bias torque command (VIF2)	0-±200.0%（torque command of 0V or 4mA）	0.1%	0	
6110	Gain torque command (VIF2)	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100	
6111	Bias torque command (VIF3)	0-±200.0%（torque command of 0V or 4mA）	0.1%	0	
6112	Gain torque command (VIF3)	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100	
6113	Torque characteristics selection in constant power zone	0: Constant torque constant power limit 1: Constant torque limit	1	0	
6114	Speed limit selection	0: Speed limit under 1st speed frequency command 1: Speed limit in function codes	1	1	
6115	Speed limit value in torque control (Forward run side)	0-8,000 rpm	1rpm	1,800	
6116	Speed limit value in torque control (Reverse run side)	0-8,000 rpm	1rpm	1,800	
6117	Torque control proportional gain	0.01-150%	0.01%	□ 1	
6118	Torque control integral time	0-500ms	0.1ms	50	
6119	Lower torque limiting value in speed limiting	0-100%	0.1%	30	

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets	User Setting Value
Extended functions					
8101	Point to Point control position limiter	1-32,767mm	1mm	32,767	
8102	Effective number of bits for Point to Point control position (Unit=mm)	1: Integer 2: 1 digit after decimal point is effective 3: 2 digits after decimal point are effective	1	1	
8103	Simple Backlash calibration	0-±5,000 pulses	1 pulse	0	
8104	Command pulse format (Optional function)	1: Forward / reverse run pulse train 2: Sign pulse train 3: 2-phase pulse train	1	1	
8105	Command pulse logic (Optional function)	1: Positive logic 2: Negative logic	1	1	
8106	PG pulse output divisor (Optional function)	1: 1/1 2: 1/2 3: 1/4 4: 1/8 5: 1/16	1	1	
8107	Deviation counter clear mode	1: Level operation 2: Rising edge operation	1	2	
8108	PG pulse multiplication value	1: ×1 2: ×2 3: ×4	1	3	
8109	PG output formation selection	1: Corresponding to open collector PG 2: Corresponding to open collector PG (optional) 3: Corresponding to bus driver PG (optional)	1	1	
8110	Position control gain	0.1-50 rad/s	0.1rad/s	1	
8111	Positioning completion width	0-32,767 pulses	1 pulse	100	
8112	Error level limit	0-1,000（set value 1=1000 pulses）.	1	100	
8113	Quick acceleration/deceleration for position control	0: Disabled 1: Enabled	1	1	
8114	Number of pulses within 1 mm	0: Pulse is specified with F8115 1-32,767 pulses	1 pulse	0	
8115	Point to point control command	0: No function 1-32,767 pulses 0.01-32,767mm（□3）	（□3）	0	
8116	Electric gear ratio function selection (Optional function)	0: Inactive 1: Active	1	0	
8117	Electric gear A data (optional function)	1-100	1	1	
8118	Electric gear B data (optional function)	1-100	1	1	
8119	Zero-servo control function selection	0: Inactive 1: Active 2: Switching on external terminal (P0) zero-servo	1	0	
8120	Zero speed	1-3,000 rpm	1rpm	30	
8121	Zero speed servo complete width	5 — 1,0000 pulses	1 pulse	10	
8122	Number of PG pulses	20 — 2,048 pulses	1 pulse	1000	
8123	For factory adjustment				
8124	For factory adjustment				
8125	PG pulse A-B polarity reversal	0: Inactive 1: Polarity reversal	1	0	
8126	Speed control ASR proportional gain in zero-servo	0: Act according to the set value of F6010 0.01-150%	0.01%	15	
8999	For factory adjustment				

The setting values can not be changed during operation.

***1: The representative parameters that are suitable for various models have been input.**

The following values have been input from * 2-1 to * 2-8 in various models of inverters.

Model	*2-1 F1012	*2-2 F1013	*2-3 F1014	*2-4 F1015	*2-5 F1016	*2-6 F1017	*2-7 F1018	*2-8 F1019
SVC06-0015 -SVC06-0075	5	10	15	20	5	10	15	20
SVC06-0110 -SVC06-0150	15	30	45	60	15	30	45	60
SVC06-0185 -SVC06-0550	30	60	90	120	30	60	90	120
SVC06-0750 -SVC06-0900	60	120	180	240	60	120	180	240
SVC06-1100 -SVC06-2500	75	150	225	300	75	150	225	300

***3: Data content and setting resolutions change with function codes. See 7-3 Description of Functions for details.**

7-3 Description of Functions

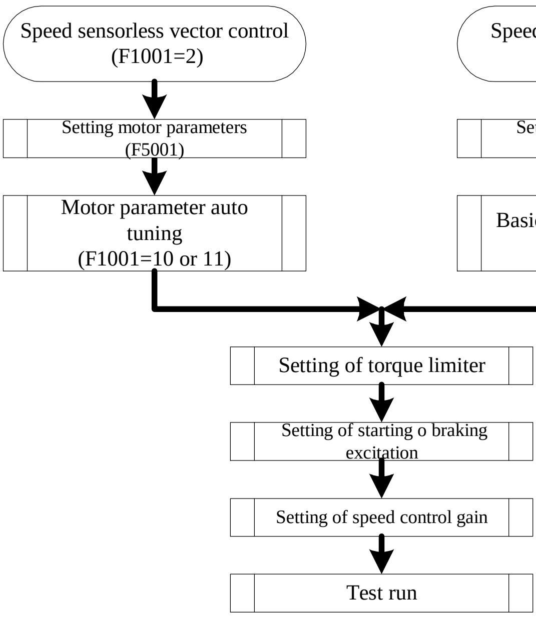
Basic functions

F1001 Motor control mode selection

A function for selecting motor control mode.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1001	Motor control mode selection	1: V/f control mode 2: Speed control (speed sensorless vector control) 3: Speed control (speed sensor vector control) 4: Torque control (speed sensorless vector control) 5: Torque control (speed sensor vector control) 6: Position control (speed sensor vector control) 10: Auto tuning mode 1 11: Auto tuning mode 2 40: V．f separation control	1	1

- F1001 = 1: the motor is controlled by the V / f graph set in V / f mode.
- F1001 = 2: Speed control mode (speed sensorless vector control), F1001 = 3: Speed control mode (speed sensor vector control).
  Speed control is a control mode that will maintain a constant speed regardless of what the load condition is. And, it is a control mode which allows the motor to generate high torque from the low-frequency field. In speed control, you can select speed sensorless vector control (F1001 = 2) or speed sensor vector control (F1001 = 3). The figure below shows the setting flow through which the vector speed control is realized.



(Related function codes)
• To carry out speed control mode selection, please refer to description of relevant parts of function code F6000.
• To carry out speed sensor vector control mode selection, please refer to description of relevant parts of function code F8100 for basic setting of PG sensor.

Notes on use of speed control mode:

Note 1: When setting the control mode of speed sensorless vector control, the following conditions must be met.

1. **One inverter to one motor.**
2. **The motor must be a Sanken designated 2-pole, 4-pole or 6-pole 3-phase induction motor or a similar motor.**
3. **The motor drive capacity must be equal to that of the standard motor suitable for the inverter rating or one rank below.**
4. **The wiring length between the inverter and the motor shall be less than 30 m. If the wiring length exceeds 30 m, conduct auto tuning of the motor parameters in advance using the auto tuning mode 2.**
   And, for vector control, the maximum wiring length shall be controlled within 100m.

Note 2: F5001 **does not apply to the setting of □ and □ in Note** 1, **please set it correctly according to the above. And, the inverter action and control characteristics cannot be guaranteed where the** F5001**'s setting does not match ratings of the connected motor.**

Note 3: **In the speed sensorless vector control mode, motor parameters, control frequency and voltage are used to drive the motor, therefore control characteristics depend on motor parameters, and the best performance may not be achieved depending on the motor. If motor characteristics, etc. are not mastered, auto measurement of motor constant shall be carried out using auto tuning, and, the use of V / f mode of which the control characteristics do not depend on motor parameters is recommended for control.**

Note 4: **When setting speed sensorless vector control mode, the following function codes shall be limited.**

F1004 — F1008: **setting inactive**

F1102 **(Starting mode) =**3 **(started by starting frequency after DC braking): setting inactive. Starting excitation shall be made by setting starting excitation time** (F6006), **and then the operation shall be started by starting frequency according to the setting values of operation starting frequency** (F1104) **and starting delay time** (F1105).

F1103 **(starting frequency): Although the setting is active,** the minimum value is 0.2**Hz in speed sensorless vector control mode.**

F1111 **(braking mode)** =2: **setting inactive. Braking excitation is made according to the setting of braking excitation time** (F6008) **when stopped. The relation between output frequency and the settings of** F1104 **and** F1112 **is handled in the same way with V / f mode.**

F1113, F1114: **Changed to** F6007, F6008 **for DC braking function.**

F1701, F1703: **Changed to** F6001, F6003 **for current limiting.**

Note 5: **Others**

1 **Upper frequency limit** (F1007) **sets the motor's rated speed as the synchronous speed, please set the frequency specified by the motor's number of poles as the maximum value of frequency setting. The operation is a weak magnetic-controlled constant power operation where the frequency setting values above rated frequency** (F5003) **are used to drive motor, however, do not set the upper frequency limit too much higher than the rated frequency as it may cause mechanical damage to the motor.**

2 **When output is stable, because the motor's speed is controlled to keep it constant, the frequency that the inverter actually outputs constantly changes. In contrast to the case of the V/f mode, the set frequency and the output frequency do not necessarily coincide when output is stable. Therefore, the output frequency may exceed the set frequency.**

3 **"Frequency arrival" and "frequency matching" set by** F1509 — F1511 **determine when the output frequency reaches or matches the set frequency. Therefore, for the "frequency matching" function, set the frequency matching range (F1508) to a few Hz because of the reason described in □.**

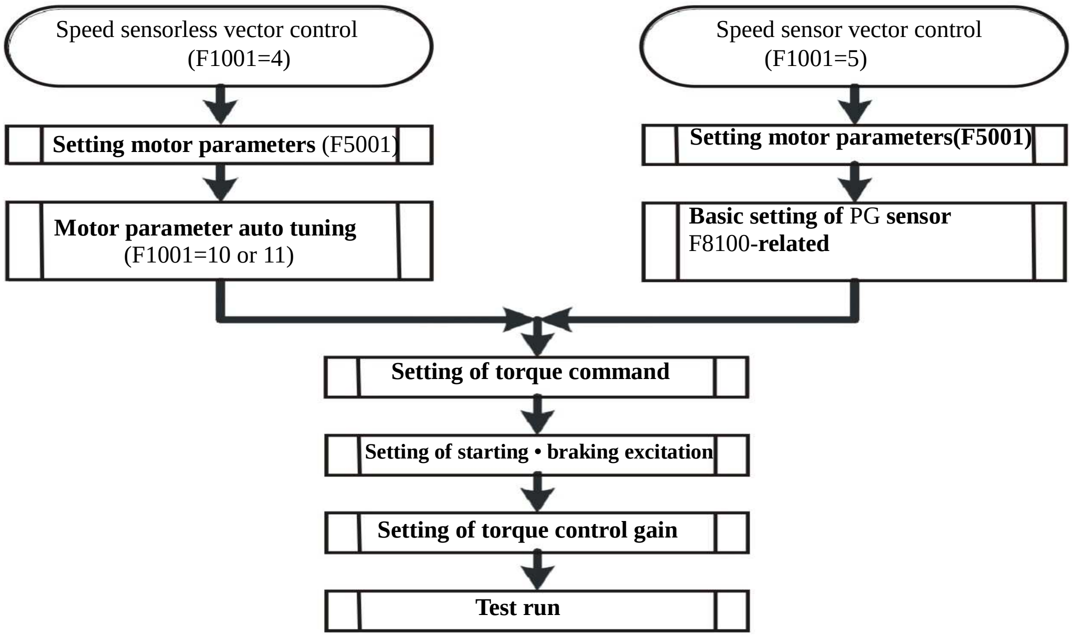
4 **All values output to the operation panel's 7-segment monitor are based on the output frequency. In the frequency display mode, the output frequency is displayed. In case of speed and no-units display, estimated speed is displayed in speed sensorless vector control; and detected speed is displayed in speed sensor vector control.**

5 **In the use of speed sensor vector control mode, please correctly configure the basic settings of PG sensor. The motor can not be normally controlled if incorrectly configured.**

- F1001 = 4: Torque control mode (speed sensorless vector control), F1001 = 5: Torque control mode (speed sensor vector control).

  The so-called torque control mode is a control mode for constant torque output. In torque control, speed sensorless vector control mode (F1001=4) or speed sensor vector control mode (F1001=5) can be selected.

  The procedure for implementation of torque control is shown as follows.



(Related function codes)

- **When selecting torque control mode, please refer to relevant description of F6100.**
- **To select speed sensor vector control mode, please refer to relevant description of F8100 for setting of PG sensor.**

Notes on use of torque control mode:

Note 1: When setting speed sensorless vector control mode, the following conditions must be met.

1. **One inverter to one motor.**
2. **The motor must be a Sanken designated 2-pole, 4-pole or 6-pole 3-phase induction motor or a similar motor.**
3. **The motor drive capacity must be equal to that of the standard motor suitable for the inverter rating or one rank below.**
4. **The wiring length between the inverter and the motor shall be less than 30 m. If the wiring length exceeds 30 m, conduct auto tuning of the motor constants in advance using the auto tuning mode 2.**

Note 2: F5001 **does not apply to the setting of □ and □ in Note 1, please set it correctly according to the above. And, the inverter action and control characteristics cannot be guaranteed where the** F5001**'s setting does not match ratings of the connected motor.**

Note 3: In the speed sensorless vector control mode, motor parameters, control frequency and voltage are used to drive the motor, therefore control characteristics depend on motor parameters. Thus sometimes the best performance may not be achieved. If motor characteristics, etc. are not mastered, auto measurement of motor parameters shall be carried out using auto tuning.

Note 4: In the use of speed sensor vector control mode, please correctly configure the basic settings of PG **sensor. The motor can not be normally controlled if incorrectly configured.**

Note 5: For starting in torque control mode with speed sensor, starting begins with the speed detected. For speed sensorless starting, flying start will be carried out. If speed tracking frequency can not be detected, the motor will be started by starting excitation.

When started by starting excitation, if over-current or other phenomena occur on the motor, then set F6005 **(Multiple for starting excitation current) and** F6006 **(Starting excitation time) longer.**

Note 6: In torque control mode, the stop function has nothing to do with the setting of function code F1111 (braking mode), and it is free run stop.

Note 7: Motor parameters will also be used for torque calculation in torque control under speed sensor mode, so the torque control accuracy may not be reached if the motor parameter setting (Function Code No. 5000 segment) is inappropriate. If the motor parameters are known, be sure to set the motor parameters. If the motor parameters are unknown, please carry out auto tuning.

● F1001=6: Position control mode

Position control mode is a mode which uses PG sensor for position control.

- The load position is controlled according to the external input pulse command. The optional board (SC-PG) is required for pulse command input.
- Some functions such as positioning control (Point to Point) etc. which do not need pulse command input, can be achieved under the standard configuration.

(Related function codes)

See description of F8100 part for basic setting of PG sensor.

Notes on position control mode:

Note 1: When setting position control mode, the following conditions shall be met.

□ **Operation command Should be set by external terminal** (F1101 = 2).

□ **One inverter drives one motor.**

□ **The motor must be a Sanken designated 2-pole, 4-pole or 6-pole 3-phase induction motor or a similar motor.**

□ **The motor drive capacity must be equal to that of the standard motor suitable for the inverter rating or one rank below.**

□ **The wiring length between the inverter and the motor shall be less than 30 m. If the wiring length exceeds 30 m, conduct auto measurement of the motor parameters in advance using the auto tuning mode 2. And, for vector control, the maximum wiring length shall not exceed 100m.**

Note 2: The setting of F5001 shall not be in violation of requirements of □ □ □ in Note 1. Please set the parameters according to the above requirements. And, the inverter action and control characteristics cannot be guaranteed where the F5001's setting does not match ratings of the connected motor.

Note 3: Please correctly configure the basic settings of PG sensor. The motor can not be normally controlled if incorrectly configured. In addition, in position control, the F8125: PG pulse A-B polarity reversal can not be used.

Note 4: Position control mode can be set only when the operation command set to external terminal (F1101 = 2). Also, the operation panel's operation control authorization switching is inactive.

Note 5: Others

1. **Depending on the position deviation, the output frequency can be up to the selected upper frequency limit** (F1007, F1316, and F1317). **Configure appropriate settings based on the actual situation of the motor and load device.**
2. **In position control, the acceleration/deceleration time** (F1012-F1019) **is inactive.**
3. **When the operation signal is OFF, it will stop by free run regardless of the function code setting.**

F1001 = 10 and 11: auto tuning modes 1 and 2

· Auto tuning is an integrated function inside the inverter, which auto detects connected motor's parameters. This function applies to the motor of which the parameters are completely unknown, and is a very effective detection function for speed sensorless vector control when the wiring length between the inverter and the motor exceeds 30m.

· The auto tuning function has two modes.

1. Auto tuning mode 1 (F1001 = 10): a mode for detecting motor parameters when the motor shaft is not rotating. It is used when auto tuning mode 2 can not be executed.
2. Auto tuning mode 2 (F1001 = 11): a mode for detecting motor parameters by rotating motor shaft.

* **See 6-2-6 for details and sequence of auto tuning.**

● F1001=40: V•f separation control

- A function which can set the inverter's output frequency and output voltage independently.
- The control mode is V / f mode.
- F2001: Through V•f separation selection, you can choose complete separation or V•f proportional separation.

(**Related function codes**)

See the following function codes for details of V•f **separation function.**

F2001 V•f **separation function selection.**

F202 V•f **separation command voltage**

F1002 1st speed frequency setting selection

A function for selecting the frequency setting method for the 1st speed frequency operation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1002	1st speed frequency setting selection	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 11: External analog VIF1 voltage +VIF2 voltage 12: External analog VIF1 voltage +VIF3 voltage 13: External analog VIF2 voltage +VIF3 voltage 14: External analog VIF1 voltage -VIF2 voltage 15: External analog VIF2 voltage –VIF1 voltage 16: External analog VIF1 voltage-VIF3 voltage 17: External analog VIF3 voltage –VIF1 voltage 18: External analog VIF1 voltage +VIF2 current 19: External analog VIF1 voltage -VIF2 current 20: External analog VIF1 current -VIF2 voltage 21: Terminal block stepping 21: Communication 25: Pulse train input 26: External analog VIF1 forward / reverse operation (0 — 10V, 5V reference) 27: External analog VIF2 forward / reverse operation (0 — 10V, 5V reference) 28: External analog VIF3 forward / reverse operation (0 — 10V, 5V reference)	1	1

● Reading analog frequency

- A function which takes the result of calculation of the 3 channels of control circuit's analog input terminals VIF1, VIF2, VIF3 (frequency command) carried out internally by the inverter as the inverter's command frequency.

Chapter 7

The inverter converts the input command of each channel into a frequency by adjusting the bias and gain code. The results are added or subtracted according to the value of F1002.

- A negative result is always regarded as 0. The upper limit of the calculation result is determined using the upper frequency limit (F1007, F1316 and F1317).

● F1002 = 21: Terminal block stepping function.

- This function allows the target frequency to be increased or decreased under ON/OFF status control of the external control terminals. This function is useful when it is difficult to input an external analog frequency or to set a frequency from the operation panel.

1) Related function codes and multifunctional input terminals

Function code	Inverter control terminal	
F1002=21	AD2	Up terminal
	AD3	Down terminal
	DCM1	Digital signal common terminal
	DCM2	Digital signal common terminal

· If the first speed frequency selection is set to terminal block stepping (F1002= 21), a frequency setting value can be entered only from external control input terminals AD2 and AD3 of the inverter host.

Note: The frequency cannot be changed from the operation panel.

· It is a function which takes AD2 terminal as the Up terminal of the set frequency and AD3 terminal the Down terminal of the set frequency.

Note: When F1002=21 **is selected, the** AD2 **and** AD3 **terminals set using** F1414-F1421 **can not be used for the** 2**nd,** 3**rd, or** 4**th acceleration/deceleration command.**

2) Increasing or decreasing the set frequency

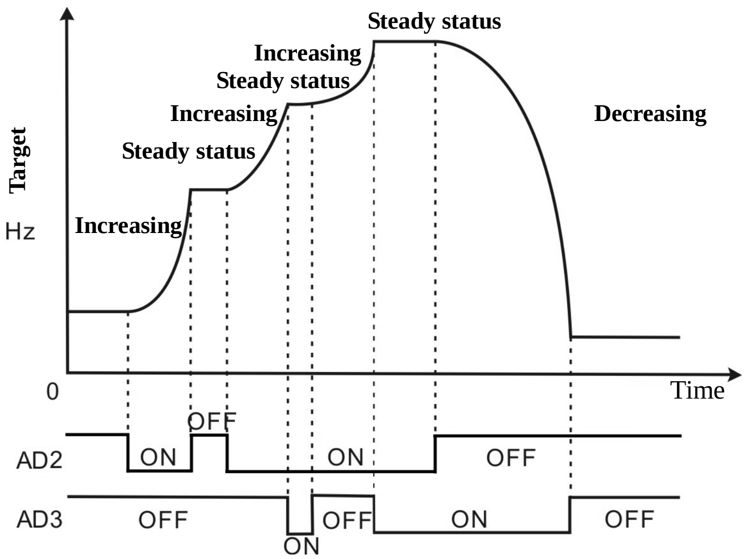
· Increasing the set frequency

Short-circuit the inverter's external control terminal AD2 to the DCM1 or DCM2 terminal. The set frequency increases gradually from the current value.

· Decreasing the set frequency

Short-circuit the inverter's external control terminal AD3 to the DCM1 or DCM2 terminal. The set frequency decreases gradually from the current value.

· Change of frequency display becomes rapid gradually from a low value.



Note 1: **The terminal block stepping function is used not only for setting the** 1**st speed frequency but also for setting the frequencies for multiple speeds. For example, short-circuit the** 2**nd speed selection terminal** 2DF **(inverter control terminal) and the** DCM1**, if the terminal block stepping increases when setting a frequency for the** 2**nd speed, the set frequency for the second speed will change. But, when changing multi-segment speed during**

increasing or decreasing action of the terminal block, the increasing or decreasing action of segments which started before change will be stopped, and the increasing or decreasing action of segments after change will be started.

Note 2: **The step function is disabled when the function lock** (F1603=1, 3) **is selected or at undervoltage.**

Note 3: **When the terminals** AD2 **and** AD3 **are both connected to either** DCM1 **or** DCM2 **in short circuit or both left open, the set frequency remains unchanged. (Maintain the current status)**

Note 4: **The frequency setting value for the increasing or decreasing by terminal block stepping function is determined by the current multi-speed frequency codes** (F1021, F2101-F2116).

- Others

Note: **Even if** F1002 = 2 — 20, 26 — 28 **is selected**, **the frequency setting value in multi-segment speed** (2nd — 8th **speed**) **operation or** JOG **operation is still the value set by** F2102 — F2116 **or** F1201.

- F1002=22: Communication

A function which sends special commands from the PC etc. to the inverter. See Chapter 7 Communication Function for frequency setting method.

- F1002=25: Pulse train input

The target frequency is determined with the pulse from the pulse train input by PG pulse as the 1st speed frequency command.

The places for pulse input are A + and A- of the control circuit terminal. See 4-6-1 for terminal configuration.

Reference parameter

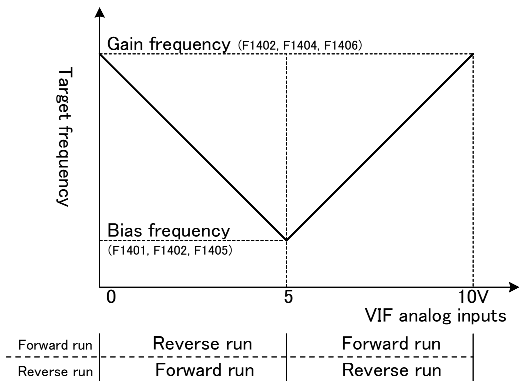
F1422 (Pulse train input reference frequency)

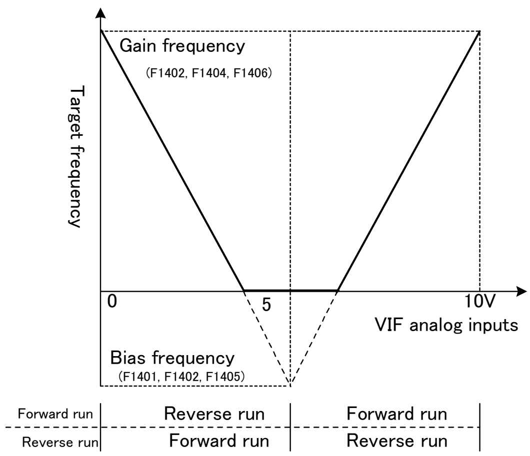
- F1002 = 26, 27, 28: Analog forward / reverse run

• This function is a function which runs in the same direction with command direction at 5 — 10V and the opposite direction to command direction at 5 — 0V based on 5V of VIF input as the center.

•·The input of each channel shall be converted into a frequency according to its bias and gain code. A negative result is always regarded as 0.

• 5V is the bias frequency, 10V and 0V the gain frequency.



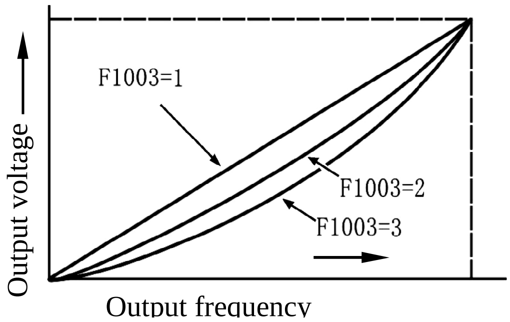


※ The operation direction of simple graph operation is the direction specified by the function code.

F1003 V/f pattern selection

A function for selecting linear characteristics or square-law decreasing characteristics for V / f pattern.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1003	V/f pattern selection	1: Linear pattern 2: Square-law decreasing pattern (weak) 3: Square-law decreasing pattern (strong)	1	1



- Arbitrary V/f pattern can be set in linear V/f pattern. (Active when special motors are used.)

Reference parameter

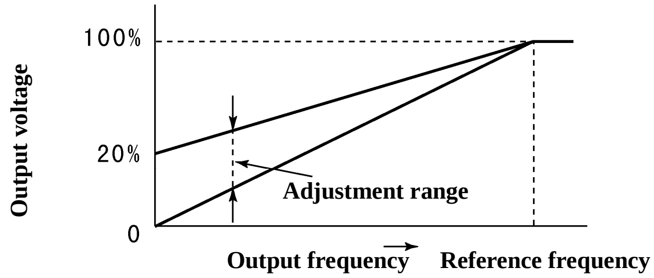
F2003 (Arbitrary V/f pattern intermediate voltage 1).
F2004 (Arbitrary V/f pattern intermediate voltage 2).
F2005 (Arbitrary V/f pattern intermediate frequency 1).
F2006 (Arbitrary V/f pattern intermediate frequency 2).

F1004 Torque boost

A function which adjusts the V/f pattern shown in the figure below to compensate for torque deficiency of the motor in the low frequency zone.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1004	Torque boost	0-20%	0.1%	□

□ **The representative parameters that are suitable for various models have been input.**



- An excessive increase will cause overcurrent, possibly activating output current limiting function. To avoid this, make adjustment while confirming the output current.

Note: The torque compensation is active only in the V / f control mode.

F1005 Base voltage

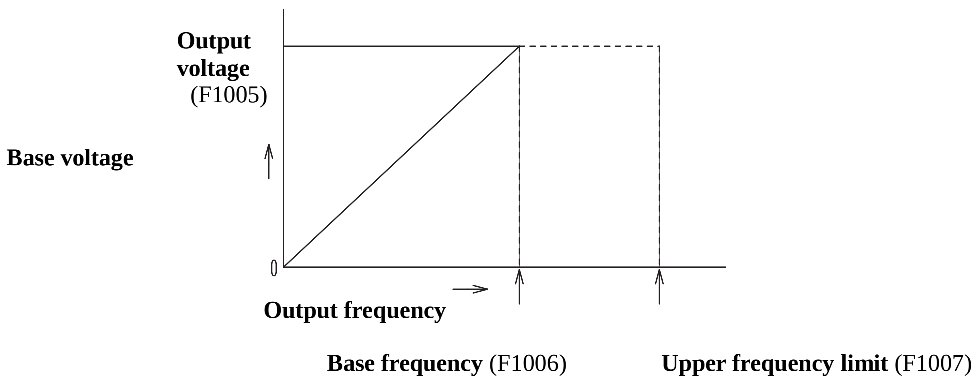
F1006 Base frequency

A function for determining an Arbitrary V/f pattern to match the motor's characteristics. Set the Base voltage and Base frequency.

Code No.	Function Name	Data Content		Setting Resolution	Factory Presets
F1005	Base voltage	200V series	0: No AVR 50-240V	1V	□
		400V series	0: No AVR 50-460V		
F1006	Base frequency	0.1-600Hz		0.01Hz	□

※ **The representative parameters that are suitable for various models have been input.**

- F1005=0: The reference voltage is equal to the highest possible output voltage that is determined by the input voltage. No automatic output voltage regulation will be performed.
- F1005=50-460[V]: Reference voltage. Automatic regulation of output voltage will be performed. (200V Series: 50-240[V].)



Note: The inverter can not output a voltage higher than the input voltage. Therefore, the automatic regulation range specified by this function is a range of maximum possible output range determined by input voltage. For example, F1005= 460V **may be set even if used in a** 400V **series distribution system. However, such a setting will only serve to make the** V/f **pattern steeper, the actual output voltage can not reach** 460V.

F1007 Upper frequency limit

F1008 Lower frequency limit

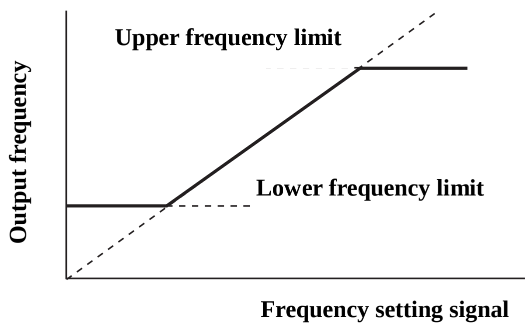
Set the upper and lower limits of the output frequency.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1007	Upper frequency limit	5-600Hz	0.01Hz	60
F1008	Lower frequency limit	0.05-200Hz	0.01Hz	0.05

- Because misoperation of the operation panel or wrong actions of external frequency command signals may cause over frequency, these functions are used for protection of possible speed range required by the mechanical side.
- Although a target frequency setting may exceed the upper frequency limit, the output frequency can not rise to a value higher than the upper frequency limit.
- Although a target frequency setting may be below the lower frequency limit, an output frequency lower than the lower limit is not actually output in constant speed operation.
- In case of lower frequency limit setting, please set it with a value greater than the starting frequency (F1103) and the operation start frequency (F1104).

Note 1: **In vector control mode, the maximum limit of the upper frequency limit is** 240Hz. **(For** 2**-pole motor, the maximum limit is** 120Hz.)

Note 2: **In speed sensorless vector control mode, the minimum limit of the lower frequency limit is** 0.2Hz.



F1009 Carrier frequency adjustment

A function for setting carrier frequency of the inverter.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1009	Carrier frequency adjustment	0-130	1	□

* **The representative parameters that are suitable for various models have been input.**

- As the value increases, the carrier frequency becomes higher. But, the maximum carrier frequency automatically varies depending on the operating status and motor capacity.

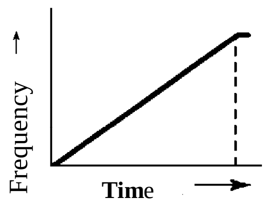
Note 1**: If the carrier frequency becomes low, the carrier noise from the motor will increase, but the leak current flowing to earth will decrease.**

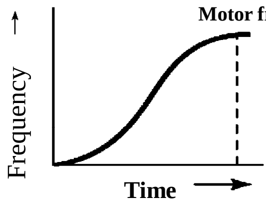
Note 2**: Raise the setting value of carrier frequency where the inverter is used in high frequency output applications.**

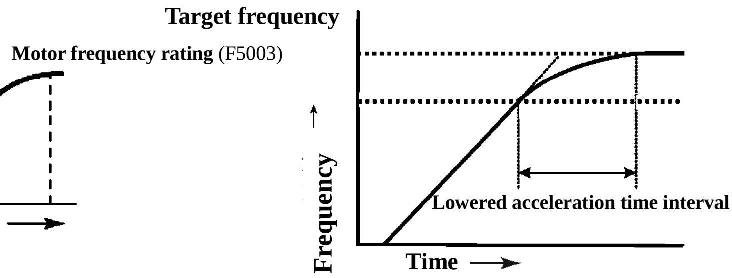
F1010 Acceleration/deceleration curve

A function for selecting the frequency change mode from three modes: linear, S-shaped and lowered acceleration/deceleration.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1010	Acceleration/deceleration curve	1: Linear 2: S-shaped 3: Reduction of acceleration / deceleration	1	1







Reduction of **acceleration/deceleration:** F1010=3

- In linear mode, the frequency change is proportional to time.
- S-shaped acceleration/deceleration right is effective in impact reducing at startup and shutdown. And, the shape of S-shaped acceleration/deceleration curve can be changed according to F1022 — F1027 in the 1st S-shaped graph, and F1028 — F1033 in the 2nd S-shaped graph.
- The so-called Reduction of acceleration/deceleration function is a function which extends the acceleration/deceleration time as the torque decreases (If the output frequency is above the motor frequency rating, the torque will decrease).

F1011	**Reference frequency for acceleration/deceleration**
F1012	**1st acceleration time**
F1013	**2nd acceleration time**
F1014	**3rd acceleration time**
F1015	**4th acceleration time**
F1016	**1st deceleration time**
F1017	**2nd deceleration time**
F1018	**3rd deceleration time**
F1019	**4th deceleration time**
F1020	**JOG acceleration/deceleration time**

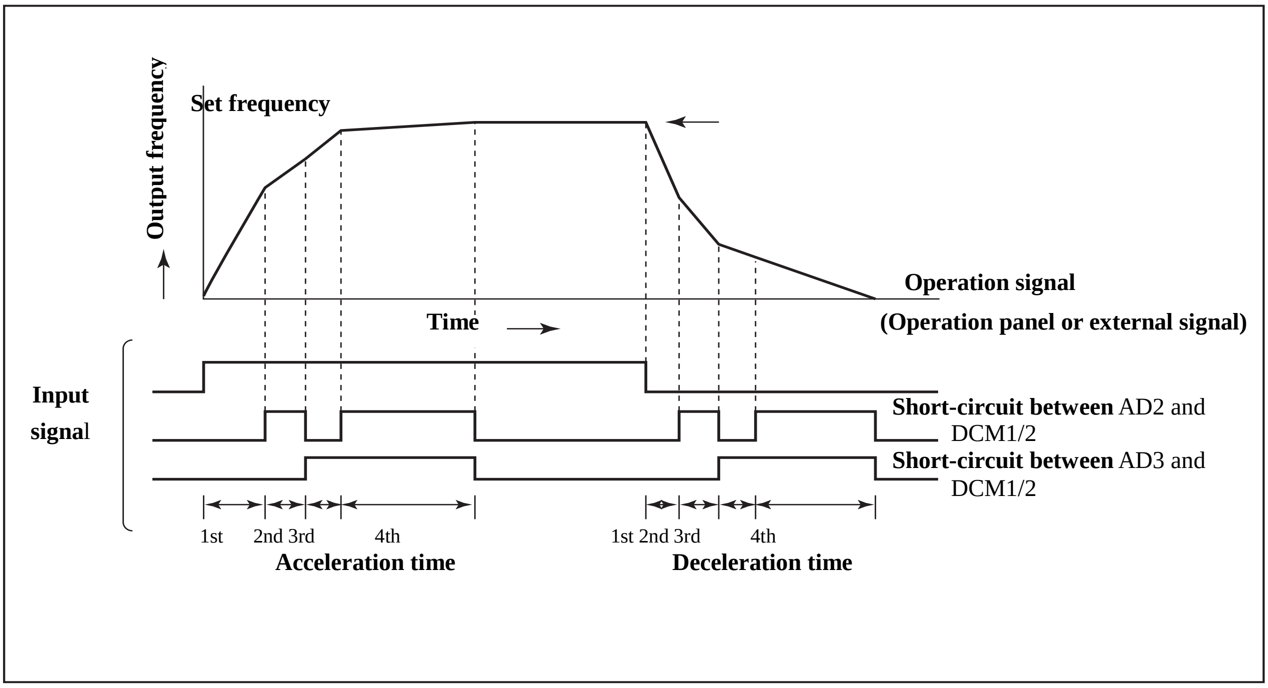
Four different acceleration slops and deceleration slops can be independently set according to four different acceleration times and deceleration times. And, F1020 is the function for setting acceleration and deceleration slopes in jog operation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1011	Reference frequency for acceleration/deceleration	1-120Hz	0.01 Hz	□
F1012	1st acceleration time	0 -6,500 sec.	0.1 s	□
F1013	2nd acceleration time	0 -6,500 sec.	0.1 s	
F1014	3rd acceleration time	0 -6,500 sec.	0.1 s	
F1015	4th acceleration time	0 -6,500 sec.	0.1 s	
F1016	1st deceleration time	0 -6,500 sec.	0.1 s	□
F1017	2nd deceleration time	0 -6,500 sec.	0.1 s	
F1018	3rd deceleration time	0 -6,500 sec.	0.1 s	
F1019	4th deceleration time	0 -6,500 sec.	0.1 s	
F1020	JOG acceleration/deceleration time	0 -20 sec.	0.1 s	0.1 s

* **The representative parameters that are suitable for various models have been input.**

Example) When F1011 = 50 Hz, F1012 = 5 seconds, the acceleration slope is set to 10Hz / s.

- In the V/f mode, even if the acceleration/deceleration time is set to 0 s, the actual value will still be 0.1 s.
- The 2nd thru 4th acceleration/deceleration times are selected by the combination of signals input to control input terminals AD2 and AD3.



F1021 JOG frequency

A function for setting frequency in JOG operation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1021	JOG frequency	0-60Hz	0.01 Hz	5

- Selection of the jog operation mode (control input terminals JOG-DCM1 or JOG-DCM2 are short-circuited) allows the JOG frequency to be specified jointly by the operation panel's quick knob and stepping mode.

Note: As long as the JOG **operation mode is selected, this mode takes precedence and cannot be changed to any other multi-speed frequency.**

F1022 1st Start of S-shaped acceleration

F1023 1st End of S-shaped acceleration

F1024 Gradient of middle of 1st S-shaped Acceleration

F1025 1st Start of S-shaped deceleration

F1026 1st End of S-shaped deceleration

F1027 Gradient of middle of 1st S-shaped deceleration

F1028 2nd Start of S-shaped acceleration

F1029 2nd End of S-shaped acceleration

F1030 Gradient of middle of 2nd S-shaped Acceleration

F1031 2nd Start of S-shaped deceleration

F1032 2nd End of S-shaped deceleration

F1033 Gradient of middle of 2nd S-shaped deceleration

A function which provides variable shape of acceleration/deceleration curve when S-shaped acceleration/deceleration (F1010 = 2) is set in the acceleration / deceleration mode. Set F1414-F1421=84, and if the terminal is put at ON, the 2nd S shape is selected, and OFF the 1st S shape.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
	1st Start of S-shaped acceleration	0-200%	1%	50
F1023	1st End of S-shaped acceleration	0-200%	1%	50
F1024	Gradient of middle of 1st S-shaped Acceleration	0-100%	1%	0
F1025	1st Start of S-shaped deceleration	0-200%	1%	50
F1026	1st End of S-shaped deceleration	0-200%	1%	50
F1027	Gradient of middle of 1st S-shaped Deceleration	0-100%	1%	0
F1028	2nd Start of S-shaped acceleration	0-200%	1%	50
F1029	2nd End of S-shaped acceleration	0-200%	1%	50
F1030	Gradient of middle of 2nd S-shaped Acceleration	0-100%	1%	0
F1031	2nd Start of S-shaped deceleration	0-200%	1%	50
F1032	2nd End of S-shaped deceleration	0-200%	1%	50
F1033	Gradient of middle of 2nd S-shaped Deceleration	0-100%	1%	0

- The acceleration, deceleration can be independently set by the shape of S-shaped acceleration/deceleration curve. And, the curvature of curves of S shape start part and arrival part and slope of middle of the S shape can be configured one by one.

F1022 — F1024, F1028 — F1030 are set for the acceleration, while the F1025 — F1033, F1031 — F1033 are set for the deceleration time.

The setting method is described as follows. Only the setting method for acceleration is illustrated since the same method is used for both acceleration and deceleration.

F1022=0-200%:	Specify the curvature of curve of S-shaped acceleration start part.
(1% stepping)	If set to 0, then the start part is linear acceleration, if set to 200, then the curvature becomes maximum.
F1023=0-200%:	Specify the curvature of curve of S-shaped acceleration arrival part.
(1% stepping)	If set to 0, then the arrival part is linear acceleration, if set to 200, then the curvature becomes maximum.
F1024=0-100%:	Set slope of middle of S-shaped acceleration.
(1% stepping)	If set to 0, then the slope set by F1011 — F1015 is selected, if set to 100, the slope two times the value set by F1011 — F1015 is selected.

- If the setting value of S-shaped acceleration/deceleration is changed, the new setting value will become active from the next acceleration/deceleration.
- In S-shaped acceleration/deceleration mode, the frequency arrival time changes depending on the setting values of F1022 — F1027. The calculation formula of arrival time is shown as follows.

$$Ts = \frac{T}{2} \times \left(\frac{200}{100+\text{ slope of middle of S shape}} + \frac{\text{S-shaped start curve} + \text{S-shaped arrival curve}}{200} \right)$$

Ts: Arrival time for S-shaped acceleration/deceleration mode (in seconds).

T: Arrival time for the setting value of F1011-F1019 in linear acceleration/deceleration mode (in seconds).

S-shaped start curve: Setting values (%) of F1022, F1025, F1028 and F1031.

S-shaped arrival curve: Setting values (%) of F1023, F1026, F1029 and F1032.

Slope of middle of S shape: Setting values (%) of F1024, F1027, F1030 and F1033.

(Example) In case of change from 20Hz to 50Hz acceleration in 1st acceleration/deceleration,

F1011 = 50 (Hz): The setting value of acceleration/deceleration reference time.

F1012=5（s）: The setting value of acceleration time.

F1022=50（%）: S-shaped curve with medium-curvature start.

F1023=50（%）: S-shaped curve with medium-curvature arrival.
F1024=0 （%）: The slope of middle part is the same with that in linear acceleration.

□ $T = \frac{5\ s}{50Hz} \times (50Hz-20Hz) = 3\ s.$

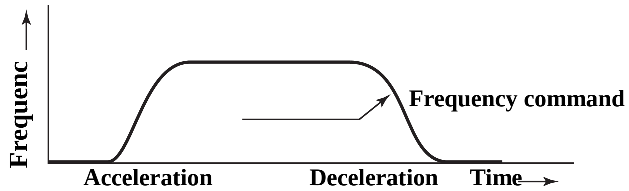
□ $Ts = \frac{3\ s}{2} \times \left(\frac{200}{100+0} + \frac{50+50}{200}\right) = 3.75\ s$

- Examples of S-shaped curves combined according to the set values are shown below. In each of these examples, acceleration/deceleration reference time and acceleration/deceleration time settings are set to the same value.

F1011=50（Hz）F1012=5（s）F1016=5（s）

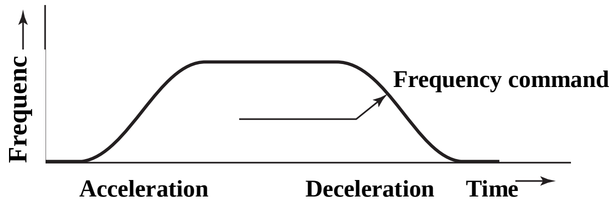
Example 1) F1022=100 F1023=100 F1024=100 F1025=100 F1026=100 F1027=100

- The arrival time is equal to that in linear acceleration / deceleration. However, since the slope of the middle portion is twice as that in linear acceleration/deceleration mode, the current limiting function may operate depending on the magnitude of the load inertia.

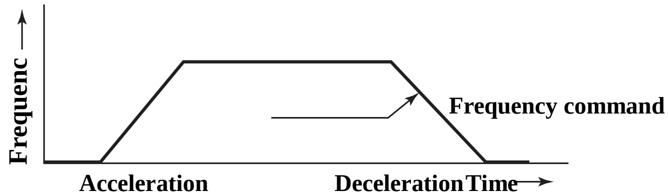


Example 2) F1022=100 F1023=100 F1024=100 F1025=100 F1026=100 F1027=100.

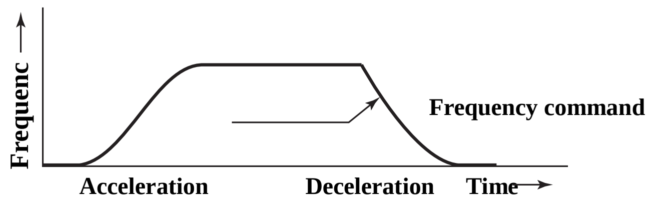
- The curvature of the S-shaped acceleration/deceleration's start portion and end portion become maximum, and the slope of the S-shaped acceleration/deceleration’s middle portion becomes the same as that in the linear acceleration/deceleration mode.



Example 3) F1022=0 F1023=0 F1024=0 F1025=0 F1026=0 F1027=0.
The result is the same with that in the linear acceleration/deceleration mode.



Example 4) F1022=100 F1023=100 F1024=0 F1025=0 F1026=0 F1027=100.
This setting value applies to the acceleration/deceleration of loads with square-law decreasing torque (such as fan etc.).



Note: Notes on use of S-shaped acceleration/deceleration

1. In case of frequency setting change in S-shaped acceleration/deceleration, S-shaped acceleration/deceleration shall be restarted from its starting point under new frequency setting. Therefore, the change in actual output frequency is not a smooth curve at the starting point of frequency change.
2. If F1002 is set to 2-20, and frequency is set through the external analog signal, the analog signal will constantly change due to influence overlap of interference component and the ripple component etc.. Therefore, in this case, the possibility that the change of actual output frequency can not form a smooth curve exists because of the reason described in □. At this point, please increase the analog signal filter time constant of F1407 — F1409, and detect effective number of bits by further adjusting the VIF of F1423 — F1425 to achieve stable analog signal.
3. In case of frequency locking (forward run signal and reverse run signal are input at the same time in operation of external terminals), if acceleration / deceleration is interrupted at a time point, the output frequency value will remain fixed. At the frequency unlocking time point, it will return to the original S-shaped acceleration/deceleration for the remaining frequency change.

   Example) If the frequency is locked at 20Hz during acceleration from 10Hz to 50Hz, stable operation will be kept at the locked frequency 20Hz, and S-shaped acceleration will restart from 20Hz to 50Hz when the frequency is unlocked.
4. In the S-shaped acceleration/deceleration, the change of acceleration/deceleration time (F1011- F1019) becomes active from the next acceleration/deceleration. Similarly, when switched to other acceleration/deceleration mode controlled by external control terminals in acceleration/deceleration (2nd acceleration/deceleration, etc.), it also becomes active from the next acceleration/deceleration
5. In case of current limiting function in S-shaped acceleration/deceleration, the remaining acceleration/deceleration is temporarily changed to linear acceleration/deceleration to carry out acceleration/deceleration.
6. The acceleration/deceleration is carried out according to linear acceleration/deceleration curve when current limiting function works in stable condition.
7. The acceleration/deceleration is also carried out according to S-shaped acceleration/deceleration curve in JOG operation.

F1034	1st speed frequency selection A
F1035	1st speed frequency selection B
F1036	1st speed frequency selection C

Through configuring this function, the setting method of 1st speed frequency can be selected using the terminal block.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1034 F1035 F1036	1st speed frequency selection A 1st speed frequency selection B 1st speed frequency selection C	1: Operation panel 2: External analog VIF1 voltage (0—5 V) 3: External analog VIF1 voltage (0—10 V or potentiometer) 4: External analog VIF2 voltage (0—5 V) 5: External analog VIF2 voltage (0—10V or potentiometer) 6: External analog VIF3 voltage (0—5 V) 7: External analog VIF3 voltage (0—10V or potentiometer) 8: External analog VIF1 current (4—20mA) 9: External analog VIF2 current (4—20mA) 10: External analog VIF3 current (4—20mA) 21: Terminal block stepping 22: Communication 25: Pulse train input 26: External analog VIF1 forward / reverse run operation (0 — 10V, 5V reference) 27: External analog VIF2 forward / reverse run operation (0 — 10V, 5V reference) 28: External analog VIF3 forward / reverse run operation (0 — 10V, 5V reference)	1	1

●This function is a function for switching the setting methods of 1st speed frequency by use of 1DFA and 1DFB terminals. Depending on the status of 1DFA and 1DFB terminals, the setting methods of 1st speed frequency can be changed as the table below.

1DFA	1DFB	**1st speed frequency action**
OFF	OFF	Determine the 1st speed frequency according to the method selected by F1002
ON	OFF	Determine the 1st speed frequency according to the method selected by F1034
OFF	ON	Determine the 1st speed frequency according to the method selected by F1035
ON	ON	Determine the 1st speed frequency according to the method selected by F1036

●See items of F1002 for input modes.
●Even if 1DFA and 1DFB are ON, the frequency setting value in multi-segment speed (2nd - 16th speed) operation or JOG operation is still the value set by F1021 or F2102 — F2116.
●The same VIF input can be specified by F1002, F1034, F1035, and F1036.
●When any one code of F1034 - F1036 is set to VIF current input, the input resistance of VIF terminal changes as the switching of 1DFA and 1DFB. Please note this when using VIF current input.

Starting • control function

F1101 Operation command selection

A function for selecting whether the operation/stop command of inverter is sent through operation panel or through external signals.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1101	Operation command selection	1: Operation panel 2: External terminal 3: Communication	1	1

- When F1101=2 (external terminal), the input signals of control terminals FR and RR are active. Other control terminal inputs are always active because they are not related to F1101 data.
- The operation control authorization can be set using external terminals POPE and RCOM. When using external terminals, the operation control authorization is as shown in the table below.

ROPE	RCOM	Operation Control Authorization
OFF	OFF	The operation command under the mode selected by F1101 is active. Can be switched by using 『OPE/EXT』key on operation panel.
ON	OFF	The operation command from operation panel is active. Can not be switched by using 『OPE/EXT』key.
OFF	ON	The operation command from communication is active. Can not be switched by using 『OPE/EXT』key.
ON	ON	The operation command from terminal block (FR terminal or RR terminal) is active. Can not be switched by using 『OPE/EXT』key.

Note 1: **When** ROPE=OFF **and** RCOM=OFF, **the operation control authorization of** F1101 **is active. When any one terminal of** ROPE **and** RCOM **is** ON, **the operation control authorization depends on the terminal status of** ROPE **and** RCOM **regardless of what the set status of** F1101 **is**.

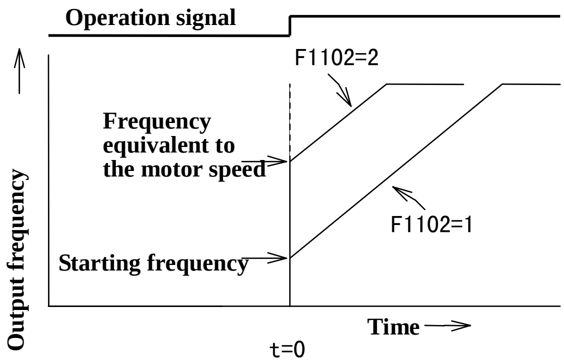
Note 2: **Shutdown by**『STOP』**key on operation panel is always active regardless of the status of** ROPE **and** RCOM **terminals**.

F1102 Starting method

A function for selecting the starting method.

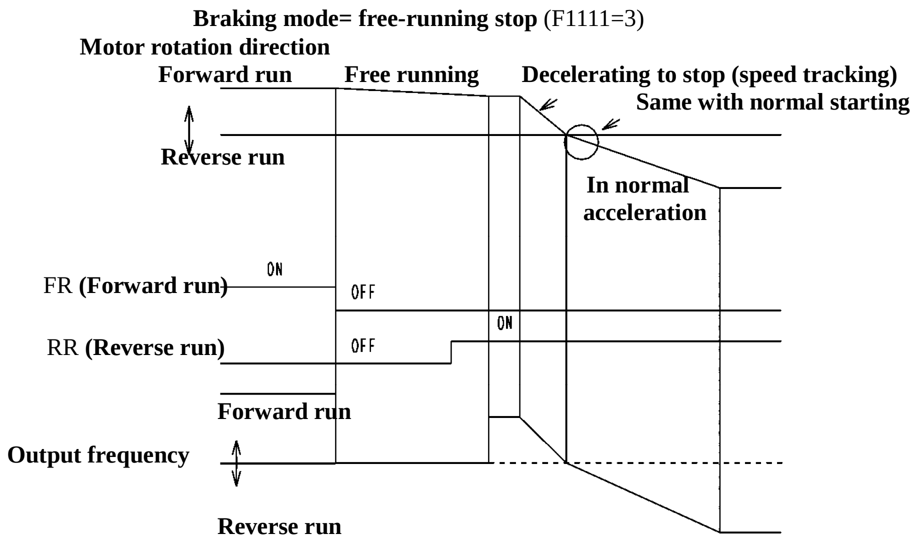
Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1102	Starting method	1: Starting frequency 2: Flying start 3: Starting frequency after DC braking	1	1

- The so-called "flying start" is a method for starting from the frequency corresponding to the motor speed detected so as to reduce the impact at startup when the motor starts from idling condition. However, in this case, if there is an electromagnetic contactor between the motor and the inverter, please set the electromagnetic contactor ON in advance, and then input operation signal.
- The so-called "started by starting frequency after DC braking" means the motor is stopped by DC braking before being started in applications such as reverse run of fan against wind, in which the inverter is stopped while the motor is rotating due to other factors. This is an effective method to reduce the impact at startup. See F1112- F1114 for DC braking setting.
- Flying start is executed when the alarm is automatically reset and restarted after momentary power failure regardless of the setting value of F1102.



Note 1: The flying start function may not be effective when the capacity of the inverter is much larger than that of the motor or when the free-running speed of the motor is very low or in an environment tends to be disturbed.

Note 2: If the inverter starts a free-running motor with a low frequency, an excessive current may be generated and trip the circuit breakers. Thus, whether current startup will cause impact can be determined not only by checking the rotation speed but also the direction of rotation. This function can start the motor in a predetermined rotation direction without any shock even when the motor is free-running in reverse, for example due to a back wind.



Note 3: In feedback control such as PID control etc., it is possible that the speed tracking does not happen when configuring the gain setting value or when affected by response speed of the system.

F1103 Starting frequency

The inverter starts to operate with this frequency. If the set frequency is lower than starting frequency, the inverter does not start.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1103	Starting frequency	0.05-60Hz	0.01Hz	1

Example 1) When setting F1103=20Hz for 50Hz operation, if operation signal is turned on, the inverter outputs 20Hz as the output frequency, and then goes up to 50Hz according to the specified acceleration slope.

Example 2) When setting F1103=20Hz for 15Hz operation, if operation signal is turned on, the inverter remains in standby and does not output.

- Once the inverter starts, it continues to run even if a frequency lower than the starting frequency (but higher than operation start frequency) is set..
- When inputting a stop signal, if the output frequency is below starting frequency, the inverter will stop outputting. (When DC braking function is disabled).

F1104 Operation start frequency

This frequency value is used to determine whether the inverter can operate or not.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1104	Operation start frequency	0-20Hz	0.01Hz	1

- If the set frequency equals or exceeds the levels of the operation start frequency and the starting frequency, the inverter starts operating at the starting frequency. And, if a frequency below the operation start frequency is set during operation, the inverter enters a standby state. And the output frequency drops to the starting frequency and then output stops. In this case, the operation mode indicator on the operation panel flashes, indicating the standby state. This function is useful for starting or stopping the inverter using only an external frequency command.

Example) F1104=20Hz, F1002=3 for the frequency setting using the quick knob. By adjusting the quick knob, the output starts when the command frequency is 20Hz or higher. At a frequency lower than 20Hz, the output frequency goes down to the starting frequency, and output stops.

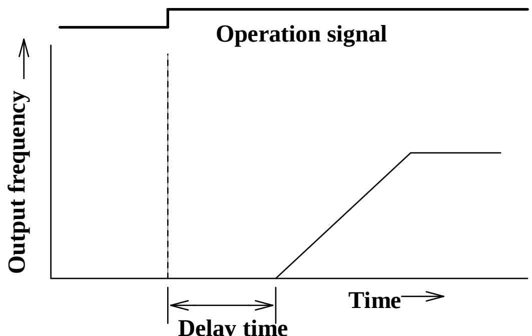
Chapter 7

F1105 Start delay time

This function is used to set the time until the inverter starts operation after inputting an operation signal.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1105	Start delay time	0 -5 sec.	0.1	0

- This function is useful for setting the delay time with a sequence circuit for changeover between inverter/mains power, etc.
- When a switch between the motor and the inverter turns on at the same time as input of the operation signal, set F1105 to approximately 0.5 sec.



F1106 Start standby time

F1107 Start standby frequency

Through the use of output frequency standby function, this function is used to keep the big inertia load in temporary standby by increasing the frequency when starting and to increase frequency when the speed goes up, so as to facilitate a smooth acceleration.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1106	Start standby time	0.0 -120.0 sec.	0.1 s	0
F1107	Start standby frequency	0.05-60.0Hz	0.01Hz	5

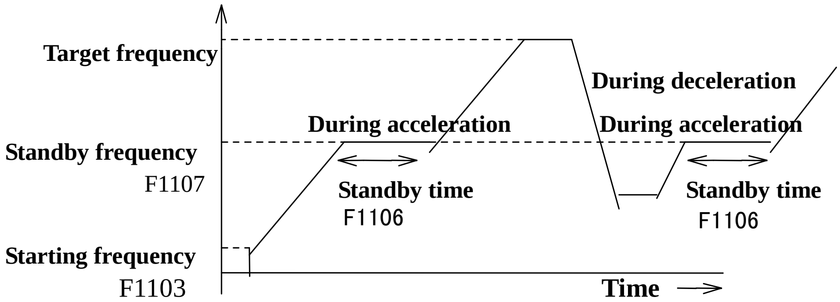
● In the F1106, if a value other than 0 is set, when the frequency set by F1107 is reached by acceleration, the frequency increase can be locked only by using the time set by F1106 (output frequency standby)

Note 1: This function is inactive when the acceleration/deceleration curve is S-shaped curve (F1010 = 2).

Note 2: If the starting frequency setting is higher than standby frequency, use the starting frequency to realize standby.

Note 3: If target frequency is lower than the standby frequency, standby action will not be executed.

Note 4: Standby action will not be executed during deceleration.



F1108 Restart after momentary power failure

Whether the inverter resumes operation after it stops due to a momentary power failure can be specified using this function. This function works properly only after a momentary power failure. If the duration of the power failure is longer, correct action can not be made as the control power supply is lost, as shown in the following table.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1108	Restart after momentary power	0: Do not restart 1: Restart 2: Compensation for momentary power failure	1	0

F1108	Short time power failure (momentary failure)			Long power failure (Re-start of the inverter)		
	Operation panel	External terminals		Operation panel	External terminals	
		Operation signal	No operation signal		Operation signal	No operation signal
0: No restart	No restart	No restart	No restart	No restart	Restart	No restart
1: Restart	Restart※1	Restart※1	No restart	No restart	Restart	No restart
2: Restart	Restart※1	Restart※1	No restart	No restart	Restart	No restart

The restart marked with ※1 means that the inverter starts in the flying start mode after a momentary power failure.

- When “F1108=2” is selected, the Momentary Power Failure Compensation function is enabled to prolong the operation time of the inverter even in the event of a power failure. The Momentary Power Failure Compensation function detects a drop in the input voltage, and reduces the output frequency and voltage of the inverter before any alarm trip, and uses the energy regenerated from the motor to keep it operating for longer.

Note 1**: The Momentary Power Failure Compensation function works when** F1001**: the motor control mode is** V/f **control or speed control** (F1001=1, 2, 3)**.**

Note 2**: While the Momentary Power Failure Compensation function is working, the output frequency of the inverter is reduced. Use this function for loads, of which the frequency reduction is allowable.**

Note 3**: Restart after momentary power failure for** F1108 = 2 **has the same “restart” effect as for** F1108 = 1**.**

Note 4**: In the** PID **control, sometimes the Momentary Power Failure Compensation function can not be fully functional as a result of the effects of PID gain setting value and the system response speed.**

Note 5**: Output voltage** AVR **function is needed to execute the Momentary Power Failure Compensation function in** V / f **control mode. Therefore, to use this function, please set the reference voltage to** F1005≠0

F1109 Allowed motor rotation direction

This function is used to restrict the rotation of the motor to a fixed direction for safety reasons etc.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1109	Allowed motor rotation direction	1: Forward reverse run 2: Forward run only 3: Reverse run only	1	1

Note 1: The terms "forward run" and "reverse run" and the actual motor shaft rotation direction changes depending on the motor structure and inverter connection method. For the inverter, when the "forward run" or "reverse run" command is given, the user should confirm it directly during test run.

Note 2: The rotation direction of Drive key on the operation panel is determined by F1110.

F1110	Direction of rotation of motor (set from operation panel)

Set the rotation direction at the Drive key on operation panel.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1110	Motor rotation direction (set from operation panel)	1: Forward run 2: Reverse run	1	1

Note: Use F1109 **to fix the motor rotation direction.**

F1111	Braking method

A function for selecting the stop mode when a stop signal is input.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1111	Braking method	1: Deceleration to stop 2: Deceleration to stop + DC braking 3: Free run stop	1	1

Chapter 7

- Deceleration to stop

  A normal stop method for reducing output frequency according to the settings of acceleration/deceleration curve (F1010) and the deceleration time (F1016 - F1019).
- Deceleration to stop + DC braking

  Similar to the case of F1111 = 1, this method is used to reduce the output frequency to the time point below DC braking start frequency (F1112); DC braking quickly stops the motor which is working. The DC braking time and DC braking force are determined according to F1113 and F1114.
- Free run stop

  Turn OFF all drive signals of the switching device at the time when a stop signal is sent to put the motor in free run state.

F1112	DC braking start frequency
F1113	**DC braking time**
F1114	**DC braking force**

A function for setting DC braking start frequency and action time and braking force when braking.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1112	DC braking start frequency	0.05-20Hz	0.01Hz	0.5
F1113	DC braking time	0.1 -10 sec.	0.1 s	2
F1114	DC braking force	1-10	1	5

- If F1111 = 2, the output frequency drops as the stop signal is input, DC braking starts at the time point where the value is below the frequency set by F1112.
- When F1111=2, the starting frequency (F1103) is inactive during braking. When output frequency drops to the DC braking start frequency (F1112), the DC braking starts.
- For DC braking action at starting means that the DC braking starts after the operation signal has met the starting conditions, and then the motor will be started by starting frequency. In this case, the action time and braking force are the setting values of F1113 and F1114. See also F1102 for Dc braking action at starting.
- After the operation signal has been input, if the set frequency is below the operation start frequency or DC braking

start frequency, the following actions will be executed according to the magnitude relation between operation start frequency and DC braking start frequency.

① Operation start frequency ≥ DC braking start frequency.

If the set frequency is lower than the DC braking start frequency, even if it is higher than DC braking start frequency, the output frequency will be decreased to DC braking start frequency, and then DC braking starts.

② Operation start frequency ＜ DC braking start frequency.

- Even if the set frequency is lower than DC braking start frequency, as long as it is greater than the operation start frequency, the operation will continue.
- When the output frequency is higher than DC braking start frequency, even if the set frequency is lower than the operation start frequency, like in ①, the output frequency will be decreased to DC braking start frequency, and then DC braking starts.
- When the output frequency is lower than DC braking start frequency, if the set frequency is lower than the operation start frequency, then DC braking will start immediately.

● During DC braking, if the  key is pressed again, the DC braking will be released.

● During DC braking in stopped state, if the operation signal is input, then the operation will be restarted in the normal operation order.

Note 1: F1113 **and** F1114 **are active only in V/f mode** (F1001=1, 40)**. In speed control mode** (F1001=2, 3, 10, 11)**, the setting of** F6005-F6008 **is equivalent to this setting.**

Note 2**: During** DC **braking, the motor tends to be over-heated as there is no self-cooling effect caused by motor rotation. Therefore, the** DC **braking force should be set to a smaller value, and it is recommended to set the value within the range in which the motor does not overheat or to install a temperature limiting relay on the motor.**

Note 3**: If the increase in** DC **braking force is ineffective, the possible reason is that current limiting function is activated by overcurrent caused by some reason.**

F1115 Duty cycle of brake resistor

A function for setting utilization rate of a brake resistor. The value shall be set within the allowable utilization rate of the brake resistor.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1115	Duty cycle of brake resistor	0: No brake resistor 2-25%ED 98: No discharge resistor protection (with discharge *1) 99: External brake unit	1%ED	*2

Note: In case of braking through an external circuit, please set F1115 = 99**.**

***1 Since the protection actions will not be executed when** F1115 = 98**, the discharge resistor and the device may be damaged. Please note this when setting.**

***2 The representative parameters that are suitable for various models have been input.**

When setting F1115 = 2-25, if it is judged that excessive current will flow in the brake resistor for a long time, in order to prevent the brake resistor connected from burning damage, the actions of braking circuit drive element shall be stopped in a certain period of time.

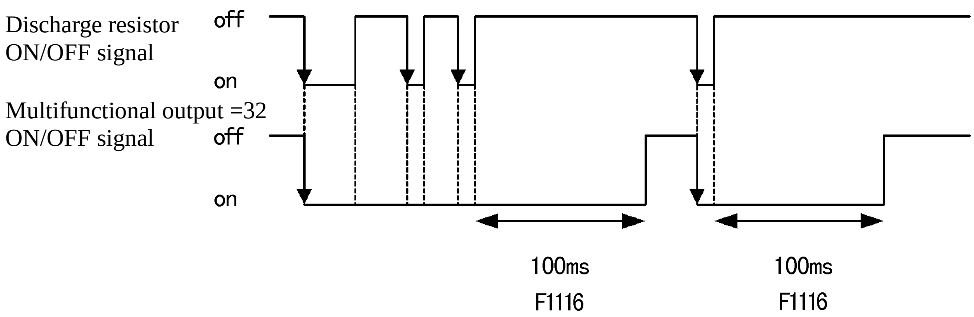
F1116 Discharge resistor on signal output time

This function is used to output signals from a multifunctional output terminal for the time set with F1116 when the discharge resistor for regenerated power discharge is turned on.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1116	Discharge resistor on signal output time	0.01 -10 sec.	0.01 s	0.1

- Set one of F1509-F1511 to“32” for the multifunctional output terminal setting. The discharge resistor on signal is output from the terminal which is set to“32”.
- During regenerated energy discharge, the discharge resistor switches between ON and OFF very quickly and repeatedly. The Discharge Resistor on Signal function facilitates the measurement of this high-speed on/off operation with a narrow pulse width in external equipment. The narrow pulse width of the on/off operation is expanded by the time set with F1116 and output by a multifunctional output terminal.

Example) When the Discharge Resistor on Time F1116=0.1 (s).



Display Function

F1201 Monitor display selection

A function for switching the display contents of operation panel.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1201	Monitor display selection	1: Frequency (Hz) 2: Output current (A) 3: Speed (rpm) 4: Load factor (%) 5: No unit display	1	1

- The change of the display value and display method in stopped state, standby state as well as operating state is shown in the following table.

F1201	Stopped	Standby/Operating
1	Flashing output frequency	Normally-on output frequency
2	Flashing 0 [A]	Normally-on output current
3	Flashing speed (□1)	Normally-on speed (*1)
4	Flashing 0 [%]	Normally-on load factor
5	The output monitor can be changed using F1202.	

（*1）The display contents may vary depending the motor control mode. The display contents are as shown in the table below.

Motor control mode	In operation (operating)	Stopped
Sensorless vector control	Estimated speed of motor	0
Others（V/f·vector）	Detecting speed of PG sensor	Detecting speed of PG sensor

Note: By using F1603, this code can be set even when the operation function is locked.

F1202 State display selection

This function is used to select output data displayed on the 7-segment monitor on the operation panel in No-Units Display mode.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1202	State monitor display selection	1: No unit (multiple of F1203) 2: Output voltage [V] 3: DC voltage [V] 4: Active power [kW] 5: Apparent power [kVA] 6: Radiator temperature [□] 7: Command speed [rpm] 8: PID1 feedback value [Hz] 9: PID2 feedback value [Hz] 10: VIF1 analog input value [Hz] 11: VIF2 analog input value [Hz] 12: VIF3 analog input value [Hz] 13: Output torque [%] 14: Partial excitation current [A] 15: Partial torque current [A] 16: Detecting position [mm] 29: Command frequency (Hz) 30: Command torque [%]	1	1

- Output voltage: the output voltage of inverter.
- DC voltage: the value of DC voltage applied to the inverter.
- Active power: the actual power consumed on load.
- Apparent power: the apparent power is used for displaying inverter output.
- Radiator temperature: internal radiator temperature.
- Command speed: the speed given by a command.
- PID feedback value: the feedback value of PID control.
- VIF analog input value: an analog signal value generated by voltage or current.
- Command frequency: the frequency given by a command.

The following display contents is shown only when the value of F1001 = 2, 3, 4, 5, 6.

- Output torque: ratio of output torque to the rated torque.
- Partial excitation current: the current value for providing motor excitation.
- Partial torque current: the current value for providing motor torque.
- Command torque: the torque given by a command.

The following display contents is shown only when the value of F1001 = 6.

- Detecting position: the detecting position in position control.(Option)

* When three detecting positions are selected, even if the positioning is finished, " ZEro. " will not be displayed.

F1203 Multiple for no-units display

This function is used when No-Units Display mode is displayed on the 7-segment monitor on the operation panel. This function is used for setting the multiple which is multiplied with output frequency when F1202 = 1 (no-units display) .

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1203	Multiple for no-units display	0-100	0.01	1

- This function is used in applications where linear velocity etc. is displayed in a simple way.

Auxiliary functions

F1301 1st jump bottom frequency

F1302 1st jump top frequency

F1303 2nd jump bottom frequency

F1304 2nd jump top frequency

F1305 3rd jump bottom frequency

F1306 3rd jump top frequency

For the inverter-driven motor, resonance generated in the co-ordination between output frequency (speed) and the mechanical system produce larger vibration and noise, and the power frequency hopping sometimes cause the change in output voltage. In this case, the frequency which generates mechanical vibration and voltage change will be jumped during operation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1301	1st jump bottom frequency	0-600Hz	0.01Hz	0
F1302	1st jump top frequency	0-600Hz	0.01Hz	0
F1303	2nd jump bottom frequency	0-600Hz	0.01Hz	0
F1304	2nd jump top frequency	0-600Hz	0.01Hz	0
F1305	3rd jump botomm frequency	0-600Hz	0.01Hz	0
F1306	3rd jump top frequency	0-600Hz	0.01Hz	0

- Three different frequencies to skip can be specified.
- The frequency jumps between the top frequency and bottom frequency set by F1301-F1306. However, no jump occurs during acceleration/deceleration.

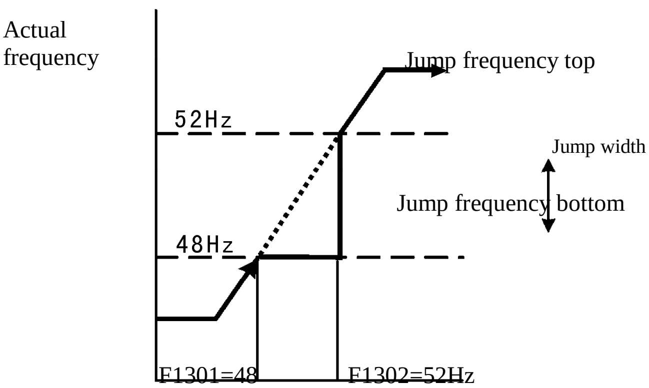
Example 1) F1301=48Hz and F1302=52Hz.

1) If the target frequency is set to 51Hz: the inverter continues to operate at 48Hz.

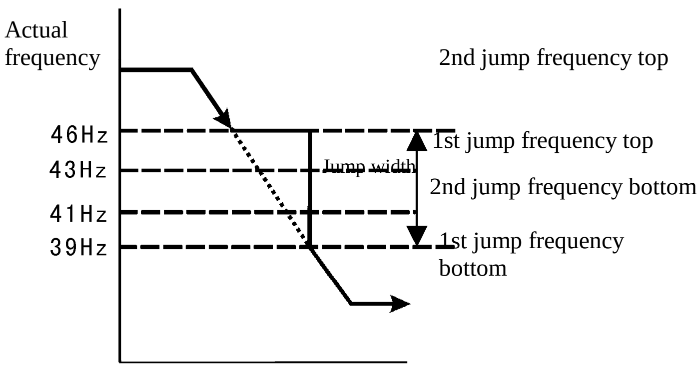
2) If the target frequency is set to 53Hz: normal acceleration skips 48-52Hz and reaches 53Hz at which the inverter continues to operate.

Example 2) F1301=39Hz, F1302=43Hz, F1303=41Hz and F1304=46Hz.

Jump frequencies are combined, and the range from 39-46Hz is skipped.



Example 1



Example 2

- The 1st, 2nd and 3rd jump frequencies can be set independently, for example, 2nd jump frequency> 1st jump frequency> 3rd jump frequency.

- The top value and the bottom value of a jump frequency can not be reversely set. Therefore, when setting the top value or the bottom value, set the values in the correct order so that the top and bottom values are not reversed. (Because in the initial settings, both the top and bottom values are specified as 0, setting the bottom value first will cause an error, such setting is prohibited.)

- When the upper frequency limit (F1007) or the lower frequency limit (F1008) is set within the jump frequency band, the frequency will jump within the range of the upper frequency limit and lower frequency limit.
- Setting a jump frequency band that includes both the upper frequency limit (F1007) or highest frequency and the lower frequency limit (F1008) is prohibited for safety reasons.

F1307 Auto alarm recovery

This function code automatically specifies whether the inverter restarts after the inverter is tripped by protection function due to overcurrent or overvoltage.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1307	Auto alarm recovery	0: No auto reset function 1: Auto reset function	1	0

- The inverter restarts in the flying start mode. And, the alarm relay does not work when the inverter is restarted.
- If three consecutive trips occur in 10 seconds, the status of 3rd trip alarm will be kept, and the alarm relay works.
- When an alarm for which auto reset is possible occurs during standby and then is released, the reset method depends on the status at that time.
  Standby: Keeps standby.
  If operation conditions are established: Setting of starting frequency is inactivated by flying start.
- When an alarm for which auto reset is possible occurs during deceleration caused by the stop signal and then is released, auto reset is performed in the alarm stop status. But operation is not restarted.
- Auto reset is possible with the following alarms:

oCH	Abnormal main switching device temperature
oCA	Overcurrent during acceleration
oCn	Overcurrent during constant speed
oCd	Overcurrent during deceleration
oCPA	Short-time overload during acceleration
oCPn	Short-time overload during constant speed
oCPd	Short-time overload during deceleration
ouA	Overvoltage during acceleration
oun	Overvoltage during constant speed
oud	Overvoltage during deceleration

F1308 Instability elimination

When the inverter is used to drive a motor, the dead time to protect a switching device from a short circuit may make the current unstable. If the current becomes unstable, the motor may generate vibration or abnormal noises. In addition, compared with the stable current, the current value may become greater. The instability elimination function is used to avoid this problem.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1308	Instability elimination	0-20	1	0

- The larger the value specified, the greater the compensation. Therefore, increase the value gradually to set the value at which instability is eliminated.

F1309 Operation direction switching in V / f control mode

This function specifies the action for operation direction switching in V / f control mode.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
1309	Operation direction switching in V / f control mode	0: Start from the direction opposite to current direction after a stop 1: Continuous operation	1	0

- When F1309 = 0, the start and stop-related functions are executed in accordance with the values of the function codes. The operation stops according to the function code. Then, the operation immediately starts from the direction opposite to current direction in accordance with the setting value of the function code. However, when switching the direction of operation, neither the DC braking in stopped state nor the DC braking at start works.
- When F1309 =1, regardless of function codes related to start or stop, acceleration will be executed consecutively in opposite direction after deceleration. When switching the direction of operation, the output frequency is continuously variable and the rotation direction can be switched smoothly.

Note 1: **When** F1309=0, **the stop or start is executed in the mode specified by the function code. Therefore, the output frequency near** 0Hz **is not continuously variable. And, because** DC **braking is executed, if the starting frequency or** DC **braking start frequency is set with a too big value, motor vibration and overcurrent alarm may occur.**

Note 2: **When reverse run speed tracking function is set, regardless of the setting of** F1309, **rotation direction switching is a continuous action.**

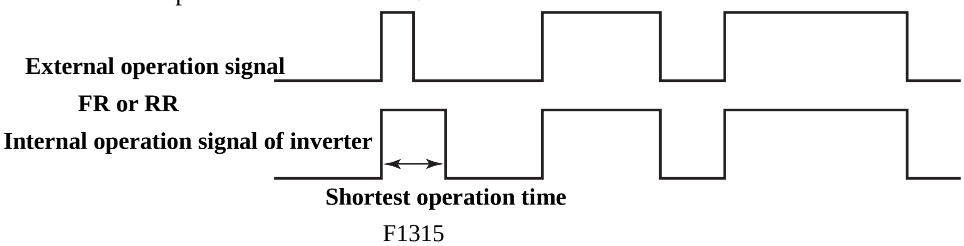
Note 3: **In speed control mode, regardless of the setting of** F1309, **rotation direction switching is a continuous action**.

F1315 Shortest operation time function

Even when a brief operation signal is input via an external control terminal, this function holds the operation command for the time set by the shortest operation time function.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1315	Shortest operation time function	0 - 99.99 sec.	0.1 s	0

- During operation by the external control terminal, the function defines the minimum ON width for the input signal of multifunctional input terminal FR or RR. In other words, the function starts counting when the input signal turns on, and the signal is assumed to remain on for the duration of the count even if the multifunctional input terminal FR or RR is set to off. After the time set by F1315, the inverter operates again according to the current status of multifunctional input terminal FR or RR.



Note 1: **If the time setting of** F1315 **is changed while the shortest operation time function is counting the time, the new value will become active from the next time.**

Note 2: **This function is active only when operation command selection:** F1101=2.

F1316 2nd Upper frequency limit

F1317 3rd Upper frequency limit

A function for setting the upper limit of output frequency. If 2MAX is set to ON using multifunctional input terminals (F1414 - F1421), then the 2nd Upper frequency limit will be used to limit frequency, if 3MAX is set to ON, then 3rd Upper frequency limit will be used. If both of them are set to ON, then the upper frequency limit of F1007 will be used for limiting frequency.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1316	2nd Upper frequency limit	5- 600Hz	0.01Hz	60
F1317	3rd Upper frequency limit	5-600Hz	0.01Hz	60

F1318 Cooling fan ON/OFF control

This function is used to select the action of cooling fan for cooling inverter.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1318	Cooling fan ON/OFF control	0: ON/OFF control 1: Normally ON	1	0

- When ON/OFF control is selected, fan ON/OFF control will be automatically executed according to the radiator temperature.

  Note: In power-on test after the fan has been replaced, check that the fan is set to normally ON.

F1319 Functions corresponding to high altitude areas

In high altitude areas, due to the unit cooling capacity, the current derating rate of parts and other reasons, it is recommended to use Larger inverters by one rank. However, when used in high-altitude areas of more than 1,000m above sea level, the rated current can be derated, and this function should be used for selecting suitable altitude where applicable.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1319	Functions corresponding to high altitude areas	1: 1,000m or below 2: 1,000-1,500m or below 3: 1,500-2,000m or below 4: 2,000-2,500m or below 5: 2,500-3,000m	1	1

- The current derating rate of inverter for each altitude range is as shown below.

Content	Current derating rate
1,000m or less	1
1,000 - 1,500m or below	0.966
1,500 - 2,000m or below	0.925
2,000 - 2,500m or below	0.900
2,500-3,000m	0.876

F1320 Rating selection

A function which changes the rating to mode A for heavy load or mode B for light load.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1320	Rating selection	1: Mode A (heavy load) 2: Mode B (light load)	1	1

- Mode A (heavy load) allows an overload capacity of 150% per minute.
- Mode B (light load) allows an overload capacity of 120% per minute.

  Note: If the mode is switched by specification selection, then the relevant function codes shall be initialized.

  e.g.) F1009, F1701, F1704, F5001, F6001 and F6102.

Input/output-related function

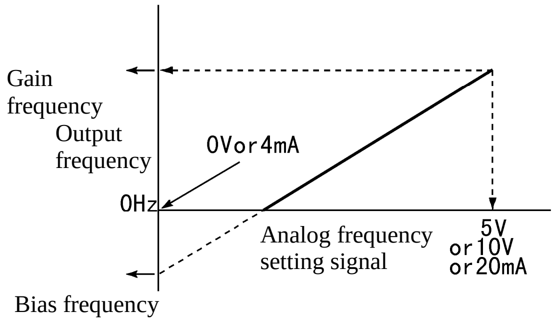
The function blocks of input and output terminals of the inverter control circuit are described as follows.

F1401	**Bias frequency (VIF1)**
F1402	**Gain frequency (VIF1)**
F1403	**Bias frequency (VIF2)**
F1404	**Gain frequency (VIF2)**
F1405	**Bias frequency (VIF3)**
F1406	**Gain frequency (VIF3)**

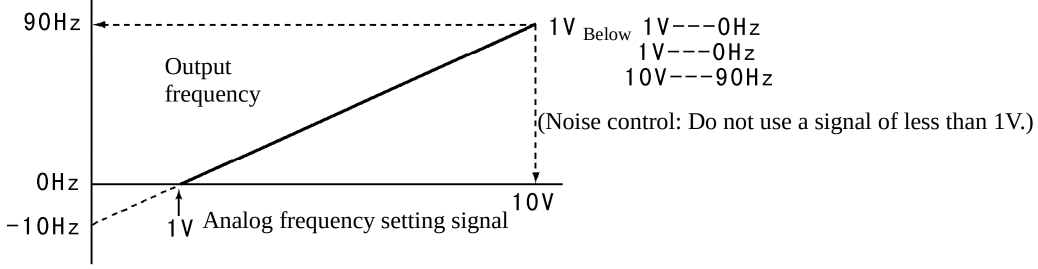
In case of setting output frequency using the analog signal, these functions are used to set a frequency (bias frequency) corresponding to minimum analog signal value (0V or 4mA) and a frequency (gain frequency) corresponding to maximum value (5V or 10V and 20mA).

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1401 F1403 F1405	Bias frequency (VIF1) Bias frequency (VIF2) Bias frequency (VIF3)	0-±600Hz (frequency at 0V or 4mA) In case of negative value, -XXXX will be displayed.	0.1Hz	0
F1402 F1404 F1406	Gain frequency (VIF1) Gain frequency (VIF2) Gain frequency (VIF3)	0-±600Hz (frequency at 5V or 10V or 20 m) In case of negative value, -XXXX will be displayed.	0.1Hz	60

The relation between the analog frequency setting signal (VIF1-VIF3) and the inverter output frequency is shown as follows.



Setting example: When F1401 =- 10.0 (-10Hz), F1402 = 90.0 (90 Hz), and F1002 = 3 (frequency setting VIF1: 0 - 10V), the output frequency is as shown below.



- By taking advantage of bias and gain frequencies, a common analog signal for frequency commands can be input to more than one inverter for proportional operation.
  Example) Input 0 - 10V analog signals to two inverters, so that 1st and 2nd inverters deliver output frequencies with a ratio of 1:2 for the purpose of proportional operation.
  Setting of 1st inverter: F1401=0.0（0 Hz）,
  F1402=50.0（50 Hz）
  Setting of 2nd inverter: F1401=0.0（0 Hz）,
  F1402=100.0（100 Hz）
  (Adjust the acceleration/deceleration time as required.)
  Note 1: **In negative setting frequency field, the output frequency is** 0 Hz.
  Note 2: **For** PID **control, the bias and gain frequencies apply to the feedback signal.**

F1407	**External analog input filter time constant (VIF1)**
F1408	**External analog input filter time constant (VIF2)**
F1409	**External analog input filter time constant (VIF3)**

Functions for setting the filter time constant of external analog signal input.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1407 F1408 F1409	External analog input filter time constant (VIF1) External analog input filter time constant (VIF2) External analog input filter time constant (VIF3)	1-500（set value 1=10ms）.	1（10ms）	10

If interference is detected in external analog signals, adjust the external analog input filter time constant.
Set the time constant to N × 10 ms (N = 1 to 500), the setting range is 10 to 5,000 ms.
Filters can be assigned to VIF1, VIF2 and VIF3 independently.

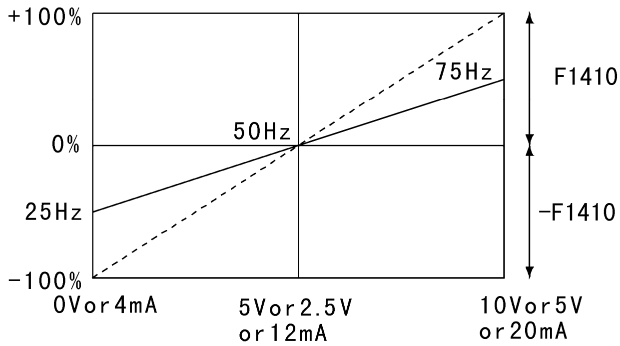
F1410	**Set frequency gain**
F1411	**Analog input switching for set frequency gain**

Using an external analog input terminal, the gain is adjustable when setting frequency.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1410	Set frequency gain	0～100%	1%	0

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1411	Analog input switching for set frequency gain	0: No analog input 1: External analog VIF1 voltage (0-5 V) 2: External analog VIF1 voltage (0-10V or potentiometer) 3: External analog VIF2 voltage (0—5 V) 4: External analog VIF2 voltage (0-10V or potentiometer) 5: External analog VIF3 voltage (0-5 V) 6: External analog VIF3 voltage (0-10V or potentiometer) 7: External analog VIF1 current (4—20mA) 8: External analog VIF2 current (4—20mA) 9: External analog VIF3 current (4-20mA)	1	0

- When several inverters are used for proportional operation, this function is useful for fine adjustment of the command frequencies of the inverters from the master to the slave.
- The external analog input terminal is switched with F1411 (Analog input switching for set frequency gain).
- Use F1410 as the set frequency value for proportional operation.
  Example 2) When the set frequency is 50Hz, F1410 = 50%, if the external analog input is 0 - 10V



VIF1 **or** VIF2 **or** VIF3 **input**

· 0V: 50Hz - (50Hz × 50%) = 25Hz.
· 5V: 50Hz - (50Hz × 0%) = 50Hz.
· 10V: 50Hz + (50Hz × 50%) = 75Hz.

F1412 MBS terminal input mode

This function is used to select the input signal action of multifunction input terminal MBS.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1412	MBS terminal input mode	1: Level triggered 2: Edge triggered	1	1

Edge operation will accept MBS input once between OFF and ON

F1413	ES input terminal function

This function can be used for switching the function of control input terminal “ES”.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1413	ES input terminal function	1: NO external thermistor signal 2: NC external thermistor signal	1	1

The function shall be switched according to the contact type.
F1413=1: ES terminal (external thermistor input terminal) is connected with an NO (normally open) contact.
F1413=2: ES terminal (external thermistor input terminal) is connected with an NC (normally closed) contact.

F1414	Selection of input terminal DI1
F1415	Selection of input terminal DI2
F1416	Selection of input terminal DI3
F1417	Selection of input terminal DI4
F1418	Selection of input terminal DI5
F1419	Selection of input terminal DI6
F1420	Selection of input terminal DI7
F1421	Selection of input terminal DI8

These functions are used to assign functions to the digital multifunctional input terminals DI1 - DI8 arbitrarily through data selection.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1414	Selection of input terminal DI1	0： 0: Unused 1: FR 2： RR 3： 2DF 4： 3DF 5: MBS 6： ES 7： RST 8： AD2 9： AD3 10： JOG 11： 5DF 12： 9DF 13： FR+JOG 14： RR+JOG 15： FR+AD2 16： RR+AD2 17： FR+AD3 18： RR+AD3 19： FR+2DF 20： RR+2DF 21： FR+3DF 22： RR+3DF 23： FR+2DF+3DF 24： RR+2DF+3DF 25： FR+AD2+2DF 26： RR+AD2+2DF 27： FR+AD2+3DF 28： RR+AD2+3DF 29： FR+AD2+2DF+3DF 30： RR+AD2+2DF+3DF 31： FR+AD3+2DF 32： RR+AD3+2DF 33： FR+AD3+3DF 34： RR+AD3+3DF 35： FR+AD3+2DF+3DF 36： RR+AD3+2DF+3DF 37： PTR 39： FR+5DF 40：HD 45: CP (Option) 46： CCL 47： PC (Option) 57： P0 58： FR+CCL 59： FR+RCCL 64： FR+MBS 65： RR+MBS 67： 2DF+AD2 68： 2DF+AD3 69： 3DF+AD2 70： 3DF+AD3 71： A×10 (Option) 72: A×100 (Option) 74： 2MAX 75： 3MAX 76： VFPID 77： PIDLCK 83： For factory adjustment 84： S2 85： PIDL 86： PIDH 87： RPID1 88： PID1EX 89： PID2EX 91： IHOLD 92： ICLEAR 109： RCCL 114：1DFA 115： 1DFB 116: 1DFA+1DFB 117： ROPE 118：RCOM 119： ROPE+RCOM 120: 1DFA+ROPE 121： 1DFB+RCOM 122：1DFA+1DFB+ROPE+RCOM 253-255: For factory adjustment	1	1
F1415	Selection of input terminal DI2			2
F1416	Selection of input terminal DI3			3
F1417	Selection of input terminal DI4			4
F1418	Selection of input terminal DI5			5
F1419	Selection of input terminal DI6			6
F1420	Selection of input terminal DI7			7
F1421	Selection of input terminal DI8			8

Digital multifunctional input terminals DI1 - DI8 can be set into any one of the functions by using the corresponding function codes F1414 - F1421.
Also, for multiplexed terminal, several functions can be input to one terminal.
For example, if F1414=13, Jog operation can be realized by connecting DI1 terminal.

Table 7-1 Multifunctional input codes

Function code No.	Input terminal name	Data range	Initial value (symbol)
F1414	DI1	0-255	1 （FR）
F1415	DI2		2 （RR）
F1416	DI3		3 （2DF）
F1417	DI4		4 （3DF）
F1418	DI5		5 （MBS）
F1419	DI6		6 （ES）
F1420	DI7		7 （RST）
F1421	DI8		8 （AD2）

Table 7-2 Multifunctional input signals

Data No.	Symbol	Function	Data No.	Symbol	Function
0	—	Unused terminal	40	HD	Operation signal hold command
1	FR	Forward run command	45	CP	Command pulse blocking signal (option)
2	RR	Reverse run command	46	CCL	Deviation counter clear signal
3	2DF	Multi-speed command 1	47	PC	P control signal
4	3DF	Multi-speed command 2	57	P0	Zero speed command
5	MBS	Free run command	58	Multiplexed terminal	FR+CCL
6	ES	External abnormal stop command	59	Multiplexed terminal	RR+CCL
7	RST	Alarm reset command	64	Multiplexed terminal	FR+MBS
8	AD2	2nd, 4th acceleration/deceleration command or up terminal	65	Multiplexed terminal	RR+MBS
9	AD3	2nd, 4th acceleration/deceleration command or down terminal	67	Multiplexed terminal	2DF+AD2
10	JOG	Jog operation command	68	Multiplexed terminal	2DF+AD3
11	5DF	Multi-speed command 3	69	Multiplexed terminal	3DF+AD2
12	9DF	Multi-speed command 4	70	Multiplexed terminal	3DF+AD3
13	Multiplexed terminal	FR+JOG	71	A×10	Electric gear ×10 (option)
14	Multiplexed terminal	RR+JOG	72	A×100	Electric gear ×100 (option)
15	Multiplexed terminal	FR+AD2	74	2MAX	2nd Upper frequency limit selection □1
16	Multiplexed terminal	RR+AD2	75	3MAX	3rd Upper frequency limit selection □2
17	Multiplexed terminal	FR+AD3	76	VFPID	V/f-PID control switching terminal
18	Multiplexed terminal	RR+AD3	77	PIDLCK	PID control locking terminal
19	Multiplexed terminal	FR+2DF	83		For factory adjustment
20	Multiplexed terminal	RR+2DF	84	S2	2nd S-shaped acceleration / deceleration time command
21	Multiplexed terminal	FR+3DF	85	PIDL	PID switching terminal (PIDL)
22	Multiplexed terminal	RR+3DF	86	PIDH	PID switching terminal (PIDH)
23	Multiplexed terminal	FR+2DF+3DF	87	RPID1	PID1 reset terminal
24	Multiplexed terminal	RR+2DF+3DF	88	PID1EX	PID1 External terminal selection
25	Multiplexed terminal	FR+AD2+2DF	89	PID2EX	PID2 External terminal selection
26	Multiplexed terminal	RR+AD2+2DF	91	IHOLD	PID integral value hold terminal

27	Multiplexed terminal	FR+AD2+3DF	92	ICLEAR	PID integral value clear terminal
28	Multiplexed terminal	RR+AD2+3DF	109	RCCL	Deviation counter reverse run clear signal
29	Multiplexed terminal	FR+AD2+2DF+3DF	114	1DFA	1st speed frequency selection 1
30	Multiplexed terminal	RR+AD2+2DF+3DF	115	1DFB	1st speed frequency selection 2
31	Multiplexed terminal	FR+AD3+2DF	116	Multiplexed terminal	1DFA+1DFB
32	Multiplexed terminal	RR+AD3+2DF	117	ROPE	Control authorization selection 1
33	Multiplexed terminal	FR+AD3+3DF	118	RCOM	Control authorization selection 2
34	Multiplexed terminal	RR+AD3+3DF	119	Multiplexed terminal	ROPE+RCOM
35	Multiplexed terminal	FR+AD3+2DF+3DF	120	Multiplexed terminal	1DFA+ROPE
36	Multiplexed terminal	RR+AD3+2DF+3DF	121	Multiplexed terminal	1DFB+RCOM
37	PTR multiplexed terminal	Simple graph operation counter reset signal	122	Multiplexed terminal	1DFA+1DFB+ROPE+RCOM
39	Multiplexed terminal	FR+5DF	253-255	For factory adjustment	

*1 **When the terminal is set to** ON, F1316: **limits the frequency with the 2nd upper frequency limit.**

*2 **When the terminal is set to** ON, F1317: **limits the frequency with the 3rd upper frequency limit.**

F1422 **Reference frequency for pulse train input**

This function is used to set the input frequency corresponding to standard pulse train in order to convert output frequency when setting the output frequency through pulse train input (F1002 = 25).

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1422	Reference frequency for pulse train input	1,000～60,000Hz	1Hz	1,000

If F1002 = 25, then the pulse from the pulse input terminals (A +, A-) can be used as a command to set the target frequency of 1st speed frequency.

When pulse train input is selected, the following functions are inactive.
- · F8108 (PG pulse multiplication value): Regardless of the value, considered as × 1.
- · F8109 (PG switching): Regardless of the value, input of standard PG terminal.

Pulse train reference frequency (F1422) is a frequency within the reference frequency (F1006). Therefore, the inverter output frequency is calculated with the following formula:
Output frequency (1st speed frequency) = pulse train input frequency × reference frequency (F1006) / pulse train reference frequency (F1422).

Note 1: **Because the pulse train input and** PG **input terminal are in common use, speed is displayed as inactive in pulse train input selection. (The correct value is not displayed)**
Note 2: **Please input pulse train only into the** A +, A- **terminals.**
Note 3: 100,000Hz **is the limit of pulse train input frequency.**
Note 4: **The conversion error will be generated in the conversion of pulse train frequency and output frequency. In order to reduce the conversion error, please increase the pulse train input frequency.**

F1423 **Effective number of bits for VIF1 detection**

F1424 **Effective number of bits for VIF2 detection**

F1425 **Effective number of bits for VIF3 detection**

Functions for setting the resolution (effective number of bits) of external analog signal reading.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1423 F1424 F1425	Effective number of bits for VIF1 detection Effective number of bits for VIF2 detection Effective number of bits for VIF3 detection	8-12bits	1bit	12bits

This function is used to make the detection value of external analog signal stable and effective where interference exists in the external analog signal. And, if the effective number of bits is reduced, then the action in S-shaped acceleration/deceleration curve becomes more stable.

Effective number of bits for VIF1-3 detection = 8, when this value is set, 4 lower bits are inactive.
= 9, when this value is set, 3 lower bits are inactive.

= 10, when this value is set, 2 lower bits are inactive.
= 11, when this value is set, 1 lower bit is inactive.
= 12, when this value is set, no inactive bit.

Effective number of bits can be assigned to VIF1, VIF2 and VIF3 independently.

F1501	Internal analog output function 1
F1502	**Internal analog output coefficient 1**
F1503	**Internal analog output bias 1**
F1504	**Internal analog output function 2**
F1505	**Internal analog output coefficient 2**
F1506	**Internal analog output bias 2**

Functions for analog output (0-10V) of a variety of internal states of inverter between the control circuit terminal's analog output terminals AOUT1, AOUT2 and analog signal common terminal ACM.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1501 F1504	Internal analog output function 1 Internal analog output function 2	0：Inactive 1: Set frequency [Hz] 2: Output frequency [Hz] 3: PID1 feedback value [Hz] 4: PID2 feedback value [Hz] 5: Output current (A) 6: Output voltage [V] 7: DC voltage [V] 8: Radiator temperature [□] 9: Load factor [%] (accumulated value of the electric thermistor) 10: Load factor [%] (ratio to rated current) 11: VIF1 analog input value [V] 12: VIF2 analog input value [V] 13: VIF3 analog input value [V] 14: Speed [rpm] 15: Active power [kW] 16: Apparent power [kVA] 17: PID1 command value [Hz] 18: PID1 input deviation value [Hz] 19: PID2 command value [Hz] 20: PID2 input deviation value [Hz] 21-23: For factory adjustment 24: External PID1 output deviation value [Hz] 25: External PID2 output value [Hz] 26: For factory adjustment 35: Command frequency (Hz) 36: Command torque [%] 99: For factory adjustment	1	0
F1502 F1505	Internal analog output coefficient 1 Internal analog output coefficient 2	0-20	0.01	1
F1503 F1506	Internal analog output bias 1 Internal analog output bias 2	0-±10V	0.1V	0

The methods of conversion between output values of possible output analog signal from AOUT1 or AOUT2 terminal and actual values are shown in the table below.

F1501 F1504 Set value	Output signal content	Conversion method
0	No function	
1	Set frequency [Hz]	120Hz/10V
2	Output frequency [Hz]	120Hz/10V
3	PID1 feedback value [Hz]	120Hz/10V
4	PID2 feedback value [Hz]	120Hz/10V
5	Output current (A)	*1
6	Output voltage [V]	500V/10V
7	DC voltage [V]	500V/5V
8	Radiator temperature [□]	100□/8V
9	Load factor [%] (integral value of the electric thermistor)	100%/5V
10	Load factor [%] (ratio to rated current)	100%/5V
11	VIF1 analog input value [V]	4-20mA current input，20mA/10V 0-5V voltage input，5V/5V 0-10V voltage input，10V/10V
12	VIF2 analog input value [V]	
13	VIF3 analog input value [V]	
14	Speed [rpm]	1,800rpm/5V
15	Active power [kW]	10kW/10V
16	Apparent power [kVA]	10kVA/10V
17	PID1 command value [Hz]	120Hz/10V
18	PID1 input deviation value [Hz]	120Hz/10V
19	PID2 command value [Hz]	120Hz/10V
20	PID2 input deviation value [Hz]	120Hz/10V
24	External PID1 output deviation value [Hz]	120Hz/10V
25	External PID2 output deviation value [Hz]	120Hz/10V
35	Command frequency [Hz]	120Hz/10V
36	Command torque [%]	400%/10V（*1）

*1 **The positive and negative values of command torque are output with** 5V **as the center.**（0V=-200%, 5V=0%, and 10V=200%）

Note 1: **Maximum allowable current:** 15mA.

（But, the converted value is no-load output voltage. If the output current increases, the output voltage will decrease. In this case, the signal output can be adjusted using output coefficient.）

*1）**Inverter capacity and output current conversion methods**

Model	**Output current signal conversion method**	
	Mode A	**Mode B**
SVC06-0015 SVC06-0022	20A/10V	20A/10V
SVC06-0040	20A/10V	50A/10V
SVC06-0055 SVC06-0075	50A/10V	50A/10V
SVC06-0110	50A/10V	100A/10V
SVC06-0150 SVC06-0185	100A/10V	100A/10V
SVC06-0220	100A/10V	250A/10V
SVC06-0300 SVC06-0370 SVC06-0450	250A/10V	250A/10V
SVC06-0550	250A/10V	500A/10V
SVC06-0750 SVC06-0900	500A/10V	500A/10V
SVC06-1100	500A/10V	750A/10V
SVC06-1320 SVC06-1600 SVC06-1850	750A/10V	750A/10V
SVC06-2000 SVC06-2200	750A/10V	1, 000A/10V
SVC06-2500	1, 000A/10V	1, 000A/10V

Output signals can be increased or decreased by the internal analog output coefficients F1502 and F1506. If the output signal from the AOUT1 or AOUT2 terminal is not of an adequate level, the signal level can be adjusted by setting the internal analog output coefficient.

F1502: Coefficient for F1501 (Internal Analog Output Function 1)

F1505: Coefficient for F1504 (Internal Analog Output Function 2)

Note 2: **If the coefficients of** F1502 **and** F1505 **are smaller than 1, the output signals are decreased.**

Bias voltage can be set for each output signal using F1503 or F1506 (internal analog output bias).

Although the negative bias voltage setting is possible, the output signal voltage will be 0V where the output signal voltage is negative.

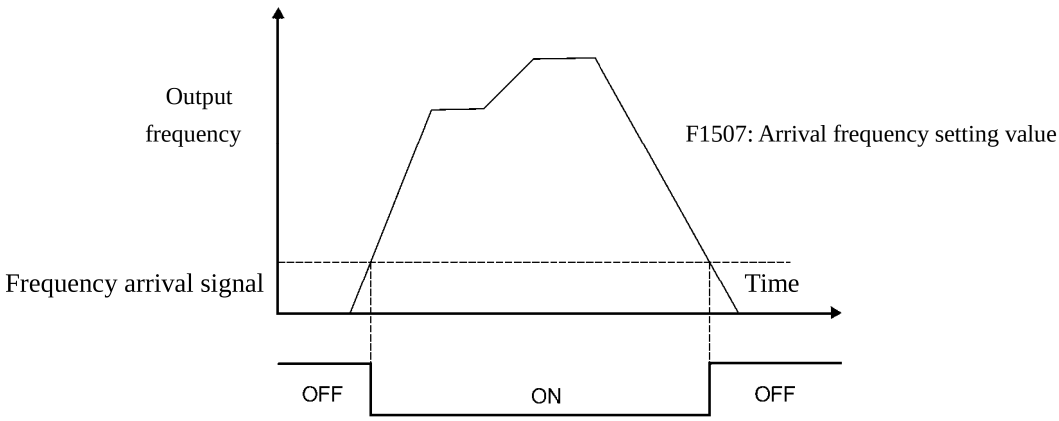
Note 3: **The** PID **controlled variables are output in the form of absolute value. In case of negative value, the output will be positive.**

F1507	Arrival frequency

This function specifies the frequency at which a frequency arrival signal is output.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1507	Arrival frequency	0-600Hz	0.01Hz	10

If the value of any one of F1509 – F1511 is 7 (frequency arrival), the signal is output from control circuit output terminals DO1 to DO3 when the output frequency exceeds the value of F1507.”
Similarly, If the value of F1513 is 7 (frequency arrival), the signal is output from control circuit relay output terminals FA1, FB1 or FC1 when the output frequency exceeds the value of F1507.”



F1508	Frequency matching range

This function specifies the out frequency band corresponding to the frequency matching signal.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1508	Frequency matching range	0-10Hz	0.01Hz	0

If the value of any one of F1509 – F1511 is 5, 6, 14 or 15, the signal is output from control circuit terminals DO1 to DO3 when the output frequency falls within the value range between ±F1508.”
Similarly, for F1513, the signal is output from control circuit relay output terminals FA1, FB1 or FC1.

Note: When the frequency is specified using an analog signal, an appropriate setting should be specified using F1508 **to prevent frequency matching signal from chattering. When the vector control is active, the output frequency constantly changes. Set** F1508 **to several** Hz.

F1509	Selection of output terminal DO1
F1510	Selection of output terminal DO2
F1511	Selection of output terminal DO3

This function is used to select the required function from the multifunctional output terminals DO1-DO3 of control circuit terminals to execute open-collector output.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1509 F1510 F1511	Selection of output terminal D01 Selection of output terminal D02 Selection of output terminal D03	0: Unused 1: In operation 1 2: Undervoltage 3: End of simple scheduled operation 4: In operation 2 5: Frequency matching (1st speed frequency) 6: Frequency matching (1st to 16th speed frequencies) 7: Frequency approach 8: Overload alarm level setting signal (the value of F1704) 9: Electric thermistor pre-alarm signal (80% electric thermistor) 10: Radiator overheat pre-alarm signal 13：Excitation and DC braking signals 14：Lower frequency limit matching signal 15：Upper frequency limit matching signal 16: Servo on ready signal 17: Zero servo completion signal 18：FR signal 19：RR signal 20：2DF signal 21：3DF signal 22：5DF signal 23：9DF signal 24：AD2 signal 25：AD3 signal 26：JOG signal 27：MBS signal 28：ES signal 29：RST signal 31: Positioning completion signal 32: Discharge resistor on signal 34: Frequency counter (output frequency) (*1) 35: Frequency counter (command frequency) (*1) 36: Overload alarm level setting signal (Including when in acceleration/deceleration) 42: Torque matching signal 43: Low speed detection signal 47: Speed counter (□1) 48: Forward run detection signal 49: Reverse run detection signal	1	1 5 8

*1 **Can not be used together with the current output function. When outputting frequency counter, set** F1515 = 0 **to disable the current output function.**

Table 7-3 Multifunctional output signals

Data No.	Function	Action
0		Unused terminal.
1	In operation 1	Inverter in operation (gate signal on) on
2	Undervoltage	Undervoltage alarming ON.
3	End of simple scheduled operation	On when simple scheduled operation ends
4	In operation 2	Inverter in operation (except DC braking and exciting) is (gate signal on) on
5	Frequency matching (1st speed frequency) （*3）	ON when the output frequency is equal to target frequency during 1st speed operation.
6	Frequency matching (1st-16th speed frequencies) （*3）	ON when the output frequency is equal to target frequency during 1st-16th speed operations.
7	Frequency arrival (*3)	Output frequency is F1507: On when the arrival frequency is exceeded.
8	Overload alarm level setting signal (the value of F1704)	Load status during normal operation is F1704: On when the overload pre-alarm value is exceeded.
9	Electric thermistor pre-alarm signal (80% of electric thermistor)	ON when the electric thermistor integral value is more than 80% of protection stop value.
10	Radiator overheat pre-alarm signal	ON when radiator overheat protection alarm occurs
13	Excitation and DC braking signals	ON during DC braking or excitation.
14	Lower frequency limit matching signal（*3）	When output frequency is F1008: ON when the lower frequency limit and F1508 are the same within the frequency matching range.
15	Upper frequency limit matching signal（*3）	When output frequency is F1007: ON when the upper frequency limit and F1508 are the same within the frequency matching range.
16	Servo on ready signal	ON during position control operation except for during excitation
17	Zero servo completion signal	When the gate pole is ON under zero-servo, the position deviation F8121: ON if below zero-servo completion range.
18	FR signal	ON if the multifunctional input terminal FR is on.
19	RR signal	ON if the multifunctional input terminal RR is on.
20	2DF signal	ON if the multifunctional input terminal 2DF is on.
21	3DF signal	ON if the multifunctional input terminal 3DF is on.
22	5DF signal	ON if the multifunctional input terminal 5DF is on.
23	9DF signal	ON if the multifunctional input terminal 9DF is on.
24	AD2 signal	ON if the multifunctional input terminal AD2 is on.
25	AD3 signal	ON if the multifunctional input terminal AD3 is on.
26	JOG signal	ON if the multifunctional input terminal JOG is on.
27	MBS signal	ON if the multifunctional input terminal MBS is on.
28	ES signal	ON if the multifunctional input terminal ES is on.
29	RST signal	ON if the multifunctional input terminal RST is on.
31	Positioning completion signal	On if position deviation is less than F8111: positioning range in position control.
32	Discharge resistor on signal	ON if the discharge resistor is on.
34	Frequency counter (output frequency) (*1)	F1512: the output frequency calculated with counter output multiple.
35	Frequency counter (command frequency) (*1)	F1512: the command frequency calculated with counter output multiple.
36	Overload alarm level setting signal (Including when in acceleration/deceleration)	On when the load condition is F1704: above overload pre-alarm value.
42	Torque matching signal	ON when the motor torque is within the range specified by F1516: torque matching level and F1517: torque matching range.
43	Low speed detection signal	ON when the motor torque is within the range specified by F1518: low speed matching level and F1519: low speed matching range.
47	Motor speed counter（*1）	Motor speed is output by the multiple specified by F1512: counter output multiple.
48	Forward run detection signal（*2）	ON when the motor speed is greater than F1518: low speed matching range in forward run direction.
49	Reverse run detection signal（*2）	ON when the motor speed is greater than F1518: low speed matching range in reverse run direction.

*1 **Can not be used together with the current output function. When outputting frequency counter or motor speed counter, set** F1515 = 0 **to disable the current output function.**

*2 **If only single-phase pulse is input to** PG **input terminal, it can not detect the direction of rotation. Therefore, the rotation direction signal can not be correctly output.**

*3 **No output in torque control or position control.**

F1512 Counter output multiple

This function specifies the output multiple when the inverter's output frequency, command frequency and motor speed are countered and output to the control circuit output terminals (DO1-DO3).

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1512	Counter output multiple	1-100	1	1

The output multiple can be set where the inverter's frequency and command frequency counter and motor speed counter (which can be set with F1509 - F1511) are output from multifunctional output terminals DO1 - DO3. When motor speed counter multiple in F1512 is 1, 1 rpm indicates 0.1Hz, and the motor rotation direction is output to the forward run detection signal and reverse run detection signal.

Example 1) When F1512 = 1, the frequency will be output from the control signal output terminals at 1 time the output frequency and command frequency of the inverter. When the inverter output frequency = 60 Hz, the frequency counter output = 60 Hz.

Example 2) When F1512 = 10, the frequency will be output from the control signal output terminals at 10 times the output frequency and command frequency of the inverter. When the inverter output frequency = 60 Hz, the frequency counter output = 600Hz.

Example 2) When F1512 = 10, the motor speed counter outputs 1500Hz with 1500rpm. (1rpm indicates 1Hz)

● Related functions

F1509-F1511=34: Frequency counter output (output frequency)
F1509-F1511=35: Frequency counter output (command frequency)
F1509-F1511=47: Motor speed counter

Note 1: **The output range of frequency counter output is** 1.5-1,500Hz. **When the coefficient calculation result of frequency counter output multiple is below** 1.5Hz, **the output is always** OFF. **And,** 1,500 Hz **is the limit when the frequency is above** 1,500 Hz.

Note 2: **Output frequency is the actual frequency output by the inverter, and may be different from command frequency according to the load condition in vector control mode. Even in constant speed operation under the vector control mode, if a certain frequency counter output is required, set** F1509 - F1511 = 35 **(command frequency).**

Note 3: **Depending on the impedance of peripheral device connected to, output waveform of the frequency counter may be delayed and uneven duty cycle may be occurred. In order to reduce uneven duty cycle, please adjust the impedance of the peripheral device to be 2KΩ or below in the range below 50mA to be flowed into open-collector.**

F1513 Relay 1 contact output selection

This function is used to select and output control circuit output terminals FA1, FB1, and FC1 relay contacts.

F1514 Relay 2 contact output selection

Reserved, this function is not provided in a standard product.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1513	Relay 1 contact output selection	0: Alarming 1: In operation 1 2: Undervoltage 3: End of simple scheduled operation 4: In operation 2 5: Frequency matching (1st speed frequency) 6: Frequency matching (1st to 16th speed frequencies) 7: Frequency approach 8: Overload alarm level setting signal (the value of F1704) 9: Electric thermistor pre-alarm signal (80% electric thermistor) 10: Radiator overheat pre-alarm signal 13：Excitation and DC braking signals 14：Lower frequency limit matching signal 15：Upper frequency limit matching signal 16: Servo on ready signal 17: Zero servo completion signal 18：FR signal 19：RR signal 20：2DF signal 21：3DF signal 22：5DF signal 23：9DF signal 24：AD2 signal 25：AD3 signal 26：JOG signal 27：MBS signal 28：ES signal 29：RST signal 31: Positioning completion signal 32: Discharge resistor on signal 36: Overload alarm level setting signal (Including when in acceleration/deceleration) 42: Torque matching signal 43: Low speed detection signal 48: Forward run detection signal 49: Reverse run detection signal	1	0

See Table 7-3 (multifunctional output terminal) for action description of functions.

F1515 Current output multiple

This function specifies the current output multiple when the inverter’s output frequency is output from the control circuit current output terminals (I+, ACM1/ACM2).

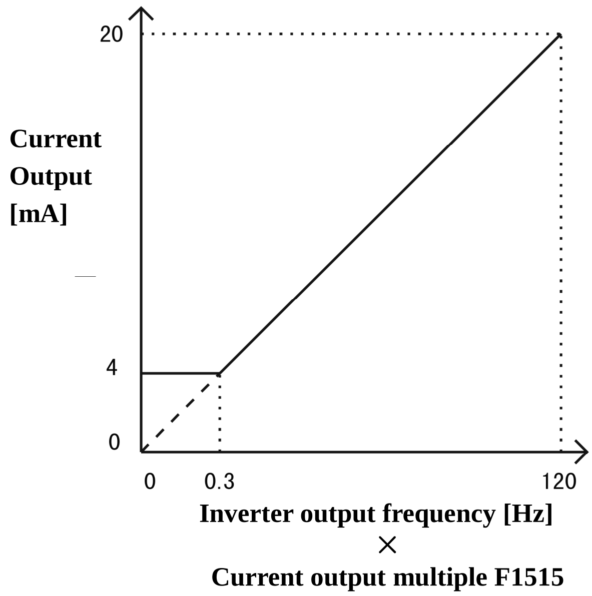
Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1515	Current output multiple	0-20 0：Inactive	0.01	1

The current output (4-20mA) proportional to the inverter’s output frequency is output between the control circuit current output terminals I+ and ACM1/ACM2.

I +: Positive side terminal (current flows from I + to ACM1/ACM2)

Note 1: **Current output function and multifunctional output terminal’s the frequency counter and motor speed counter can not be used at the same time. When it is required to use frequency counter and motor speed counter, set** F1515 = 0.

The converted value of inverter output frequency and current output is shown as follows:
When the inverter output frequency ×F1515 (current output multiple) = 3Hz, the frequency output = 4mA.
When the inverter output frequency ×F1515 (current output multiple) = 120Hz, the frequency output = 20mA.



Current output multiple may be changed in function code F1515, please make appropriate adjustment based on service condition.

* **Adjust the maximum output frequency to** 20mA **or below.**

Adjust the impedance of current output load side to 500Ω or below. In case of large impedance, the current output shall be 20mA or below.
When the current output makes output frequency=0 Hz, multiple=0, please output the minimum value 4mA.
Make sure that there is no wiring short-circuit and open circuit at load side before current output.
The signal wire may not work correctly due to short-circuit or open circuit.

F1516 Torque matching level

F1517 Torque matching range

These functions are used to set torque level and torque matching range output by the torque matching signal. This function is active in vector control mode.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1516	Torque matching level	0～±200%	0.1%	100

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1517	Torque matching range	0～50%	0.1%	25

If any one of F1509 – F1511 is 42 (frequency matching signal), the signal is output from control circuit output terminals DO1 to DO3 when the output torque matches the set value. The matching range is specified with the set value of F1517. Similarly, for F1513, the signal can also be output from control circuit relay output terminals FA1, FB1 or FC1.

F1518	Low speed matching level
F1519	Low speed matching range

These functions are used to set torque level and torque matching range output by the torque matching signal.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1518	Low speed matching level	0-2,000 rpm	1rpm	100

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1519	Low speed matching range	0-100 rpm	1rpm	10

If any one of F1509 – F1511 is 43 (low speed detection signal), the signal is output from control circuit output terminals DO1 to DO3 when the detected speed matches the value set by F1518. The matching width is specified with the set value of F1519. Similarly, for F1513, the signal can also be output from control circuit relay output terminals FA1, FB1 or FC1. The low speed matching range is also used in forward run detection signal or reverse run detection signal for multifunctional output.

System functions

The inverter system, repair and maintenance functions as well as function blocks for operation setting of the control panel are described as follows.

F1601 Copy function

This function transfers the function code data from the host side to the operation panel side or other hosts.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1601	Copy function	0：Inactive 1: Transfer the current code data to the operation panel 2: Transfer the contents stored by operation panel to the inverter host (excluding the motor parameters measured) 3: Transfer the contents stored by operation panel to the inverter host (including the motor parameters measured)	1	0

- Transfer the current function code data to the operation panel, and then to the host of copying side. When copying, " SEnd "or a flashing " rEAd " will be displayed on 7-segment monitor.
- To transfer data to the host of copying side, turn the power OFF before transmission in order to re-close the inverter to reset.
- When the motor parameters are set by F5001 - F5016, the copy function can not be used. Because during replication, if the motor parameters conflicts with the set value of other function code(s), the motor parameters or the conflicted function code(s) will be initialized. When motor parameters are set by F5009 - F5014, set F1601 = 3 to transfer data to the host.

  (Sequence) Sequence for copying to other inverter(s).

  1 Transfer the current function code data to the operation panel with F1601=1. Refer to the sequence of 5-5-1.

  2 During transmission of data, the flashing " SEnd " is displayed. Please wait for the display of SEnd until it disappears.

  3 Turn the power OFF, remove the operation panel and install it to other host. Please also turn OFF the power of other hosts before work.

  4 Turn ON the power of other hosts.

  5 Transfer data from the operation panel to other hosts with F1601 = 2.

  6 During transmission of data, the flashing "rEAd" is displayed. Please wait for the display of rEAd until it disappears.

  7 After the transmission of data to the copy side and before operation, turn the power OFF to reset inverter.
- As an exception, the active codes and data of F1320, F1601, F1602, F1604, all of F18XX blocks, all of F33XX blocks, F5001 - F5008, F5015, F5016, F6010 - F6016, F6117, F6118, as well as optional functions can not be copied. And, in case of copy between different inverter capacities and rated voltages, the data may not be copied depending on its contents. (e.g.: F1005)
- The copy function can not be used during operation of the inverter. Please stop the inverter before copying.

Note 1: Since copy function is subject to software version, data may not be copied due to compatibility of the software version.

*** For upgrade, please contact the sales shops.**

Note 2: In the event of an error during data transmission to operation panel, please do not transfer data to the same or any other inverter.

Note 3: **During action of copy function, the monitor's display flashes. When the monitor's display is flashing, do not pull out or insert the operation panel nor turn off the power.**

Note 4: **During action of copy function, no part of the operation panel can be operated.**

Note 5: **This code can not be written using communication function. The undefined response shall be returned.**

Note 6: **When the inverter host capacity of the copying side is different and** F1601 = 3, **conflict and interference errors may occur if the data is transferred from the panel to the host. When using** F1601 = 3 **for a copy of motor parameters, check if the inverter capacities of the copying source and copying side are the same.**

F1602 Changed code display function

This function compares the factory presets, user's initial value, and current function code data and displays the function codes for which data values have changed.
This is an effective function for finding out the difference between the current function code and the factory presets or the user's initial value. Repair and maintenance functions such as confirmation of codes etc. can be easily executed.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1602	Changed code display function	0: Inactive 1: Display differences from factory preset 2: Display differences from the user's initial value	1	0

- As an exception, even if F1601, F1602, F1604, F1805, and the read only function code are changed, they shall not be displayed by this function.
  (Operation method)
  1 Through F1602 = 1, search the code number of function codes of which the factory presets have changed.
  2 When searching the changed function code number, a flashing " F ind " is displayed. Please wait for the display of F ind until it disappears.
  3 When the changed function code number is found, it will be displayed (flashing). See "5-5-2 Changed Code Display Operation" for detailed operation methods.

Note 1: **When** F1604 = 99 a**nd the user's initial value is not determined,** 'Er d" **will be displayed if** F1602 = 2 **is executed.**

Note 2: **When the associated code page changes accordingly if the rated initial values of motor and inverter are different, even the codes which are not changed by the user will be displayed as changed codes.**

Note 3: **This code can not be written using communication function. The undefined response shall be returned.**

Reference parameter
F1604 (Data initialization)

F1603 Function lock

This function is used to disable the operation panel's function code data setting in order to prevent misoperation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1603	Function lock	0: Code data changeable (No lock function) 1: Code data unchangeable (except F1603) 2: Code data (except frequency setting-related) unchangeable (excluding F1603, F1021, F2101 - F2116) 3: Code data unchangeable (excluding F1603 and the data change by use of the communication function)	1	0

- The function code data can be viewed even if the operation locking is active. When the locked code data settings are confirmed, "Er n " will be displayed.
- When F1603 = 1, the frequency setting value is also unchangeable.
- When F1603 = 2, the frequency setting value is changeable.
- Reading read only function code is possible even in locked state.
- F1201 as an object other than the locked object.

Chapter 7

F1604 Data initialization

This function initializes function code data to the factory presets or user's initial value.
Not only the factory presets but also the value determined by user (user's initial value) can be fixed as the initial value of the inverter. And, data initialization can be selected from either the factory presets or user's initial value.
By fixing the user's initial value, the function code data can be initialized to the user's initial value even if it is overwritten for some reason, allowing for resetting the function code within a minimum range.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1604	Data initialization	0：Inactive 1：Initialize to factory presets 2: Invalid parameter by auto tuning 3: Initialize to user's data 99: Set user's initial value	1	0

- F1604=1: Initialize to factory presets
  Function codes are initialized to factory presets.
- F1604=2: Motor parameters measured by auto tuning are invalid.
  Return to the motor's initial value of the parameters measured by auto tuning selected by F5001.
  If the motor's initial value can not be stored in the inverter, the parameters measured by auto tuning will be initialized to factory presets.
  Parameters measured by auto tuning: F5009-F5014.
- F1604 = 3, 99: user data related
  User data initialization and data confirmation shall be carried out in accordance with the following operation sequences.
  (Sequence1) Setting the initial value of user data.
  1. Set the required function code.
  2. Confirm the user's initial value with F1604=99.
  3. Check that "rEAdY" is displayed and that the set value is flashing, press ▶ key to confirm.
  4. "dEC id" keeps flashing while the user's initialization value is being stored. Wait until "dEC id" disappears.
  5. Once "dEC id" has disappeared, the function code data can be initialized to the user's initial value with F1604=3.

  (Sequence 2) Initialization of the user data
  1. Set F1604=3 to initialize the data determined by F1604=99.
  2. Check that "rEAdY" is displayed and that it is alternately displayed with the set value, press ▶ key to confirm.
  3. "in itY" keeps flashing while the user's data is being initialized. Wait until "in itY" disappears.
  4. When "in itY" disappears, the user's data initialization is completed.

Note 1: **In operations where the initial value is used, "rEAdY" is displayed for confirmation. Now, the ▶ key is used for this purpose.**
Note 2: **As an exception,** F1804 **and** F1805 **can not be initialized.**
Note 3: **When the user's initial value is not determined,** " Er d " **will be displayed if** F1604 = 3 **(the user's data initialization) is executed.**
Note 4: **In serial communication function** "dEC id" "in it" **and** "in itY" **are not displayed.**

F1605 Quick knob long-pressing cancel selection

This function is used to select continuous pressing action of the on operation panel in function code display mode.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1605	Quick knob long-pressing cancel selection	0: Long pressing cancel disabled 1: Long-pressing cancel enabled	1	0

- When F1605=1, the same operation with can be made by continuous pressing action of in function code display mode.

  Note 1: **In status display mode, frequency setting** B **is selected regardless of the setting of** F1605. **See "5-3-4 Frequency input" for long pressing of key in status display mode.**

  Note 2: **When setting** F1605 = 1 **and** F1606 = 2 **or** F1606 = 3 **at the same time, the "Set" action or "Cancel" action of the function code setting value varies depending on the duration time (length) for which the key is pressed. Please give full attention to avoid misoperation.**

Reference parameter:

F1606 (Function code value setting key selection)

F1606 Function code value setting key selection

This function is used to select the key for confirming the set value of a function code.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1606	Function code value setting key selection	1: Set key 2: Press the quick knob 3: Press the set key or quick knob	1	1

- Set F1606 = 2 or F1606 = 3, the function code value can be set by pressing .**Note** 1: **When setting** F1605 = 1 **and** F1606 = 2 **or** F1606 = 3 **at the same time, the "Set" action or "Cancel" action of the function code setting value varies depending on the duration time for which the key is pressed. Please give full attention to avoid misoperation.**

Reference parameter

F1605 (Quick knob long-pressing cancel selection).

F1607 Target frequency setting time-out

This function is used to set the time for auto returning to the status display when frequency setting B is not in operation.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1607	Target frequency setting time-out	0: Timeout disabled 1-60 sec.	1 s	5

- When F1607=0 is set, the state of frequency setting B will continue until is pressed.

Protection functions

The function blocks related to inverter protection function setting are described as follows.

F1701 Output current limiting function

The current at which the output current limiting function begins to work can be specified. This is useful for driving a motor with a small capacity compared with that of the inverter, or to make the best use of the inverter capacity to achieve the speediest acceleration.

Code No.	Function Name	Data Content		Setting Resolution	Factory Presets
F1701	Output current limiting function	Mode A	0：Inactive 50-200%	1%	150
		Mode B	0：Inactive 50-150%		120

- The value is set with the ratio to rated current.
- The so-called output current limiting function is used to limit the inverter's output current to prevent overload during acceleration/deceleration or during normal operation. Use of this function enables the inverter to temporarily operate in the ways described below:
  1) During acceleration/deceleration: Reduce the acceleration/deceleration slope. This extends the time until the set frequency is reached. The extended time varies depending on the magnitude of this setting and the inertia of the load. Generally, accelerating or deceleration of a load with a large inertia requires a considerable current, requiring a relatively high setting.

     Example 1) When F1701=200% (Mode A).
     Maximum use of the inverter capacity to minimize the acceleration/deceleration time.
     (In mode B, the maximum value of F1701 is 150%)

     Example 2) Set current limit to the same value as the rated current of a motor with small capacity:
     F1701 = (rated motor current/rated inverter current) × 100[%].
     However, the drive frequency can only be specified within a range of 50 - 200% of the rated current of the inverter. (in mode A)
     (Possible range of setting is 50-150% in mode B）
  2) During constant speed operation: When the inverter's output current exceeds this setting, the output frequency is automatically reduced. The output frequency is reduced with the acceleration/deceleration slope specified by F1703.

  Note 1: **The current limiting function during normal operation is generally useful for loads with a reduced torque such as fans and pumps. However, this function has an adverse effect on overloads during constant speed operation with loads with normal and constant torque. The factory preset, therefore, of** F1703 **(Output current limiting function at constant speed)**= 0 **disables the output current limiting function during operation. When driving reduced torque load, if the** F1703 ≠ 0, **it is recommend to effectively use the output current limiting function during constant speed operation.**

  Note 2: **During the acceleration/deceleration caused by the output current limiting function in constant speed operation, the output current limiting function during acceleration/deceleration described in 1) and overvoltage stalling prevention function do not work.**
- In vector control mode (speed control mode), because the torque limiter function is used to limit current, this function may not work.

  Reference parameter
  - F1003 (V/f pattern selection).
  - F1320 (Specification selection).
  - F1703 (Output current limiting function at constant speed).

F1702 Electric thermal setting

The current at which the electric thermal begins to work (electric thermal overload setting) is specified as a ratio to the rated inverter current. Rated current is the base of the ratio.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1702	Electric thermal setting	0：Inactive 20～105%	1%	100

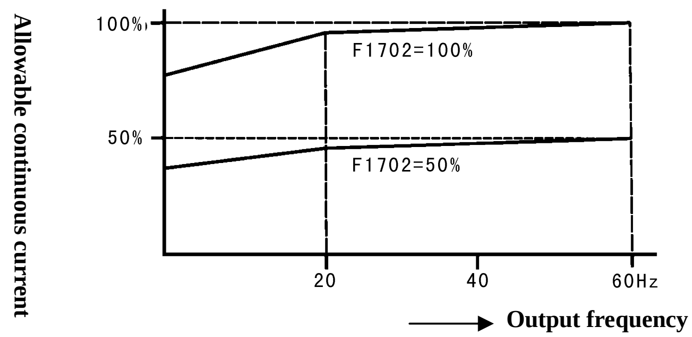
- When a motor with a small capacity is driven, F1702 should be set to a small value which matches the rated motor current.(Refer to example 1)
- For general-purpose motors, due to low cooling efficiency of the motor in the low speed zone, the electric thermal works faster as the frequency decreases. When using an inverter-driven motor, current can not be compensated according to the frequency value. Refer to F1705 (motor types).
- The electric thermal overload function also works during DC braking.

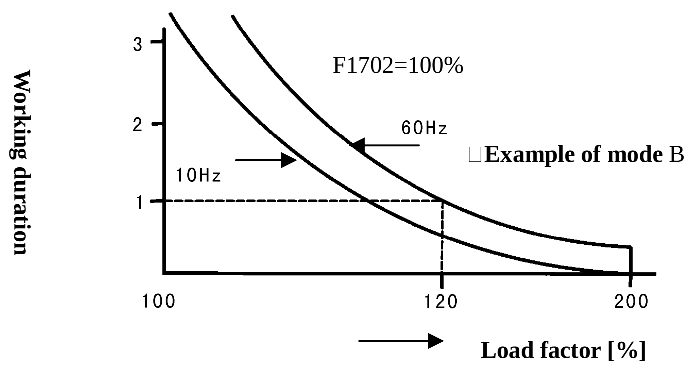
Note 1: **The so-called overload protection caused by thermal works by monitoring the output current of the inverter to prevent the motor from overloading. It can only be used when one inverter is allocated to each motor. When many small capacity motors are connected with one inverter, each motor should be equipped with a thermal, and each motor shall be protected by inputting thermal relay contact to the control terminal** ES **(external thermal relay).**

Example 1) To drive a 2.2 kW motor using mode A of SVC06-0040:
Set F1702 = (rated current of 2.2 kW motor)/ (rated current in mode A of SVC06-0040: 9.0 A) × 100%

Example 2) When set to F1702=50%:
50% of the rated inverter current specified is equivalent to 100% of the load factor in the electric thermal function. Accordingly, 75% of the rated inverter current is equivalent to 150% of the load factor in the electric thermal function.

Reference parameter
F1414 - F1421 (select the input terminals DI1- DI8)
F1705 (Motor type)





F1703 Output current limiting at constant speed

During constant-speed running, the action of output current limiting can be selected to be ON or OFF.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1703	Output current limiting at constant speed	0: No function 1: with V/f (current acceleration / deceleration time) 2: with V/f (1st acceleration / deceleration time) 3: with V/f (2nd acceleration / deceleration time) 4: with V/f (3rd acceleration / deceleration time) 5: with V/f (4th acceleration / deceleration time) 6: with V/f and speed control mode (1st acceleration / deceleration time) 7: with V/f and speed control mode (2nd acceleration / deceleration time) 8: with V/f and speed control mode (3rd acceleration / deceleration time) 9: with V/f and speed control mode (4th acceleration / deceleration time)	1	0

- The motor control mode and acceleration / deceleration time can be selected separately. The acceleration / deceleration time is the time set in F1012~F1021. (no external signal is required)
- With the speed control mode (F1001=2 or 3), the output current can still be limited by the torque limiter even the function of output current limiting at constant speed is OFF. Also, even if the function of output current limiting at constant speed has been set (F1703=1~9), when the limit value on the torque limiter is low, the situation of using a current limit lower than the values set in F1701 can still happen.

  Note 1: **The code for limiting actions of output current at constant speed and the code for selecting of normal** 1st ~ 4th **acceleration/deceleration time share the same code.**

  Note 2: **The situation that the output current is limited by speed control through the torque limiter may be used in case that the values set in** F1012~F1021 **don't decelerate.**

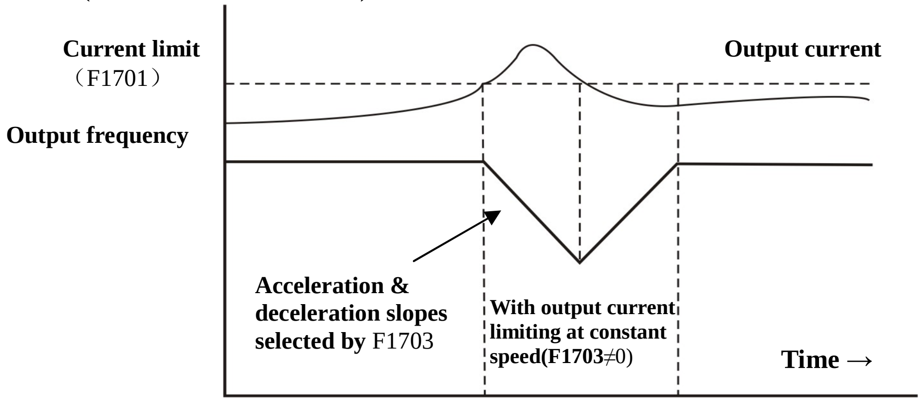
  Note 3: **Use torque control mode, this function won't work since the control methods are different.**

Reference parameter

F1701 (output current limiting)

F1012～F1015 (1st ~ 4th acceleration time)

F1016～F1021 (1st ~ 4th deceleration time)



F1704 Overload pre-alarm value

The function to output a overload pre-alarm signal for the current from the control signal output terminal (set by F1509~F1511) or multi-function relay (set by F1513) when the inverter is powered off because of overload or there is an abnormal situation at the side of the loading device.

Code No.	Function Name	Data Content		Setting Resolution	Factory Presets
F1704	Overload pre-alarm value	Mode A	20～200%	1%	150
		Mode B	20～150%		120

- The setting values are set according to the ratio with the rated current.
- When the output current from the inverter exceeds the values set in F1704, the overload pre-alarm signal will be output.

Reference parameter

F1509～F1511 (select output terminal D01 ~ D03)

F1513 (select contact output of relay 1)

F1705 Motor type

The function to select the type of the motor connected to the inverter.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1705	Motor type	1: General-purpose motor 2: Motor specifically for inverter	1	1

- Change the actions of the electric thermistor according to the motor types. Refer to F1702 (Electric thermistor setting)

Reference parameter

F1702 (Electric thermistor setting)

F1706 Switching between "OV" & "LV" alarms when stopped

Select the alarms of "OV" (overvoltage) and "LV" (lowvoltage) when the inverter is stopped.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1706	Switching between "OV" & "LV" alarms when stopped	0: "OV" enabled, "LV" disabled 1: "OV" disabled, "LV" enabled 2: "OV" disabled, "LV" disabled 3. "OV" enabled, "LV" enabled	1	1

- In the seven-segment monitor on the operation panel, overvoltage is shown as OU, lowvoltage is shown as LU.

Note 1: **With this function, even when the alarm is disabled, the protecting action is still effective. But the alarm will not be displayed on the operation panel, the alarm relay will neither output, therefore the reason of the alarm can not be detected.**

Note 2: **When the display of OU & LU as well as the relay output influence other logic actions, please set this function.**

F1707 Missing Phase detection function

The function to select the detections of input & output phase loss.

Chapter 7

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1707	Missing Phase detection function	0: no input phase loss, no output phase loss 1: input phase loss, no output phase loss 2: no input phase loss, output phase loss 3: input phase loss, output phase loss	1	3

- When an input phase loss is detected, the alarm display is oPn 1.
- When an output phase loss is detected, the alarm display is oPn o.

Note 1: **When leaving the factory, both detection functions of input & output phase loss are enabled. However, please disable these functions with consideration of the errors caused by peripherals and interference. Furthermore, in order to decrease the false detection ratio of input phase loss, the detection function should be carried out according to the load ratio during normal running with stable load.**

F1708 Overvoltage stalling prevention

The function of overvoltage stalling prevention is selected to control the deceleration slope, therefore prevent the overvoltage trip in regeneration caused by sudden deceleration of the motor and other reasons.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1708	Overvoltage stalling prevention	0: without overvoltage stalling prevention 1: with overvoltage stalling prevention	1	1

Note 1: **When this function is set with the overvoltage stalling prevention disabled, it is effective when the deceleration is finished within the deceleration time. However, since the DC voltage of the inverter will rise, enough discharging units must be equipped**.

Reference parameter
F1115 (Brake resistor utilization rate)

F1709 Feedback signal disconnecting detection time

Set the detection time when the PID control feedback signal or PG feedback signal are disconnected.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1709	Feedback signal disconnecting detection time	0: Only warning 0.01～119.9s 120: Without disconnecting detection	0.01s	5

- Though F1709=0 is used to detect the disconnection, there is only warning but without stop alarm.
- Use F1709=120, never detect the disconnection.

F1710 Carrier frequency variable by lowering temperature

The function to change carrier frequency automatically according to the radiator fin temperature of the inverter.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1710	Carrier frequency variable by lowering temperature	0: disabled 1: enabled	1	0

- In case of F1710=1, in order to prevent power off caused by overheating, the carrier frequency will be changed automatically.
- The values of F1710 are available only when F1320=1 (mode A). When F1320=2 (mode B), the carrier frequency will be changed automatically without referring to values of F1710.

Informative Functions

The functional blocks representing the inverter will be illustrated as follows.

F1801 Inverter host software version query

Show software version of the inverter host.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1801	Inverter host software version query	Inverter host software version	—	—

- The functional code to read dedicated data.
- Show the software version of the inverter as “uXXXX”. XXXX represents the software version.
  (Example) When the software version of the inverter host is “1.00”, the seven-segment monitor displays 0100.

F1802 Version query of data stored on inverter host

Show the storage version installed on the inverter host.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1802	Version query of data stored on inverter host	Inverter host storage version	—	—

- The functional code to read dedicated data.
- Show the storage version of the inverter as tXXXX. XXXX represents the storage version.

F1803 Operation panel software version query

Show the software version of operation panel.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1803	Operation panel software version query	Operation panel Software version	—	—

- The functional code to read dedicated data.
- Show the software version of currently connected operation panel as “PXXXX”. XXXX represents the software version.

F1804 Operation time display

The inverter displays the accumulated time of operation by the unit of time.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1804	Operation time display	Inverter operation time	1 hour	—

- The functional code to read dedicated data.

F1805	**Reading alarm data**

The function to read the five alarms stored by time sequence.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1805	Reading alarm data	0: No function 1: Read start 9: Record erase	1	0

- The function to read the alarms displayed on the inverter. Read the last five alarms.
- In case that the alarm will not be recorded, it will display "End" when F1805=1 is set.
- The record will be erased when F1805=9. Meanwhile, the data of F1806 ~ F1810 will also be erased.
- Please refer to "5-5-4 Reading operations of alarm data" for details.

Note 1: **This code cannot be written with the communication function; otherwise, the undefined response will be replied.**

F1806	**Alarm status confirmation 1**
F1807	**Alarm status confirmation 2**
F1808	**Alarm status confirmation 3**
F1809	**Alarm status confirmation 4**
F1810	**Alarm status confirmation 5**

The function of the inverter to read output frequency, output current and other data when the alarm stops.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1806 F1807 F1808 F1809 F1810	Alarm status confirmation 1 Alarm status confirmation 2 Alarm status confirmation 3 Alarm status confirmation 4 Alarm status confirmation 5	Inverter status in case of an alarm (alarm name, output frequency, output current, output voltage, DC current, output power, radiator fin temperature)	—	—

- The functional code to read dedicated data.
- In case that the alarm will not be recorded, it will display "End" when F1805=1 is set.
- When F1805=9 is set, the data recorded in F1806 ~ F1810 will be erased.
- Please refer to "5-5-5 Alarm status confirmation operation" for detailed operation method and display content.

Note 1: **This code cannot be written with the communication function; otherwise, the undefined response will be replied.**

Note 2: **The motor parameters will automatically test the alarm status in 1 and 2, but only the alarm name will be displayed, other status will be displayed as 0 and will not be recorded.**

Energy-saving Function

F1901	Energy-saving mode selection
F1902	Simple energy saving rate
F1903	Simple energy saving time

Decrease the output voltage and realize an energy-saving operation. Simple energy saving is an arbitrarily set function, it is the mode to automatically decrease the output voltage and control the highest efficiency.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F1901	Energy-saving mode selection	0: No function 1: Simple energy-saving mode (V/f mode) 2: Auto energy-saving mode	1	0
F1902	Simple energy saving rate	0～50%	1%	0
F1903	Simple energy saving time	0～65000s	1s	10

(1) F1901=1 Simple energy saving (V/f)

- With the V/f mode and after the specified time during the constant speed running after the acceleration, the voltage will be decreased by a certain ratio, therefore realizing the function of energy saving.
- For loads of general fans and pumps, the input current is decreased by reducing the output voltage of the inverter in the V/f constant mode, therefore realizing the energy saving. Simple energy saving is adjusted manually to form a voltage-frequency relationship which matches with the load and torque characteristics, and realizing the energy saving.

1) Related functional code

F1901=1 Simple energy saving mode (V/f)

F1902=0～50% Simple energy saving rate

F1903=0～65000s Simple energy saving timer T1

2) Actions of simple energy-saving mode

- If operation command is input into the inverter, normal acceleration will start and then enter the constant speed running status.

  When simple energy saving mode (F1901=1) can be selected, after certain time specified by the timer T1 (F1903) during constant speed running, the simple energy saving function will be enabled. For the output voltage of currently output signal, the simple energy saving is the action to decrease the output voltage by the ratio specified by F1902. Before energy saving and when the output voltage is about 200V, set F1902=50%, the output voltage will be decreased to about 100V after the time period specified by timer T1.
- Since energy saving rate (F1902) can be adjusted even when the inverter is running, please set the values which are compliant with the load characteristics.

  When simple energy saving is enabled, the afterwards output voltage will maintain the decreasing ratio to realize the V/f control even when the command frequency is modified. However, when the stoppage command of the inverter is enabled, the voltage will be recovered to the original value slowly, deceleration will be carried out when the voltage is fully recovered.

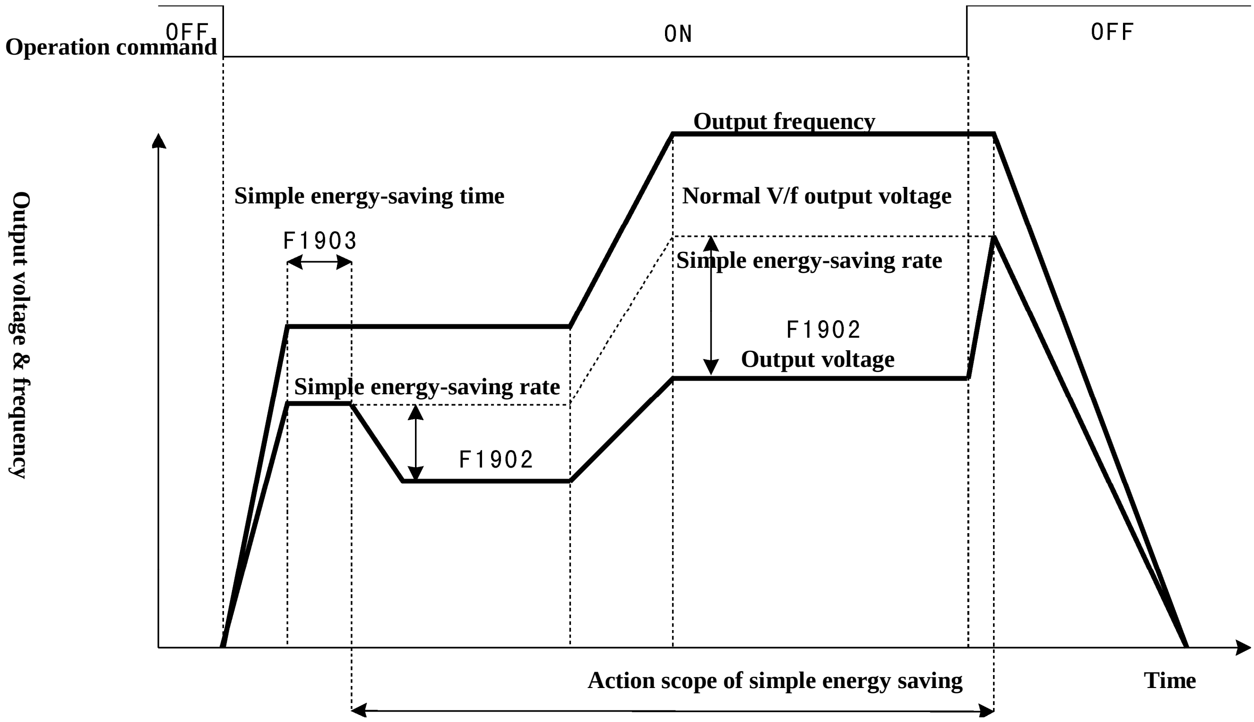
3) Decrease output voltage and recovery time

- When simple energy saving is enabled, in order to avoid large changes of loaded torque, the voltage should drop slowly, a slope of about ten seconds is required for maximum output voltage value.

  Example 1) When maximum output voltage is 440V, an output voltage of 200V will be run. If the rate is 50%, about 2.3 seconds is required to decrease the voltage to about 100V.
- In case that the energy saving is disabled through stopping command, in order to avoid the poor control caused by inadequate torque, the voltage recovery should be carried more quickly. For maximum voltage output, the slope is about one second.

  Example 2) For simple energy saving in example 1, about 0.23 second is required to recover to original voltage through the stopping command. A deceleration will be carried out after the recovery.

4) Attentions
   - Simple energy saving function only decreases the output voltage of the inverter. Therefore, since the load conditions are different, the voltage drop may result in the slow down of the speed. In devices with low speed forbidden, the energy saving and rotating speed should be compensated by the combination of auto energy saving mode (speed control) and PID control.
   - For loads without energy saving even when the output voltage is decreased, never use this method.
   - When restarting by the functions of speed tracking, alarm auto resetting, instantaneous stop restarting and etc., the simple energy saving function should be started from the beginning. (Speed tracking can be added)
   - Since the stopping action in simple energy saving is used for deceleration after the output voltage is recovered to the original value, the actual stopping time will change according to the recovering time of the voltage. When time sequence control is adopted, please take consideration of this recovery time.



(2) About auto energy saving function

The auto energy saving function is based on the V/f control method and speed control method.
Please make a selection with a motor control mode of F1001.

① F1001=1 (V/f mode)

- Based on V/f mode, the energy saving function is realized by supplying high-frequency voltage to the torque required by the load.
- Different from the simple energy saving function with manual adjusting of optimal voltage, this function can automatically calculate the high-frequency voltage value even when the load is changed, therefore realizing a stable energy saving.
- When energy saving, motor speed control and other feedback controls are operated synchronously, they can be used together with PID controlling function when a sensor is installed on the system. (Please set F3002 for PID feedback input)

1) Actions of auto energy saving mode (V/f mode)

   · The auto energy saving mode can be used for the starting of inverter operation and the control of auto energy saving mode. During energy saving, the output voltage for high-efficient operation will be calculated and the voltage will be changed slowly.

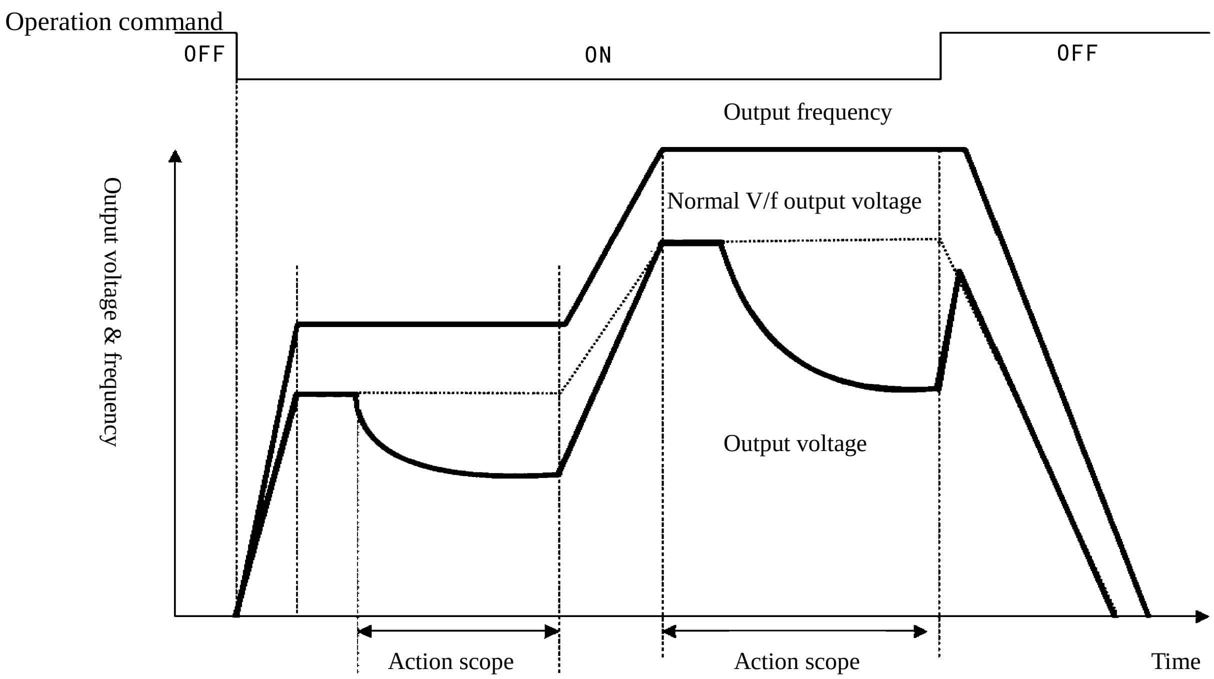
   Whereas, in case that the acceleration / deceleration time is very short, the energy saving mode will be enabled after constant-speed operation is entered.

- Auto energy saving remains continuous operation, even when the torque is changed very slowly. Furthermore, for the changes of frequency and quick torque alteration, the inverter will disable the energy saving operation quickly, therefore preventing the inadequate torque caused by loaded torque alteration.

2) Attentions

- This function only controls the output voltage of the inverter. Therefore, the speed may decrease because of the pressure rise/drop according to the load situation. When it is used on the devices with a problem when the speed is reducing, the combination of an auto energy saving mode (speed control) and the use of PID control system with a speed sensor can make a compensation to the energy saving and the speed. Refer to F30xx ~ F33xx for PID functions.
- The time required for voltage rising to realize a high-efficient voltage value will be changed according to the actual load condition.
- For changes of pre-set frequency, stopping command and rapid load alteration, in order to avoid the reducing of driving power caused by inadequate loading torque, the decreased or increased output voltage will be recovered to the original voltage within several milliseconds.
- Different from the actions in simple energy saving, the deceleration will be enabled simultaneously when the stopping command is carried out, therefore it equals to the normal stopping time. But, when the regenerating energy cannot be used fully, the deceleration time will be prolonged through the protective function.
- For fans and pumps, it is effective for the square torque during light loading, but it may be noneffective for the constant torque during heavy loading.
- When restarting by the functions of speed tracking, alarm auto resetting, instantaneous stop restarting and etc., the simple energy saving function should be set from the beginning. (Speed tracking can be added)
- Energy saving action functions only when the loaded torque alteration is stable during constant speed running. Therefore, when the frequencies are changed by analog frequency input and other methods, the energy can also be saved by increasing the frequency matching range (F1508) in case the frequency is changed very slowly.
- Linear Graphic is used for the V/f figure of auto energy saving mode.

Chapter 7



② F1001=2, 3 (speed control mode)

- The function of energy saving is realized by increasing motor frequency for arbitrary load torque, basing on the speed control mode (F1001=2: speed sensorless vector control; or F1001=3: speed sensor vector control).
- Different from manually adjusting of optimum voltage in simple energy saving, this function is used to reduce the motor consumption under normal operation; even the load has been changed, this function is still available for high-efficient operation under arbitrary load torque.
- Since this function is based on the speed controlling, the speed should also be compensated during energy saving.

1) Actions of auto energy saving mode

- · This function will be enabled by only setting the auto energy saving mode (F1901=2).
- · Start the running of the inverter with this auto energy saving mode, after stable & normal operation is reached, the control of auto energy saving will be started.
- · Auto energy saving function works continuously under the energy saving actions, therefore, it is still effective even when the torque is changed very slowly. Also, for the frequency changes and fast torque changes, it can recover to normal operation from energy saving mode and eliminate the inadequate torque caused by load torque changes.

2) Attentions

- · Even though the auto energy saving mode is set, normal control actions will be used during the acceleration/deceleration.
- · Different from the stopping actions in simple energy saving, since this function enters the deceleration together with stopping command, the stopping time equals to the time of normal stopping actions. However, when the regenerated energy cannot be used fully and a torque limiter is required, the deceleration time will be prolonged according to the protective function.
- · Auto energy saving control is effective during constant-torque operation. When rated speed has been exceeded during constant-power operation, a weak magnetic control will be adopted as normal modes.
- · The function of auto energy saving is more obvious under light loads.

V·f Separation Function

F2001	V•f separation function selection
F2002	**V•f separation command voltage**

V•f separation function is based on V/f control mode, it can separately control the output frequency and output voltage of the switcher. A complete separation and proportional separation can be selected by the function codes.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F2001	V•f separation function selection	1：V•f proportional separation 2：complete separation	1	1
F2002	V•f separation command voltage	0：no function (command is given by VIF1) 0.01～10.00V	0.01V	0

By setting the V•f separation function F1001=40, the “V•f separation function” is effective.

1) Related control terminals on the inverter

Mark	Control terminals on inverter
VIF1	Voltage command input terminal
+V1	Potentiometer connecting terminal
ACM1 or ACM2	Analog signal public terminal

2) Input method of frequency & voltage command

- The frequency command (F1002) is selected according to speed 1, the setting can be made on the operation panel and from external.

Note: If frequency command F1002 is iteratively set with VIF1 external analog, it will conflict with the output voltage command during V•f separation. Therefore, the iterative setting of the VIF1 terminal should be avoided.

- The output voltage command can input the DC voltage (0~10V) into the external control terminals “VIF1” and “ACM1” or “ACM2” on the inverter and input voltage into “VIF1” from internal power supply “+V” and external potentiometer. For the external potentiometer, please refer to the connection and correct installation of control circuit terminals.
  (Parameters of external potentiometer: resistance =5kΩ, capacity=over 0.3W.)
- The output voltage command can input the 0~10V voltage into VIF1 and set the V•f separation command voltage: correspond to VIF1 command voltage in F2002. When the command voltage is set by function code, please set the V/f separation command voltage: F2002≠0.

3) Gain of output voltage command

① V•f proportional separation （F1001=40 & F2001=1）

- In normal V/f pattern, the voltage command Vin for current frequency is gained through the external control terminal “VIF1” inputs (0~10V), and the output voltage command is sent to the inverter. There is a proportion between the frequency command and the voltage command. However, the proportion is changed with the changes of VIF1 inputs.

The relationships between VIF1 voltage input and gain coefficient are as follows:

Gain coefficient

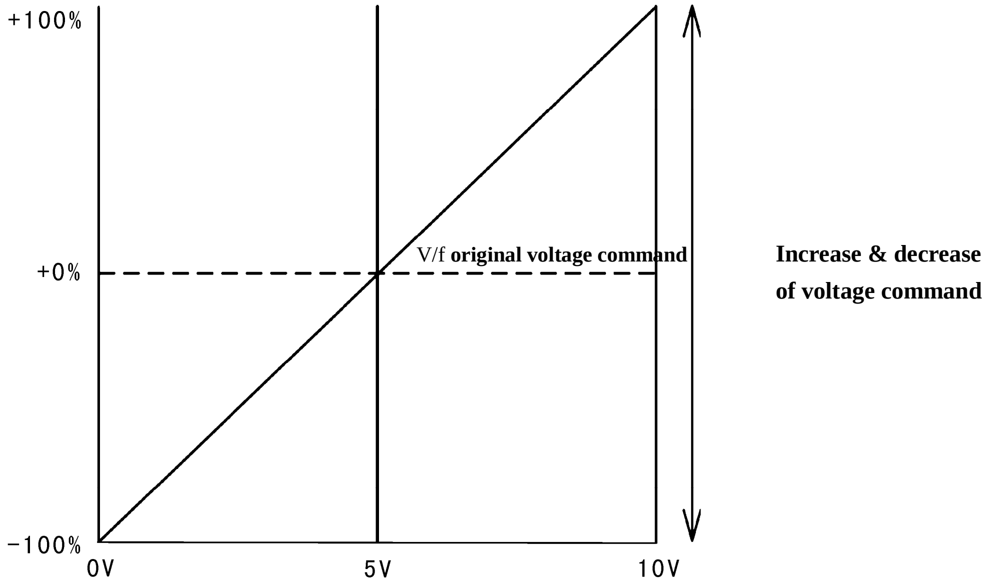
VIF1=0V input，→Vout=Vin－（Vin×100%）=0（V）

=5 V input，→Vout=Vin＋（Vin×0%）= Vin（V）

=10 V input，→Vout=Vin＋（Vin×100%）= 2Vin（V）

Vin= Current voltage command

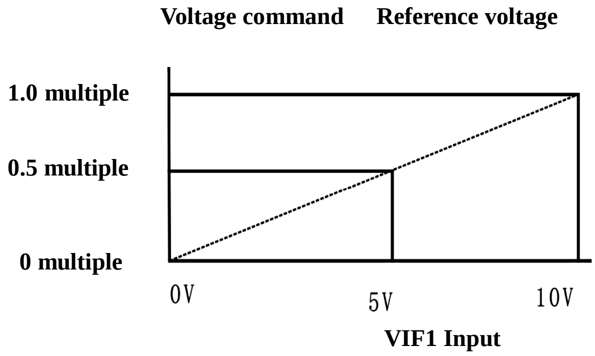
- Vout= Voltage command after processing



Note: output voltage F1005: is set by reference voltage. When the voltage command is too large while the potentiometer is at maximum limit, please decrease the F1005.

② Complete separation (F1002=40 & F2001=2)

- Use the reference voltage (F1005) in V/f pattern as the maximum value, gain this voltage command through the external control terminal "VIF1" inputs (0~10V) and use it as the output voltage command of the inverter. The frequency command and voltage command are totally separated from each other.
  The relationships between VIF1 voltage input and gain coefficient are as follows:
  Gain coefficient (linear function)
  VIF1=0V input, →Output voltage is 0 multiple of reference voltage.
  VIF1=5V input, →Output voltage is 0.5 multiple of reference voltage.
  VIF1=10V input, →Output voltage is 1.0 multiple of reference voltage.



Note 1: **this function is noneffective during DC braking.**

Note 2: **AVR functions which are accorded to reference voltage (F1005 data) are effective.**

Note 3: **Even though the settings of instability elimination (F1308) are effective, the performance of frequency and voltage commands from this function are reduced.**

Note 4: **The bias and gain of VIF1 voltage coefficient are set to be noneffective.**

Note 5: **The frequency and voltage commands are unattached, therefore, for the output frequency, the motor may over-excited when the voltage command is too large, and the inverter may trip off because of over current. Please pay attention to the settings of frequency and voltage commands. (Especially during the acceleration/ deceleration actions)**

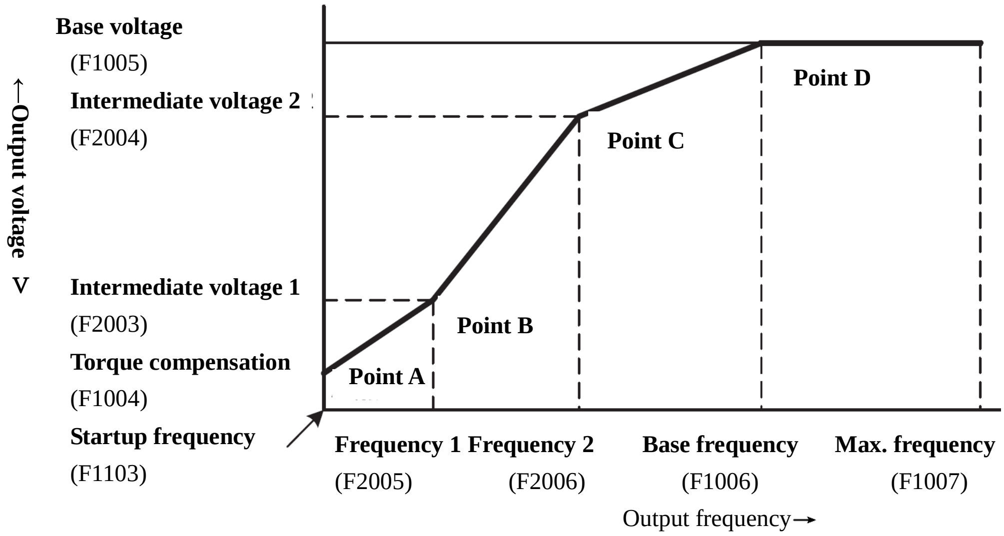
Arbitrary V/f Pattern Function

F2003	**Arbitrary V/f pattern intermediate voltage 1**
F2004	**Arbitrary V/f pattern intermediate voltage 2**
F2005	**Arbitrary V/f pattern intermediate frequency 1**
F2006	**Arbitrary V/f pattern intermediate frequency 2**

Arbitrary V/f pattern can be set when linear V/f pattern is selected as the V/f pattern of F1003.

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F2003	Arbitrary V/f pattern intermediate voltage 1	0～460V	1V	0
F2004	Arbitrary V/f pattern intermediate voltage 2	0～460V	1V	0
F2005	Arbitrary V/f pattern intermediate frequency 1	0.05～600Hz	0.01Hz	20
F2006	Arbitrary V/f pattern intermediate frequency 2	0.05～600Hz	0.01Hz	40

Set intermediate voltage 1 & 2 and intermediate frequency 1 & 2 as follows.



- When intermediate voltage 1 & 2 are smaller than the voltage command determined by F1004 (torque compensation), a voltage command determined by torque compensation will be for limitation.
- When intermediate voltage 1 & 2 are larger than the voltage command determined by F1005 (reference voltage), the reference voltage will be used for limitation.
- When intermediate frequency 1 & 2 are smaller than F1003 (startup frequency), the startup frequency will be used for limitation.
- When intermediate frequency 1 & 2 are larger than F1006 (reference frequency), the reference frequency will be used for limitation.

Note 1: **Trip operation may happen when the output command changes fast, so more attention must be paid to the changes of settings during operation.**

Note 2: **Please set F2003=F2004 and F2005=F2006 when only an intermediate point is required.**

Auto Torque Compensation Function

F2007	**Auto torque compensation selection**
F2008	**Slip compensation response time constant**
F2009	**Slip compensation multiple**

The function of auto torque compensation based on V/f control code. It can select voltage compensation and slip compensation. However, since the motor parameters are required to be set, please carry out this function after the auto detection 2 of the motor parameters have been finished (when the motor parameters are not clear).

Code No.	Function Name	Data Content	Setting Resolution	Factory Presets
F2007	Auto torque compensation selection	0：No auto torque compensation 1：Voltage compensation function 2：Slip compensation function	1	0
F2008	Slip compensation response time constant	0～1000（Setting 1=10ms）	1	10
F2009	Slip compensation multiple	0.01～2	0.01	1

① F2007=1 Auto torque compensation function (voltage compensation)
The function to automatically adjust the voltage according to the load condition.
When the load is heavy (large current), the output voltage will be increased to output torque.

② F2007=2 Auto torque compensation function (slip compensation)
If the load becomes heavier, the motor speed will decrease, and the motor slip will become larger. The auto slip compensation will increase the precision of the speed.

Note 1: **In order to cooperate the control of motor characteristics, please carry out the auto detection of motor parameters** (F1001=11: **motor parameter auto detection** 2).
Note 2: **When a special motor is used and the output is unstable, the auto torque compensation can not be selected. Please select torque compensation** (F1004).
Note 3: **When** F1005 **is** 0, **the auto torque compensation is noneffective.**
Note 4: **Noteffective during** DC **braking actions.**
Note 5: **When** V/f **pattern** F1003=2 **&** 3 **(low speed & deceleration mode) is set, it is noneffective.**
Note 6: V•f **separation control is noneffective.**
Note 7: **Energy saving function** (F1901=1 & 2) **is noneffective.**
Note 8: **When the settings of special motor and auto detection conflict, the auto detection will not be carried out. Please set the motor parameters manually.**

③ F2008 Slip compensation response time constant.
The function to set the slip compensation response time.

Note 1: **When the speed is unstable, please increase this time constant.**
Note 2: **The large loading inertia will result in a voltage alarm, please make an adjustment.**

④ F2009 Slip compensation multiple
The function to set the speed precision of slip frequency compensation.
Normally is “1”, no setting is required. When it is higher than command frequency, please set it to be smaller than 1.

Multi-speed Function

F2101	**1st speed frequency**
F2102	**2nd speed frequency**
F2103	**3rd speed frequency**
F2104	**4th speed frequency**
F2105	**5th speed frequency**
F2106	**6th speed frequency**
F2107	**7th speed frequency**
F2108	**8th speed frequency**
F2109	**9th speed frequency**
F2110	**10th speed frequency**
F2111	**11th speed frequency**
F2112	**12th speed frequency**
F2113	**13th speed frequency**
F2114	**14th speed frequency**
F2115	**15th speed frequency**
F2116	**16th speed frequency**

The function to set the frequency during multi-speed operation.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2101	1st speed frequency	0 -～600Hz	0.01Hz	0
F2102	2nd speed frequency			10
F2103	3rd speed frequency			20
F2104	4th speed frequency			30
F2105	5th speed frequency			40
F2106	6th speed frequency			50
F2107	7th speed frequency			60
F2108	8th speed frequency			0
F2109	9th speed frequency			0
F2110	10th speed frequency			5
F2111	11th speed frequency			15
F2112	12th speed frequency			25
F2113	13th speed frequency			35
F2114	14th speed frequency			45
F2115	15th speed frequency			55
F2116	16th speed frequency			0

- The frequency during multi-speed operation can be selected from 1st speed to 16th speed through the combination of control terminals 2DF, 3DF, 5DF and 9DF. According to the input status of the terminals, the inverter will run with the selected frequency.
- 2DF, 3DF, 5DF and 9DF can be set to be an arbitrary terminal of DI1~DI8 through the settings of F1414~F1421.
- For frequency during multi-speed operation, the new frequency can be set through the operation panel.

Example 1) When 3rd speed is selected, the frequency set by operation panel will be stored in F2103.

Example 2) During the halfway of changing the frequency of 3rd speed operation, the output frequency of the inverter with the speed switched to 5th speed will change to 5th speed. However, the set frequency is 3rd speed frequency (F2103).

- External terminals are other functions and multiplexed functions.

  Example) 67：2DF＋AD2

  For these multiplexed terminals, the information for multi-speed operation will be only used as the terminal status of 2DF, AD2 status has no relationship with the multi-speed operation. For multi-speed switching of external terminals and the operation status of inverter as well as F1101: when the content selected by operation command has no relationship, it is effective.

Function Code	**Frequency**	2DF	3DF	5DF	9DF
F2101	1st speed	OFF	OFF	OFF	OFF
F2102	2nd speed	ON	OFF	OFF	OFF
F2103	3rd speed	OFF	ON	OFF	OFF
F2104	4th speed	ON	ON	OFF	OFF
F2105	5th speed	OFF	OFF	ON	OFF
F2106	6th speed	ON	OFF	ON	OFF
F2107	7th speed	OFF	ON	ON	OFF
F2108	8th speed	ON	ON	ON	OFF
F2109	9th speed	OFF	OFF	OFF	ON
F2110	10th speed	ON	OFF	OFF	ON
F2111	11th speed	OFF	ON	OFF	ON
F2112	12th speed	ON	ON	OFF	ON
F2113	13th speed	OFF	OFF	ON	ON
F2114	14th speed	ON	OFF	ON	ON
F2115	15th speed	OFF	ON	ON	ON
F2116	16th speed	ON	ON	ON	ON

Graph Operation Function

Simple scheduled operation function (F2201=1)

F2201 **Selection of scheduled operation**

F2202 **Simple scheduled operation repetitions**

The function to select an operation mode.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2201	Selection of scheduled operation	0：Normal operation 1：Simple scheduled operation 2：Disturbed operation	1	0
F2202	Simple graph operation repetitions	0：Continuous 1～250：Repetition count	1	1

- The function to establish a graph with the function codes for auto operation of running direction, set frequency, operation time, acceleration/ deceleration time and so on. This can be used effectively during setting the operating graph of auto operation.
- The operating graph including stopping timer can be set into 16 graphs. Furthermore, the total 16 graphs can be operated as one cycle, also it can be operate repeatedly within the specified times. Since the operating status will be stored in the memory during power failure, the inverter will continue the interrupted graph when it is returned to normal operation.

1) Use control terminals on inverter

Control Terminal	Content	Function Code Setting	
DI1～DI8*	Timer reset function	F1414～F1421	37
DO1～DO3*	Cycle completion signal	F1509～F1511	3
DCM1、DCM2	Digital signal public terminal		

***Please select the terminals through the function codes and set the contents.**

2) Startup of simple scheduled operation
   - Please set F2201=1 (simple scheduled operation). When motor control mode is V/f or speed control, the simple scheduled operation is effective.
   - The operating command is only effective for operation panel, external control circuit terminal and other forward run, so please input forward run command which has no relationship with the operation direction.
   - The operation direction and acceleration/deceleration time can be set by the 16 timers from T1 to T16.

3) Setting method
   - Enter 2-digit value into the forward/reverse run and acceleration/deceleration (F2221~F2235) in T1~T15.

Chapter 7

F2221 **Forward/reverse run and Acceleration/Deceleration in T1**

F2222 **Forward/reverse run and Acceleration/Deceleration in T2**

F2223 **Forward/reverse run and Acceleration/Deceleration in T3**

F2224 **Forward/reverse run and Acceleration/Deceleration in T4**

F2225 **Forward/reverse run and Acceleration/Deceleration in T5**

F2226 **Forward/reverse run and Acceleration/Deceleration in T6**

F2227 **Forward/reverse run and Acceleration/Deceleration in T7**

F2228 **Forward/reverse run and Acceleration/Deceleration in T8**

F2229 **Forward/reverse run and Acceleration/Deceleration in T9**

F2230 **Forward/reverse run and Acceleration/Deceleration in T10**

F2231 **Forward/reverse run and Acceleration/Deceleration in T11**

F2232 **Forward/reverse run and Acceleration/Deceleration in T12**

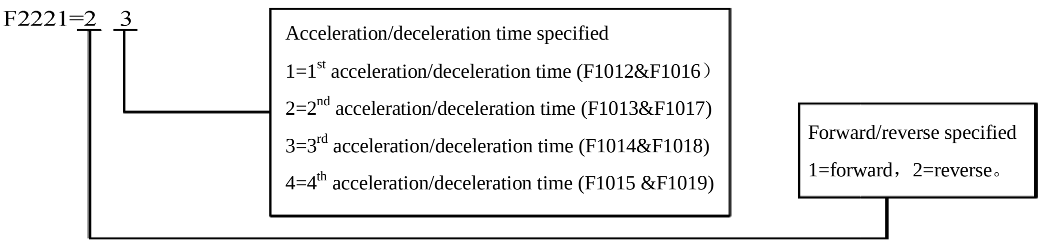
F2233 **Forward/reverse run and Acceleration/Deceleration in T13**

F2234 **Forward/reverse run and Acceleration/Deceleration in T14**

F2235 **Forward/reverse run and Acceleration/Deceleration in T15**

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2221	Forward/reverse and Acceleration/Deceleration in T1	X Y	—	11
F2222	Forward/reverse and Acceleration/Deceleration in T2	X…1：forward, 2：reverse		11
F2223	Forward/reverse and Acceleration/Deceleration in T3	Y…1～4： Acceleration/deceleration		11
F2224	Forward/reverse and Acceleration/Deceleration in T4	time specified		11
F2225	Forward/reverse and Acceleration/Deceleration in T5			21
F2226	Forward/reverse and Acceleration/Deceleration in T6			21
F2227	Forward/reverse and Acceleration/Deceleration in T7			21
F2228	Forward/reverse and Acceleration/Deceleration in T8			11
F2229	Forward/reverse and Acceleration/Deceleration in T9			11
F2230	Forward/reverse and Acceleration/Deceleration in T10			11
F2231	Forward/reverse and Acceleration/Deceleration in T11			11
F2232	Forward/reverse and Acceleration/Deceleration in T12			21
F2233	Forward/reverse and Acceleration/Deceleration in T13			21
F2234	Forward/reverse and Acceleration/Deceleration in T14			21
F2235	Forward/reverse and Acceleration/Deceleration in T15			21

Example: set the operation direction and acceleration/deceleration time in T1 into the third acceleration/deceleration time with reverse run



Note 1： **The inching operation before startup of simple graph operation should be as normal. (Forward & reverse)**
For the occasions of half stop during simple graph operation, the inching operation should also be as normal.

Note 2: **Use the startup, braking and other conditions of the simple graph operation, operate as normal unless special instructions have been shown.**

Note 3: **For operating direction specified in** T1~T15, **when the rotation direction is fixed according to the allowable direction of the motor, the use of an operation timer with an unallowed direction will lead the inverter into standby and wait for the startup of the next timer.**

Note 4: **During simple graph operation, since the acceleration/deceleration time is specified by each timer, the switching of acceleration/deceleration time by multi-functional input terminals** AD2 **and** AD3 **are noneffective.**

4) Each timer operated with simple graph operation

- When the simple graph operation is started with rotation direction specified by function codes and acceleration/deceleration time according to the forward run command, T1~T15 as well as T0 will start to count by sequence. After a specified time period, it will move to the next timer. This operation timer will start from T1 and continue to T2, T3…T15, T0 by sequence. However, when the time of the operation timer is 0s, the current timer will be skipped and continue to the next timer.

F2203	**Operation timer T1**
F2204	**Operation timer T2**
F2205	**Operation timer T3**
F2206	**Operation timer T4**
F2207	**Operation timer T5**
F2208	**Operation timer T6**
F2209	**Operation timer T7**
F2210	**Operation timer T8**
F2211	**Operation timer T9**
F2212	**Operation timer T10**
F2213	**Operation timer T11**
F2214	**Operation timer T12**
F2215	**Operation timer T13**
F2216	**Operation timer T14**
F2217	**Operation timer T15**

Please set each expected time in the following function codes.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2203	Operation timer T1	0～65000s	1s	10
F2204	Operation timer T2			
F2205	Operation timer T3			
F2206	Operation timer T4			
F2207	Operation timer T5			
F2208	Operation timer T6			
F2209	Operation timer T7			
F2210	Operation timer T8			
F2211	Operation timer T9			
F2212	Operation timer T10			
F2213	Operation timer T11			
F2214	Operation timer T12			
F2215	Operation timer T13			
F2216	Operation timer T14			
F2217	Operation timer T15			

Chapter 7

Note: When a timer is changed during operation, the value will be effective from the next cycle. If the change is made after the operation, the value will become effective since the cycle is started.

F2218 Operation stop time T0

5) About the operation stop time T0

During simple graph operation, besides the above-mentioned T1~T15, there is an operation stop time T0 (F2218). Each timer in simple operation is used as a cycle, but the cycle switching (i.e. moving from T15 to T1) after one complete operation is stopped will be used when trying to move to the next cycle.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2218	Operation stop time T0	0～65000s	1s	10

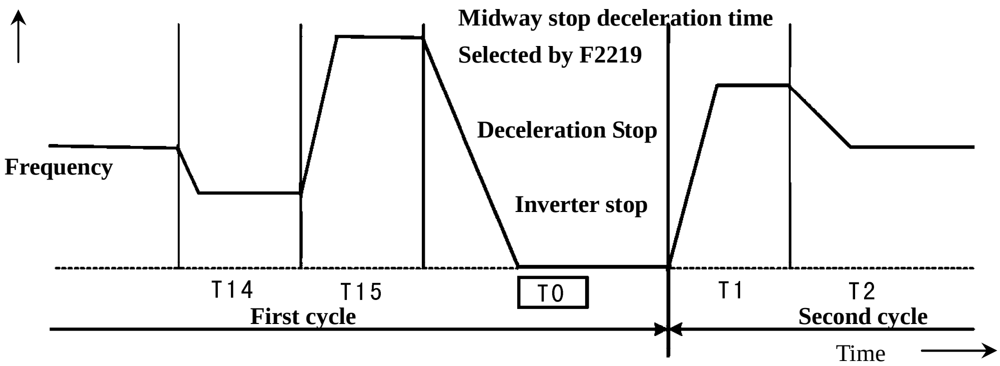
Note 1: **The frequency cannot be specified during the operation stop time T0. Usually under the status of stopping deceleration.**

Note 2: **The deceleration time in stopping action will decelerate from first deceleration time to fourth deceleration time specified by midway stop deceleration time (F2219).**

Note 3: **When the operation stop time T0 is finished and the inverter is still stopping deceleration, it will last until the inverter is fully stopped, otherwise, it will not enter the next cycle. Therefore, the stop time of T0 should be set longer than the time from T15 to deceleration stopping.**

Note 4: **The braking mode is the same as usual operation. (DC braking, braking excitation, idle stopping are effective)**

Note 5: **When operation stop time is not required, please set F2218=0. When move the cycle from T15 to T1, the inverter will operate continuously.**



6) Use of frequency value for each timer

- The frequency of each timer is set by function codes of multi-speed frequency (1st ~ 15th speed frequency) with standard functions. However, for the frequency set for T1, when 1st speed frequency (F1002) selects 1, 21 and 22, the 1st speed frequency (F2101) is the set frequency; for occasions other than 1, 21 and 22, the set frequency is the frequency set for specified function.
- Setting method

Operation timer	Content
Operation timer T1	F1002=1、21、22→1st speed frequency (F2101) F1002=2～20→Analog frequency input（VIF1, VIF2, VIF3 terminals） F1002=25→Pulse train input F1002=26～28→Absolute value of analog input frequency (VIF1, VIF2, VIF3 terminals) (Rotation direction as specified by F2221)
Operation timer T2～T15	Decided by contents of F2102～F2115=0～600Hz

Note 1: **During actions of each operation timer (T1~T15), if the frequency is changed by multi-speed frequency code (F2102~F2115), direct step setting or terminal stepping functions, the frequency in current operation timer will also change. Furthermore, the changed frequency will be shown in the function codes of multi-speed frequency.**

Example) When operation timer T2 is running and the frequency is changed on the operation panel, make an acceleration/deceleration according to the changed frequency, enter the changed frequency values in to F1202.

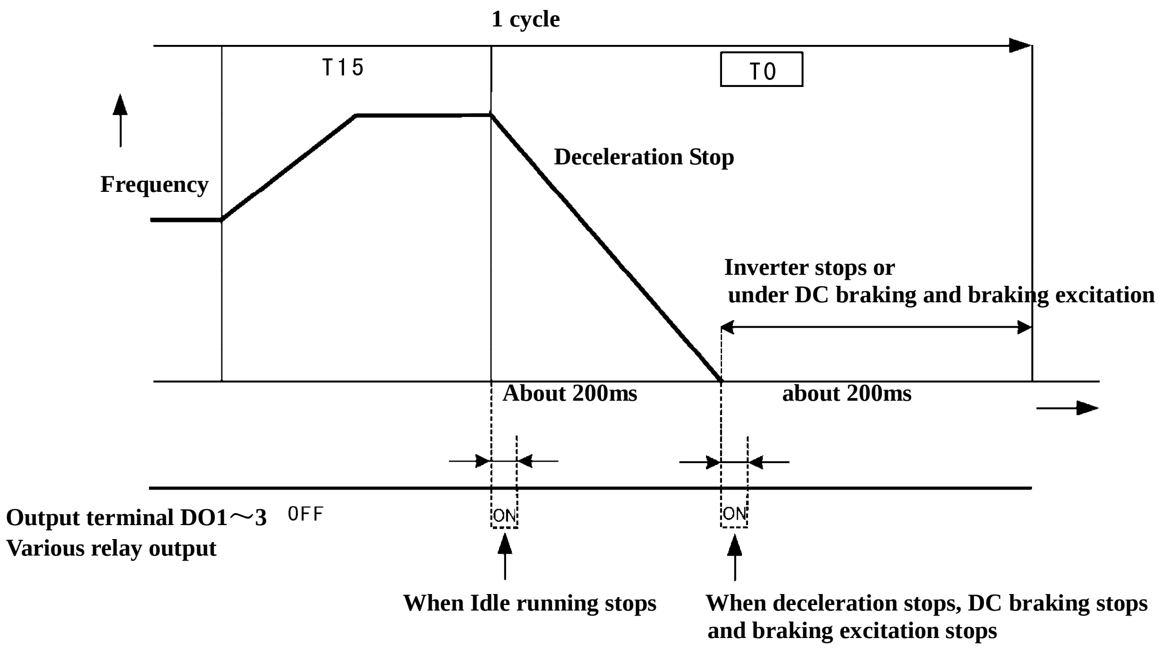
Note 2: **Since the simple graph operation will specify multi-speed frequency in each timer, the multi-speed changes made for control circuit input terminals will be noneffective.**

7) Cycle completion signal of simple graph operation

- If a control terminal output function is set in cycle completion of simple graph operation (any one of F1509~F1511 is 3), before the operation timer T0 stops the inverter or enters into DC braking and braking excitation, the open-circuit output of collector between control circuit output terminal and DCM1 & 2 is set to ON and is about 200ms. Please put the external action command to OFF after one cycle is completed, or use it when peripheral equipments and the programs are required to be synchronized.

Note 1: **There is an output when the cycle completion signal of simple graph operation passes the T0. When an output is not wanted, make a setting beyond F1509~F1511=3, or set the operation timer T0 to 0.0s.**

Note 2: **On the last operation timer when the total cycle (simple graph operation repetition count) is completed, when the inverter stops or starts DC braking and braking excitation, the cycle completion signal which has no relationship with the timer status will be ON.**



8) Figure of simple graph operation and function code setting

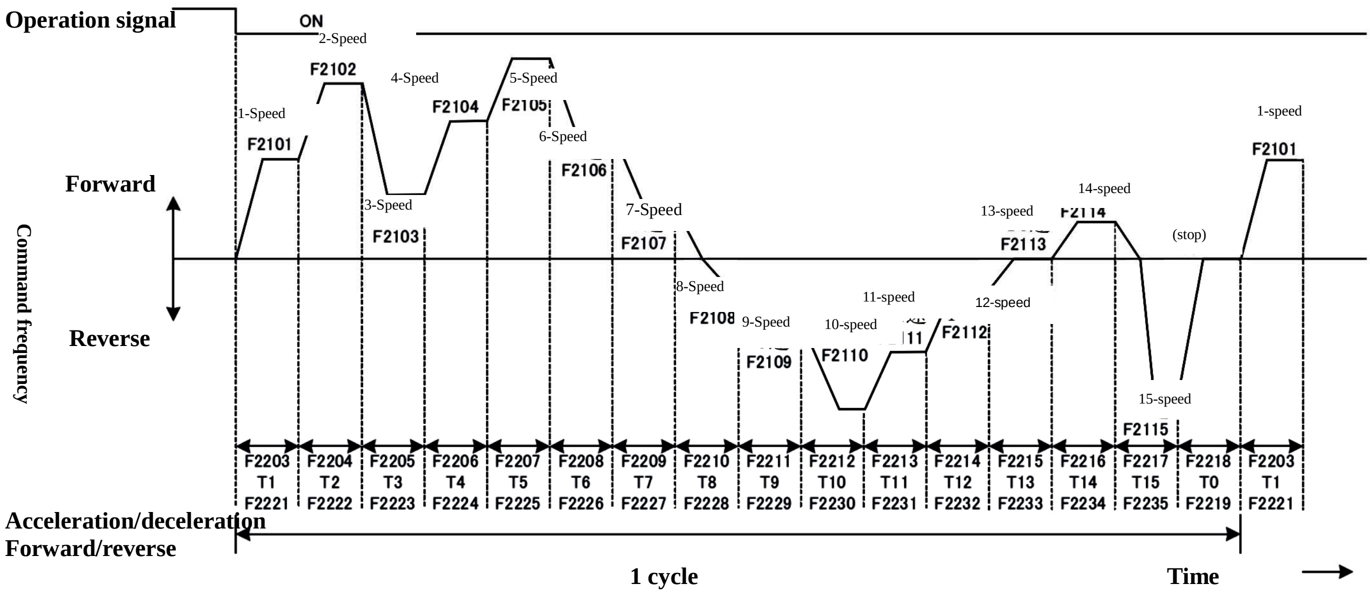
- The following figure summarizes the correspondence between the actions of simple graph operation and the function codes.

  Operation timing T0~T15: F2203～F2217=0～65000s

  Multi-speed frequency 1~15: F2101～F2115=0～600Hz

  Forward/reverse, acceleration/deceleration time: F2221～F2235

  Repetition count: F2202=0～250 (0: without limit)



9) Midway stop and midway start of simple graph operation
   - During simple graph operation, when the inverter must be stopped because of some undiscovered reason, the deceleration time during this period can be set independently and separated from the operation timer.
   - When stop command between operation timers T1~T15 (including alarms) are entered into the inverter, the inverter will stop deceleration or idle running, and stay at the midway stop status during simple graph operation. The stop deceleration time should be accorded to the deceleration time of midway stop deceleration time (F2219). F2219 will make a choice from 1st deceleration time to 4th deceleration time of F1016~F1019.

F2219 | Midway stop deceleration time

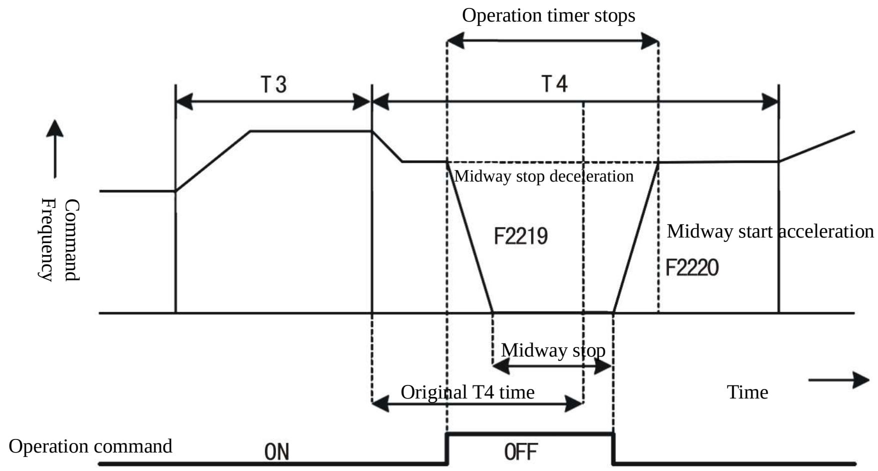
F2220 | Midway start acceleration time

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2219	Midway stop deceleration time	1: 1st deceleration time (value of F1016) 2: 2nd deceleration time (value of F1017) 3: 3rd deceleration time (value of F1018) 4: 4th deceleration time (value of F1019)	1	1
F2220	Midway start acceleration time	1: 1st acceleration time (value of F1012) 2: 2nd acceleration time (value of F1013) 3: 3rd acceleration time (value of F1014) 4: 4th acceleration time (value of F1015)	1	1

Note: When stop command (or idle running) enters into the inverter, the current operation timer will be maintained, and prepared for the next operation. When the operation command enters again, the operation timer will continue to work if original frequency is reached.

- During midway stop, if the conditions for another start are satisfied, the inverter will start acceleration to the original frequency set in the operation timer and enters into the midway start status. The acceleration time of this period is accorded to the acceleration time of midway start acceleration time (F2220).
- F2219 can make a choice from 1st deceleration time to 4th deceleration time of F1012~F1015. When the pre-set frequency is reached, the operation timer will work again.

Reference: During midway stop, even if the power supply is cut off, it still can record the last status of operation timer, therefore, when daily operation is finished and the inverter is stopped or the power supply is cut off, the operation on the next day will continue with the last operation.



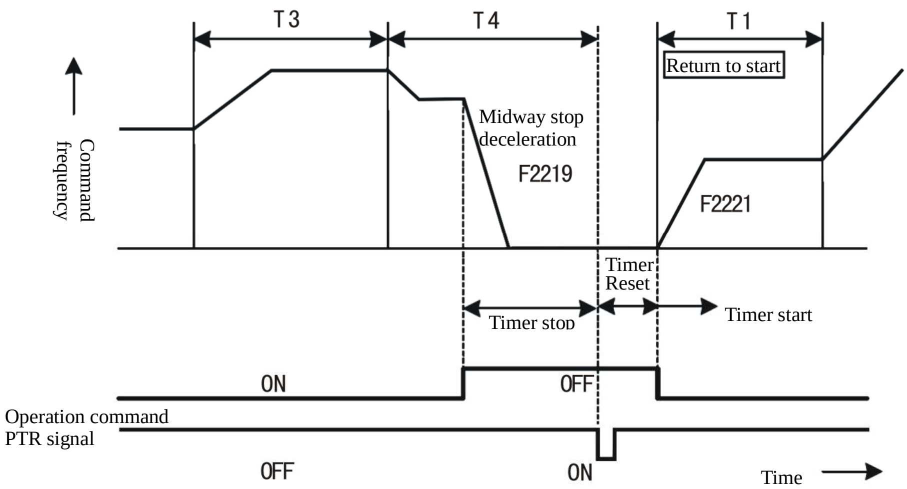
10) Resetting of simple operation timer during midway stop

- Keep the timer running during midway stop. Therefore, when conditions for another start are satisfied, the inverter will start acceleration to the original frequency set in the operation timer and continues with the remaining simple graph operation. If the maintained status of the operation timer is not used, please use the reset functions on the control circuit terminals to reset the operation timer.
- Since the reset function has reset the total timers in simple graph operation, the next operation will start the cycle from timer 1.

11) Setting & resetting method

- Please use the resetting of simple graph operation timers (any one of F1414~F1421 equals to 37) to set the multi-function input terminals.
- If the inverter stays in stop status because of midway stop, please short-circuit the control circuit terminal and DCM1 or DCM2 for over 100msec. Therefore rest the simple graph operation timer.
- When the inverter is fully stopped because of midway stop, please reset the operation timer before the input of the next operation signal. When inverter is during running, standby and start acceleration, even the reset of the timer is noneffective.

Note: If reset command of operation timer is input continuously, even when the next status is in midway stop state, the timer can still reset. Please input reset command only when necessary.



Disturb Operation Function（F2201=2）

Disturb operation function (F2201=2)

F2236	Disturb modulation analog input switching
F2237	Disturb modulation rate

- The function to periodically set the frequency change and repeat the actions through the pre-set acceleration/deceleration time. According to the difference between the shaft diameters of front end and terminal end, it is effective for the system desiring to change the rotating speed.
- For the frequency set in disturb operation, since it is freely modulated according to external analog command, the setting value of repeated frequency can be adjusted in conjunction with load status.

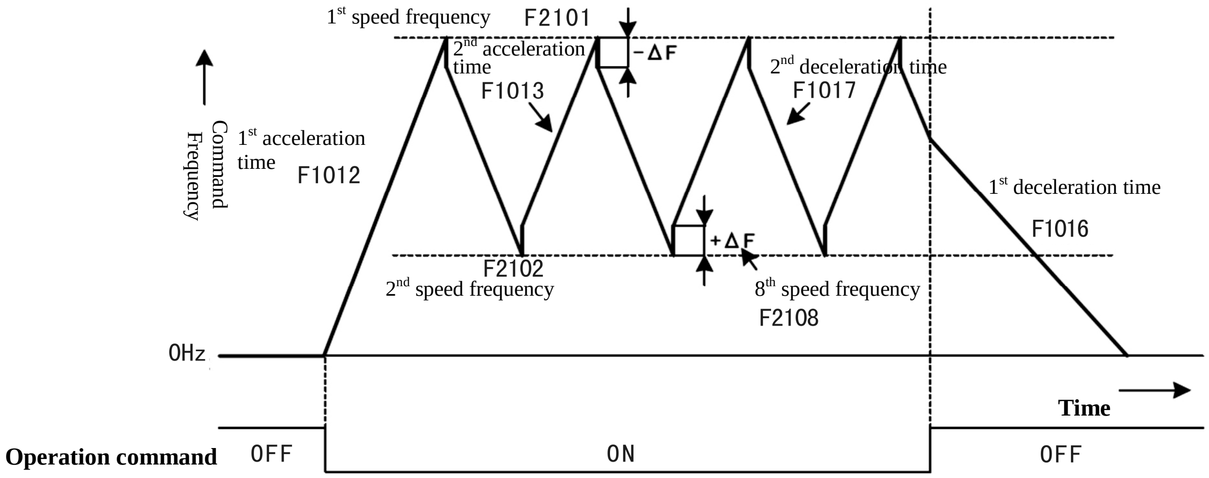
Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2236	Disturb modulation analog input switching	0: No analog input 1: External analog VIF1 voltage (0～5V) 2: External analog VIF1 voltage (0～10V or potentiometer) 3: External analog VIF2 voltage (0～5V) 4: External analog VIF2 voltage (0～10V or potentiometer) 5: External analog VIF3 voltage (0～5V) 6: External analog VIF3 voltage (0～10V or potentiometer) 7: External analog VIF1 current (4～20mA) 8: External analog VIF2 current (4～20mA) 9: External analog VIF3 current (4～20mA)	1	0
F2237	Disturb modulation rate	0～50%	1%	0

1) Use of inverter terminal

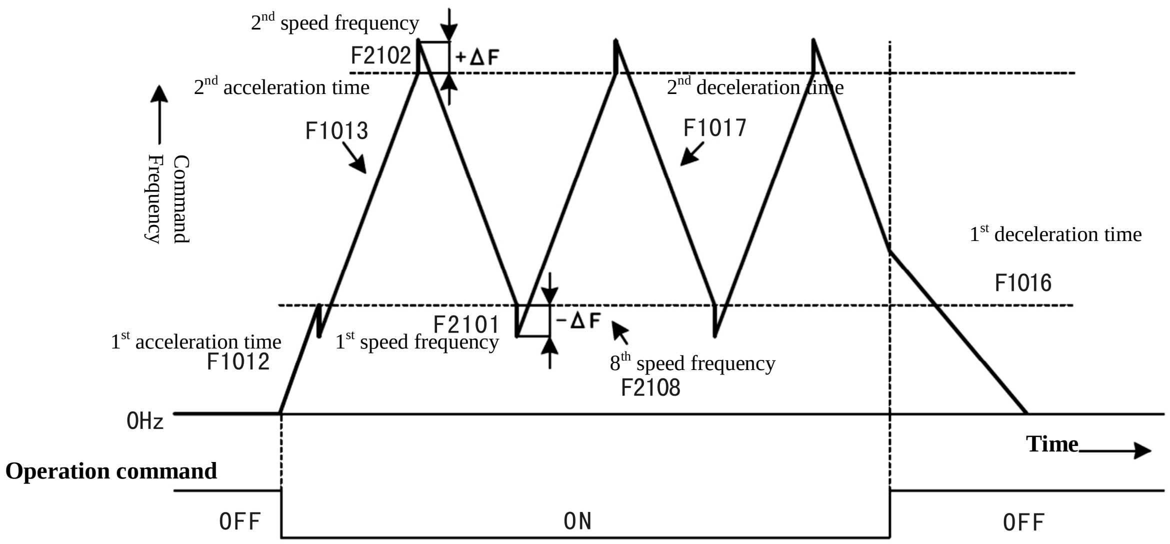
Control terminal	Content	Function code setting
VIF1 ～VIF3	Modulation signal input	F2236
ACM1、ACM2	Analog signal public terminal	

2) Basic actions of disturb operation
- Please set F2201=2 (disturb operation). No matter what is the control mode of the motor, the disturb operation is always effective.
- Since there are two settings of frequency value, it must be set according to 1st speed frequency (F2101) and 2nd speed frequency (F2102).
- When an operation command is input, the both frequencies will be repeated with a sequence of 1st speed frequency→2nd speed frequency→1st speed frequency…Also, when output frequency reaches the preset frequency, in order to prevent twining, an increase/decrease (△F) will be made to the instantaneously set frequency. When 1st speed frequency is reached, 8th speed frequency (F2108) will be used to subtract the preset frequency from 1st speed frequency; when 2nd speed frequency is reached, this value will be added to act as the set frequency.
  The next set frequency when 1st speed frequency is reached→1st speed frequency – 8th speed frequency (△F).
  The next set frequency when 2nd speed frequency is reached→2nd speed frequency + 8th speed frequency (△F).
- For start (from operation command ON to the 1st speed frequency is reached) and stop (from stop command ON to stop) of the acceleration and deceleration time during disturb operation, the frequency is changed through 1st acceleration/deceleration time, furthermore, it can also be changed through 2nd acceleration/deceleration time.

■ **When 1st speed frequency ＞ 2nd speed frequency**



■ **When 2nd speed frequency ＞ 1st speed frequency**



Note 1: **The 1st speed frequency in disturb operation is set by F2101. Therefore, the 1st speed frequency will not be set through external analog & digital (option) or terminal step. Please use F1002=1, 21.**

Note 2: **The inching operation before disturb operation is as normal.**

Note 3: **During disturb operation, since the acceleration/deceleration time can be set by 1st and 2nd, the switching of acceleration/deceleration time through control circuit input terminal AD2 and AD3 are noneffective. However, when AD2 and AD3 are set by terminal stepping function, the terminal stepping function is effective.**
When control circuit input terminal is selected by operation signal holding function (F1414~F1421=38), its function is available.

Note 4: **Since the multi-speed in disturb operation mode is set by 1st speed and 2nd speed, the multi-speed set by control circuit input terminal 2DF and 3DF are noneffective.**

Note 5: **When restart the operation with the functions of speed tracking, alarm auto reset and instantaneous-stop restart, it will be restarted toward the 1st speed frequency.**

3) Modulation of disturb operation

- The 1st speed frequency and 2nd speed frequency in disturb operation can be modulated by external analog command. When analog input is switched to be non-zero, the corresponding analog input will be modulation command. The maximum gain (frequency) of analog command will be set by gain frequency (F1402 or F1404 or F1406). However, since the polarity of analog input is positive, in order to modulate larger and smaller the frequency, a disturb modulation rate (F2237) can be used to adjust the offset of modulation rate.

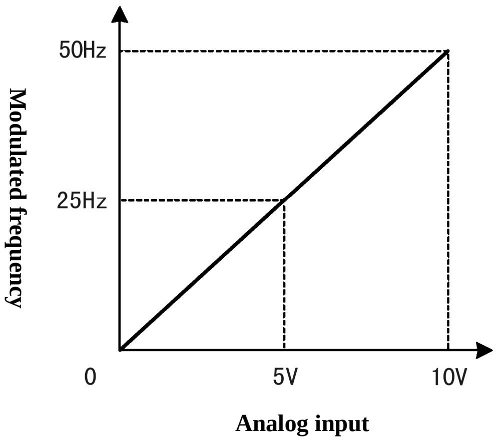
2-1) Setting and modulating method

- Use F2236 (analog input switching) to specify the modulation input.
- Use F1402 or F1404 or F1406 (setting of gain frequency) to set a maximum analog input.

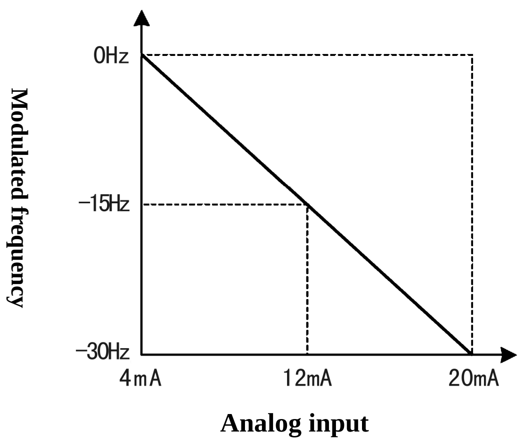
Gain frequency implies the switched frequency (modulated frequency) when a maximum analog input is specified by F2236, i.e. the switching gain corresponding to modulated frequency of analog input. When gain frequency is decided, the input analog signal will be switched into modulated frequency. This frequency is added by the two frequencies (1st & 2nd speed frequency) in disturb operation to be modulated as a new frequency.

However, the function codes of 1st speed frequency and 2nd speed frequency will not change directly. The gain frequency can also be negative. I.e. the switched modulation frequency of analog input command tends to be negative or is already negative. The negative modulation frequency in disturb modulation will be calculated by subtraction.

Example 1 Analog input VIF1=0～10V
Gain frequency F1402=50Hz



Example 2 Analog input VIF1=4～20 mA
Gain frequency F1402=-30Hz



2-2) Offset of modulation rate

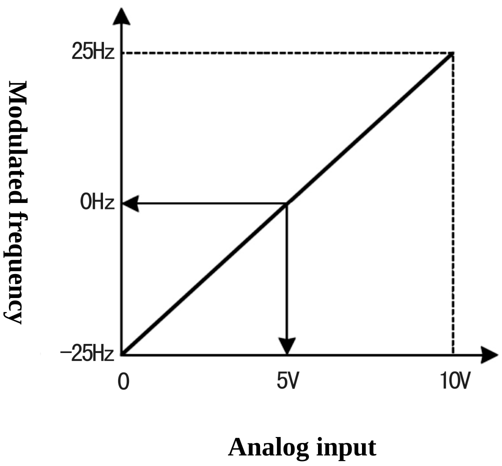
After adjustment of modulation frequency is finished by analog input, the input modulation frequency is the two frequencies (1st speed frequency and 2nd speed frequency) in disturb operation, they are the new values calculated by addition for modulation.

However, as shown in example 1 and 2, through the polarity of gain frequency (F1402 or F1404 OR 1406), any side set in the addition calculation or subtraction calculation will be modulated.

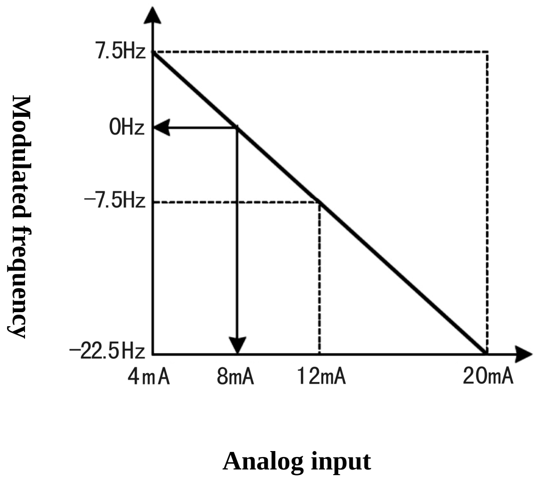
In this way, when the original frequency (1st speed frequency and 2nd speed frequency) is modulated larger or smaller, the disturb modulation rate (F2237) can be modulated by setting an offset. The offset is set according to the proportion of F2237=0~50%.

The above-mentioned proportion refers to be position of 0Hz (modulation frequency) specified by analog input. Even though the specified analog modulation input and the gain of modulation frequency through the 0Hz are totally changed, the change scope of modulation frequency is set by the settings in gain frequency (F1402 or F1404 or F1406).

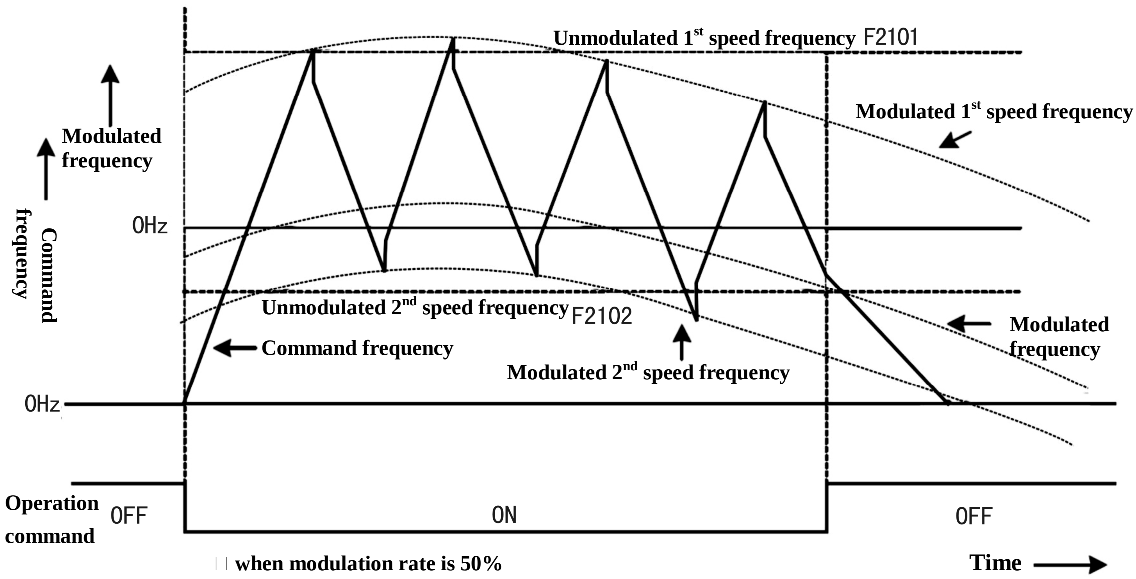
Example 1 Analog input VIF1=0～10V
Gain frequency F1402=＋50Hz
Disturb modulation rate F2237=50%



Example2 Analog input VIF1=4～20 mA
Gain frequency F1402=-30Hz
Disturb modulation rate F2237=25%



Examples of total actions are as follows.



Note 1: **For modulation input during disturb operation modulation, bias frequency (F1401) is noneffective.**

LCD Display Function

The followings are descriptions of LCD display function blocks.

F2301 LCD contrast adjustment

Adjust the contrast of LCD display on operation panel.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2301	LCD contrast adjustment	1～63	1	48

- When LCD is connected, it’s an effective function code.

F2302 LCD language selection

Select the language of LCD display on operation panel.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2302	LCD language selection	0：Startup options (English display) 1：English 2：Chinese 3：Japanese	1	0

- When LCD is connected, it’s an effective function code.
- When F2302=0, it shows English display. The next time when the inverter is powered on, the menu of LCD language selection will display.

Note 1: **Set F1604=1, when factory initialization is carried, since F2302=0, it will display in English.**

Note 2: **Even F1603 lock function code is used, this function can still be changed.**

F2303 LCD’s 1st display parameter setting

F2304 LCD’s 2nd display parameter setting

F2305 LCD’s 3rd display parameter setting

Status display mode. Select content displayed in LCD.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2303 F2304 F2305	LCD's 1st display parameter setting LCD's 2nd display parameter setting LCD's 3rd display parameter setting	0：No selection 1：Frequency [Hz] 2：Output current [A] 3：Speed [rpm] 4：Load factor [%] 5：Output voltage [V] 6：DC voltage [V] 7：Active power [kW] 8：Apparent power [kVA] 9：Radiator temperature [□] 10：Command speed [rpm] 11：PID1 feedback value [Hz] 12：PID2 feedback value [Hz] 13：VIF1 analog input value 14：VIF2 analog input value 15：VIF3 analog input value 16：Output torque [%] 17：Partial excitation current [A] 18：Partial torque current [A] 19：Detecting position [㎜] 32：Command frequency [Hz] 33：Command torque [%]	1	1 2 4

- When LCD is connected, it's an effective function code.

F2306 LCD backlight off time

When no action on the operation panel is required, set the LCD backlight off time.

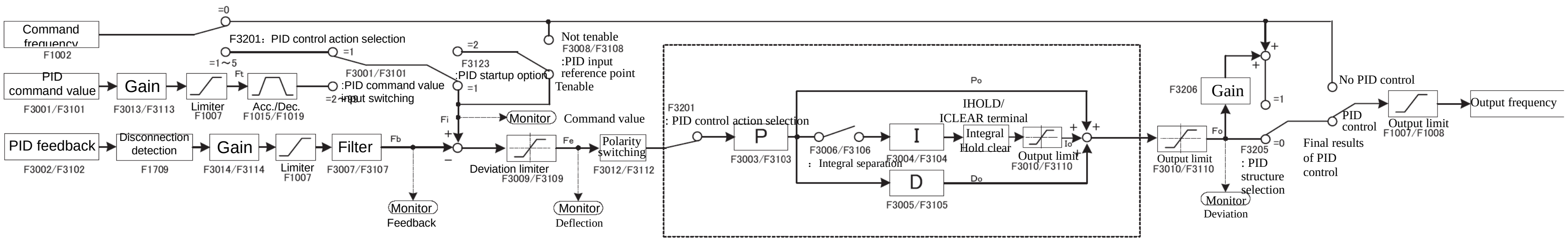
Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F2306	LCD backlight off time	0：Off 1～600[minute(s)] 999：Normally on	1 min.	10

- When LCD is connected, it's an effective function code.
- When backlight is off, the display on LCD will also be eliminated.
- When F2306=0, the backlight of LCD is normally off. Therefore, there is no display on LCD.
- When F2306=999, LCD backlight will not be off.

Chapter 7

PID Function

The followings are descriptions of PID control function blocks.
Multiple PID controls have been installed in this product. Each PID control is used to set the equipment status and can be used commutatively.
Also, there are multiple options for PID command and feedback values, which are used in each system.
The next page shows the basic formation of PID control.



PID Operation

Figure 7-1

7-3 Description of Functions

The follows are function codes related to PID control.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
1709	Feedback signal disconnection detection time	0：only warning 0.01～199.99 second(s) 120：No detection	0.01s	5
3001	PID1 command value input switching	1: Frequency 2: External analog VIF1 voltage (0~5V) 3: External analog VIF1 voltage (0~10V or potentiometer) 4: External analog VIF2 voltage (0~5V) 5: External analog VIF2 voltage (0~10V or potentiometer） 6: External analog VIF3 voltage (0~5V) 7: External analog VIF3 voltage (0~10V or potentiometer) 8: External analog VIF1 current (4~20mA) 9: External analog VIF2 current (4~20mA) 10: External analog VIF3 current (4~20mA) 11: Function code setting (by F3017) 99: Pulse train input	1	1
3002	PID1 feedback input switching	0: No input 1: External analog VIF1 voltage (0~5V) 2: External analog VIF1 voltage (0~10V or potentiometer) 3: External analog VIF2 voltage (0~5V) 4: External analog VIF2 voltage (0~10V or potentiometer) 5: External analog VIF3 voltage (0~5V) 6: External analog VIF3 voltage (0~10V or potentiometer) 7: External analog VIF1 current (4~20mA) 8: External analog VIF2 current (4~20mA) 9: External analog VIF3 current (4~20mA) 10: Communication mode 99: PG feedback PID	1	0
3003	PID1 control proportional gain	0～100	0.01	0.1
3004	PID1 control integral time	0.01～100 second(s)	0.01s	0.1
3005	PID1 control differential time	0～100 second(s)	0.01s	0
3006	PID1 control integral separation judgment value	5～100% (upper frequency limit reference)	0.1%	20
3007	PID1 feedback signal input filter time constant	1～500（set value 1=10ms）	1	10
3008	Indirect PID1 input reference	5～100%（target value reference）	0.1%	20
3009	PID1 deviation limit value	0：No limit 1～100%（upper frequency limit reference）	0.1%	100
3010	PID1 output limit value	0: No limit 1～100%（upper frequency limit reference）	0.1%	100
3011	PID1 operation polarity switching	1: command value — feedback value 2: feedback value — command value	1	1
3012	PID1 gain polarity switching	1: The positive or negative deviation indicates the same gain 2: The positive or negative deviation indicates different gain	1	1
3013	PID1 command value gain	0～50	0.01	1
3014	PID1 feedback value gain	0～50	0.01	1
3015	PID1 control proportional gain（negative：F3012=2）	0～100	0.01	0.1
3016	PID1 control integral time（negative：F3012=2）	0.01～100 second(s)	0.01s	0.1
3017	PID1 control command value	0～6000	0.1	0

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
3018	PID1 control feedback value (communication function)	0～6000	0.1	0
3019	Frequency corresponding to PID1 control maximum command value	0～600Hz	0.01Hz	60
3101	PID2 command value input switching	1: Frequency 2: External analog VIF1 voltage (0~5V) 3: External analog VIF1 voltage (0~10V or potentiometer) 4: External analog VIF2 voltage (0~5V) 5: External analog VIF2 voltage (0~10V or potentiometer） 6: External analog VIF3 voltage (0~5V) 7: External analog VIF3 voltage (0~10V or potentiometer) 8: External analog VIF1 current (4~20mA) 9: External analog VIF2 current (4~20mA) 10: External analog VIF3 current (4~20mA) 11: Function code setting (by F3017) 99: Pulse train input	1	1
3102	PID2 feedback input switching	0: No input 1: External analog VIF1 voltage (0~5V) 2: External analog VIF1 voltage (0~10V or potentiometer) 3: External analog VIF2 voltage (0~5V) 4: External analog VIF2 voltage (0~10V or potentiometer) 5: External analog VIF3 voltage (0~5V) 6: External analog VIF3 voltage (0~10V or potentiometer) 7: External analog VIF1 current (4~20mA) 8: External analog VIF2 current (4~20mA) 9: External analog VIF3 current (4~20mA) 10: Communication mode 99: PG feedback PID	1	0
3103	PID2 control proportional gain	0～100	0.01	0.1
3104	PID2 control integral time	0.01～100 second(s)	0.01s	0.1
3105	PID2 control differential time	0～100 second(s)	0.01s	0
3106	PID2 control integral separation judgment value	5～100%（upper frequency limit reference）	0.1%	20
3107	PID2 feedback signal input filter time constant	1～500（set value 1=10ms）	1	10
3108	Indirect PID2 input reference	5～100%（target value reference）	0.1%	20
3109	PID2 deviation limit value	0：No limit 1～100%（upper frequency limit reference）	0.1%	100
3110	PID2 output limit value	0：No limit 1～100%（upper frequency limit reference）	0.1%	100
3111	PID2 operation polarity switching	1：command value — feedback value 2：feedback value — command value	1	1
3112	PID2 gain polarity switching	1：The positive or negative deviation indicates the same gain 2: The positive or negative deviation indicates different gains	1	1
3113	PID2 command value gain	0～50	0.01	1
3114	PID2 feedback value gain	0～50	0.01	1
3115	PID2 control proportional gain （negative：F3012=2）	0～100	0.01	0.1
3116	PID2 control integral time （negative：F3012=2）	0.01～100 second(s)	0.01s	0.1
3117	PID2 control command value	0～6000	0.1	0
3118	PID2 control feedback value (communication function)	0～6000	0.1	0

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
3119	Frequency corresponding to PID2 control maximum command value	0～600Hz	0.01Hz	60
3123	PID start mode selection	1: Direct input mode 2: Conditional input mode	1	1
3124	PID end mode selection	1: Direct input mode 2: Conditional input mode	1	2
3125	PID end setting value	1～100%（upper frequency limit reference）	0.1%	20
3201	PID control action selection	0: Open loop control 1: PID1 control 2: PID2 control 3: For factory adjustment 4: External terminal switching PID control 5: Timing switch PID control	1	0
3203	External PID control selection	0: No external PID control 1: PID1 external control 2: PID2 external control 3: For factory adjustment 4: PID1, PID2 external control 5: For factory adjustment 6: For factory adjustment	1	0
3204	External PID operation mode selection	1: Operation interlocked with inverter operation 2: PID output after power input 3: PID output controlled by external terminals	1	1
3205	PID component selection	0: Without command value addition calculation 1: With command value addition calculation	1	0
3206	Command value addition calculation PID control gain	0.01～100	0.01	1
3207	PID1/PID2 switching time	0.1～6000 minute(s)	0.1min.	1

【PID Control Action Selection】

F3201 PID control action selection

The function to select PID action.

- When setting F3201≠0, the following PID controls can be selected.
  - ·F3201=0: Normal operation mode without PID control
  - ·F3201=1: PID1 control mode
  - ·F3201=2: PID2 control mode
  - ·F3201=3: For factory adjustment
  - ·F3201=4: PID control mode switched by external terminals
  - ·F3201=5: PID control mode switched by timing
- PID control is effective in vector control of V/f and speed control mode.
- The basic formation of PID1 and PID2 are the same, therefore they can be used separately or combinedly.
- Details of each PID control mode is sorted according to the category of each function.

  Note: During the operation status of inverter stopping, DC braking, excitation and so on, the PID control will not be used.

【Command Value of PID Control】

F3001	**PID1 command value input switching**
F3101	**PID2 command value input switching**
F3013	**PID1 command value gain**
F3113	PID2 **command value gain**
F3019	**Frequency corresponding to PID1 control maximum command value**
F3119	**Frequency corresponding to PID2 control maximum command value**

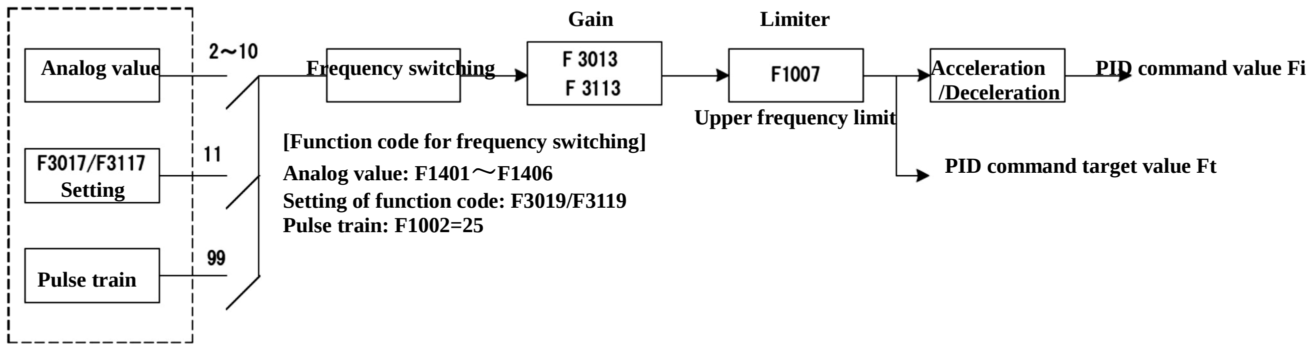
The function to select the command value of PID control.
The function to select control command value, F3001 for PID1 and F3101 for PID2.

- Select the following PID command value in the setting of F3001/F3101.
  - F3001/F3101=0: Frequency
    The 1st speed frequency selected by F1002 and the frequency according to multi-speed command are the command values.
  - F3001/F3101=2～10: various analog input values (VIF1～VIF3)
    The settings of various analog input values (VIF1～VIF3) are the command values.
    Analog input is the same as normal frequency, the input value will be switched into frequency by gain frequency and bias frequency of F1401~F1406, this frequency will be the command value used for PID control.
  - F3001/F3101=11: use setting values of F3017 (PID1)/F3117 (PID2) as the command values.
    The setting values of F3017 (PID1)/F3117 (PID2) will be switched into frequency by the setting values of F3019 (PID1)/F3119 (PID2).
    The maximum value (6000) of F3017 (PID1)/F3117 (PID2) will be switched into the frequency set by F3019 (PID1)/F3119 (PID2).
    Example) When F3017=3000 and F3019=60Hz, the command value of PID will be 30Hz.
  - F3001=99: pulse train input
    F1002=25: same as pulse train, the pulse train input from external is the command value.
    About the pulse train input, please refer to the pulse train function of F1002.
- Each PID command value can be gained by F3013 (PID1)/F3113 (PID2).
- Each PID command value will be limited according to the upper frequency limit after the gain, then acceleration/deceleration will be processed.
  When PID command value is beyond the frequency setting, the acceleration/deceleration time will be based on reference frequency: F1011 is the reference, run the operation according to 3rd acceleration time: F1014, 3rd deceleration time: F1018.

Note 1: **The PID control of acceleration/deceleration (beyond the frequency setting) will share the 3rd acceleration/deceleration time used in normal operation, this is a fixed use.**

Note 2: **During the 3rd acceleration time: F1014, when any one of F1018 during 3rd deceleration time =0, the acceleration/deceleration will not be carried, the PID command target value will be directly used as PID command value.**

The following shows the formation of PID command value.



PID command value input switching F3001/F3101

Chapter 7

Note 3: **The judgment of inverter startup condition is not the command values of PID, like the normal operation, it is determined by the status of target frequency, start frequency and operation startup frequency.**
Therefore, when the setting is beyond the frequency of F3001/F3101≠1, the input switching of PID command value during operation startup is required to set the multi-speed target frequency larger than start frequency and operation startup frequency.

Note 4: **PID command value input switching: when the setting is beyond the frequency of F3001/F3101≠1, since the control value is different from normal frequency command, the functions based on normal frequency will not work, such as acceleration/deceleration characteristics, constant-speed protection, speed tracking and so on. Please pay attention to this.**

【Feedback Value of PID Control】

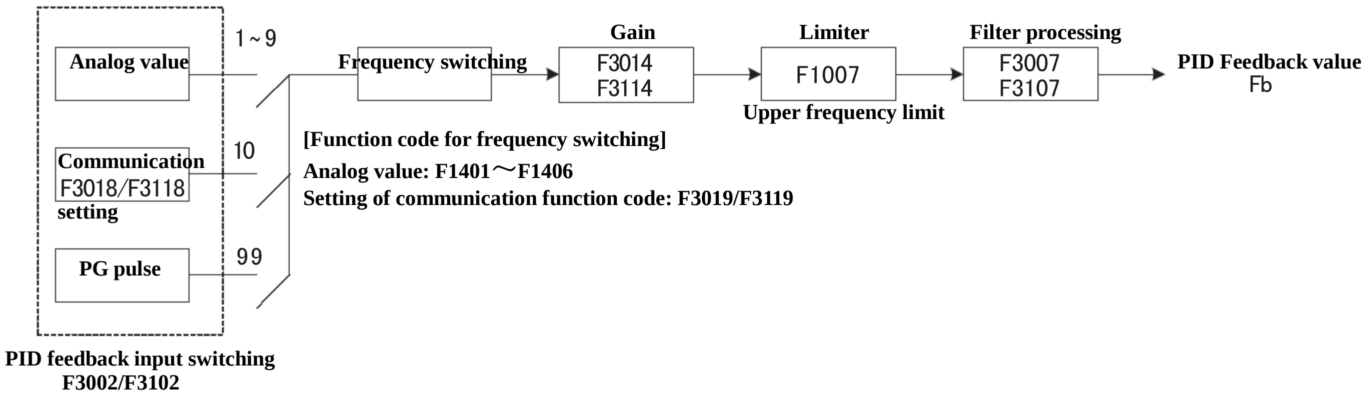
F3002	**PID1 feedback input switching**
F3102	**PID2 feedback input switching**
F3014	**PID1 feedback value gain**
F3114	**PID2 feedback value gain**
F3007	**PID1 feedback input filter time constant**
F3107	PID2 **feedback input filter time constant**

The function to select the feedback value of PID control.
The function to select feedback input, F3002 for PID1 and F3102 for PID2.

- Select the following PID feedback value in the settings of F3002/F3012.
  - F3002/F3012=0: no input
    When the feedback input is not selected, the PID control selected by PID1 and PID2 will be noneffective. The normal open loop operation will be carried out.
  - F3002/F3012=1~9: various analog feedback input values (VIF1~VIF3)
    Input feedback value through various analog inputs (VIF1~VIF3).
    Analog input is the same as normal frequency command, the input value will be switched into frequency by gain frequency and bias frequency of F1401~F1406, this frequency will be used as feedback value for PID control.
  - F3002/F3012=10: the values set by F3018 (PID1)/F3118 (PID2) are the feedback values.
    When feedback value is input by communication function, please enter the data in F3018 (PID1)/F3118 (PID2).
    The values set by F3018 (PID1)/F3118 (PID2) are switched into frequency by the frequency set by F3019 (PID1)/F3119 (PID2).
    The maximum value (6000) of F3018 (PID1)/F3118 (PID2) will be switched into the frequency set by F3019 (PID1)/F3119 (PID2).
    Example) When F3118=1200 and F3119=100Hz, the feedback value of PID2 is 20Hz.
  - F3002/F3012=99: The speed is switched into frequency by PG feedback pulse input (A+, A-/B+, B- terminals), the frequency will be used as feedback value input.
    For PG feedback pulse input and setting method, please refer to Chapter 4 “Connection of PG Sensor” and “Function description of PG sensor (F8110/F8122/F8125)”.
- Each PID feedback value can be gained by F3014 (PID1)/F3114 (PID2).
- After each PID feedback value is gained, F3007 (PID1)/F3107 (PID2) can be used for filter. The setting value=1 of F3007 (PID1)/F3107 (PID2) is the time constant for 10ms filter.
  Example) When F3007=10, the filter time constant =100ms.

Note: When there is a speed control by PG sensor, the PG feedback will be processed internally. Therefore, never use PG feedback PID function (F3002=99 or F3102=99). If the functions of PG sensor speed control and PG feedback PID are used together, a correct control cannot be realized.

The following shows the formation of PID feedback value.

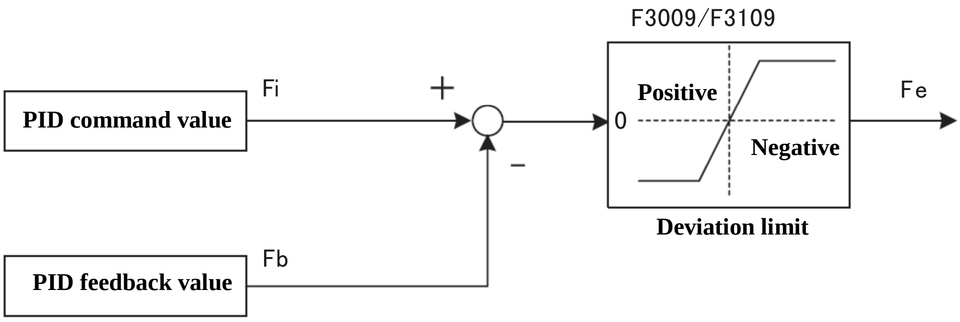


【Deviation Limit of PID Control】

F3009	**PID1 deviation limit value**
F3109	**PID2 deviation limit value**

The function to make a positive/negative limit for the deviation of command value and feedback value in PID control.

- Upper frequency limit: For frequency of F1007, the rate set by F3009/F3109 will be used as the limit value.
  - · F3009/F3109=0: no limit
  - · F3009/F3109=1～100%: Use the rate to upper frequency limit for control.
    Example) When F1007=50Hz and F3009=20%, ±10Hz will be used to control the deviation of PID1 control.



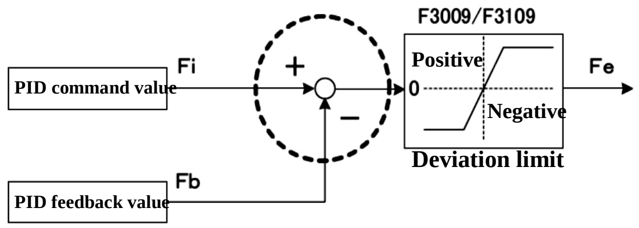
【PID Operation Polarity Switching】

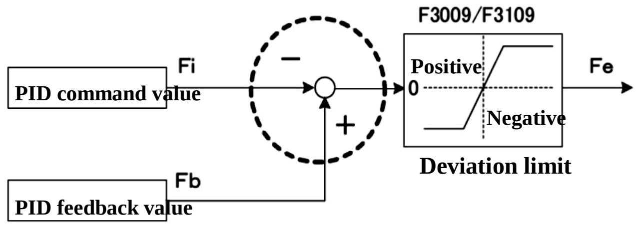
F3011	**PID1 operation polarity switching**
F3111	**PID2 operation polarity switching**

The function to switch the deviation operation results of command value and feedback value in PID control.

- For PID deviation of Fe, the polarity will be switched according to the settings of F3011/F3111.
  - · F3011/F3111=1: command value – feedback value.
    The polarity of deviation Fe will not be changed.
  - · F3011/F3111=2: feedback value – command value.
    The symbol of deviation Fe will be reversed. (Polarity reversion)

Chapter 7





Note 1: **Since deviation Fe is calculated by command value – feedback value, the polarity reversion will not be carried out when F3011/F3111=1. When deviation operation is used for reversed polarity, set F3011/F3111=2.**

Note 2: **When F3011/F3111=2, the PID control output will be made towards increase by inverter stop action. When the system cannot be stopped, set F3124: PID end mode selection=1:, direct end mode for stop action.**

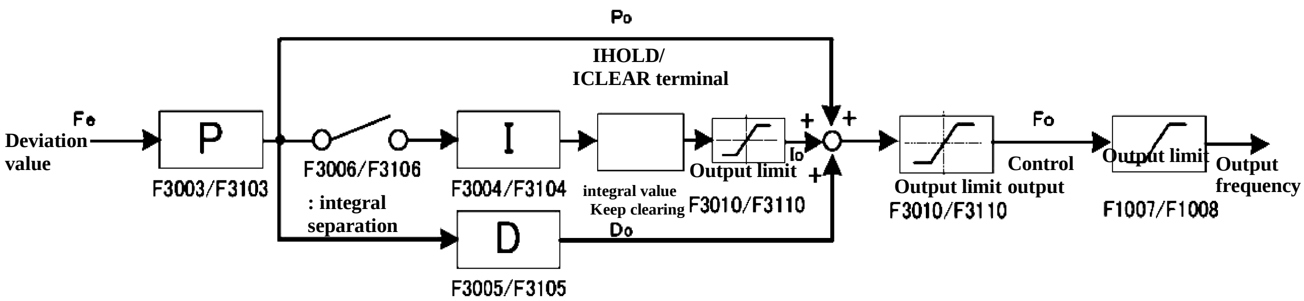
【PID Operation】

F3003	**PID1 control proportional gain**
F3103	**PID2 control proportional gain**
F3004	**PID1 control integral time**
F3104	**PID2 control integral time**
F3005	**PID1 control differential time**
F3105	**PID2 control differential time**

The function to make a PID operation for deviation value of command value and feedback value.

- Adjustment of PID control proportional gain
  - F3003/F3103=0～100: used when adjusting the proportional gain.
    To output a control value which is proportional to the deviation value. However, the deviation cannot be cleared by only P control. Please make an adjustment within a stable scope and make sure there is no vibration during the control.
- Adjustment of PID control integral time
  - F3004/F3104=0.01～100 second(s): used when adjusting the integral time.
    After an integral action, the deviation value will be output as the control value, it is effective for deviation clearing. However, the response to fast changes will be slowed down.
    Since static difference only exists in P control, it will be used together with integral control.
    In order to make a fast stabilization, the integral time should be set short. When there is an over-adjustment, the time must be set much longer.
- Adjustment of PID control differential time
  - F3005/F3105=0.01～100 second(s): used when adjusting the differential time.
    After a differential action, the deviation value will be output as the control value. It can be used for fast changes when the response is improved. When there is an over-adjustment, the time must be set much shorter.

The following shows the basic formation of PID control.



F3010	PID1 output limit value
F3110	PID2 output limit value

The function to make output limit for output of integral operation output and PID operation output.

- For integral and PID operation output, F1007: a positive/negative limit will be made by the rate to upper frequency limit.
  - · F3010/F3110=0: no limit
  - · F3010/F3110=1～100%: make a limit by the rate to upper frequency limit.
    Example) When F1007=60Hz and F3010=90%, ±54Hz will be used to limit the deviation of PID control.

Note: Even though output Fo is controlled for positive/negative limit of F3010/F3110, the actual output frequency of the inverter is controlled by the upper frequency limit F1007 and lower frequency limit F1008.

F3012	PID1 gain polarity switching
F3112	PID2 gain polarity switching
F3015	PID1 control proportional gain (negative)
F3115	PID2 control proportional gain (negative)
F3016	PID1 control integral time (negative)
F3116	PID2 control integral time (negative)

The function to switch positive/negative proportional gain and integral time through the polarity of deviation.

- With the polarity of deviation, the switching of positive/negative proportional gain and integral time can be selected.
  - · F3012/F3112=1： The positive or negative deviation indicates the same gain
    When deviation has no relationship with polarity, use F3003/F3103: proportional gain and F3004/F3104: integral time for PID operation.
  - · F3012/F3112=2： The positive or negative deviation indicates different gains
    The proportional gain and integral time used for operation are different according to the polarity of deviation.
    When deviation ≥ 0 (positive)
    Use F3003/F3103: proportional gain and F3004/F3104: integral time for PID operation.
    When deviation < 0 (negative)
    Use F3015/F3115: proportional gain (negative) and F3016/F3116: integral time (negative) for PID operation.

Note: In normal control system, same proportional gain and integral time will be normally used. But for system with an obvious result of gain by positive/negative polarity, please try this function.

F3006	PID1 control integral separation judgment value
F3106	PID2 **control integral separation judgment value**

The function to invalid the integral according to the deviation value.
When the status change of the control system is large and large vibration or unstable has been caused by sharp increase of integral output, please adjust this function.

- Set the judgment value for PID control integral separation
  - · F3006/F3106=5～100%: the rate to upper frequency limit.
    Deviation between PID command value and PID feedback value: when the conditions specified by Fe have been satisfied, the integral control is noneffective (separation).
    Separation conditions are F3006/F3106: integral separation judgment value and upper frequency limit and deviation: absolute value of Fe. The judgment will be as follows.

Conditions of integral separation: ｜Fe｜> upper frequency limit×F3006/F3106

Chapter 7

【Start Mode of PID Control】

F3008	**Indirect PID1 input reference**
F3108	**Indirect PID2 input reference**
F3123	**PID start mode selection**

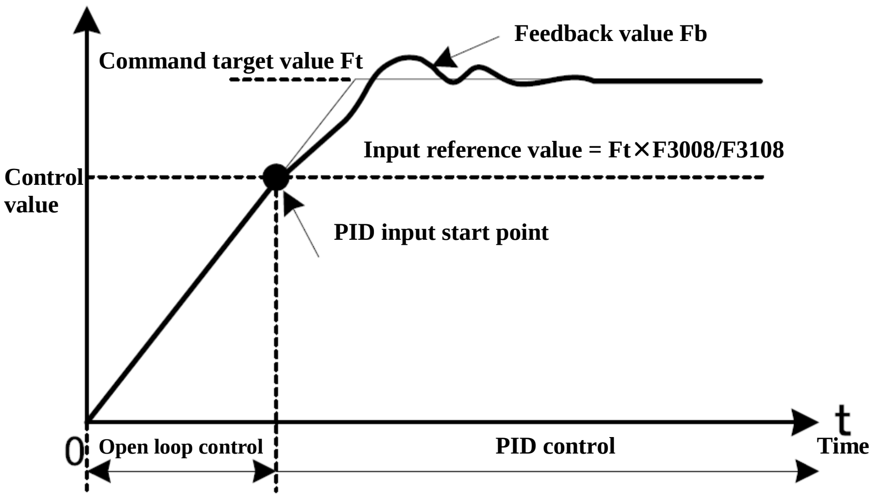
The function to select the input mode for PID control.

- The direct input mode and indirect input mode can be selected by selecting the function code.
  - F3123=1: direct input mode…Normal PID control.
  - F3123=2: Conditional input mode.

    When the conditions specified by PID command value and PID feedback value are satisfied, the PID action will be started by switching open loop control into PID control.

    Start conditions are F3008/F3108: input reference and PID command target value: Ft and feedback value: Fb. The judgment will be as follows.

    PID start condition: Fb□Ft×F3008/F3108



Note 1: **When PID control is started once the PID start conditions are satisfied, the PID control will continue even the second start conditions are not satisfied. However, once the inverter is in stop status and other conditions will not carry out PID control, the start operation of PID control will be carried out again according to the PID conditions.**

Note 2: **When PID command value input switching is F3001/F3101=1, the frequency will be target frequency Ft under normal mode.**

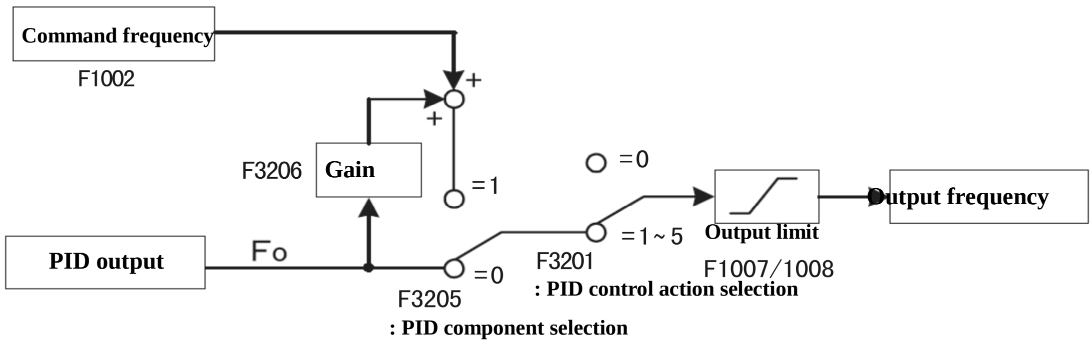
【Formation of PID Control】

F3205	**PID constitution selection**
F3206	**Command value addition calculation PID control gain**

The function to select the output formation of PID control.

- You can use PID control output directly as the frequency output, you can also add command frequency and PID control output and use the summation as the frequency output.

- When command frequency is added to PID control output for the frequency output, you can gain the PID control output and then make an addition calculation.
  - · F3205=0: Without command value addition calculation
    Use the PID control output directly as the frequency output.
  - · F3205=1: With command value addition calculation
    When PID control output is gained by F3206: After command value addition calculation is added to command frequency, it will be used as the frequency output.

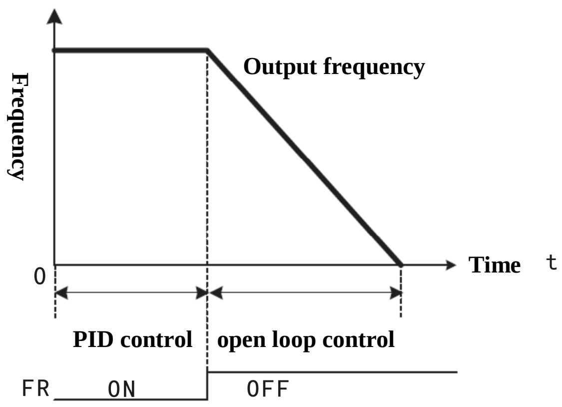


【End Mode of PID Control】

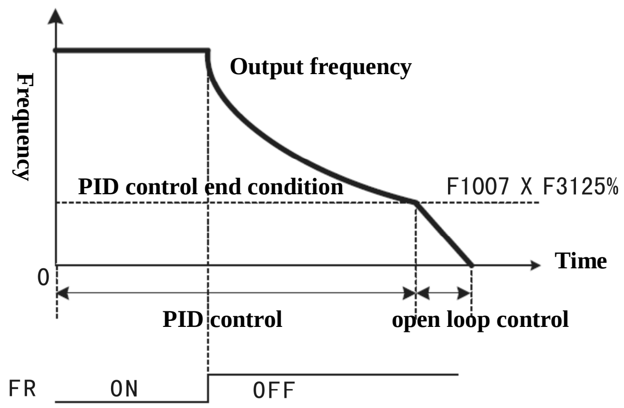
F3124	PID end mode selection
F3125	PID end setting value

The function to select PID control end mode when inverter stops the acceleration/deceleration.

- When selecting stop deceleration with the following function code, i.e. make a stop without a PID control open loop mode, or the specified conditions have been satisfied, a open loop mode will be used to stop the deceleration.
  - · F3124=1: direct end mode.
    At the same time of stopping the deceleration, end the PID control forcibly by the open loop mode.
  - · F3124=2: conditional end mode.
    When it starts to stop deceleration and the output frequency of the inverter becomes to be the PID end setting value: frequency operated by F3125, the PID control will be ended forcibly by the open loop mode.
    The conditions of PID control are to make a judgment of the output frequency with the PID end setting value: frequency set by F3125 comparing to the upper frequency limit: F1007.



<F3124=1>



<F3124=2>

Note 1: PID operation polarity switching function: when F3011/F3111=2, the PID control output tends to increase because of the stop action, when the system cannot be stopped, please set F3124: PID end mode selection = 1: direct end mode to stop the action.

Note 2: When zero servo action is effective in PID control, end the PID control and start the open loop zero servo action.

【Feedback Signal Disconnection Detection】

F1709	Feedback signal disconnection detection time

The function to set the disconnection detection of feedback signal and the detection time.

- Detect the relationship between PID control command value and feedback value, when there is an abnormal situation, it will be judged as disconnection, warning or alarm for shutdown.
  - F1709=0: only warning (the inverter will continue to run).
    During disconnection detection, even when it is judged as disconnection, the inverter will continue to run, a warning of FbEr will be displayed.
    If it stops during warning display, the inverter will also stop the idle running.
  - F1709=0.01～119.99: set the detection time of disconnection judgment. (Initialization=5s)
    During disconnection detection, when it is judged as disconnection, GAL 1 will be displayed and an alarm for shutdown will be output.
    When the system response speed is very slow and a false detection may happen, please prolong the detection time.
  - F1709=120: no disconnection detection.
    No action of disconnection detection, warning or alarm for shutdown.

【PID Various Variables Output】

F1501	Internal analog output function 1
F1504	Internal analog output function 2

The function to output (0~10V) the various variables in PID control from the analog output AOUT1/AOUT2.

- F1501 will output signal through AOUT1, F1504 will output signal through AOUT2. Refer to the following table for output variable and setting.
- The output format of each PID variable is 120Hz/10V.
- Please adjust the coefficient and offset of output signal according to F1502 (AOUT1)/F1505 (AOUT2) and F1503 (AOUT1)/F1506 (AOUT2).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
1501 1504	Internal analog output function 1 Internal analog output function 2	3: PID1 feedback value [Hz] 4: PID2 feedback value [Hz] 17: PID1 command value [Hz] 18: PID1 input deviation value [Hz] 19: PID2 command value [Hz] 20: PID2 input deviation value [Hz] 24: External PID1 output value [Hz] 25: External PID2 output value [Hz]	1	0 0

Note: The variable of PID control will be output with an absolute value. When it is negative, it will be positive during output.

Besides analog output, the internal variables in PID control can also be displayed on operation panel timely.

- The follows are function code and variable as well as the setting value displayed on the operation panel.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
3301	Reading PID1 command value	Only for reading	1	—
3302	Reading PID1 feedback value	Only for reading	1	—
3303	Reading PID1 input deviation value	Only for reading	1	—
3304	Reading PID1 output value	Only for reading	1	—
3305	Reading PID2 command value	Only for reading	1	—
3306	Reading PID2 feedback value	Only for reading	1	—
3307	Reading PID2 input deviation value	Only for reading	1	—
3308	Reading PID2 output value	Only for reading	1	—

Note 2: **The variable of PID control will be output with an absolute value without a symbol.**

【Control Switching by External Terminals】

The function to switch various control actions in PID control with the signal input by external multi-function terminal (DI1~DI8).

● The following is the table of multi-function terminal input signal in PID control.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
1414	Selection of input terminal DI1	76：V/f-PID control switching terminal/VFPID	1	1
1415	Selection of input terminal DI2	77：PID control locking terminal/PIDLCK		2
1416	Selection of input terminal DI3	85：PID switching terminal/PIDL		3
1417	Selection of input terminal DI4	86：PID switching terminal /PIDH		4
1418	Selection of input terminal DI5	87：PID1 resetting terminal/RPID1		5
1419	Selection of input terminal DI6	88：PID1 external terminal selection/PID1EX		6
1420	Selection of input terminal DI7	89：PID2 external terminal selection/PID2EX		7
1421	Selection of input terminal DI8	91：PID integral value holding terminal/IHOLD		8
		92：PID integral value eliminating terminal/ICLEAR		

● VFPID Signal

Used to switch from open loop control to PID control.

ON: Open loop control. (No PID feedback control)
Use PID command value directly as the PID output.

OFF: Switch from Open loop control to PID control.

Note: When start PID control with ON→OFF and return the VFPID signal to open loop control by another OFF→ON, since the PID command value is directly used as the PID output, the output frequency will change greatly in case that the integral output is large before ON, it may also cause an over-current alarm.
When return from OFF to ON, please send a stop command during inverter stoppage or after PID control is locked by PIDLCK signal, it must be used with a stop action.

● PIDLCK Signal

Hold control output in PID control, use it when stop action is carried under that status.

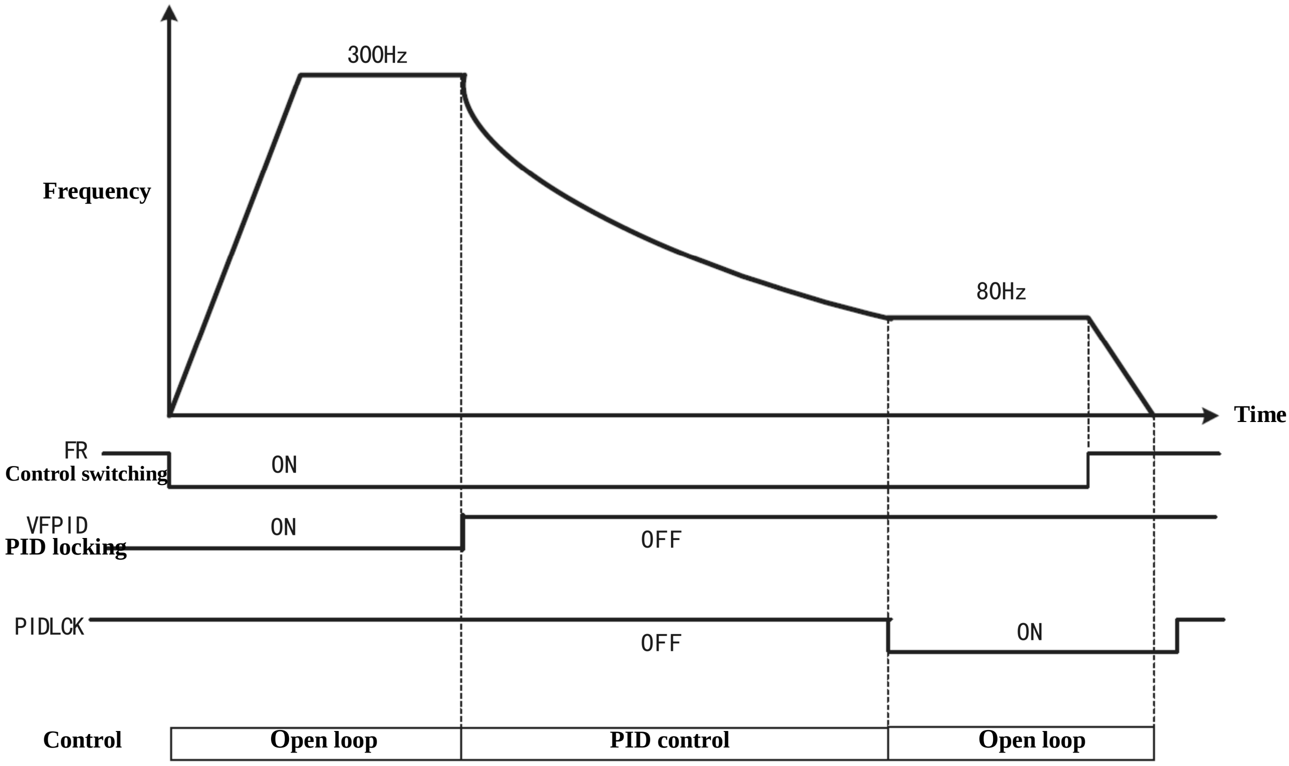
ON：Lock the PID control output (hold). (no PID feedback control)
The PID control output changes with a proportion to PID command value.

OFF：Carry out PID control.

The followings are application examples of VFPID signal and PIDLCK signal.

Example) Start = open loop control
Constant-speed = switch to PID control, and start operation.
End = Lock PID control, open loop control deceleration stops.

Chapter 7



- IHOLD Signal:
  The terminal to lock the integral operation of PID control and hold the integral value.
  ON： Lock the integral operation of PID control and hold the integral value.
  Don't clear integral value in ON, hold the previous value.
  OFF： Carry out normal PID control.

- ICLEAR Signal:
  The terminal to stop the integral operation of PID control and clear the integral value.
  ON： Stop the integral operation of PID control and clear the integral value.
  OFF： Carry out normal PID control.

Note: When clearing the integral output, sometimes the current output frequency may change rapidly.

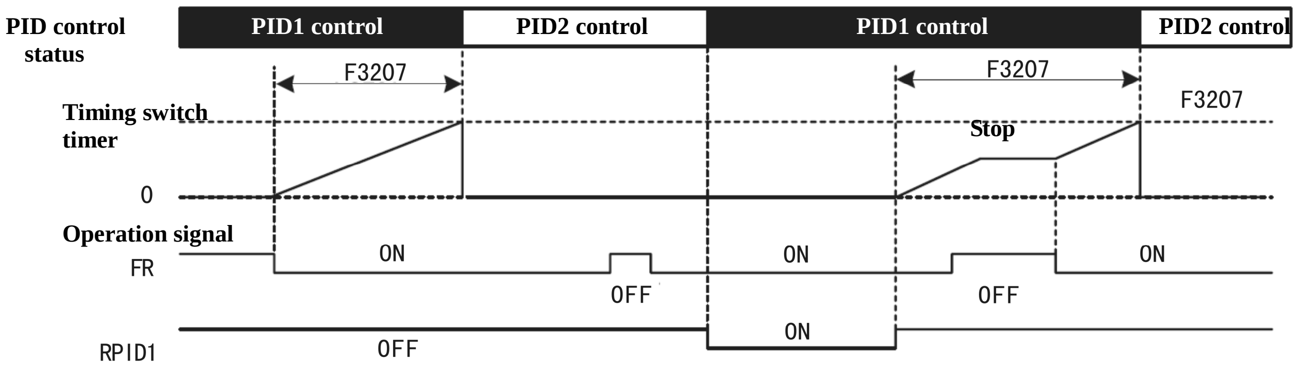
【Timing Switch of PID Control】

The function to automatically switch from PID1 control to PID2 control within the preset time period.

- Use the following function code and input signals of external multi-function terminals (DI1~DI8).
  Selection of PID control action
  · F3201=5: switch the PID function timely.
  PID1/PID2 switching time
  · F3207=0.1～6000 minute(s): set the switching time.
  RPID1 Signal
  The terminal to forcibly switch the control into PID1 control after switching to PID2 control.
  ON： Switch the control in PID2 control to PID1 control.
  During this period, the time count of timing switch will be stopped.
  OFF： Continue the time count for timing switch.

- When set F3201=5, the switch will be carried out automatically through PID1 and PID2 controls set by F3207.
  The control will start from PID1 control, when setting time is reached, it will switch to PID2 control.
  In PID2 control, if RPID1 signal is connected, it will return to PID1 control again.
  If RPID1 signal is OFF, the timer for timing switch will continue to count and carry out the same action.
  Note 1: **During stop, the timer for timing switch will stop (hold). When power is OFF, the time on the timer will also be recorded.**
  Note 2: **After startup of the timer for timing switch, the timer will work.**
  Note 3: **During operation of the timer for timing switch, when the settings of F3207 are changed, they will be switched into changes.**

  The followings are examples of actions



【External Terminal Switching PID Control】

The external terminal switching PID control is the function to coordinate various PID controls and system status, and then make a switch through the external terminals. It can be applied in the following systems.
□ When the motor load is changed and the controls in the same PID control are difficult.
□ When switching motor or load according to the status of the system.
Each PID control is selected by the selection of function code or external multi-function terminal input signal (DI1~DI8).
Use inverter as the component of the PID controller, this can control the external peripheral devices.

- Use the following function codes and external multi-function terminal input signals (DI1~DI8).
  PID control action selection
  ·F3201=4: external terminal switching PID control

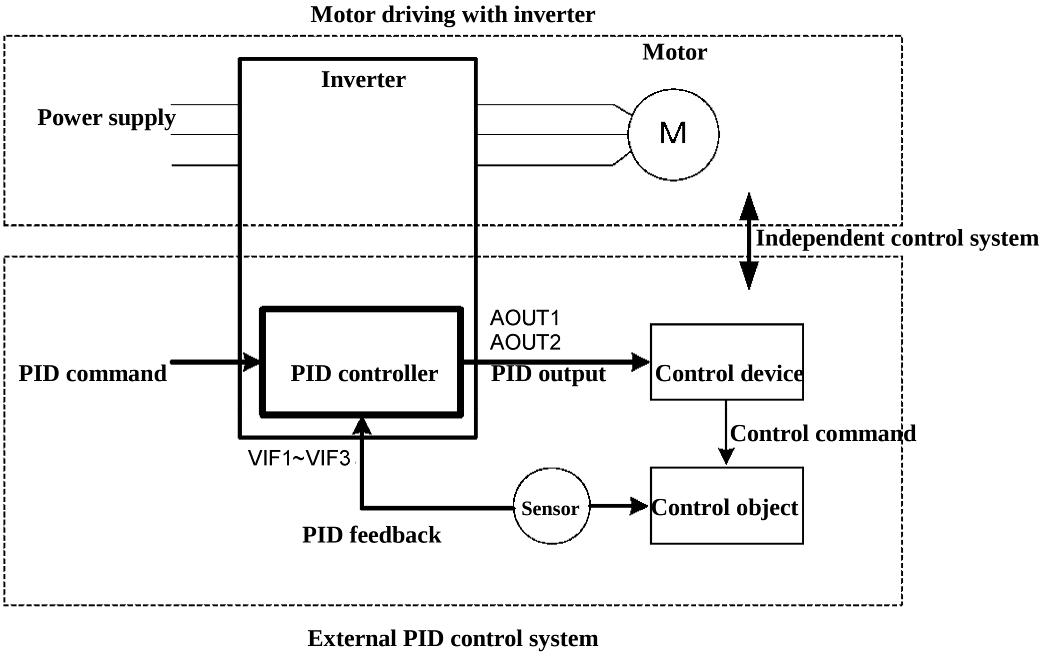
  PIDH/PIDL Signal: PID switching terminal
  With the status of the two terminals, the PID control will be switched as follows.

External multi-function terminal input signal (DI1~DI8)		
=86 : PIDH	=85 : PIDL	PID switching terminal
OFF	OFF	Open loop control
OFF	ON	PID1 control
ON	ON	PID2 control
ON	OFF	Open loop control

Note: When switching the PID control through external terminals, the PID control output may change rapidly according to the system control status; there may also be the protective actions for over-current, over-voltage and so on.
When adjusting switching time and each PID control parameter, please make an adjustment upon fully consideration of the changes to the actions of the control system.

【External PID Control】

The external PID control doesn't mean to use PID control output as the control for output frequency of the inverter, it means to use inverter as an independent PID controller and use it to control the external peripheral devices.
The formation and action of each PID control is set and selected together with the normal PID control function of the inverter output frequency.



F3203	External PID control selection

F3204	External PID operation mode selection

- The function to select external PID actions.
  - F3203=0: no external PID control
  - F3203=1: PID1 external control is effective
  - F3203=2: PID2 external control is effective
  - F3203=3: For factory adjustment
  - F3203=4: Both PID1 and PID2 external controls are effective
  - F3203=5: For factory adjustment
  - F3203=6: For factory adjustment

Matching to the selection of external PID, select the operation mode of external PID control. This function is used to decide the start and stop of the external PID control.

- Select the operation mode of external PID control
  - F3204=1: Operation interlocked with inverter operation
    Start operation interlocked with inverter operation and start the external PID control. When the inverter is stopped, stop PID control.
  - F3204=2: PID output after power input
    Start operation interlocked with inverter power supply and start the external PID control. When detecting the undervoltage during inverter power supply OFF, stop the PID control.
  - F3204=3: PID output controlled by external terminals
    Start the operation of external PID control through the external multi-function terminal input (DI1~DI8).

PID1EX Signal

The terminal to operate or stop the PID1 control.

ON： Operate PID1 control

OFF： Stop PID1 control

PID2EX Signal

The terminal to operate or stop the PID2 control.

ON： Operate PID2 control

OFF： Stop PID2 control

Note 1: **During external PID control, the PID component selection: F3205 is noneffective, it will not make an addition calculation for the frequency command value of the inverter.**

Note 2: **During external PID control, stop PID control and reset/clear the operation results of PID control.**

Note 3: **When trying to stop the external PID control, please use PID control selection in inverter stoppage: F3203=0.**

● External PID control is output through the AOUT1/AOUT2 analog output terminal.
External PID1 output: please set F1501 (AOUT1) or F1504 (AOUT2)=24.
External PID2 output: please set F1501 (AOUT1) or F1504 (AOUT2)=25.

For analog output terminal functions related to PID control, please refer to 【various variables output】 internal analog output function: content of F1501/F1504.

● After gaining by external PID command value, it will be limited by upper frequency limit and then carry out acceleration/deceleration.
When PID command value is beyond the frequency setting, the acceleration/deceleration time will be based on acceleration/deceleration standard frequency: F1011 and set the actions according to 4^{th} acceleration time: F1015 and 4^{th} deceleration time: F1019.

Note 1: **The acceleration/deceleration for external PID control with off-set frequency will share a same time with 4^{th} acceleration/deceleration time in normal operation, this is a fixed application.**

Note 2: **When any one of 4^{th} acceleration time: F1015 and the 4^{th} deceleration time: F1019 is set to 0, the acceleration/deceleration will not be carried, and the PID command target value will be directly used as the PID command value.**

Chapter 7

Communication Function

The followings are descriptions of function blocks in communication function.
For details of communication function, please refer to section 7-4.

F4001 Message checksum

The function to select or deselect the checksum in the communication message.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4001	Message checksum	0: No 1: Yes	1	1

F4003 Pull up/down function selection

The function to select pull up/down of RS485 communication circuit.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4003	Pull up/down function selection	0: No 1: Yes	1	0

F4004 Communication response time

The function to set response time from inverter.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4004	Communication response time	10～6000ms	1ms	10

F4005 Serial communication function

The function to select communication function.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4005	Serial communication function	0: No function 1: Dedicated protocol communication function 2: ModBus communication function	1	0

F4006 Inverter No.

The function to set inverter number.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4006	Inverter No.	0～254: for ModBus only (1～32: RS485 communication)	1	1

Please set the value with 1-254. Pay attention not to repeat with other inverter numbers. It is not required to set the number sequentially, a loss of number is allowable.

Note 1: **When setting a repetitive number, it cannot ensure a normal communication**.

Note 2: **In dedicated protocol communication, number 1-32 is effective.**

F4007 Communication speed

The function to set communication speed.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4007	Communication speed	1: 1200bps 2: 2400bps 3: 4800bps 4: 9600bps 5: 19200bps 6: 38400bps 7: 57600bps	1	4

F4008 Parity bit

The function to set the parity bit.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4008	Parity bit	0: No 1: Odd 2: Even	1	1

F4009 Stop bit

The function to set the stop bit.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4009	Stop bit	1: 1 bit 2: 2 bits	1	1

F4010 End bit

The function to set the end code for dedicated protocol communication function.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4010	End bit	0：CR+LF 1：CR	1	0

Chapter 7

F4011 Specified command INV response selection

The function to limit the response message sent from the inverter to specified command, therefore increase the communication speed.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4011	Specified command INV response selection	0: Sent 1: Not send (error response sent) 2: Not send (no error response sent)	1	0

F4101 ModBus communication timeout setting

The function to set ModBus communication timeouts time.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4101	ModBus communication timeout setting	0: No function 0.01-600 second(s)	0.01s	

During ModBus communication, if no message has been received within the time period set by F4101, it will be considered as communication timeouts.

F4102 ModBus communication timeout action

The function to select ModBus communication timeout action.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F4102	ModBus communication timeout action	0: Hold the status 1: Stop alarm	1	0

During ModBus communication, if no message has been received within the time period set by F4101, it will be considered as communication timeouts. When F4102=1 is selected, the inverter alarm will stop.

Motor Parameter

F5001 Motor poles, voltage and capacity

Set the poles, voltage and capacity of the motor connected to the inverter.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5001	Motor poles, voltage and capacity	XYZZZ X: Poles Y: Rated voltage Z: Motor capacity		※

※ Typical values have been entered for each motor model.

● The followings are applicable values and displaying contents.

1) Poles: 4 kinds of 2-8 poles.

2	4	6	8

2) Rated voltage: show the setting range of rated voltage by serial number.

Serial No.	1	2	3	4	5	6	7	8
Rated voltage	200	220	230	380	400	415	440	460

3) Motor capacity: the following table shows the setting scope of the motor capacity.
Unit: [kW]

0.37	△0.4	0.55	0.75	△1.1	△1.5	△2.2
△3.0	△3.7	△4.0	△5.5	△7.5	11.0	15.0
18.5	22.0	30.0	37.0	45.0	55.0	75.0
90.0	110	132	160	185	200	220
250	280	315	355			

Symbol △ means that there is a blank.

Display example) When using a motor of 4 poles, 220V and 2.2kW, the 7-segment monitor will display:

42 2.2

Display example) When change the rated voltage for the motor of 4 poles, 200V and 2.2kW.

42 2.2 → 42 2.2 → 41 2.2

Note: In V/f mode (F1001=1), in order to display the speed, only pole data is used.
In the modes of speed control, torque control and position control (F1001=2, 3, 4, 5, 6), determine the standard values of all control constants according to the setting value of corresponding function codes. Therefore, this function code must be set correctly when used in the modes of speed control, torque control and position control. For setting method for special motor used in these modes, please contact with us.
Rated voltage: Smaller than 3 for 200V series inverters.
Smaller than 4 for 380V series inverters.
Motor capacity: The same class or one class smaller than the inverter class.
When motor is not selectable, it may display Exxxx Er C .

F5002 Motor current rating

F5003 Motor frequency rating

F5004 Motor speed rating

F5005 Motor insulation type

Set the rated current, frequency and speed as well as insulation type for the motor.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5002	Motor current rating	0.1-999.9 About 30 — 110% of the inverter current rating	0.1A	※
F5003	Motor frequency rating	10-600Hz	1Hz	※
F5004	Motor speed rating	0-24000 rpm	1rpm	※
F5005	Motor insulation type	1: Type A 2: Type E 3: Type B 4: Type F 5: Type H	1	※

※Typical values have been entered for each motor model.

- Normally, please set the motor rated values. When these values cannot be set, the auto detection results and the controls of speed, torque and position will become worse.
  Note 1: **the setting values are interlocked with the settings of motor poles, voltage and capacity (F5001). Therefore, when F5001 is changed, F5002~F5005 will automatically set the standard values according to F5001.**
  Note 2: **The above setting values cannot be used in V/f mode (F1001=1, 40).**
  Note 3: **In speed control mode, when operating speed exceeds the rated speed, it will be flux-weakening control.**

F5006 Rated voltage during auto detecting of motor parameters

The function code used for special motor and in other occasions during auto detecting of motor parameters.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5006	Rated voltage during auto detecting of motor parameters	0: Use voltage selected by F5001 100-460V (voltage of F5001 is noneffective)	1V	0

When the rated voltage of F5001 is used, the setting is not required. (F5006=0)

F5007 Rated motor slip ratio

Set the rated slip ratio of the motor in use.
The standard for addition and correction of slip ratio in auto torque increase (F2007=2).
When the motor is loaded, add and correct the slip ratio to control the speed decrease.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5007	Rated motor slip ratio	0-50%	0.1%	2

Please calculate with the following formula.

$$\text{Synchronized speed} = \frac{120 \times \text{Reference frequency (F1006)}}{\text{Motor poles P (poles in F5001)}}$$

$$\text{Rated motor slip ratio} = \frac{\text{Synchronized speed} - \text{Rated speed (F5004)}}{\text{Synchronized speed}} \times 100\%$$

F5008	Setting of motor parameter auto detecting range

The function to set the range of valid detecting constant according to the factory presets during motor parameter auto detection (F1001=10, 11).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5008	Setting of motor parameter auto detecting range	0: No range 50-300%	0.1%	200

Note: When the range of motor parameter auto detecting results is extended, the controls of speed, torque and position and auto torque increase may become worse. Please change the setting during auto detecting errors of special motors and motor parameters.

F5009	Motor stator resistance
F5010	**Motor rotator resistance**
F5011	**Motor stator inductance**
F5012	**Motor rotator inductance**
F5013	**Motor mutual inductance**
F5014	**Motor excitation current**

The function code to set parameters for the motor in use.

Code No.	Function Name	Date Content		Setting Resolution	Factory Presets
F5009	Motor stator resistance	55kW or bellow	0.001-65Ω	0.001Ω	※
		75kW or above	0.01-650Ω	0.01Ω	
F5010	Motor rotator resistance	55kW or bellow	0.001-65Ω	0.001Ω	※
		75kW or above	0.01-650Ω	0.01Ω	
F5011	Motor stator inductance	55kW or bellow	0.1-6000mH	0.1mH	※
		75kW or above	0.01-600mH	0.01mH	
F5012	Motor rotator inductance	55kW or bellow	0.1-6000mH	0.1mH	※
		75kW or above	0.01-600mH	0.01mH	
F5013	Motor mutual inductance	55kW or bellow	0.1-6000mH	0.1mH	※
		75kW or above	0.01-600mH	0.01mH	
F5014	Motor excitation current	0.01-650A		0.01A	※

※Typical values have been entered for each motor model.

●The setting scope of F5009-F5013 and the minimum values will be changed with the changes of motor capacity set by F5001.

- When motor test report and other documents with motor constant are used, please enter into the above-mentioned function code.
- Save the motor constant detected by motor parameter auto detection (F1001=10, 11) into F5009-F5014
- In vector control, when the inverter output voltage at motor rated speed is lower than motor rated voltage, please increase the setting of excitation current.

Note: When the auto detection cannot be finished correctly, the detecting results should not be saved into the function codes. Only results during correct finish can be stored into the function codes.

Chapter 7

F5015 Motor inertia moment

F5016 Load inertia moment ratio

Set the motor inertia moment and the load inertia moment ratio.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F5015	Motor inertia moment	0-65kgm^2	0.001k gm^2	※
F5016	Load inertia moment ratio	1-200 multiple(s)	0.01 multiple	1

※Typical values have been entered for each motor model.

- An effective function during vector control (speed control, torque control and position control).
- After the setting of load inertia moment ratio, the command can be controlled.
- Mechanical vibration may happen in case that the load inertia moment ratio is large; therefore an optimum gain should be adjusted.
- Please set motor unit value for motor rotation inertia.

- When load inertia moment can be ignored, there is no need to set the load inertia moment ratio.
- When driving cylinder and other loads with larger inertia, please set the load inertia moment ratio.

Vector Speed Control Function

The followings will describe the speed control function code of vector control (speed sensored and speed sensorless).

F6001 Torque limiter (power running)

F6003 Torque limiter (regeneration)

The function to limit torque generated by motor during the speed control of vector control (speed sensored and speed sensorless). The torque limiter in electric running and regeneration running can be set separately. Even though corresponding to the output current limit (F1701) in V/f mode, the motor torque can be directly limited by vector control mode.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6001	Torque limiter (power running)	Mode A: 0-200%	0.1%	150%
		Mode B: 0-150%		120%
F6003	Torque limiter (regeneration)	Mode A: 0-200% Mode B: 0-150%	0.1%	100%

- The setting value ratio related to rated torque.
- The motor rated torque is calculated automatically according to motor capacity (set by F5001) and rated speed.
- The torque limiter (power running) will limit the torque with a same direction to the braking direction.
- The torque limiter (regeneration) will limit the torque with a reverse direction to the braking direction.
- The setting ranges of torque limiter (power running) are different when selected by mode A (F1320=1) and mode B (F1320=2). (Refer to the above table.)

  Note:
  - **According to the load difference, it may not be able to accelerate or decelerate when the setting of torque limiter is too small, please pay attention to this.**

Reference parameter

F1001 (motor control mode selection)
F1320 (rated selection)
F5001 (motor poles, voltage and capacity)
F5004 (motor speed rating)
F6002 (torque limiter analog input function (power running))
F6004 (torque limiter analog input function (regeneration))

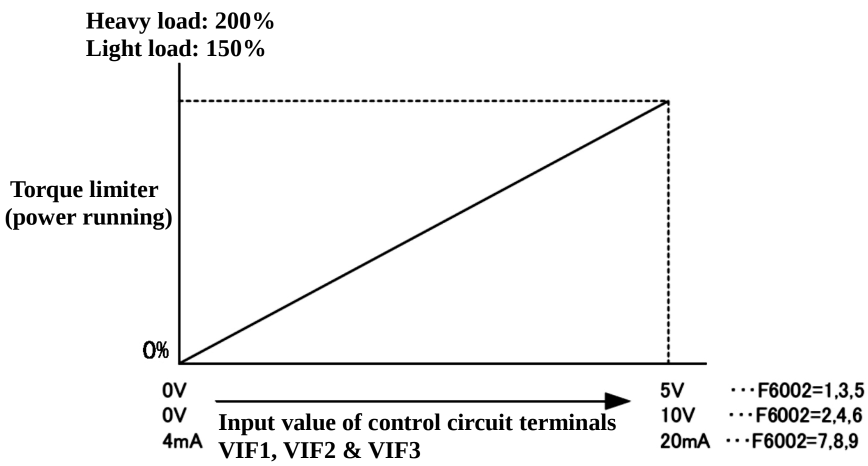
Chapter 7

F6002	Torque limiter analog input function (power running)

The function to change the torque limiter values in power running status with the analog input command of control circuit terminals VIF1, VIF2 and VIF3.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6002	Torque limiter analog input function (power running)	0: F6001 1: External analog VIF1 voltage (0-5V) 2: External analog VIF1 voltage (0-10V or potentiometer) 3: External analog VIF2 voltage (0-5V) 4: External analog VIF2 voltage (0-10V or potentiometer) 5: External analog VIF3 voltage (0-5V) 6: External analog VIF3 voltage (0-10V or potentiometer) 7: External analog VIF1 current (4-20mA) 8: External analog VIF2 current (4-20mA) 9: External analog VIF3 current (4-20mA)	1	0

- When F6002=0, the torque limiter during power running will use the value set by F6001.
- When F6002=1, 3, 5, the torque limiter values in power running status are determined by input values of control circuit terminals VIF1, VIF2 and VIF3 (0-5V).
- When F6002=2, 4, 6, the torque limiter values in power running status are determined by input values of control circuit terminals VIF1, VIF2 and VIF3 (0-10V) or potentiometer.
- When F6002=7, 8, 9, the torque limiter values in power running status are determined by input values of control circuit terminals VIF1, VIF2 and VIF3 (4-20mA).



Note 1: **For torque limiter (power running) values corresponding to control circuit terminal input signal, the change range of mode A is 0-200%, the change range of mode B is 0-150%.**
Note 2: **This function is effective only when selected by the speed control of vector control (F1001=2 or 3).**

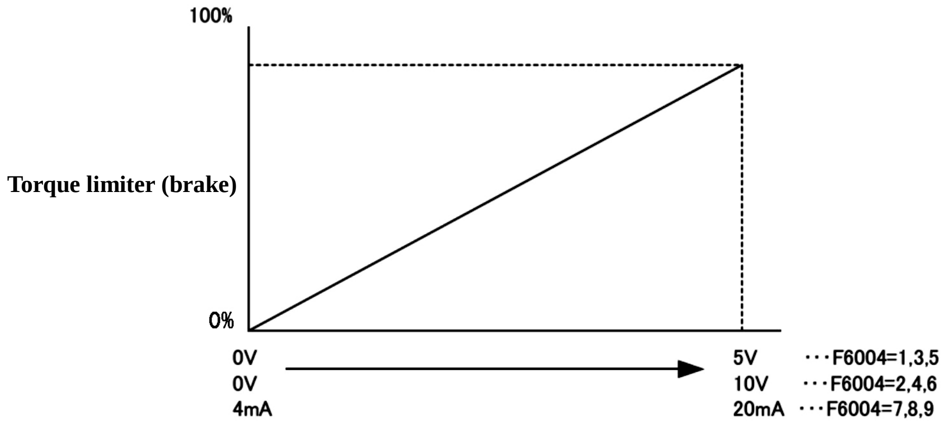
Reference parameter
F1001 (motor control mode selection)
F6001 (torque limiter (power running))

F6004	Torque limiter analog input function (regeneration)

The function to change the torque limiter values in braking status with the analog input command of control circuit terminals VIF1, VIF2 and VIF3.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6004	Torque limiter analog input function (regeneration)	0: F6003 1: External analog VIF1 voltage (0-5V) 2: External analog VIF1 voltage (0-10V or potentiometer) 3: External analog VIF2 voltage (0-5V) 4: External analog VIF2 voltage (0-10V or potentiometer) 5: External analog VIF3 voltage (0-5V) 6: External analog VIF3 voltage (0-10V or potentiometer) 7: External analog VIF1 current (4-20mA) 8: External analog VIF2 current (4-20mA) 9: External analog VIF3 current (4-20mA)	1	0

- When F6004=0, the torque limiter during braking will use the value set by F6003.
- When F6004=1, 3, 5, the torque limiter values in braking status are set by input values of control circuit terminals VIF1, VIF2 and VIF3 (0-5V).
- When F6004=2, 4, 6, the torque limiter values in braking status are set by input values of control circuit terminals VIF1, VIF2 and VIF3 (0-10V) or potentiometer.
- When F6004=7, 8, 9, the torque limiter values in braking status are set by input values of control circuit terminals VIF1, VIF2 and VIF3 (4-20mA).



Input value of control circuit terminals VIF1, VIF2 & VIF3

Note 1: **For torque limiter (brake) values corresponding to control circuit terminal input signal, the change range is 0-100%.**
Note 2: **This function is effective only when selected by the speed control of vector control (F1001=2 or 3).**

Reference parameter
F1001 (motor control mode selection)
F6003 (torque limiter (brake))

F6005 Multiple for starting excitation current

The function to set the starting excitation current in vector control mode (speed sensored and speed sensorless).
Correspond to DC braking force in V/f mode during startup (F1114).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6005	Multiple for starting excitation current	0.1-2 multiple(s) (for applicable motor)	0.01 multiple	1

- The factory presetting values are set to be equal to (1.0 multiple) the excitation current of corresponding motor.
- When setting this function, please input the ratio value related to the motor excitation current. (Maximum of 2 multiples)

Note 1: **If excitation current is over-increased, there may be a shutdown because of over-current.**
Note 2: **When the braking force is not changed and the excitation current ratio is enlarged, the current limiting function will be enabled because of the over-current caused by some reason**.

Reference parameter
F1001 (motor control mode selection)

F6006 Starting excitation time

The function to set the starting excitation time in vector control mode (speed sensored and speed sensorless).
Correspond to DC braking time in V/f mode during startup (F1113).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6006	Starting excitation time	0-10 second(s) (0 means no starting excitation)	0.1s	※

※ Typical values have been entered for each motor model.

- Set the connecting time for excitation current set by F6005.
- When 0 is set, the braking function during startup will be disabled.
- Excitation will not be carried out during the startup of alarm auto resetting and restart after instantaneous-stop, it will be changed into the startup of speed tracking.

Note: The setting value is interlocked with the settings of motor poles, voltage and capacity (F5001). Therefore, when F5001 is changed, F6006 will be automatically set to standard values according to F5001.

Reference parameter
F1001 (motor control mode selection)
F5001 (motor poles, voltage and capacity)

F6007 Multiple for braking excitation current

The function to set the braking excitation current in vector control mode (speed sensored and speed sensorless).
Correspond to DC braking force in V/f mode during shutdown (F1114).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6007	Multiple for braking excitation current	0.1-2 multiple(s) (for applicable motor)	0.01 multiple	1

- The factory presetting values are set to be equal to (1.0 multiple) the excitation current of corresponding motor.
- When setting this function, please input the ratio value related to the motor excitation current. (Maximum of 2 multiples)

Note 1: **If excitation current is over-increased, there may be a shutdown because of over-current.**
Note 2: **When the braking force is not changed and the excitation current ratio is enlarged, the current limiting function will be enabled because of the over-current caused by some reason.**

Reference parameter
F1001 (motor control mode selection)

F6008 Braking excitation time

The function to set the braking excitation time in vector control mode (speed sensored and speed sensorless). Correspond to DC braking time in V/f mode during startup (F1113).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6008	Braking excitation time	0-10 second(s) (0 means no starting excitation)	0.1s	※

※ Typical values have been entered for each motor model.

- Set the connecting time for excitation current set by F6006.
- When 0 is set, the braking function during startup will be disabled.

Note: The setting value is interlocked with the settings of motor poles, voltage and capacity (F5001). Therefore, when F5001 is changed, F6008 will be automatically set to standard values according to F5001.

Reference parameter
F1001 (motor control mode selection)
F5001 (motor poles, voltage and capacity)

F6009 Current control gain compensation

This function is to compensate the setting values of current control gain during the speed control in the vector control mode (speed sensored and speed sensorless). The function not only can be used to adjust speed control gain, but also can be used when the motor vibration cannot be eliminated.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6009	Current control gain compensation	0.5-1.5	0.01	1

- The initial value of current control gain compensation (F6009) is 1. The gain will be controlled with the current preset according to various motors.
- The current control gain is adjustable according to the settings in current control gain compensation. The variable range is 0.5-1.5 multiples.
- During adjusting control gain and before using this function, please firstly make an adjustment with speed control gain (F6010 & F6011). When the adjustment of speed control gain cannot improve the control performance, please adjust this function.

Note 1: **Optimum values have been set for current control gain according to different motors, the users cannot make a direct change.**
Note 2: **When the limit value of current control gain compensation has been increased or decreased, the control performance may become worse.**

Reference parameter
F6010 (Speed control ASR proportional gain)
F6011 (Speed control ASR integral time)

F6010 Speed control ASR proportional gain

The function to set the proportional gain of speed control (ASR) in vector control mode (speed sensored and speed sensorless).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6010	Speed control ASR proportional gain	0.01-150%	0.01%	※

※ **Typical values have been entered for each motor model.**

- Typical values applicable for the motor should be set for factory presets.
- As the target for adjustment, please set 100% for motor response 200rad/s.

Note 1: **Besides this function code, the proportional gain of speed control will change according to the settings of motor inertia moment (F5015) and load inertia moment ratio. Therefore, when adjusting the motor response by this function, please set motor inertia moment to be equal to actual load.**
Note 2: **When using the function of motor vibration reduction rate (F6014), the speed control proportional gain will automatically change according to the setting and load conditions.**

Chapter 7

Reference parameter
F1001 (motor control mode selection)
F5015 (motor inertia moment)
F5016 (load inertia moment ratio)
F6014 (motor vibration reduction rate)

F6011 Speed control ASR integral time

The function to set integral time of speed control (ASR) in vector control mode (speed sensored and speed sensorless).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6011	Speed control ASR integral time	0-20 second(s)	0.001s	※

※ **Typical values have been entered for each motor model.**

- When there is proportional control, motor speed may generate static difference comparing to speed command value, therefore, please set this function code and add the integral control.
- As the target for adjustment, increase the value by 10ms by stage, then make sure the motor speed is the same as the command speed.
- When PC (P control signal) of multi-function input terminal is ON, the integral time will be disabled and only proportional gain is controlled.

Note: When integral time is becoming larger, the motor may generate a vibration, therefore the values of this function cannot be set too large.

F6012 Speed detection filter cut-off frequency

The function to set the filter cut-off frequency (to eliminate high-frequency component) when the feedback speed signal is interfered in vector control mode (speed sensored).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6012	Speed detection filter cut-off frequency	0: No function 0.01-500Hz	0.01Hz	0

- This function is only effective in the control with speed sensored.
- The factory preset value is 0 (no function). The feedback speed will be used directly in the control.
- When the setting is beyond “0”, the high-frequency component in feedback speed value (higher than cut-off frequency) will be filtered.
- When the motor vibration is large, set this function to decrease the motor vibration.

Note: Since the use of this function will slow down the motor response, please disable this function under normal conditions.

F6013 Torque detection filter cut-off frequency

The function to set the filter cut-off frequency (to eliminate high-frequency component) when the feedback torque signal is interfered in vector control mode (speed sensored and speed sensorless).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6013	Torque detection filter cut-off frequency	0: No function 0.1-5000Hz	0.1Hz	0

- This function is applicable in the vector control with any one of speed sensored and speed sensorless.
- The factory preset value is 0 (no function).
- When the setting is beyond “0”, the high-frequency component in feedback torque value (higher than cut-off frequency) will be filtered.
- When the motor vibration is large, set this function to decrease the motor vibration.

Note: Since the use of this function will slow down the motor response, please disable this function under normal conditions.

F6014	Motor vibration reduction rate

F6015	Lower frequency limit for motor vibration reduction function

F6016	Upper frequency limit for motor vibration reduction function

The function to reduce motor vibration under the occasions of vibration caused by mechanical sympathetic vibration in vector control mode (speed sensored and speed sensorless).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6014	Motor vibration reduction rate	0: No function 1: 75% 2: 50% 3: 25%	1	0
F6015	Lower frequency limit for motor vibration reduction function	0-240Hz	0.01Hz	0
F6016	Upper frequency limit for motor vibration reduction function	0-240Hz	0.01Hz	0

- The factory preset is F6014=0 (no function).
- When F6014 is set beyond 0, decrease the proportional gain of speed control within the range of 1st speed command frequency set in lower frequency limit for motor vibration reduction function (F6015) and upper frequency limit for motor vibration reduction function (F6016).
- Motor vibration reduction rate is the reduction rate related to speed control ASR proportional gain (F6009). The motor vibration cannot be eliminated even when the rate is set to be 25%, please decrease the setting of speed control ASR proportional gain.
- Besides this function, the speed detection filter function (F6012) or torque detection filter function (F6013) can also be used to adjust and reduce the motor vibration.

Examples of setting
When command frequency is 15Hz-25Hz mechanical sympathetic vibration,
F6014=1（75%）
F6015=15.00Hz
F6016=25.00Hz
Note: The setting of lower frequency limit for motor vibration reduction function must be carried out referring to the settings of upper frequency limit for motor vibration reduction function. (When the setting exceeds the setting in upper frequency limit, the setting will be invalid because of the inconsistent detection.)

Reference parameter
F1001 (motor control mode selection)
F6010 (speed control ASR proportional gain)

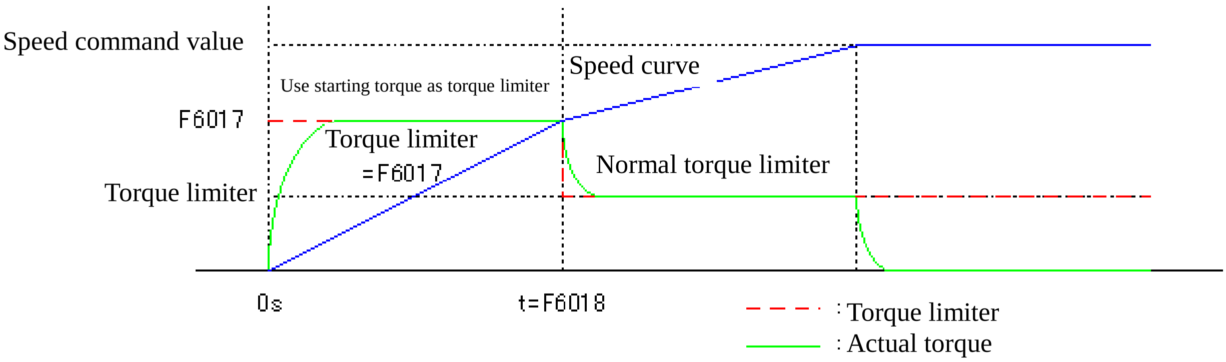
Chapter 7

F6017	Starting torque
F6018	**Starting torque duration time**

The function to separately set the starting torque limiting value during speed control in vector control mode (speed sensored and speed sensorless). This function is used when the motor cannot start because of the setting of torque limiting value is low.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6017	Starting torque	0-100％	0.1%	30
F6018	Starting torque duration time	0-6500 second(s)	0.1s	1

- The setting value of starting torque (F6017) is a ratio related to rated torque.
- The torque limiting of starting torque is effective from startup to the starting torque duration time (F6018).
- When starting torque duration time ends, the torque will be limited according to the setting value in torque limiter.
- When any one function code of F6017 or F6018 is set to 0, the torque limiter is noneffective. The torque will be limited from the startup according to the setting value in torque limiter.



Note: If the starting torque is set too large, the motor may accelerate rapidly. Therefore, please carefully set the starting torque.

Reference parameter
F1001 (motor control mode selection)
F6001 (torque limiter (power running))
F6003 (torque limiter (brake))

F6019 **Variable 2nd gain for speed control**

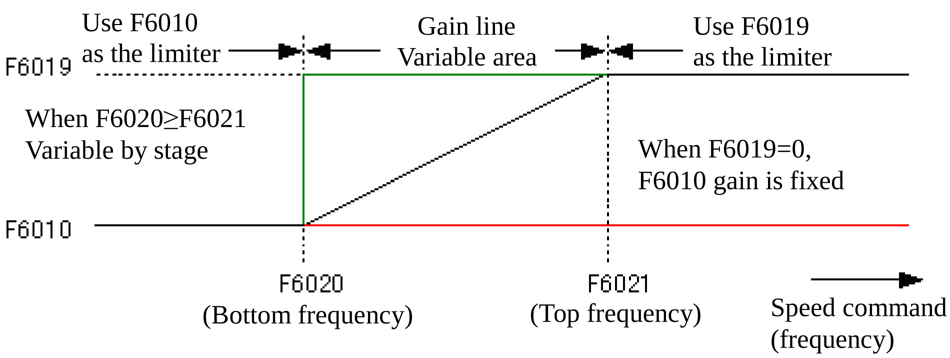
F6020 **Frequency bottom of variable gain for speed control**

F6021 **Frequency top of variable gain for speed control**

The function to vary speed control proportional gain according to speed command (frequency) during the speed control in vector control mode (speed sensored and speed sensorless). When making a speed control with a large range from low speed to high speed, different speed control gains are required within low speed zone and high speed zone, at this time this function can be used.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6019	Variable 2nd gain for speed control	0: No variable gain function 0.01-150%	0.01%	15
F6020	Frequency bottom of variable gain for speed control	0-240Hz	0.01Hz	10
F6021	Frequency top of variable gain for speed control	0-240Hz	0.01Hz	30

- When variable 2nd gain for speed control is set to 0, the speed control proportional gain for the whole speed area is the setting value of speed control ASR proportional gain (F6010) and this value is fixed.
- When variable 2nd gain for speed control is not 0, the variable function of speed control proportional gain is effective.
- The speed command at the low speed side of variable speed control proportional gain is set by frequency bottom of variable gain for speed control (F6020).
- The speed command at the high speed side of variable speed control proportional gain is set by frequency top of variable gain for speed control (F6021).
- When speed command (frequency) is smaller than the inner limiter in the speed area of F6020, the speed control proportional gain will be set by F6010; it will be set by F6019 when the peed command (frequency) is larger than inner limiter in the speed area of F6021.
- When command frequency is within the area of F6020 and F6021, the speed control proportional gain will be changed according to slope determined by the setting values and frequency range of F6010 and F6019 to the change linear of speed command (frequency).
- Variable 2nd gain for speed control (F6019) can set large or small speed control ASR proportional gain (F6010).
- When the setting of frequency top of variable gain for speed control (F6021) is smaller than the setting of frequency bottom of variable gain for speed control (F6020) (F6020≥F6021), the speed control proportional gain will be changed by stage with F6020 as the threshold value.
- The initial setting of speed control proportional gain function is F6019=15%, F6020=10Hz and F6021=30Hz. During initial status, the speed control proportional gain function is effective.



Note: Speed control integral gain has no relationship with this function, it is fixed to be the setting value of F6011.

Reference parameter
F6010 (speed control ASR proportional gain)
F6011 (speed control ASR integral time)

Torque Control Function

The followings are descriptions of function codes for torque control (speed sensored and speed sensorless).

F6101 Torque command selection

The function to select the setting method of torque command during torque control. During selection of motor control mode, it is effective when torque control is set (F1001=4 or 5).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6101	Torque command selection	1: Operation panel 2: External analog VIF1 voltage (0-5V) 3: External analog VIF1 voltage (0-10V or potentiometer) 4: External analog VIF2 voltage (0-5V) 5: External analog VIF2 voltage (0-10V or potentiometer) 6: External analog VIF3 voltage (0-5V) 7: External analog VIF3 voltage (0-10V or potentiometer) 8: External analog VIF1 current (4-20mA) 9: External analog VIF2 current (4-20mA) 10: External analog VIF3 current (4-20mA)	1	1

- When F6101=1, it is the values set on operation panel (F6102).
- When F6001=1, 3, 5, it will be set by the input values of control circuit terminals VIF1, VIF2 & VIF3 (0-5V).
- When F6001=2, 4, 6, it will be set by the input values of control circuit terminals VIF1, VIF2 & VIF3 (0-10V).
- When F6001=7, 8, 9, it will be set by the input values of control circuit terminals VIF1, VIF2 & VIF3 (4-20mA).

Note 1: Please use a potentiometer of over 0.3W and 5kΩ.

Note 2: When torque command is set by potentiometer, please set gain torque command with a scope of about 10% for the actual torque command (F6108, F6110 and F6112).

Example) With the VIF1 input, when set with a potentiometer from 0 to 100%, please set F6108=110%.

Reference parameter
F1001 (Motor control mode selection)
F6102 (Torque command)
F6107 (Bias torque command VIF1)
F6108 (Gain torque command VIF1)
F6109 (Bias torque command VIF2)
F6110 (Gain torque command VIF2)
F6111 (Bias torque command VIF3)
F6112 (Gain torque command VIF3)

F6102 Torque command

The function to set the torque command when selecting operation panel in torque command (F6101=1).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6102	Torque command	Mode A: 0-±200.0% Mode B: 0-±150.0%	0.1%	10

- The setting value is a ratio related to rated torque.
- The rated torque of the motor is automatically calculated from motor capacity (set by F5001) and rated speed.

- When setting with a positive value, it will be a torque command of forward rotation or reverse braking.
- When setting with a negative value, it will be a torque command of forward braking or reverse rotation.
- The setting range of torque command is different when selected by mode A (F1320=1) and mode B (F1320=2). (Refer to the above table)
  Note: If the torque command is too small because of the load, it may cannot accelerate or decelerate. Please pay attention to this.

Reference parameter
F1001 (motor control mode selection)
F1320 (specification selection)
F5001 (motor poles, voltage and capacity)
F5004 (motor speed rating)
F6101 (torque command selection)

F6103 Positive upper value of torque command

F6104 Positive lower value of torque command

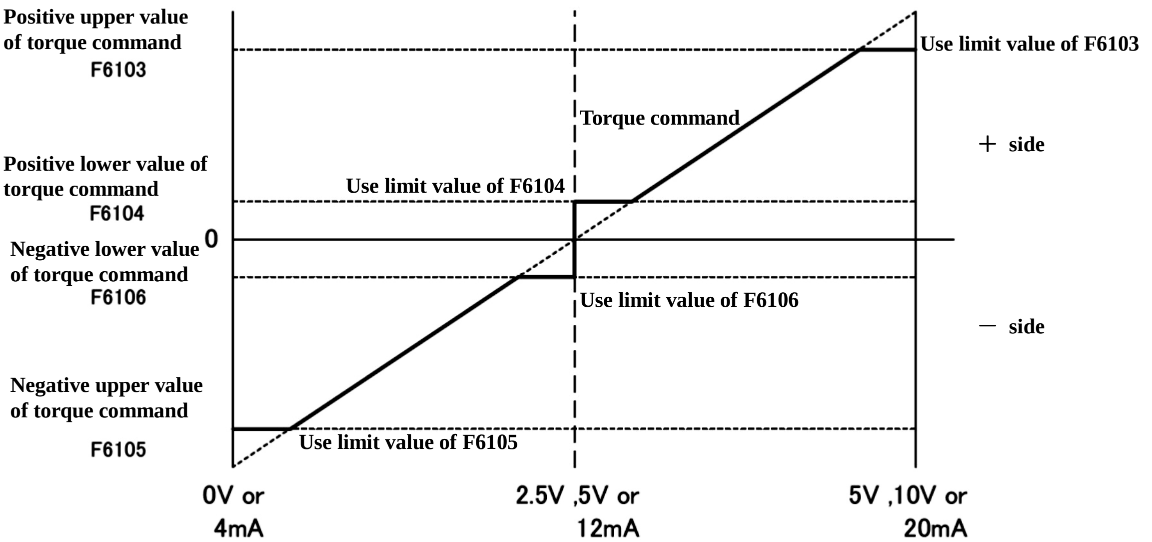
F6105 Negative upper value of torque command

F6106 Negative lower value of torque command

The function to set the limit value for torque command value in torque control mode.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6103	Positive upper value of torque command	20.0-200.0%	0.1%	100
F6104	Positive lower value of torque command	0-20.0%	0.1%	5
F6105	Negative upper value of torque command	20.0-200.0%	0.1%	100
F6106	Negative lower value of torque command	0-20.0%	0.1%	5

- The setting value is ratio related to rated torque.
- The following figure shows the actions of torque command limiter with this function.



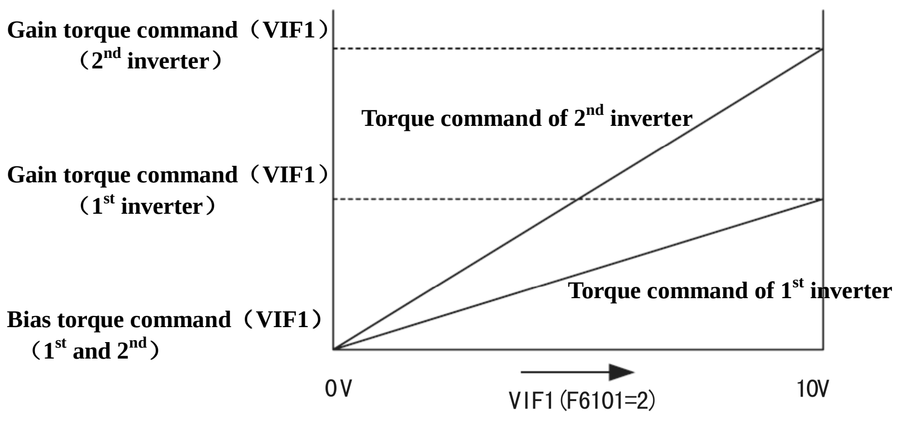
Note 1: If the upper value of the torque limiter is too large, the motor may accelerate rapidly, special attention must be paid when setting this upper value.
Note 2: When the lower value of the torque limiter is smaller than the torque at the load side, the inverter may be unable to accelerate.

F6107	Bias torque command (VIF1)
F6108	Gain torque command (VIF1)
F6109	Bias torque command (VIF2)
F6110	Gain torque command (VIF2)
F6111	Bias torque command (VIF3)
F6112	Gain torque command (VIF3)

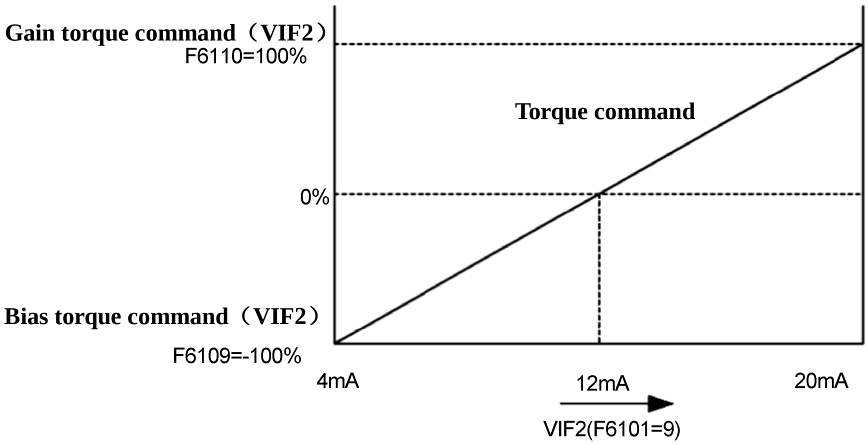
When setting torque command through analog signal, this function will set the torque with the torque command value in minimum analog signal (0V or 4 mA) (bias torque command value) and the torque command value in maximum analog signal (5V or 10V or 20 mA) (gain torque command value).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6107	Bias torque command（VIF1）	0-±200.0%（torque command of 0V or 4mA）	0.1%	0
F6108	Gain torque command（VIF1）	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100
F6109	Bias torque command（VIF2）	0-±200.0%（torque command of 0V or 4mA）	0.1%	0
F6110	Gain torque command（VIF2）	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100
F6111	Bias torque command（VIF3）	0-±200.0%（torque command of 0V or 4mA）	0.1%	0
F6112	Gain torque command（VIF3）	0-±200.0%（torque command of 5V or 10V or 20mA）	0.1%	100

- When selecting F6101=2, 3, 8 and using VIF1 terminal, please use F6107 and F6108 to make an adjustment.
- When selecting F6101=4, 5, 9 and using VIF2 terminal, please use F6109 and F6110 to make an adjustment.
- When selecting F6101=6, 7, 10 and using VIF3 terminal, please use F6111 and F6112 to make an adjustment.
- By using the setting of bias torque command and gain torque command, a common analog torque command signal will be input by several inverters for proportional operation.
  Example) Through analog signal VIF1 (0-10V), operate a proportional operation with two inverters and a torque ratio of 1:2,
  Select torque command F6101=2 (same for 1st and 2nd inverter).
  Setting of 1st inverter: F6107=0%，F6108=50%。
  Setting of 2nd inverter: F6107=0%，F6108=100%。



- The torque command at forward and reverse rotation sides can be set synchronously.
  Example) When torque command is set with analog signal VIF2 (4-20mA) and a range of ±100%,
  Select torque command: F6101=9.
  Setting of bias and gain: F6109=100%, F6110=100%.



Note: Actual torque command value is the limiting value set by F6103-F6106.

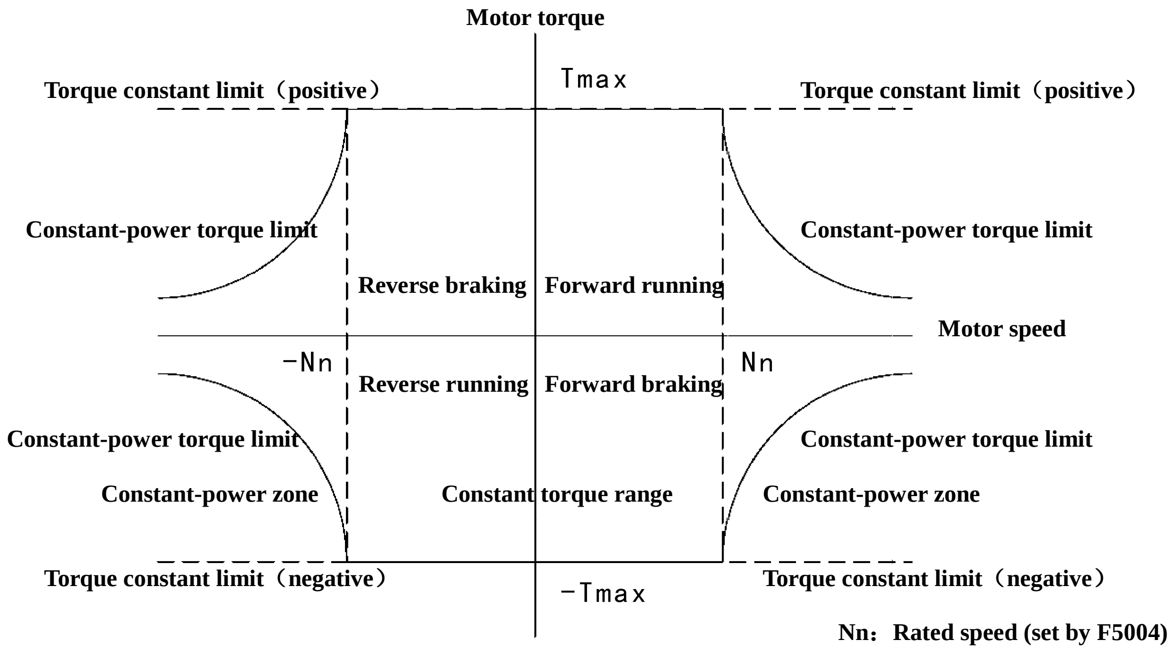
Reference parameter
F6101 (torque command selection)

F6113	Torque characteristics selection in constant power zone

The function to torque limit in constant power zone.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6113	Torque characteristics selection in constant power zone	0: Constant torque constant power limit 1: Constant torque limit	1	0

- During constant torque constant power limit, when motor output (set by F5001) is fixed in constant power zone (exceed the speed range of rated speed), the torque command value will decrease automatically. (Factory presets) Rated speed (set by F5004) × motor torque = motor power: (fixed in constant power zone).
- During constant torque limit, the torque command will not decrease, and will operate with a fixed torque command.
- During constant torque (speed range within rated speed), if it is not set according to this function, it will run with a fixed torque command.
- According to the settings of this function, the relationship between speed range and torque is shown as follows.



Note: When certain toque limit is selected (F6113=1), since there is no possible of overload in constant-power zone, the certain torque output limit must be set (F6113=0).

Reference parameter

F5001 (motor poles, voltage & capacity)

F5004 (motor speed rating)

F6114	Speed limit selection

F6115	Speed limit value in torque control (Forward run side)

F6116	Speed limit value in torque control (Reverse run side)

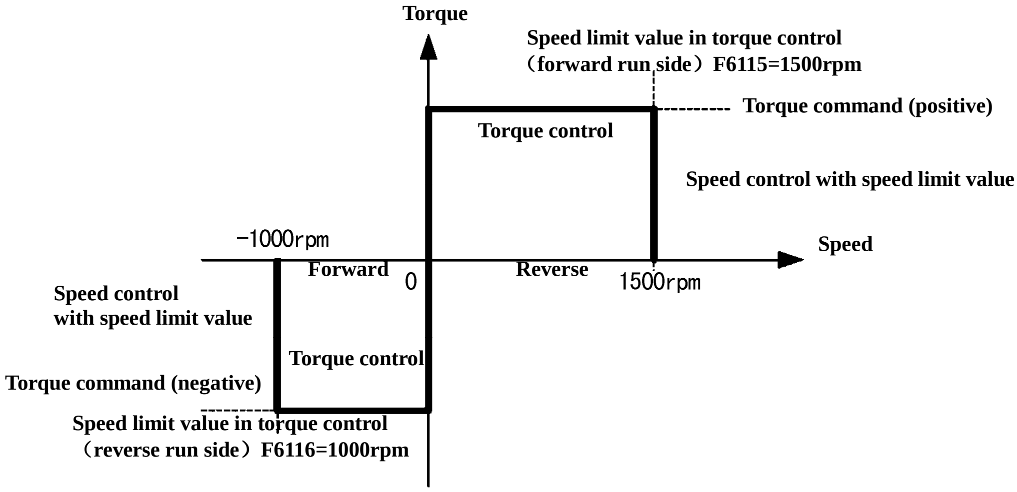
The function to set speed limit value in torque control mode (speed sensored and speed sensorless).

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6114	Speed limit selection	0: Speed limit under 1st speed frequency command 1: Speed limit in function codes	1	1
F6115	Speed limit value in torque control (Forward run side)	0-8000rpm	1rpm	1800
F6116	Speed limit value in torque control (Reverse run side)	0-8000rpm	1rpm	1800

- Carry out torque control within the speed range set by this function.
- When speed limit value is exceeded, switch the speed control using speed limit value as the command.
- When using F6114=0:1 speed frequency command to set the speed control, the synchronized speed operated from 1st speed frequency command will be used for speed control. In this case, the values should be set according to the settings of 1st speed frequency setting selection (F1002).

  Example) When the speed limit value is set within the scope of 0-5V with the external analog VIF3 input,
  Speed limit selection: F6114=0.
  1st speed frequency setting selection: F1002=6.
- When speed limit in function codes (F6114=1) is set, the speed limit value in torque control (forward run side) (F6115) and speed limit value in torque control (reverse run side) (F6116) will be used for speed control. With the default values, the setting of using function codes is effective. The speed limit values in forward run and reverse run can be set separately. Also, when fixed speed limit value is required from the startup, please select the settings described here.

  Example When speed control value in forward run side is 1500rpm and the speed control value in reverse run side is -1000rpm,
  Speed limit selection: F6114=1.
  Setting of speed control value: F6115=1500rpm, F6116=1000rpm.



Note 1: In torque control, since it is controlled by fixed torque having no relationship with the speed, the speed command will be noneffective.
Note 2: In torque control, since the motor is accelerated continuously, the speed limit value must be set. When motor has reached the limit value, it will switch to the speed control with speed limit value as the command value.
Note 3: The speed limit value in torque control is the speed range calculated by upper frequency limit (F1007), lower frequency limit (F1008) and motor poles (F5001). Therefore, when speed is limited beyond the upper limit and the lower limit, the upper frequency limit and the lower frequency limit should also be changed. The upper frequency can select the 2nd upper frequency limit (F1316) and 3rd upper frequency limit (F1317) through the switching function of external terminals.

Reference parameter
F1002 (1st speed frequency setting selection)
F1007 (upper frequency limit)
F1008 (lower frequency limit)
F1316 (2nd upper frequency limit)
F1317 (3rd upper frequency limit)

F6117 Torque control proportional gain

The function to set the torque control proportional gain.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6117	Torque control proportional gain	0.01-150%	0.01%	※

***Typical values have been entered for each motor model.**

- In factory presets, the typical values suitable for the motor must be set.
- As the adjustment target, the motor response 2000rad/s should be set as 100%.

Note: In motor control mode selection (F1001), the proportional gain is only effective when torque control (F1001=4 or 5) is selected. When speed control (F1001=2 or 3) is selected, it will be automatically changed through the speed control proportional gain.

Reference parameter
F1001 (motor control mode selection)

F6118 Torque control integral time

The function to set the torque control integral time.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6118	Torque control integral time	0-500ms	0.1ms	50

- Only in proportional control, the motor torque will generate static difference to the torque command value, therefore, this function code must be set together with the integral control.
- The approximate adjustment scope is 1ms per step from the default value, make sure that the motor torque is consistent with the command torque.

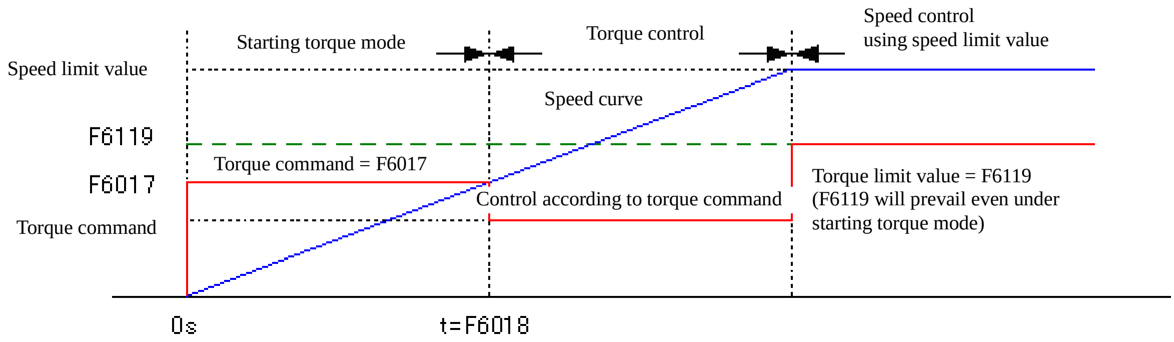
Note: When prolonging the integral time, the motor may generate vibration, therefore the setting value of this function should not be too large.

F6017	Starting torque
F6018	Starting torque duration time
F6119	Lower torque limit value in speed limiting

This function is used to separately set the starting torque command value for torque control in vector control mode (speed sensored and speed sensorless). It is used in the occasions when the motor cannot start because the command value is too small. Furthermore, it can set the lower torque limit value (as the speed limit value) (F6119) in speed limiting. However, the starting torque (F6017) and starting torque duration time (F6018) will share the same function code in speed control.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F6017	Starting torque	0-100%	0.1%	30
F6018	Starting torque duration time	0-6500 second(s)	0.1s	1
F6119	Lower torque limit value in speed limiting	0-100%	0.1%	30

- The starting torque setting value (F6017) is a ratio related to rated torque.
- When torque control is started at the status of motor stop or low-speed running below 20Hz, it will be effective from the beginning to starting torque duration time (F6018). However, when it is started during the status of high-speed running (20Hz and above), the torque will be controlled according to the normal torque command value even when the starting torque setting is effective.
- During running with starting torque, the starting torque setting value will become into torque command when the torque is smaller than the starting torque setting value. But during running of starting torque, the torque will be controlled according to the torque command value when torque command value is larger than starting torque.
- After the starting torque duration time is finished, the torque will be controlled according to the command value. During this time, the torque command value is effective even when the command value is smaller than the setting value of starting torque.
- When any function code of F6017 or F6018 is set to 0, the starting torque is noneffective. The torque will be controlled according to the torque command value from the beginning of the operation.
- During torque control mode (F1001=4 or 5) and the speed is controlled by speed limit value, the settings of F6119 will be used for torque control when torque command value is smaller than the settings of F6119. Contrarily, the torque command value will become into the torque limit value in speed control.
- In the torque control when speed limit value is not reached, the setting value of F6119 is noneffective; the torque command can be set from the beginning of 0%.
- During running with starting torque, the lower torque limit value in speed limiting (F6119) is effective as the torque limit value when speed limiting value is used for speed control.
- When speed control is not stable in the speed limiting with the initialized value, please enlarge the setting values of F6119.



Note 1: If the setting value of starting torque is set too large, the motor may accelerate rapidly. Therefore, please set the starting torque carefully.

Note 2: If the lower torque limit in speed limiting (F6119) is too small, the speed control under speed limiting may be unstable. Therefore, sufficient allowance must be remained for the setting value.

PG Sensor Function

Please refer to the follows for basic setting functions of motor speed and position controls through the use of PG sensor.

F8108 PG pulse multiplication value

F8109 PG output formation selection

F8110 Position control gain

F8122 Number of PG pulses

F8125 PG pulse A-B polarity reversal

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8108	PG pulse multiplication value	1: ×1 2: ×2 3: ×4	1	3
F8109	PG output formation selection	1: Corresponding to open collector PG 2: Corresponding to open collector PG (optional) 3: Corresponding to bus driver PG (optional)	1	1
F8110	Position control gain	0.1-50rad/s	0.1rad/s	1
F8122	Number of PG pulsed	20-2048 pulse(s)	1 pulse	1000
F8125	PG pulse A-B polarity reversal	0: No function 1: Polarity reversal	1	0

When controlling the speed, torque or position with the PG sensor, please make the basic settings according to the following sequences.

Sequence Flow of Basic Function Setting for PG Sensor

Sequence 1
Setting of motor poles, voltage and capacity（F5001）

↓

Sequence 2
Selection of motor control mode（F1001）

↓

Sequence 3
Selection of input method of PG sensor signal（F8109）

↓

Sequence 4
Setting of number of PG pulses（F8122）

↓

Sequence 5
Setting of PG pulse multiplication value（F8108）

↓

Sequence 6
Setting of PG pulse A-B polarity reversal（F8125）

↓

Sequence 7
Setting of control gain

Sequence 1: Setting of motor poles, voltage and capacity (F5001).
Please set the poles, voltage and capacity for the motor in use.

Example) In case of a motor with 4 poles, 380V and 3.7kW
Please set F5001=44_3.7

Note: If the settings of the motor and F5001 are not appropriate, the speed control or position control will not be carried out correctly. Please set suitable values in F5001.

Sequence 2: Selection of motor control mode (F1001).
The setting of operation mode for speed control, torque control or position control with PG sensor.

Example) According to the selected control mode, please make the following settings with function code F1001.
F1001=3: speed control (vector control of speed sensor)
F1001=5: torque control (vector control of speed sensor)
F1001=6: position control (vector control of speed sensor)

Sequence 3: Selection of input method for PG sensor signal (F8109)
Please select the PG sensor signal used by F8109 (PG output formation selection). The followings are specifications for PG sensors corresponding to each setting value.

F8109	Specification
1	Open collector output (power voltage 24V) Voltage output signal-phase, two-phase (voltage output 24V)
2	Open collector output (active voltage 24V, 12V) Voltage output signal-phase, two-phase (voltage output 24V, 12V)
3	Bus driver output

※ The max. input pulse frequency will be 491.52KHz in any mode.

Note 1: **The standard PG signal input will be open collector/push-pull, the power supply will only correspond to PG sensor of 24V. When using PG sensors beyond the specification described here, options must be prepared additionally (SC-PG).**

Note 2: **If the function code contents and terminal connections are different, "OCx" (over-current) and other alarms may happen.**

Sequence 4: Setting of number of PG pulses (F8122)
Please set the number of pulses per revolution for the PG sensor used in F8122 (number of PG pulses). It can be set within the scope of 20-2048 pulses. (Factory preset is 1000 pulses)

Example) When the number of PG pulses is 512PPR,
Please set F8122=512.

Note: If the number of PG pulses is set falsely, the correct control will not be able to be carried out. The following table shows the examples of actions during false setting.

Example for false setting of number of PG pulses (when number of PG pulses is 1000 PPR)	Rotating speed
1000 PPR→500PPR	Stable when the speed is lower than command speed
1000 PPR→2000PPR	Stable when the speed is higher than command speed (use upper frequency limit F1007 to ensure stable)

Sequence 5: Setting of PG pulse multiplication value (F8108)
Set the PG pulse multiplication value. Through this setting, the pulse count per revolution will be multiplied by using the setting of multiplication value, therefore improving the control precision.

Example) In case of a setting with 4 multiplications
F8108=3 (using the default setting)

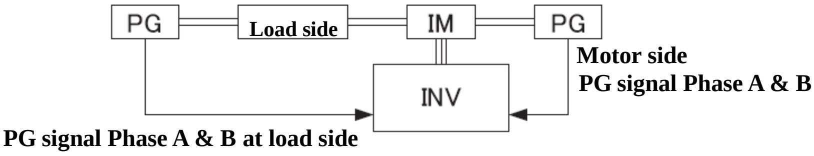
Note 1: When using a setting with 4 multiplications, please be sure to input the two phases of phase A and phase B.

Note 2: Even when the multiplication is changed, the motor speed will not be changed. Please set the pulse number on the encoder equal to the pulse number of F8122.

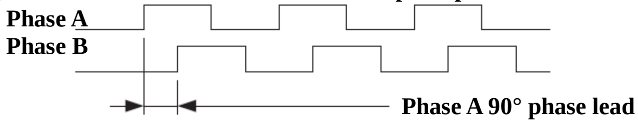
Note 3: Since the setting value of F8122 x multiplication value of F8108 is not the pulse number on the encoder, special attentions must be paid. (F8122 and F8108 are different functions). For example, when using an encoder of 1000 PPR, please set F8122=1000. The setting of F8122=500 and F8108 will influence the normal operation.

Sequence 6: Setting of PG pulse A-B polarity reversal (F8125)

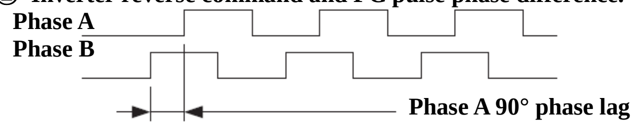
During connections of PG input terminal, the relationship between rotating direction and phase A/B must be connected as the following figure.



① Inverter forward command and PG pulse phase difference.



② Inverter reverse command and PG pulse phase difference.



In case of forward command: To phase B, phase A is 90° phase lead.
In case of reverse command: To phase B, phase A is 90° phase lag.

The function of PG pulse A-B polarity reversal (F8125) is used to switch the signal rather than change the wiring in case that the relationship between the rotating direction and phase A/B is reversed after connecting the PG sensor signal wiring.

Note 1: With this function, the speed can be controlled without changing the connection of phase A and phase B. If possible, please use this function based on the correct connection of phase A and phase B.

Note 2: When using the functions of zero-servo (F8119) and position control, disable the function of PG pulse A-B polarity reversal (F8125=0). If this function is enabled, the control will not be exact.

Sequence 7: Setting of control gain

- Setting of control gain during speed control ASR

  Example) When control response of proportional gain is 50rad/s and the integral time is 100ms,
  Speed control ASR proportional gain: F6010=25% (200rad/s at 100%)
  Speed control ASR integral time: F6011=0.100s (100ms).

Note: The initialized value of speed control ASR proportional gain varies according to the different settings of motor category is F5001. Even standard motor gain is set, there still may be large gain for different motors. Therefore, when initially running the motor, please adjust the speed control ASR proportional gain.

- Setting of control gain during position control

  Example) When control response of position control gain is set with 20rad/s, speed control ASR proportional gain is set with 100rad/s and integral time is set with 100ms,
  Position control gain: F8110=20rad/s
  Speed control ASR proportional gain: F6010=50% (200rad/s at 100%)
  Speed control ASR integral time: F6011=0.100s (100ms).

Note 1: The initialized value of position control gain is set by 1 rad/s, however, according to different motors, too large gain may still happen. Therefore, please adjust the speed control ASR proportional gain during initial running of the motor.

Note 2: If the setting of speed control gain is too large, over adjustment may happen on target position, therefore, please adjust the gain while observing the motor rotation and the motor current.

Note 3: In case there is a vibration during motor rotating, please set speed control ASR integral time to 0 or smaller than the current value. When setting to "47" (P control signal, PC) through multi-function input terminals, the speed control can be treated as proportional control for input signal.

Reference parameter
F1001 (motor control mode selection)
F1414-F1421 (selection of input terminal DI1-DI8)

F5001 (motor poles, voltage and capacity)
F6010 (speed control ASR proportional gain)
F6011 (speed control ARS integral time)

F8119	Zero-servo control function selection

F8120	Zero speed

F8119	Zero speed servo complete width

In speed control (with sensor) mode (F1001=3), this function can carry out the zero speed command control when the motor is stopped.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8119	Zero-servo control function selection	0: Inactive 1: Active 2: Switching zero-servo on external terminal (P0)	1	0
F8120	Zero speed	1-3000rpm	1rpm	30
F8121	Zero servo complete width	5-10000 pulse(s)	1 pulse	10

The followings are setting sequences of zero-servo function.

Sequence 1: Setting of selection of zero-servo control function (F8119)

Please set F8119 according to the zero-servo mode in use.

When F8119=0 (inactive, factory preset):

No zero-servo function. (Normal motor will stop)

When F8119=1 (active):

After the run command is OFF, it will switch into position control mode when the speed decelerates to 0 (set by F8120) and carry out stop action. When running command (FR, RR) is ON, it will run in the speed control mode again. (The inverter will keep running even in zero-speed status)

※When direction is switched during signal switching, speed tracking in reverse run and other actions, the zero-servo function will not work and keep running.

※When the speed is bellow zero, the zero-servo function will not work even though the running command is input (standby status).

When F8119=2 (zero-servo switching on external terminal (PO)):

Send zero speed command (P0) to multi-function terminal DI1-DI8 (F1414-F1421): set data = 57, the multi-function input terminal will become the external zero-servo command terminal. When P0 terminal is ON and the speed is below zero (F8120), it will switch into zero-servo action. Furthermore, when P0 terminal is ON, turn ON the inverter running signal, and the zero-servo will be carried out.

※When direction is switched during signal switching, speed tracking in reverse run and other actions, the zero-servo action will be carried out bellow zero if the P0 terminal is ON. When switching the running direction, please turn the P0 terminal OFF.

Note: When completely stopping inverter from zero speed status (gate OFF), please turn the MBS terminal of (multi-function input terminal function set to “5”) idle-run stopping terminal on the main control panel to ON.

Sequence 2: Setting of zero speed (F8120)

Set the speed when starting zero speed control by F8120, the unit is rpm, minimum scope is 1rpm and the maximum value is 3000rpm.

Example) When carrying out zero speed control below 10rpm,
F8120=10rpm

Note: Attentions must be paid that during zero-servo (speed) switching in high-speed rotation; it may cause over-current & over-voltage and result in the shutdown alarm of the inverter. Please set the zero-speed setting in low speed as possible.

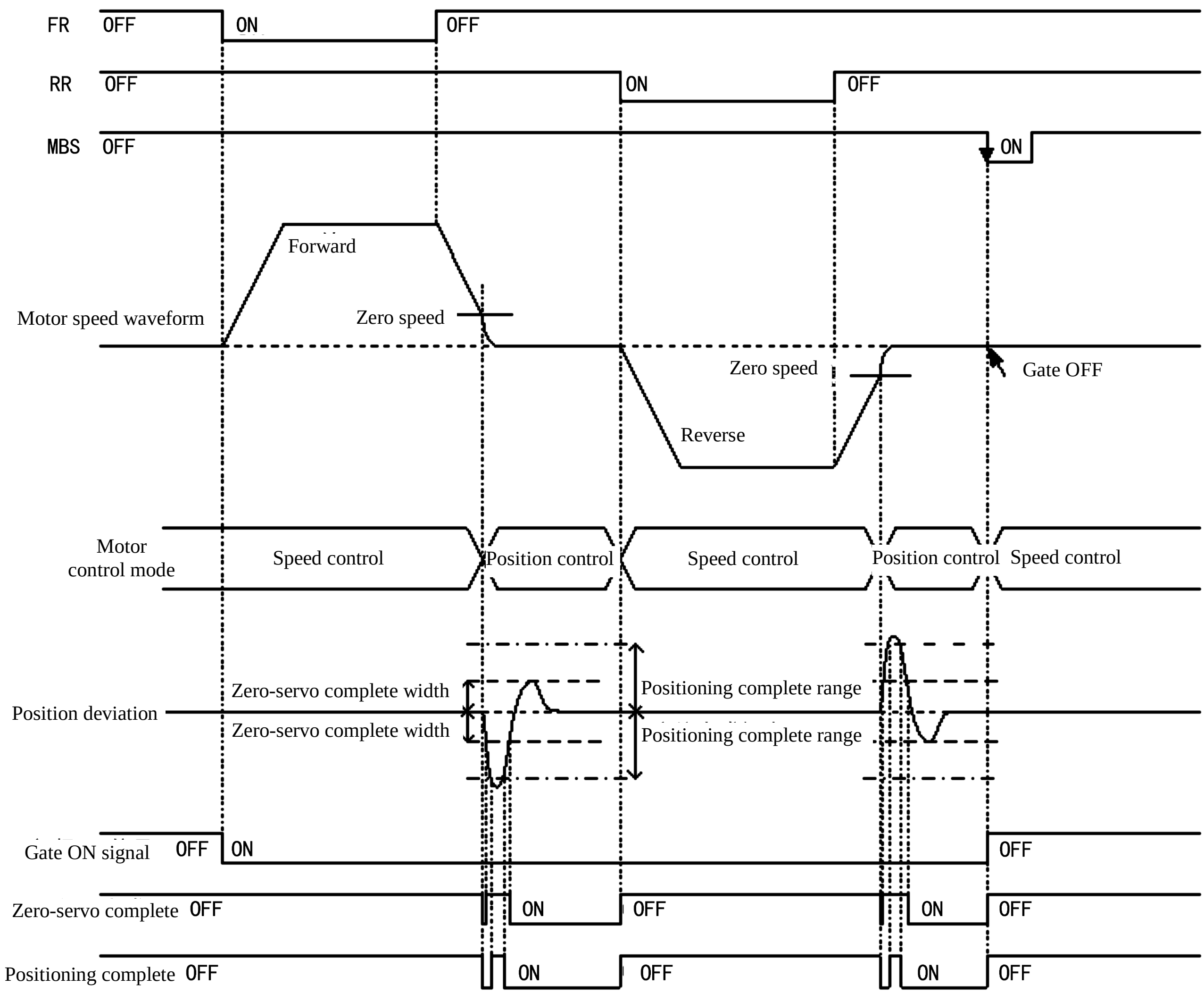
Sequence 3: Setting of zero servo complete width (F8121)

When the position deviation is smaller than the value specified in F8121, the zero-servo complete signal will be output. The zero-servo complete signal will not be output when the inverter is in absolute stop (gate & OFF) status.

Example) When multi-function output terminal DO2 is set to the zero-servo complete signal for complete width of 20 pulses,
F1510 (output terminal DO2 selection) =31
F8121=20 pulses

Note: If the complete width is reduced, the complete signal ON/FF superposition may happen. Therefore certain width must be specified when setting the width value.

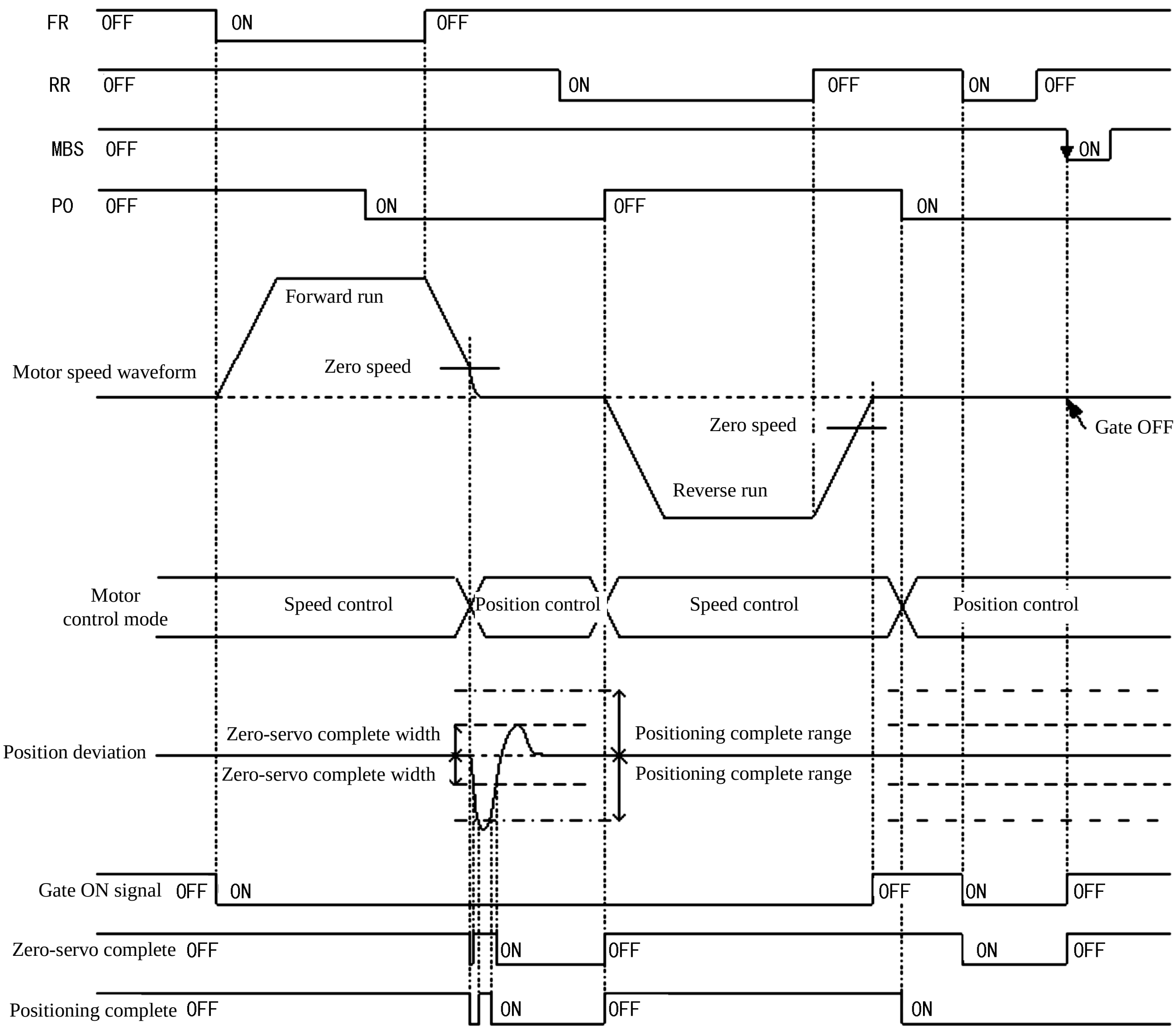
(1) Example 1 of zero-servo action: F8119=1 (zero-servo switching under zero speed)
When stop command is ON and the speed is decelerated to zero speed (F8120), please switch to position control mode and carry out stop actions. When restarted with a run command (FR, RR) ON, it will run again with the speed control mode.



Note 1: When stopping the inverter completely from zero speed status, please set the idle-run terminals (MBS) of multi-function terminals on main control panel to ON.
Note 2: Please note that when switching the zero-servo (speed) under high-speed rotation, there may be an over-current or over-voltage causing an inverter shutdown alarm. When switching from speed control to position control, please carry out this action under low speed as possible.
Note 3: When inputting command pulse during zero-servo, run the inverters with a position control mode according to the input pulse. (An optional board of SC-PG is required for command pulse inputting)

∗ For positioning complete signal and positioning complete width, please refer to the following position control function.

(2) Example 2 of zero-servo action: F8119=2 (zero-servo switching by external terminal (PO))
Only when P0 is ON and the speed is bellow zero speed (set by F8120), the zero-servo function is effective. When running command (FR, RR) is ON, the action will normally be speed control if P0 signal is off.



Note 1: **When stopping the inverter completely from zero speed status (gate OFF), please set the idle-run terminals (MBS) of multi-function terminals on main control panel to ON under the OFF status of running signal. Furthermore, when running signal is OFF, the inverter can also be stopped completely (gate OFF).**
Note 2: **Even though the inverter is completely stopped (gate OFF status), the position deviation will be cumulated in the position control action when PO terminal is ON.**
Note 3: **When inputting command pulse during zero-servo, run the inverters with a position control mode according to the input pulse. (An optional board of SC-PG is required for command pulse inputting)**
Note 4: **Please note that when switching the zero-servo (speed) under high-speed rotation, there may be an over-current or over-voltage causing an inverter shutdown alarm. When switching from speed control to position control, please carry out this action under low speed as possible.**

∗ For positioning complete signal and positioning complete width, please refer to the following position control function.

F8126 Speed control ASR proportional gain in zero-servo

This function is used to set the speed control proportional gain in zero-servo running. It is used when controlling with gain which is different from the speed control gain in motor running.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8126	Speed control ASR proportional gain in zero-servo	0: Act according to the set value of F6010 0.01-150%	0.01%	15

- The initialized value of speed control ASR proportional gain in zero-servo is 15% (30rad/s).
- When F8126 setting is not 0, please refer to the settings of F8126 for speed control proportional gain in zero-servo.
- When F8126 setting is 0, please refer to the settings of F6010 even for the speed control proportional gain in zero-servo.

Note: The speed control integral gain has no relationship with this function, it is a fixed value set by F6011.

Reference parameter
F6010 (speed control ASR proportional gain)
F6011 (speed control ASR integral time)

Position Function Control

The followings are functions required for position control. An optional board (SC-PG) should be configured for the position control of pulse command. Please refer to the instructions of optional board for details.

F8101 **Point to point control position limiter**

F8102 **Point to point control**

F8107 **Deviation counter clear mode**

F8144 **Number of pulses within 1 mm**

F8115 **Point to point control command**

The function of point to point control is a function to run according to the number of pulses even when there is no pulse command.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8101	Point to point control position limiter	1-32767mm	1mm	32767
F8102	Point to point control Effective number of bits (unit=mm)	1: Integer 2: 1 digit after decimal point is effective 3: 2 digits after decimal point is effective	1	1
F8107	Deviation counter clear mode	1: Level operation 2: Rising edge operation	1	2
F8114	Number of pulses within 1 mm	0: Number of pulse is specified with F8115 1-32767 pulse(s)	1 pulse	0
F8115	Point to point control command	0: No function 1-32767 pulse(s) (※1) 0.01-32767mm(※1)	1 pulse 0.01/0.1/1mm (※1)	0

※1: The data content and setting resolution of F8115 depend on the settings of F8114 and F8102, the following table shows the variation.

F8114	F8102	F8115 Data content	F8115 Setting Resolution
0	Overall	0: No function 1-32767 pulse(s)	1 pulse
Beyond 0	1 (integer)	0: No function 1-32767mm	1mm
	2 (1 digit after decimal point is effective)	0: No function 0.1-3276.7mm	0.1mm
	3 (2 digits after decimal point is effective)	0: No function 0.01-327.67mm	0.01mm

The following is the setting sequence for point to point function.

Sequence 1: Setting of point to point control command (F8102, F8115)

Set the point to point control position command. The setting range is variable according to the combination with F8102 (Effective number of bits in point to point control position).

・When F8115=0: No point to point control function

・When F8115 setting is not 0: the range will vary according to the values of F8114 and F8102. Please refer to the above table.

※During the setting of control command is not 0, please set the initialization value in F8115 when inputting the deviation counter clearing signal (CCL). When inputting the deviation counter reverse clearing signal, please set the initialization value in F8115 with a negative. Then the deviation counter connected to the power supply will be cleared.

※The deviation counter is a counter to count the deviations of command pulse and PG feedback pulse. When inputting the command pulse, an optional board (SC-PG) must be configured additionally.

Note: Set F8115 with a positive number. However, when CCL is ON, it is a forward run; when RCCL is ON, it will be reverse run. During reverse running (set RCCL to ON), the setting value for the deviation counter in F8115 is a negative.

Sequence 2: Setting of number of pulses within 1mm (F8114)

When F8114=0:

The command value of F8115 will be set as the number of pulses. If only the position of the motor rotator will be controlled, please select this one.

When F8114 is not 0:

Please set the output number of pulses for the controlled object within 1mm. This setting is applicable for a linear movement of the controlled object.

Sequence 3: Setting of point to point control position (F8101)

Use this setting when limiting the movement distance. The adjustable range of this limit value is 1-32767mm.

Note: When the limit value is smaller than the command value set by F8115, this limit value will prevail.

Sequence 4: Setting of deviation counter clear mode (F8107)

Select the action for the deviation counter clearing signal (CCL, RCCL).

When F8107=0: level operation (the deviation counter will always be cleared when terminal is ON)

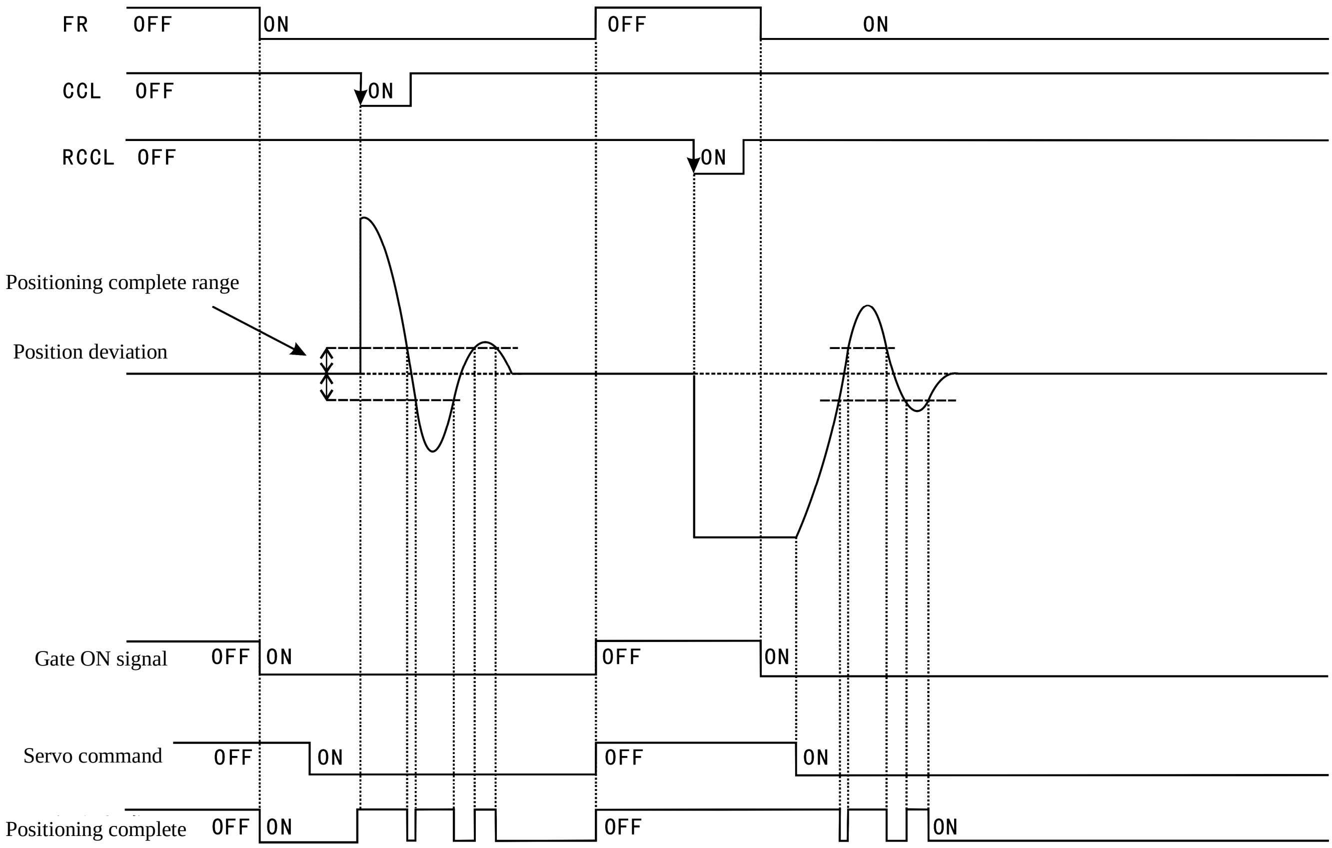
When F8107=1: edge operation (the deviation counter will be cleared once when the terminal is ON)

Note: In order to eliminate the movement error caused by the width of reset pulse, please use the edge operation as possible.

According to the above descriptions, please refer to the following table for the setting range and limit of the function codes related to point to point control.

F8102: point to point control Setting Resolution	=1(1mm)	=2(0.1mm)	=3(0.01mm)
Position control range	1-32767mm	0.1-3276.7mm	0.01-327.67mm
Number of pulses within the maximum distance when the maximum number of pulses is set in F8114	1073676289 pulses	107367628 pulses	10736762 pulses
F8114: Limit for number of pulses within 1mm	Must be smaller than 32767 within 1mm	Must be smaller than 3276 within 0.1mm	Must be smaller than 327 within 0.01mm

With this function, the controlled object can also be moved to the position set by function code without a command pulse. After the movement, the deviation counter clearing signal (CCL, RCCL) will be input through the multi-function input terminals to move a same distance. The actions during point to point control are as follows.



Note: The forward run (run) and reverse run (RP) cannot be distinguished during the position control mode. The CCL will be forward run and the RCCL will be reverse run even when RR is set ON.

F8103 Simple Backlash calibration

This function is used to compensate the gear offset in position control mode.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8103	Simple Backlash calibration	0-±5000 pulse(s)	1 pulse	0

The function is effective under the following conditions.
Condition 1: The initialization value of deviation counter switches from positive to negative
Carry out one addition/reduction for the setting value of F8103
Example) When the initialization value switches from 200 to -300,
F8103=1000: the initialization value of the deviation counter =-300+1000=700
F8103=-500: the initialization value of the deviation counter =-300-500=-800

Condition 2: The initialization value of deviation counter switches from negative to positive
Carry out one addition/reduction after reversing the signs for the setting value of F8103
Example) When the initialization value switches from -400 to 200,
F8103=500: the initialization value of the deviation counter =200-500=-300
F8103=-200: the initialization value of the deviation counter =200+200=400

Condition 3: When the polarity of the deviation counter doesn’t change,
The addition/reduction is not required for the setting of F8103.

Note 1: **The compensation is limited for only once running. After the running is completed, the compensation will be cleared before entering zero-servo or stop status. A new compensation will be implemented in the next running action.**

Note 2: **After the simple offset compensation value is set, the operation panel will display the position (mm) when the run direction is opposite to the last command direction, and it is also different from the detecting position which is displayed normally.**

F8111 Positioning complete width

During position control, the range value for output of positioning complete signal will be specified by the number of feedback pulses.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8111	Positioning complete width	0-32767 pulses	1 pulse	100

●When the position deviation value is smaller than the setting value in F8111, a positioning complete signal will be output.

Note: If the positioning complete range is reduced, there may be a repetition of ON/OFF for positioning complete signal. Therefore, the range must be set correctly.

∗ The operation panel is interlocked with the positioning complete signal and will display ZEro.

F8112 Error level limit

For position control mode and zero-servo function, after setting of this function, the position deviation counter abnormal (PGEr) alarm (display: PGEr) will shutdown the equipment when the position deviation exceeds the error level limit.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8112	Error level limit	0-1000（setting value =1000 pulses）	1	100

- When position deviation exceeds the setting values in F8112, it will display PGEr and the inverter will alarm and shutdown.
- The setting range is adjustable between 0-1000. 1 refers as 1000PG pulses.
- When F8112=0 is set, the over-error alarm is noneffective.

Note 1: **Release the alarm only after the motor is shutdown.**

Note 2: **When motor speed exceeds the detectable range, the abnormal (PGEr) alarm may also occur on the deviation counter.**

Note 3: **During re-running, if the abnormal alarm has been repeated for several times, please input the deviation counter clearing signal and then release the alarm.**

F8113 Quick acceleration/deceleration for position control

This function is used when the setting value of position control gain is small, it is also used to move to the target position quickly.

Code No.	Function Name	Date Content	Setting Resolution	Factory Presets
F8113	Quick acceleration/deceleration for position control	0: Disabled 1: Enabled	1	1

- 1: When “Enabled” is set, the speed variation (acceleration/deceleration slope) for position control at low speed will be controlled by quick acceleration/deceleration function (initial setting).
- In order to avoid alarm and shutdown, the speed variation can also be adjusted with this function even when the position control gain is set very small, therefore ensuring the smooth start and stop.

Reference parameter

F8110 (position control gain)

7-4 Serial Communication Function

7-4-1 Outline

- The serial communication function is an interface function that controls the inverter using serial signals from a computer. It can control inverter start/stop, frequency setting, operation status monitoring and function code reading & setting.
- An RS485 communication interface is embedded in the inverter. With this interface, the computer can control multiple inverters.
- The communication mode is RS485, SANKEN protocol and Modbus-RTU protocol can be used for RS485.
- The Modbus communication is composed with a master computer (PLC or PC) and up to 254 lower computers. (248-254 are reserved.)
- In SANKEN protocol of RS485, one master computer and up to 32 inverters can be connected.
- The followings are communication specifications.

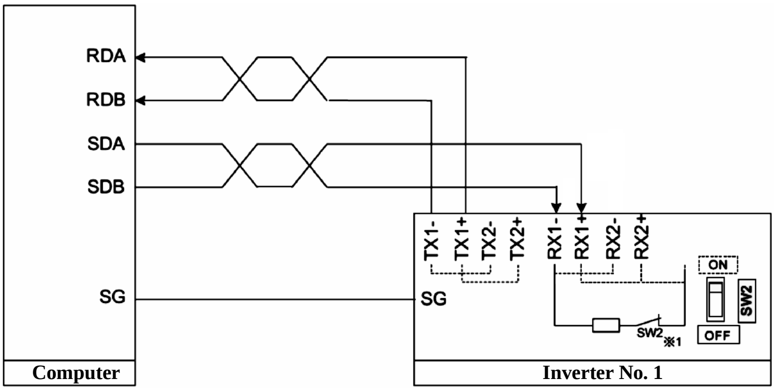
Electrical characteristic		RS485 Communication	
Communication provision		SANKEN protocol	Modbus-RTU protocol
Communication form		Bus form of 4-wire/2-wire （RS485 standard）	
Transmission distance		Total extension 500m Terminal resistance must be connected	
Number of connections		Up to 32	Up to 247*Note
Connection cable		Shielded Twisted-Pair is recommended	
Communication mode		Full duplex communication/Half duplex communication	
Communication speed [bps]		Selectable 57600/38400/19200/9600/4800/2400/1200	
Synchronization mode		Synchronization of start/stop	
Data form		ASCⅡ or BINARY	BINARY
Data length		8bit	
Stop digit		Selectable 1bit or 2bit	
Parity check		Yes（even, odd）No Selectable	
Error correction		Data and correction	CRC correction
Message end code	ASCⅡ	Selectable CR＋LF/CR	No
	BINARY	No	

Note: SANKEN protocol is the dedicated protocol used by our company (F4005=1).
***Note: When the number exceeds 32, a relay must be installed.**

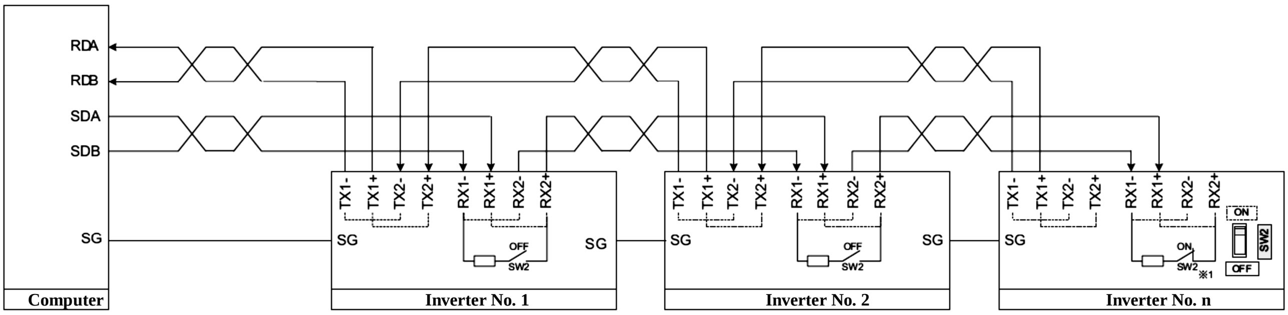
7-4-2 Terminal functions and wiring

(1) Terminal functions

① RS485 communication interface (one inverter)



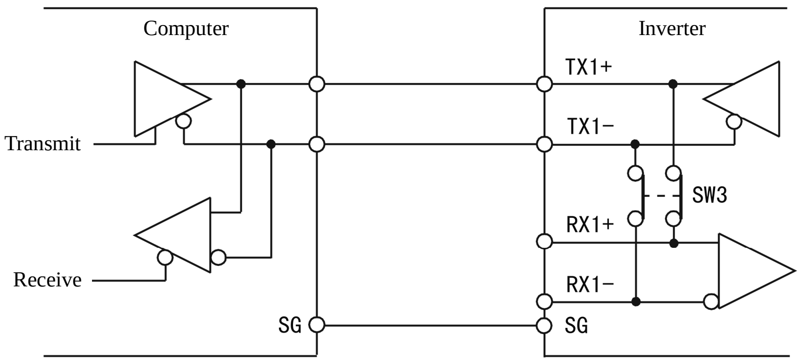
② RS485 communication interface (multiple inverters)



*1 For the farthest inverter from the computer, the terminal resistance switch SW2 should be set to ON.

③ For 2-wire connection

When 2-wire connection is used in the computer, the connection (ON) of switch SW3 on the control panel can fulfill the 2-wire communication.



Note: At the computer side, receiving status is existed beyond the transmission. During the program designing of the computer, please prevent the receiving of communication signal during the transmission status.

7-4-3 Inverter operation and related function code setting by serial communication

(1) Setting of serial communication use

Serial communication F4005 setting	Operation of operator panel	Serial communication						Description
		Function code		Operation		Frequency		
		Reference	Set	Start	Stop	Display	Set	
0: No function	Enabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Serial communication cannot be used.
1: Communication of dedicated protocol	Enabled	Enabled	Enabled	Enabled ∗1	Enabled	Enabled	Enabled ※2	Operation panel can be used at the same time.
2: Modbus-RTU protocol	Enabled	Enabled	Enabled	Enabled ∗1	Enabled	Enabled	Enabled ※2	

∗1: Set F1101=3 for operation by serial communication.
∗2: Set F1002=22 for frequency setting by serial communication.

(2) Setting of function codes related to the computer and serial communication

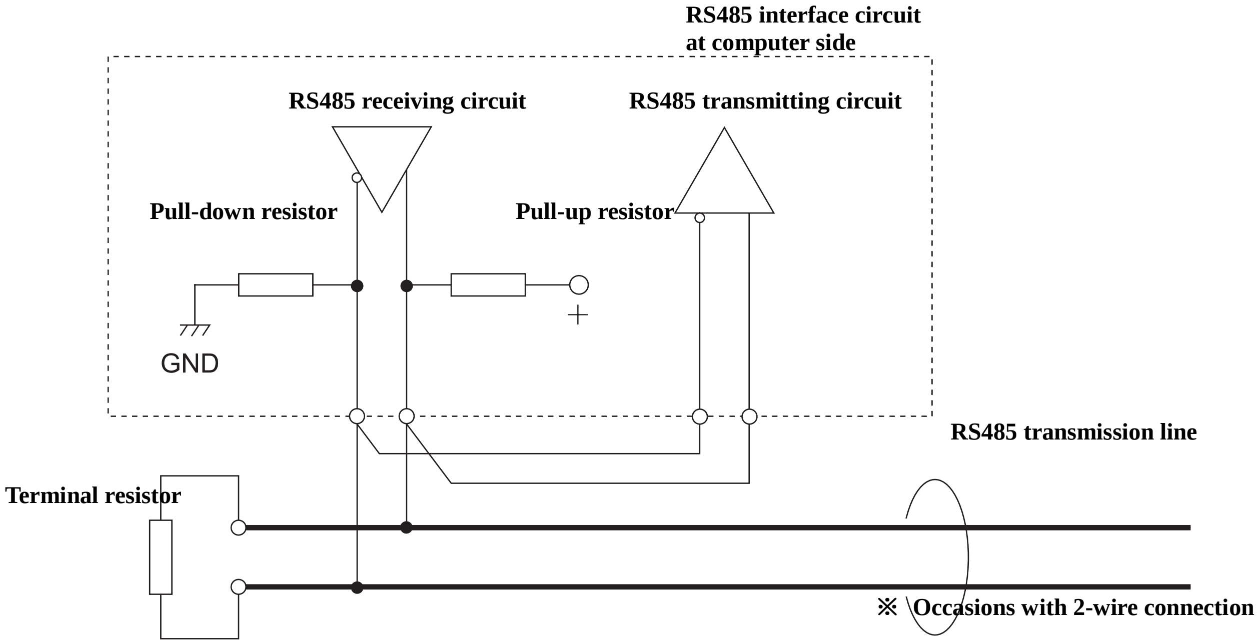
Code	Description
F4001	Message checksum Select whether to add a checksum to a communication message. 0: No 1: Yes (Factory preset)
F4003	Selection of Pull-up/down ※1 Select pull-up/down for the RS485 communication circuit. 0: No (Factory preset) 1: Yes
F4004	Communication response time Set a communication response time. 1-6000ms (Factory preset =10ms)
F4005	Serial communication Select a serial communication. 0: No function (Factory preset) 1: Communication with dedicated protocol 2: Modbus communication
F4006	Inverter No. Set the inverter number (Factory preset = 1) · Please set value of 1-32 by a communication with the dedicated protocol. · Please set value 1-247 by a Modbus communication. Please set a number which is not the same with other numbers, otherwise, the inverter may not work normally. The inverters need not be numbered sequentially.

F4007	Communication speed Set a communication speed 1: 1200bps 2: 2400bps 3: 4800bps 4: 9600bps 5: 19200bps 6: 38400bps 7: 57600bps
F4008	Parity bit Set a parity bit. 0: None 1: Odd (Factory preset) 2: Even
F4009	Stop bit Set a stop bit. 1: 1 bit (Factory preset) 2: 2 bits
F4010	End code Set an end code. 0: CR＋LF (Factory preset) 1: CR ※ No end code for BINARY and Modbus communication
F4011	Specified command INV response selection Prevent the inverter from sending response message to the specified command message at PC side. 0: Sent (Factory preset) 1: Not sent (Error response sent) 2: Not sent (Error response not sent)
F4101	Modbus communication timeout setting Set a Modbus communication timeout 0: No function (Factory preset) 0.01-600s
F4102	Modbus communication timeout action Set a Modbus communication timeout action. 0: keep the status (Factory preset) 1: Stop alarm

Note: Do not set a communication-related function code during communication, otherwise, the function may be noneffective.

※1: Set the output of the RS485 communication interface to high impedance when not used for data transmission. To prevent unstable output or malfunctioning, please set the pull-up/down function code (F4003=1) when no pull-up/down is embedded in the RS485 communication interface circuit to maintain a safe circuit at low impedance.

Chapter 7



7-4-4 Communication with dedicated protocol (SANKEN communication protocol)

(1) List of command code (OP)

The followings are command codes in communication (ASCⅡ).

Command Type	Command	Processing
Data reading	"A"	Alarm No.
	"B"	Function code data
	"C"	Output frequency
	"D"	Output current
	"E"	DC voltage
	"F"	Radiator fin temperature
	"G"	Load factor
	"H"	Operation status 1
	"I"	Operation status 2
	"J"	Control terminal input status
	"K"	Output voltage
	"L"	VIF1 control circuit terminal input
	"M"	VIF2 control circuit terminal input
	"T"	VIF3 control circuit terminal input
Data writing	"N"	Function code data
	"O"	Frequency setting ※1
Operation control	"P"	Forward run ※2
	"Q"	Reverse run ※2
	"R"	Stop ※2
	"S"	Alarm reset
Automatic alarm	"X"	Automatic alarm permitted
	"Y"	Automatic alarm prohibited
	"Z"	Automatic alarm
Batch operation	"a"	Select inverters for batch control
	"b"	Specify direction of rotation for batch inverter control
	"c"	Release batch inverter control
	"d"	Batch start ※2
	"e"	Batch stop ※2
Error	"?"	Error response

※1: Effective only when operation command F1002=22 (communication) is selected
※2: Effective only when operation command F1101=3 (communication) is selected

(2) Frequency setting command

- The frequency setting (O) command provides a function for setting the frequency from a computer, equivalent to directly setting the frequency from the panel. The set frequency is written into an appropriate frequency-related function code (F1021, F2101-F2116) depending on the status of signal input into the control circuit terminals (2DF, 3DF and JOG) at that time.

  Example) If control circuit terminals 2DF and DCM1 are connected when the inverter has received command O, the set frequency is written to function code F2102 as the 2nd speed frequency.

  Note: Set F1002=22 before setting a frequency using command O or writing data to a frequency-related function code (F1021, F2101-F2116) using the function code data write (N) command.

(3) Batch operation function

- The batch operation function allows selected inverters or all inverters connected through a communication line to be started and stopped simultaneously by a computer.

  1) Batch operation of selected inverters
  ① Select inverters for batch operation using command a
  ② Specify the direction of rotating for inverters using command b for batch operation
  ③ Transmit command d with “inverter number 33” to simultaneously start the inverters selected using command a. The inverters return no response to command d.
  ④ Transmit command e with “inverter number 33” to simultaneously start the inverters selected using command a. The inverters return no response to command e.
  2) Connect the batch operation of all inverters. The operation direction will be preset by command b.
  ① Preset the operation direction using command b.
  ② Transmit command d with “inverter number 34” and simultaneously start all the connected inverters. The inverters return no response to command d.
  ③ Transmit command e with “inverter number 34” and simultaneously start all the connected inverters. The inverters return no response to command e.
  3) Release of batch operation
  ① Transmit command c with “inverter number 35” to release the inverters selected using command a from batch control.

  Note: During batch operation, keep in mind the followings:
  1) **Inverters return no response to command c, d or e.**
  2) **If command c, d or e sent from a computer is not received normally for some reason, the connected inverter cannot execute the command. Therefore, the computer should transmit an Operation Status 1 (H) command to each inverter to confirm that whether the inverter is now executing the received command correctly.**
  3) **For the meanings of inverter numbers 33, 34 and 35, please refer to “Message format”. Different numbers from 1 to 32 are given to inverters connected using a communication line to identify them as message destinations. “33” to “35” are special inverter numbers indicating that the messages are addressed to all inverters connected for batch operation.**

(4) Automatic alarm function

- If an alarm occurs, the automatic alarm function automatically issues an Automatic Alarm (Z) command to notify the computer of the alarm. This function enables the computer to detect an inverter alarm immediately.
- An inverter can issue command Z automatically only if an Automatic Alarm Permitted (X) command is received from the computer. However, if the Automatic Alarm Prohibited (Y) command is received after command X, the inverter cannot issue command Z.

  Note: If automatic alarm is enabled, the inverter automatically issues an Automatic Alarm command in case of an alarm. Consequently, message collision may occur on a communication line. The causes of message collision and preventive actions are as follows:
  (1) **If the computer transmits a command to an inverter and the inverter in which an alarm has occurred issues command Z simultaneously**
  ① **The computer detects the message collision. Transmit the message again.**
  ② **If the computer cannot detect the message collision, the messages cannot be sent to their destinations correctly. Therefore, a normal response from the destination cannot be expected.**
  (2) **If an alarm occurs simultaneously in several inverters permitted to issue command Z**
  ① **Since a message collision destroys the messages, the computer will discard the received abnormal message.**

- An alarm permitted inverter automatically issues command Z about every two seconds in case of an alarm. The automatic transmission stops if an Alarm Reading (A) command is received. If command Z is received, the computer must transmit command A immediately to the inverter issuing command Z.

Note: If command A is received, the inverter issuing command Z will stop automatic alarm transmission. Command Z cannot be issued again even if the cause of the alarm has not yet been solved (for example, the fin temperature is too high and the overheat protection function has been activated) or the alarm status has not been reset.

7-4-5 Programming Design

(1) Message Format

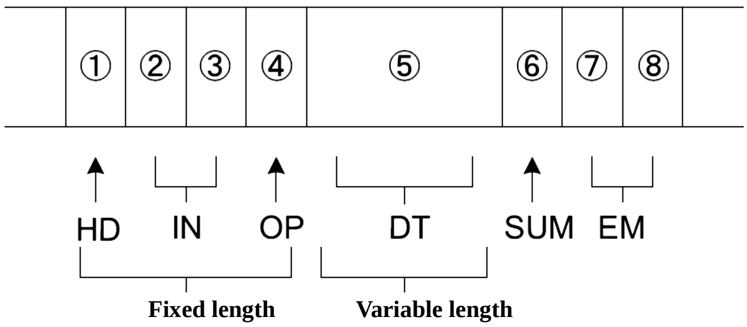
- Messages have the following two formats:

  ① ASCⅡ format: consisting of character codes only

  ② BINARY format: consisting of an inverter number and data in hexadecimal. Since message of this format is shorter than the ASCⅡ-format message, the communication time for one message is shorter. This format is available only for the frequency setting (O), forward run (P), reverse run (Q), stop (R) and alarm reset (S) commands.

  If the message check function is disabled (F4001=0), "SUM" is not necessary for messages in ASCⅡ or BINARY format.

1) Message from computer to inverter (ASCⅡ format)



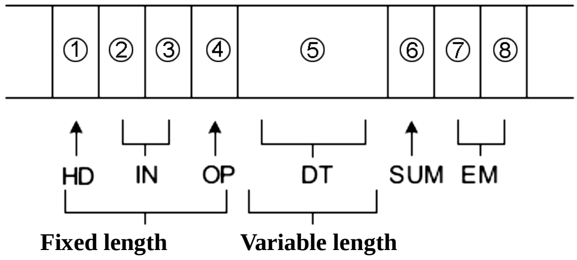
Item		Name	Content
①	HD	Start code	Message transmission start code（“*”：ASCⅡ code 2AH）
②③	IN	Inverter No.	Inverter number. Data format: 2 bytes fixed The inverter number is set by function code F4006 Example: Inverter number 20 ②→“2”、③→“0”
④	OP	Command code	Inverter command code
⑤	DT	Data	Example: Function code data read/write contents 1） Function code number section (Data length: 4 bytes fixed) Example: code number F2103 (1)→“2”(2)→“1”(3)→“0”(4)→“3” 2） Function code data section (Data format: 5 bytes fixed) Example: code data 123 (5)→“0”(6)→“0”(7)→“1”(8)→“2”(9)→“3” (1) (2) (3) (4) (5) (6) (7) (8) (9) Code number Code data ◎The data length and format are determined by each command. For details, please refer to Details of message formation.
⑥	SUN	Checksum	Obtain the 2’s complement of the lowest byte of the binary sum of data ①-⑤. Change bit 7 to 0 and bit 6 to 1. (See reference 1.)
⑦⑧ or ⑦	EM	End code	The code to end data transmission. Please determine it according to function code F4010. ASCⅡ code 0DH（“CR”）and 0AH（“LF”）or 0DH（“CR”）

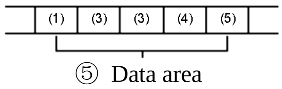
Reference 1: As an example of checksum calculation for ASCⅡ format, set the function code F2101 of the first inverter to 50.00HZ.

Item		Name	Content
①	Start code	*	(1) 2AH “*”
② ③	Inverter No.	01	(2) 30H “0” (3) 31H “1”
④	Command code	N	(4) 4EH “N”
⑤	Data	Function code number F2101	(5) 32H “2” (6) 31H “1” (7) 30H “0” (8) 31H “1”
		Function code data 50.00 Hz※	(9) 30H “0” (10) 35H “5” (11) 30H “0” (12) 30H “0” (13) 30H “0”
Sum of ASCⅡ codes (1)-(13)			292H Lower byte: 92H
2’s complement of the lower byte of the sum			6EH
⑥	Change bit 7 to 0 and change bit 6 to 1.		6EH=01101110B→01101110B=6EH Checksum: 6EH

※ **Frequency data consists of a 3-digit integer part and a 2-digit decimal part.**

2) Message from inverter to computer (ASCⅡ format)



Item		Name	Content
①	HD	Start code	Message transmission start code（“*”：ASCⅡ code 2AH）
②③	IN	Inverter No.	Inverter number. Data format: 2 bytes fixed The inverter number is set by function code F4006 Example: inverter number 20 ②→“2”、③→“0”。
④	OP	Command code	Same as command code from computer ”?” for error response
⑤	DT	Data	Example: Function code data read 1） When reading a positive, the data is 5 bytes long (fixed). Example: when reading data 123 (1)→“0”(2)→“0”(3)→“1”(4)→“2” (5)→“3” Example: When no data is read, normal end code will be (1)→“e”(2)→“F”(3)→“F”(4)→“F” (5)→“0” 2） During response error, an error code or interference code of 5 bytes long (fixed) is returned.  ◎The data length and format are determined by each command. For details, please refer to Details of message formation.
⑥	SUN	Checksum	Obtain the 2’s complement of the lowest byte of the binary sum of data ①-⑤. Change bit 7 to 0 and bit 6 to 1. (See reference 1.)
⑦⑧ or ⑦	EM	End code	The code to end data transmission. Please determine it according to function code F4010. ASCⅡ code 0DH（“CR”）and 0AH（“LF”）or 0DH（“CR”）

※ The following messages are used for commands N and B for signed function codes:

In F1402: gain frequency (VIF1) with signed 10 multiples data format, the example is as follows:

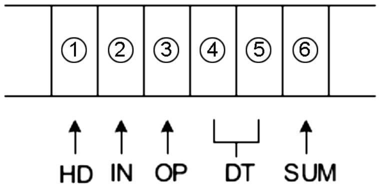
〈Command N〉 Example 1) When setting +50.00Hz for F1402
The data (DT) written is: $\boxed{0}\boxed{0}\boxed{5}\boxed{0}\boxed{0}$ or $\boxed{+}\boxed{0}\boxed{5}\boxed{0}\boxed{0}$.

Example 2) When setting -50.00Hz for F1402
The data (DT) written is: $\boxed{-}\boxed{0}\boxed{5}\boxed{0}\boxed{0}$

〈Command B〉 Example 3) When setting +50.00Hz for F1402
The data (DT) read is: $\boxed{0}\boxed{0}\boxed{5}\boxed{0}\boxed{0}$.

Example 4) When setting -50.00Hz for F1402
The data (DT) read is: $\boxed{-}\boxed{0}\boxed{5}\boxed{0}\boxed{0}$.

3) Message from computer to inverter (BINARY format)



Item		Name	Content
①	HD	Start code	Message transmission start code（“@”：ASCⅡ code 40H）
②	IN	Inverter No.	Inverter number Example: 14H for inverter number 20
③	OP	Command code	Inverter command code
④⑤	DT	Setting data	Data sent to inverter Example: For data 123 ④→00H ⑤→7BH ※Added only to a command code when there is applicable setting data.
⑥	SUN	Checksum	Add the two’s complement of the lower byte of the BINARY sum of data ①-⑤.（See Reference 2）

Reference 2: As an example of checksum calculation for BINARY format, set 50.00 Hz on the first inverter

①Start code	**=40H ：**	**“@”**
②Inverter No.	**=01H**	
③Command	**=4FH ：**	**“O”**
④Data (upper byte)	**=13H ：**	**50.00Hz→5000D→1388H**
⑤Data (lower byte)	**=88H ：**	
⑥Sum of ①-⑤	**=12BH：**	**40H＋01H＋4FH＋13H＋88H=12BH**
⑦Lower byte of 12BH	**=2BH ：**	
⑧Two’s complement of 2BH	**=D5H ：**	**Checksum**

⑵Details of message formation

① ASCⅡ-format message

<table>
<tr><th rowspan="2">OP—CD</th><th colspan="2">Example of communication data (when inverter number is 1)</th></tr>
<tr><th>Transmission from computer to inverter</th><th>Transmission from inverter to computer</th></tr>
<tr><td>A</td><td>· Reading of alarm number
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>A</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· External thermal alarm (14)
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>A</td><td>0</td><td>0</td><td>0</td><td>1</td><td>4</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The response is 0 if no alarm is detected.
· Refer to list of alarm codes for details of alarm numbers.</td></tr>
<tr><td>B</td><td>· Reading of function code
· F4006 Inverter number
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="4">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>B</td><td>4</td><td>0</td><td>0</td><td>6</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· F4006=1
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>0</td><td>B</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The read data is a fixed floating-point value, with a same format as the display on the operation panel of the inverter.
· If a read error occurs, “eXXXX” is returned as an error code. See list of alarm codes for details of the error codes.
· Refer to “Note” for the read data format of F5001 (motor poles, voltage and capacity).</td></tr>
<tr><td>C</td><td>· Reading of output frequency
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>C</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· Output frequency: 50 Hz
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>C</td><td>0</td><td>5</td><td>0</td><td>0</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The frequency data is multiplied by 100.</td></tr>
<tr><td>D</td><td>· Reading of output current
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>D</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· Output current: 12[A]
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>D</td><td>0</td><td>0</td><td>1</td><td>2</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The current data is multiplied by 10.</td></tr>
<tr><td>E</td><td>· Reading of DC voltage
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>E</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· DC voltage: 600V
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>E</td><td>0</td><td>6</td><td>0</td><td>0</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The voltage data is multiplied by 10.</td></tr>
<tr><td>F</td><td>· Reading of fin temperature
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>F</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· Fin temperature: 50[℃]
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>F</td><td>0</td><td>0</td><td>0</td><td>5</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The fin temperature data is multiplied by 1.</td></tr>
<tr><td>G</td><td>· Reading of load factor
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>G</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table></td><td>· Load factor: [40%]
<table>
<tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th colspan="5">DT</th><th>SUM</th><th>EM</th></tr>
<tr><td>*</td><td>0</td><td>1</td><td>G</td><td>0</td><td>0</td><td>0</td><td>4</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· The load factor data is multiplied by 1.</td></tr>
</table>

OP—CD | **Example of communication data (when inverter number is 1)**

Transmission from computer to inverter | **Transmission from inverter to computer**

H

Transmission from computer to inverter:

· Reading of operation status 1

HD	IN		OP	SUM	EM
*	0	1	H	SUM	CR or CR+LF

Transmission from inverter to computer:

· The operation status is returned as bit data

HD	IN		OP	DT					SUM	EM
*	0	1	H	0	0	0	X	X	SUM	CR or CR+LF

· The data has a 2-byte formation.

· See Operation Status 1 data for the bit correspondence of data X.

I

Transmission from computer to inverter:

· Reading of operation status 2

HD	IN		OP	SUM	EM
*	0	1	I	SUM	CR or CR+LF

Transmission from inverter to computer:

· The operation status is returned as bit data

HD	IN		OP	DT					SUM	EM
*	0	1	I	0	X	X	X	X	SUM	CR or CR+LF

· The data has a 4-byte formation.

· See Operation Status 2 data for the bit correspondence of data X.

J

Transmission from computer to inverter:

· Reading of control terminal input status

HD	IN		OP	SUM	EM
*	0	1	J	SUM	CR or CR+LF

Transmission from inverter to computer:

· The terminal status is returned as bit data

HD	IN		OP	DT					SUM	EM
*	0	1	J	0	X	X	X	X	SUM	CR or CR+LF

· The data has a 4-byte formation.

· See control terminal input data for the bit correspondence of data X.

K

Transmission from computer to inverter:

· Reading of output voltage

HD	IN		OP	SUM	EM
*	0	1	K	SUM	CR or CR+LF

Transmission from inverter to computer:

· Output voltage: 400[V]

HD	IN		OP	DT					SUM	EM
*	0	1	K	0	4	0	0	0	SUM	CR or CR+LF

· The output voltage data is multiplied by 10.

L

Transmission from computer to inverter:

· Reading of VIF1 control terminal input value

HD	IN		OP	SUM	EM
*	0	1	L	SUM	CR or CR+LF

Transmission from inverter to computer:

· The VIF1 control terminal input value is returned.

HD	IN		OP	DT					SUM	EM
*	0	1	L	0	4	0	9	5	SUM	CR or CR+LF

· Up to 4095 (12 bit) are returned for the maximum input (10V).

M

Transmission from computer to inverter:

· Reading of VIF2 control terminal input value

HD	IN		OP	SUM	EM
*	0	1	M	SUM	CR or CR+LF

Transmission from inverter to computer:

· The VIF2 control terminal input value is returned.

HD	IN		OP	DT					SUM	EM
*	0	1	M	0	4	0	9	5	SUM	CR or CR+LF

· Up to 4095 (12 bit) are returned for the maximum input (10V).

T

Transmission from computer to inverter:

· Reading of VIF3 control terminal input value

HD	IN		OP	SUM	EM
*	0	1	T	SUM	CR or CR+LF

Transmission from inverter to computer:

· The VIF3 control terminal input value is returned.

HD	IN		OP	DT					SUM	EM
*	0	1	T	0	4	0	9	5	SUM	CR or CR+LF

· Up to 4095 (12 bit) are returned for the maximum input (10V).

<table>
<tr><th rowspan="2">OP—CD</th><th colspan="2">Example of communication data (when inverter number is 1)</th></tr>
<tr><th>Transmission from computer to inverter</th><th>Transmission from inverter to computer</th></tr>
<tr><td>N</td><td>
· Writing of function code data
· Writing 50Hz to F1008 “lower frequency limit”
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="9">DT</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>N</td><td>1</td><td>0</td><td>0</td><td>8</td><td>0</td><td>5</td><td>0</td><td>0</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td><td>
· Writing of OK
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="5">DT</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>N</td><td>e</td><td>F</td><td>F</td><td>F</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· Interference error（Example: interference with F4007）
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="5">DT</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>N</td><td>e</td><td>4</td><td>0</td><td>0</td><td>7</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· Setting error（error code）
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="5">DT</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>N</td><td>e</td><td>F</td><td>F</td><td>F</td><td>5</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· See list of error codes for details of error code.
· See “Note” for the written data format of F5001 (motor poles, voltage and capacity).
</td></tr>
<tr><td>O</td><td>
· Setting of the frequency
· Set the target frequency to 55Hz
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="5">DT</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>O</td><td>0</td><td>5</td><td>5</td><td>0</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· Set the frequency data by a multiple of 100
</td><td>
· Same as for code data write
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td colspan="5">ST</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>O</td><td>e</td><td>F</td><td>F</td><td>F</td><td>0</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
· ”eFFFA” is returned if the frequency setting is not permitted.
</td></tr>
<tr><td>P</td><td>
· Forward run command
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>P</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td><td>
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>ST</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>P</td><td>ST</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
*ST：“0”：Normal
“1”：Operation control is not permitted
“2”：No operation in alarm status
</td></tr>
<tr><td>Q</td><td>
· Reverse run command
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>Q</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td><td>
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>ST</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>Q</td><td>ST</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
*ST：“0”：Normal
“1”：Operation control is not permitted
“2”：No operation in alarm status
</td></tr>
<tr><td>R</td><td>
· Stop command
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>R</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td><td>
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>ST</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>R</td><td>ST</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
*ST：“0”：Normal
“1”：Operation control is not permitted
</td></tr>
<tr><td>S</td><td>
· Alarm reset
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>S</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td><td>
<table>
<tr><td>HD</td><td colspan="2">IN</td><td>OP</td><td>SUM</td><td>EM</td></tr>
<tr><td>*</td><td>0</td><td>1</td><td>S</td><td>SUM</td><td>CR or CR+LF</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th rowspan="2">OP—CD</th><th colspan="2">Example of communication data (when inverter number is 1)</th></tr>
<tr><th>Transmission from computer to inverter</th><th>Transmission from inverter to computer</th></tr>
<tr><td>X</td><td>· Automatic Alarm Permitted
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>X</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td><td>
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>X</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td></tr>
<tr><td>Y</td><td>· Automatic Alarm Prohibited
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>Y</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td><td>
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>Y</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td></tr>
<tr><td>Z</td><td>· Command A (reading of alarm number) is transmitted when automatic alarm is received to obtain the alarm number.</td><td>· Automatic alarm
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>Z</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td></tr>
<tr><td>a</td><td>· Selecting inverters for batch operation
· Selecting inverter number 1
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>a</td><td>SUM</td><td>CR or CR+LF</td></tr></table></td><td>
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>ST</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>a</td><td>ST</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
*ST: “0”: Normal
“1”: Operation control is not permitted
“2”: No operation in alarm status</td></tr>
<tr><td>b</td><td>· Selecting the direction of rotation of batch-operation inverters
· Selecting inverter number 1
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>DT</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>b</td><td>DT</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
*DT: “0”: Forward run
“1”: Reverse run</td><td>
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>ST</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>b</td><td>ST</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
*ST: “0”: Normal
“1”: Operation control is not permitted
“2”: No operation in alarm status</td></tr>
<tr><td>c</td><td>· Releasing of inverters in batch operation
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>3</td><td>5</td><td>c</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
· Send with inverter number 35</td><td>· No response is returned.
· The command can be ignored if operation control is not permitted.</td></tr>
<tr><td rowspan="2">d</td><td>· Batch start command
· The selected inverters are started simultaneously.
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>3</td><td>3</td><td>d</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
· Send with inverter number 33</td><td>· No response is returned.
· The command can be ignored if operation control is not permitted.</td></tr>
<tr><td>· Batch start command
· All connected inverters are started simultaneously.
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>3</td><td>4</td><td>d</td><td>SUM</td><td>CR or CR+LF</td></tr></table>
· Send with inverter number 34</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">OP—CD</th><th colspan="2">Example of communication data (when inverter number is 1)</th></tr>
<tr><th>Transmission from computer to inverter</th><th>Transmission from inverter to computer</th></tr>
<tr><td rowspan="2">e</td><td>· Batch stop command
· The selected inverters are stopped simultaneously.
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>3</td><td>3</td><td>e</td><td>SUM</td><td>CR or CR+LF</td></tr></table>· Send with inverter number 33</td><td rowspan="2">· No response is returned.
· The command can be ignored if operation control is not permitted.</td></tr>
<tr><td>· Batch stop command
· All connected inverters are stopped simultaneously.
<table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>3</td><td>4</td><td>e</td><td>SUM</td><td>CR or CR+LF</td></tr></table>· Send with inverter number 34</td></tr>
<tr><td>?</td><td>· Error response
(Response of parity, SUM error and command code undefined)</td><td><table><tr><th>HD</th><th colspan="2">IN</th><th>OP</th><th>DT</th><th>SUM</th><th>EM</th></tr><tr><td>*</td><td>0</td><td>1</td><td>?</td><td>DT</td><td>SUM</td><td>CR or CR+LF</td></tr></table>*DT: "p": Parity error
"s": Checksum error
"u": Command code undefined
"d": Data length, format abnormal</td></tr>
</table>

Note: The data formats for reading of F5001 (poles, voltage and capacity) and the F5001 data format have a 5-digit formation.

X Y ZZZ

Ⓐ Ⓑ Ⓒ

Ⓐ **Number of poles**
Examples) 4 poles →"4"

Ⓑ **Rated voltage**
Set the rated voltage using the corresponding setting number as follows:

Setting No.	1	2	3	4	5	6	7	8
Rated voltage	200	220	230	380	400	415	440	460

Example) 380V →"4"。

Ⓒ **Rated capacity**
Set the rated capacity using the corresponding setting number as follows:

Rated capacity	0.37kW	0.4kW	0.55kW	0.75kW	1.1kW	1.5kW	2.2kW
Setting No.	1	2	3	4	5	6	7
Rated capacity	3.0kW	3.7kW	4.0kW	5.5kW	7.5kW	11.0kW	15.0kW
Setting No.	8	9	10	11	12	13	14
Rated capacity	18.5kW	22.0kW	30.0kW	37.0kW	45.0kW	55.0kW	75.0kW
Setting No.	15	16	17	18	19	20	21
Rated capacity	90.0kW	110kW	132kW	160kW	185kW	200kW	220kW
Setting No.	22	23	24	25	26	27	28
Rated capacity	250kW	280kW	315kW	355kW			
Setting No.	29	30	31	32			

Example） When writing 4.0kW →"010" or "_10"
When reading 4.0kW →"_10"
Where, "_" is ASCⅡ code 5FH.

② **BINARY format**

Note: A BINARY-format message can be transmitted for the following commands only.

<table>
<tr><th rowspan="2">OP—CD</th><th colspan="2">Example of communication data (when inverter number is 1)</th></tr>
<tr><th>Transmission from computer to inverter</th><th>Transmission from inverter to computer</th></tr>
<tr><td>O</td><td>· Setting of frequency
· Setting target frequency to 55Hz
<table><tr><td>HD</td><td>IN</td><td>OP</td><td colspan="2">DT</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>O</td><td>15h</td><td>7Ch</td><td>SUM</td></tr></table>
· Set the frequency data by a multiple of 100</td><td>
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>ST</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>O</td><td>ST</td><td>SUM</td></tr></table>
· ST returns the contents of the error code.</td></tr>
<tr><td>P</td><td>· Forward run command
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>P</td><td>SUM</td></tr></table></td><td>
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>ST</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>P</td><td>ST</td><td>SUM</td></tr></table>
*ST: “00h”: Normal
“01h”: Operation control is not permitted
“02h”: No operation in alarm status</td></tr>
<tr><td>Q</td><td>· Reverse run command
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>Q</td><td>SUM</td></tr></table></td><td>
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>ST</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>Q</td><td>ST</td><td>SUM</td></tr></table>
*ST: “00h”: Normal
“01h”: Operation control is not permitted
“02h”: No operation in alarm status</td></tr>
<tr><td>R</td><td>· Stop command
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>R</td><td>SUM</td></tr></table></td><td>
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>ST</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>R</td><td>ST</td><td>SUM</td></tr></table>
*ST: “00h”: Normal
“01h”: Operation control is not permitted</td></tr>
<tr><td>S</td><td>Alarm reset
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>S</td><td>SUM</td></tr></table></td><td></td></tr>
<tr><td>?</td><td>· Error response
(Response of parity, SUM error and command code undefined)</td><td>
<table><tr><td>HD</td><td>IN</td><td>OP</td><td>ST</td><td>SUM</td></tr><tr><td>@</td><td>01h</td><td>?</td><td>01h</td><td>SUM</td></tr></table>
*ST: 01h fixed</td></tr>
</table>

Chapter 7

(3) Inverter operation and control terminal board input status data
Data read by from Operation Status 1 (H), Operation Status 2 (I) and Control Terminal Board Input Status (J) commands are as follows:

① Operation Status 1
Operation Status 1 data is returned in two bytes
First byte

bit	7	6	5	4	3	2	1	0
	0	1	0	x	x	x	x	x

bit	4	3	2	1	0	
JOG	0	0	0	0	0	JOG operation
Stage 1	0	0	0	0	1	Current number of stages in multi-speed operation
Stage 2	0	0	0	1	0	
Stage 3	0	0	0	1	1	
Stage 4	0	0	1	0	0	
Stage 5	0	0	1	0	1	
Stage 6	0	0	1	1	0	
Stage 7	0	0	1	1	1	
Stage 8	0	1	0	0	0	
Stage 9	0	1	0	0	1	
Stage 10	0	1	0	1	0	
Stage 11	0	1	0	1	1	
Stage 12	0	1	1	0	0	
Stage 13	0	1	1	0	1	
Stage 14	0	1	1	1	0	
Stage 15	0	1	1	1	1	
Stage 16	1	0	0	0	0	

bit4：alarm：0：No，1：Yes

bit5：alarm：0：No，1：Yes

Second byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	y	y	x	x

	bit 1	0	
Multi-speed	0	0	JOG/ Multi-speed operation
Analog	0	1	Operation by external analog frequency command
Option	1	0	Operation by frequency command from the digital input board

bit2 warning：0：No，1：Yes
bit3 warning：0：No，1：Yes

② Operation Status 2
Operation Status 2 data is returned in four bytes

First byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	x	x	x	x

bit0：During starting excitation
bit1：During braking excitation
bit2： During DC braking
bit3：During Vslow

Second byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	x	x	x	x

bit0：Decelerating to stop
bit1：Raising frequency
bit2：Lowering frequency
bit3：Matching frequency

Chapter 7

Third byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	x	x	x	0

bit1：Reverse run (see note)
bit2：Gate ON
bit3：Frequency locked

Note: The "Reverse run" bit during stop is changed through the last operation status. When it is necessary to confirm forward or reverse run, please also confirm the status of "Gate ON" bit.

Fourth byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	0	0	0	x

bit0：Standby

③ Control terminal board data
Control terminal board data is returned in four bytes.

First byte

bit	7	6	5	4	3	2	1	0
	0	1	0	0	x	x	x	x

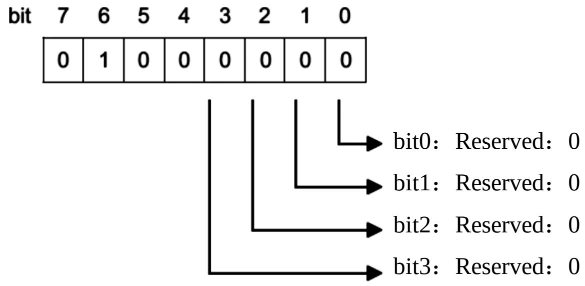
bit0 : DI 1
bit1 : DI 2
bit2 : DI 3
bit3 : DI 4

Second byte

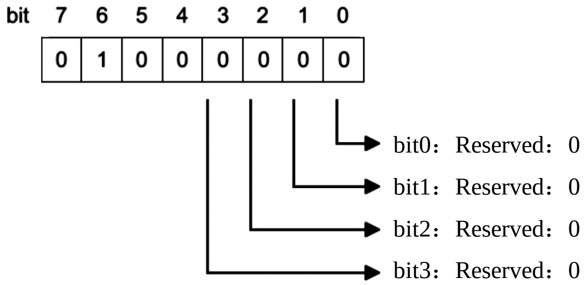
bit	7	6	5	4	3	2	1	0
	0	1	0	0	x	x	x	x

bit0 : DI 5
bit1 : DI 6
bit2 : DI 7
bit3 : DI 8

Third byte



Fourth byte



(4) List of error codes during function setting

ASCⅡ	BIN	Error description
“exxxx”		Setting value conflicts with function code number Fxxxx
“eFFF0”	F0H	Normal setting
“eFFF1”	F1H	Function code value is out of range, user’s initial value is not determined, or motor constant is not registered.
“eFFF2”	F2H	Function code setting conflicts with mounted optional board
“eFFF3”	F3H	Function code setting conflicts with mounted options
“eFFF4”	F4H	Unable to change function code during inverter operation
“eFFF5”	F5H	Unable to change function code with operation function locked
“eFFF9”	F9H	Unable to change function code during LV
“eFFFA”	FAH	Frequency setting is not permitted (check the setting values of F1002)
“eFFFB”	FBH	Inverter control microcomputer busy (send the message again)
“eFFFC”	FCH	Reserved
“eFFFE”	FEH	Access to undefined code (access the code which cannot be accessed in serial communication function)

ASCⅡ：ASCⅡ-format message communication
BIN：BINARY-format message communication

(5) List of inverter alarm codes

Alarm No.	Alarm code	Description
1	AL1	Memory abnormality
2	AL2	System abnormality
3	AL3	System abnormality
4	AL4	System abnormality
5	AL5	System abnormality
9	AL9	System abnormality
10	AL10	System abnormality
11	ACER	Overload protection during acceleration
12	CNER	Overload protection during constant speed
13	DCER	Overload protection during deceleration
14	ES	External thermal abnormality
15	OH	Radiator temperature abnormality
16	LVA	Undervoltage during acceleration
17	LVN	Undervoltage during constant speed
18	LVD	Undervoltage during deceleration
19	OCH	Main switch element temperature abnormality
20	OCA	Overcurrent during acceleration
21	OCN	Overcurrent during constant speed
22	OCD	Overcurrent during deceleration
23	OCPA	Momentary overload during acceleration
24	OCPN	Momentary overload during constant speed
25	OCPD	Momentary overload during deceleration
26	OLA	Overload during acceleration
27	OLN	Overload during constant speed
28	OLD	Overload during deceleration
29	OVA	Overload during acceleration
30	OVN	Overload during constant speed
31	OVD	Overload during deceleration
32	OVP	Braking resistor overvoltage protection
33	GAL1	Disconnection of feedback signal cable (PID control)
34	GAL2	Overspeed
35	GAL3	ModBus Communication timeout
39	PONG	24V Power supply abnormality
40	FANL	Cooling fan abnormality
41	PGER	Disconnection of PG feedback signal, abnormality of position deviation counter
42	OPNI	Missing input phase
43	OPNO	Missing output phase
44	GNDF	Grounding output overcurrent alarm
45	RYOFF	Main relay abnormality

Note: According to the inverter software edition, there may be some alarm numbers beyond the above list of alarm codes.

(6) Communication processing by the inverter

● If an error is detected in a message from the upper computer, the inverter executes the following processing:

1) ASCⅡ-format message

① Parity error, SUM error, or undefined command code
The inverter returns an error message with the command code “?” and a one-byte communication error code for DT.
Example) When inverter number is “1”

*	0	1	?	DT	SUM	EM

② DT data too long or short, or data cannot be interpreted
The same error processing as ① is executed if a message in data defined by a code is too long or short, or the received message data cannot be interpreted.

③ Timeout processing
The receive status is terminated forcibly if the entire message cannot be received within 150ms after receiving start code. The inverter returns communication error code “d”.

④ Start code not detected
If data is being received without a correct start code, the above error is reported after a correct start code is detected.

⑤ List of communication error codes
“s”: Checksum error
“u”: Command code not defined
“d”: Abnormality of data length and format

⑥ Other errors
The timeout processing applies to other errors related to message reception from a computer. The computer returns no response.

2) BINARY-format message
When an error is detected in a received message, the inverter returns an error message to the computer with OP set to “?” and ST set to 1 (BINARY).

① Abnormality detection item
Parity error, SUM error, undefined command code, or message data too short (receive timeout)
Example) BINARY format

@	IN	?	ST	SUM

(7) Message transmission and reception between inverter and computer

1) Basics

① The serial communication protocol is based on a procedure for an inverter to respond to a computer command. Whenever a command is received from a computer, the inverter returns a response. If the computer sends more commands to the inverter without waiting for a response from the inverter, the inverter may not work normally.

② Due to an inverter or communication line fault, however, the computer may not be able to receive a response from the inverter. To prevent the response wait status from locking the communication sequence, the computer should use a receiver timeout of two seconds or longer.

③ The following commands are exceptions:

1) Command Z: The command to automatically notify the computer of an alarm, the transmission of this command is not influenced by computer command.

Chapter 7

2) Command c, d and e: The inverter cannot return a response to these batch control commands.

④ When sending commands c, d and e with no response from the inverter, the computer should insert an interval of about 10 ms between two commands.

2） Message transmission and receive timings on the RS485 communication interface

When the RS485 communication interface is connected by 2-wire method, it will be half-duplex communication line. Therefore, when transmitting and receiving a message, the computer should use the timing described below when sending a collision between computer-sent and inverter-sent messages.

3） Specified command INV response selection

In order to improve communication speed, the response sent by inverter can be selected.
The communication formats of ASCⅡ and BINARY will not return a response from an inverter to the following commands. The error response can also be selected.

F4011=0: Sent
=1: Not sent (error response sent)
=2: Not sent (error response not sent)

① ASCⅡ-supported commands
N、O、P、Q、R、S、a、b

② BINARY-supported commands
O、P、Q、R

⑻ List of character code

Upper 4 bits→

Lower 4 bits ↓

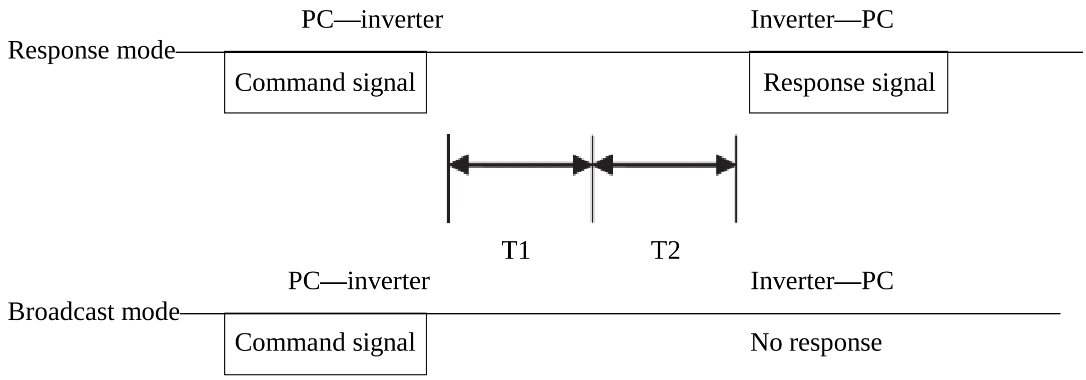
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0		DE		0	@	P	‘	p				ー	タ	ミ		
1	SH	D1	!	1	A	Q	a	q			。	ア	チ	ム		円
2	SX	D2		2	B	R	b	r			「	イ	ツ	メ		年
3	EX	D3	#	3	C	S	c	s			」	ウ	テ	モ		月
4	ET	D4	$	4	D	T	d	t			、	エ	ト	ヤ		日
5	EQ	NK	%	5	E	U	e	u			・	オ	ナ	ユ		時
6	AK	SN	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		分
7	BL	EB		7	G	W	g	w			ァ	キ	ヌ	ラ		秒
8	BS	CN	(	8	H	X	h	x			ィ	ク	ネ	リ	♠	
9	HT	EM	)	9	I	Y	i	y			ゥ	ケ	ノ	ル	♥	
A	LF	SB	*	:	J	Z	j	z			ェ	コ	ハ	レ	♦	
B	HM	EC	+	;	K	[	k	{			ォ	サ	ヒ	ロ	♣	
C	CL	→	,	<	L	¥	l	⨍			ャ	シ	フ	ワ	●	
D	CR	←	−	=	M	]	m	}			ュ	ス	ヘ	ン	○	
E	SO	↑	.	>	N	^	n	~			ョ	セ	ホ	゛		
F	SI	↓	/	?	O	_	o				ッ	ソ	マ	゜		

7-4-6 ModBus-RTU Communication

The followings are descriptions of ModBus-RTU communication.

(1) Message transmission and receive timings between inverter and computer

The transmission and receive timings of RTU message are as follows:



T1: Data receive complete time

The maximum time for judging 1-frame data complete by message receive cycle is the time needed to transmit 3.5-bit data with current baud rate. Therefore, the response signal must be within the time of T1.

T2: Communication response time (F4004)

By changing the communication time, the response interval sent by inverter can also be changed.

The response mode is a normal or error response sent by inverter to the command from the PC.

No response is sent in broadcast mode.

〈Communication timeout function〉

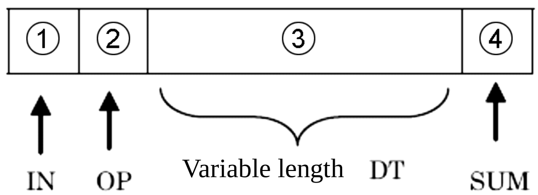
In ModBus communication, the setting of function code F4101: ModBus communication timeout can be used to set the response timeout during communication.

When exceeding the time period set by F4101, the inverter will act according to the setting of function code F4102: ModBus communication timeout actions.

F4102=0	Status keeping
F4102=1	Alarm stop (GAL3 alarm)

(2) Message format

The message format is as follows. The RTU format is consisted with data in hexadecimal.



IN： Address (inverter number)
The 1byte length for IN is selectable from 0-247, 0 refers to broadcast mode (batch operation).

OP： Operation code (command code)
Used as a command code
The 1byte length for OP is defined as the following table from 0-255. Blanks with shading are used by OP.

OP	Description
0-2	Not used
3（03H）	Register reading
4-15	Not used
16（10H）	Continuous register writing (max. one data)
17-127	Not used
128-255	Saved as exceptional response

DT： Data
DT contains all information (register, data and etc.)

SUM： CRC（checksum）
SUM is the 2byte length of CRC check mode.

The followings are examples of messages (computer → inverter, inverter → computer (normal & abnormal response)).

1) Message from computer to inverter (RTU)

Item		Name	Description
①	IN	Inverter number	0: broadcast mode 1-247: termination inverter number Data format is fixed as 1byte Inverter number, the data set by function code F4006 Example: inverter number 2 ②→‘02’
②	OP	Command code	Command code (1byte fixed)（03H、10H）
③	DT	Data	Example ①: Data content read from register（03H） 1） Register number (2-byte fixed) Example: register number 07D0H (1)→‘07’，(2)→‘D0’ 2） Number of registers (2-byte fixed) Example: two registers (3)→‘00’，(4)→‘02’ ·Data（DT）（4byte） (1) | (2) | (3) | (4) Example ② Data content written into the register (10H) 1） Register number (2-byte fixed) Example: register number 03E8H (1)→‘03’(2)→‘E8’ 2）Setting of number of registers (2-byte fixed) Example: setting register (3)→‘00’(4)→‘01’ 3）Number of data (1-byte fixed) Example: setting data (5)→‘02’ 4）Data content (variable, byte = number of data (5)) Example: Setting register 0001H (6)→‘00’(7)→‘01’ ·Data（DT）（7byte） (1) | (2) | (3) | (4) | (5) | (6) | (7)
④	SUM	Checksum	CRC check (2 byte fixed)

2) Message from inverter to computer (RTU) (normal response)

Item		Name	Description
①	IN	Inverter number	0: Broadcast mode 1-247: inverter number of sender Data format is fixed as 1byte Inverter number, the data set by function code F4006 Example: inverter number 2 ②→'02'
②	OP	Command code	same as the code sent from computer to inverter
③	DT	Data	Example ①: Data content read from register（03H） 1）Number of data (1-byte fixed) Example: 4 data are read (1)→'04' 2）Data content (variable, byte = number of data (1)) Example: 4 data are read (2)→'00'(3)→'00'(4)→'13'(5)→'88' ·Data （DT）（5byte ） (1) (2) (3) (4) (5) Example ② Data content written into the register (10H) 1）Register number (2-byte fixed) Example: register number 03E8H (1)→'03'(2)→'E8' 2）Setting number of registers (2-byte fixed) Example: writing in two registers (3)→'00'(4)→'02' ·Data （DT）（4byte） (1) (2) (3) (4)
④	SUM	Checksum	CRC check (2-byte fixed)

3) Message from inverter to computer (RTU) (abnormal response)

Item		Name	Description
①	IN	Inverter number	0: Broadcast mode 1-247: termination inverter number Data format is fixed as 1byte Inverter number is the data set by function code F4006 Example: inverter number 2 ②→‘02’。
②	OP	Command code	Computer-sent command code +80H; Top digit 1 means abnormal.
③	DT	Data	Abnormality response data format is fixed as 1-byte For alarm contents, see list of alarms for dedicated protocol.
④	SUM	Checksum	CRC check (2-byte fixed)

(3) OP category

In OP in RTU format, 03H: register reading and 10H: register writing are existed. The followings are descriptions for registers used in batch operation.

1） Register reading

· OP=03H

· During register reading, the data listed in the following table can be read. When reading the function code data, please set “function code number + 8000H” value in the register.
Up to 5 data can be read simultaneously.
For setting errors of function codes, please refer to list of error codes.

Chapter 7

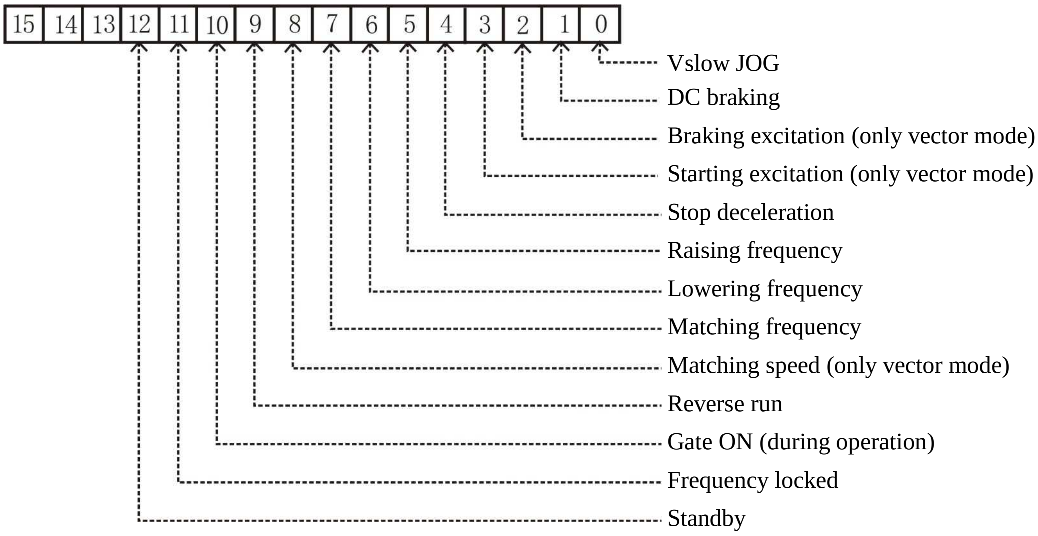
Processing method	Register No. DEC	Register No. HEX	Description	
Reading	2000	7D0H	Alarm content	
			0 = No alarm; Other = list of alarm codes ※1	
	2001	7D1H	Reading of command frequency	
	2002	7D2H	Reading of output frequency	
	2003	7D3H	Reading of output current	
	2004	7D4H	Reading of DC voltage	
	2005	7D5H	Reading of radiator temperature	
	2006	7D6H	Reading of load factor	
	2007	7D7H	Reading of Operation Status 1	
			BIT0-BIT4	JOG＋16th speed operation (operation status)
				0000：speed segment 0, JOG operation
				00001：1st speed operation
				00010：2nd speed operation
				…..…..…..…..
				10000：16th speed operation
			BIT5	Operation by external analog input frequency（operation status）
			BIT6	Operation by option input frequency（operation status）
			BIT7	1 = alarm; 0 = no alarm
			BIT8	1 = alarm; 0 = no alarm
			BIT9 and above	System reserved
	2008-2009	7D8H-7D9H	Reading of Operation Status 2	
			STATUS FLAG（32bit） ※2	
			BIT17 and above	System reserved
	2010	7DAH	Reading of Operation Status 3	System reserved
	2011	7DBH	Reading of Operation Status 4	System reserved
	2012	7DCH	Reading of external terminal input status 1	
			BIT0-BIT7	DI1-DI8 (ON/OFF)
				1=ON; 0=OFF
			BIT8 and above	System reserved
	2013	7DDH	Reading of external terminal input status 1	
			BIT0-BIT2	DO1-DO3 (HIGH/LOW)
				1=LOW; 0=HIGH
			BIT3	RY1 (HIGH/LOW)
				1=HIGH; 0=LOW
			BIT4 and above	System reserved
	2014	7DEH	Reading of output voltage	
	2015	7DFH	Reading of VIF1 control terminal input value	
	2016	7EOH	Reading of VIF2 control terminal input value	
	2017	7E1H	Reading of VIF3 control terminal input value	
	2018	7E2H	Reading of AOUT1 output value	
	2019	7E3H	Reading of AOUT2 output value	
	2020-2029	7E4H-7EDH	System reserved	

※1 **Please refer to list of alarm codes for communication with dedicated protocol.**

※2 **STATUSFLAG（status flag）**

In RAM bit status, the status flags are shown as follows.
And, the “only vector mode” bit is reset and cleared only in vector mode; all the bits will be cleared in V/f mode. (Clear = 0, Reset = 1)

FL-STFLG bit formation



※ **b13-b31 is system reserved.**

2）Continuous register writing

- OP=10H.
- With continuous register writing, the data listed in the following table can be written.
  When writing a function code data, please set “function code number + 8000H” value in the register; and only one data can be written per time.
  For setting errors of function codes, please refer to list of error codes.

Process method	**Register No.**		**Description**			
	DEC	**HEX**				
Write in	1000	3E8H	Frequency command	Setting of target frequency (1st speed)		
	1001	3E9H	Operation command			
			BIT 0	Not used		
			BIT 1	Forward run	1=Enabled	0=Disabled
			BIT 2	Reverse run	1=Enabled	0=Disabled
			BIT 3	Stop	1=Enabled	0=Disabled
			BIT4 and above	Not used		
	1002	3EAH	Rest command			
			BIT 0	Alarm reset	1=Enabled	0=Disabled
			BIT1 and above	Not used		
	1003-1009	3EBH-3F1H	System reserved			

Note: The data format of all function codes are the same with dedicated communication protocol.
However, F5001 (poles, voltage and capacity) is consisted by the following data.
Data length: 16bit
bit15~bit8: capacity
bit7~bit4: voltage
bit3~bit0: number of poles

3）Batch operation

By setting the address (inverter number) to 0, batch operation shown in the following table can be carried out.

- IN=0 (broadcast mode)
- During batch operation, the inverter returns no response.

<table>
<tr><th rowspan="2">Process method</th><th colspan="2">Register No.</th><th colspan="3">Description</th></tr>
<tr><th>DEC</th><th>HEX</th><th colspan="3"></th></tr>
<tr><td rowspan="8">Batch operation</td><td>3000</td><td>BB8H</td><td colspan="3">Selecting inverters for batch operation</td></tr>
<tr><td rowspan="3">3001-3002</td><td rowspan="3">BB9H-BBAH</td><td colspan="3">Specifying direction of rotation for inverters in batch control</td></tr>
<tr><td>3001</td><td colspan="2">Selecting inverters for batch control</td></tr>
<tr><td>3002</td><td>Direction of rotation</td><td>1=Forward, 2=Reverse</td></tr>
<tr><td>3003</td><td>BBBH</td><td colspan="3">Releasing inverters in batch operation</td></tr>
<tr><td>3004</td><td>BBCH</td><td colspan="2">Batch start</td><td>1=Start</td></tr>
<tr><td>3005</td><td>BBDH</td><td colspan="2">Batch stop</td><td>1=Stop</td></tr>
<tr><td>3006-3009</td><td>BBEH-BC1H</td><td colspan="3">System reserved</td></tr>
</table>

(4) Processing of inverter communication error

- The following error processing will be carried out when an error is detected in the message received from the computer. According to error content, it can be divided into Error Response not Sent and Error Response Sent.

1） Error response not sent

- Serial communication error
  In case of parity error and other errors in serial communication
- Error of received data frame length
  When received data length is longer than maximum data length of 256-byte or shorter than the minimum data length (address 1-byte + command code 1-byte + CRC 2-byte) of 4-byte
- CRC Error
  Error during receiving CRC checksum of data frame
- Broadcast mode
  In broadcast mode, no response is returned.

2） Error response sent

- Command code not defined
  When command code is beyond 03H or 10H, error detection will be carried out and an error code will be returned.
- PDU Error
  When number of data for communication message has an error, an error code will be returned.
- Address error
  When starting address or starting address + number of registers is beyond the following range of valid address, an error code will be returned.
  Reading command 2000-2019
  Writing command 1000-1002
- Error of specified execution
  When setting the register with a value beyond the setting values listed in the data sheet (for frequency setting of register number 1000, the range of 0-60000 is valid), or no control is permitted when setting the start command for register number 1001, an error code will be returned.

(5) List of error codes during function code setting

Error code	Description
01H	Command code not defined
02H	Address error
03H	PDU error
04H	Specified execution error
F0H	Inconsistency between function code number XXXX and setting value
F1H	Function code value setting too large, undefined user initialization, or an un-registered inverter number
F2H	Inconsistency between function code setting value and optional board
F3H	Inconsistency between function code setting value and option
F4H	Inverter operation, function code cannot be changed
F5H	Operation locked, function code cannot be changed
F9H	Function code cannot be changed in LV
FAH	Frequency setting is not allowed, please enter F1002 setting value
FBH	Inverter busy, please send message again
FCH	System reserved
FEH	Selection of undefined code (access the code with serial communication function)

8. Protection & Error Function

8-1 Operation error

- The operation error is displayed in the operation of operator panel (key, quick-turn knob), or some unallowed operations or code inputs in function code data inputting (operation, code input).

  When an operation error is displayed, the operation and code input are noneffective.

- The operation error can be displayed either in operation state or stop state. The display will automatically disappear after 3 seconds, and the inverter will return to the status before the operation error.

- During display of operation error, inverter will keep running (*1). The control from external terminals or communication is still effective. But, only the stop key Stop on the operator panel is effective.

  *1 **It can also be displayed in stop status.**

8-1-1 List of error operation

8-1 List of error operation

Monitor display	Description
Er A	The frequency cannot be set on the operator panel.
Er b	Specify the undefined function code number. (not displayed on standard operator panel)
Er C	The entered values exceed the allowable range. Or the motor parameters of F5001 (motor poles, voltage and capacity) are not registered.
Er d	User initialization data is not registered. Please use F1604=99 to set the initial user data definition.
Er E	Cannot start with the operator panel.
Er H	The entered setting value conflicts with the optional board.
Er J	The entered setting value conflicts with the optional board.
Er L	Since the inverter is in operation, the function code data cannot be changed.
Er n	Since the operator panel is locked, the function code data cannot be changed.
Er o	Since software editions are different, the data cannot be transmitted. (copy function)
Er P	A password is required, please confirm with the sellers.
Er r	The memory content on operator panel cannot be sent to the master computer. (copy function)
Er S	Automatic testing of motor parameters cannot be carried out for the connected motor.
Er t	The current function code data cannot be sent to the operator panel. (copy function)
Er u	The function code cannot be changed because of undervoltage.
Er IO	No communication between operator panel and inverter computer. Please disconnect the power supply, and confirm the connection of operator panel and optional board. Consult the seller when the error is displayed repeatedly.
oFF L	No communication between operator panel and inverter computer. Please disconnect the power supply, and confirm the connection of operator panel and printed circuit board. Consult the seller when the error is displayed repeatedly.

8-2 Conflict & interference error

- During function code entering, a conflict & interference error will be displayed when the entered data conflicts with the settings of other function codes. The displayed 4-digit number is the number of conflict & interference function code.
- The entered data is invalid when a conflict & interference error is displayed. Please correct it to a value without a conflict, or change the values of the conflict & interference function code.
- For function code and error display related to conflict and interference, please refer to Table 8.2.

8-2-1 List of conflict & interference error

Table 8.2 List of conflict & interference error

Setting function code			Error code	Description
No.	**Name**	**Setting**		
1001	Motor control mode selection	All (exclude 1 and 40)	E5001	The setting motor cannot be used in vector control
			E1007/E1316/E1317	Exceed the upper frequency limit
		2	E1901	Simple energy-saving function (only in V/f mode) cannot be used in vector control mode
		3	E1002	Cannot set PG input repeatedly
			E1901	Simple energy-saving (only in V/f mode), cannot be used in vector control mode
		4	E1901	Energy-saving mode cannot be used in torque control
			E2201	Pattern, disturb operation cannot be used in torque control
			E3201	PID control action cannot be used in torque control
		5	E1002	Cannot set PG input repeatedly
			E1901	Energy-saving mode cannot be used in torque control
			E2201	Pattern, disturb operation cannot be used in torque control
			E3201	PID control action cannot be used in position control
		6	E1002	Cannot set PG input repeatedly
			E1101	Position control mode is only effective when operation command is external terminal
			E1901	Energy-saving mode cannot be used in position control
			E2201	Pattern, disturb operation cannot be used in position control
			E3201	PID control action cannot be used in torque control
		10,11	E1901	Energy-saving mode cannot be set when motor parameter are measured automatically
			E2201	Pattern, disturb operation cannot be set during automatic measurement
			E3201	PID control action cannot be set during automatic measurement
		40	E1901	Energy-saving mode cannot be set during V•f separation control
			E2201	Pattern, disturb operation cannot be set in V•f separation mode
			E3201	PID control action cannot be set in V•f separation mode
		All	Exxxx	Cannot set analog input repeatedly

Setting function code			Error code	Description
No.	Name	Setting		
1002	1st speed frequency setting	2-20 26-28	Exxxx	Cannot set analog input repeatedly
		25	E1001	When 1st speed frequency is pulse train input, the required PG sensor control mode cannot be used
1003	V/f pattern	2, 3	E2007	Automatic torque compensation and square ratio lowing mode cannot be used together
1007	Upper frequency limit	All	E1008	Upper frequency limit cannot be smaller than lower frequency limit
			E1001	Exceed the possible upper frequency limit
1008	Lower frequency limit	All	E1007/E1316/E1317	Lower frequency limit cannot be larger than upper frequency limit
1010	Acceleration / deceleration curve	2, 3	E2007	Automatic torque compensation and S acceleration / deceleration degression cannot be used together
1101	Operation command selection	1, 3	E1001	During position control (F1001=6), only terminal board command (F1101=2) can be used
1301	1st jump bottom frequency	All	E1302	No larger than the value of 1st jump top frequency
1302	1st jump top frequency	All	E1301	No smaller than the value of 1st jump bottom frequency
1303	2nd jump bottom frequency	All	E1304	No larger than the value of 2nd jump top frequency
1304	2nd jump top frequency	All	E1303	No smaller than the value of 2nd jump bottom frequency
1305	3rd jump bottom frequency	All	E1306	No larger than the value of 3rd jump top frequency
1306	3rd jump top frequency	All	E1305	No smaller than the value of 3rd jump bottom frequency
1316	2nd upper frequency limit	All	E1008	Upper frequency limit cannot be smaller than lower frequency
			E1001	Exceed the possible upper frequency limit/motor parameter sheet error
1317	3rd upper frequency limit	All	E1008	Upper frequency limit cannot be smaller than lower frequency
			E1001	Exceed the possible upper frequency limit/motor parameter sheet error
1411	Analog input switching for set frequency gain	All	Exxxx	Cannot set analog input repeatedly
1901	Energy-saving mode selection	1	E1001	Only V/f control can use simple energy-saving mode
			E2007	Automatic torque compensation and simple energy-saving mode cannot be used together
			E3201	PID control action and simple energy-saving mode cannot be used together
		2	E1001	Only V/f control speed control can use simple energy-saving mode
			E2007	Automatic torque compensation and auto energy-saving mode cannot be used together
2002	V•f separation command voltage	0	Exxxx	Cannot set analog input repeatedly
2007	Auto torque compensation selection	Beyond 0	E1003	Automatic torque compensation, cannot be used unless V/f mode is linear
			E1010	Automatic torque compensation, cannot be used unless acceleration / deceleration curve is linear
			E1901	Automatic torque compensation and energy-saving mode cannot be used together
2201	Graph operation selection	1,2	E1001	In current control mode, graph or disturb operation cannot be used
		All	Exxxx	Cannot set analog input repeatedly
2236	Disturb modulation analog input switching	All	Exxxx	Cannot set analog input repeatedly
3001	PID1 command value input switching	All	Exxxx	Cannot set analog input repeatedly
3002	PID1 feedback input switching	All	Exxxx	Cannot set analog input repeatedly
3101	PID2 command value input switching	All	Exxxx	Cannot set analog input repeatedly
3102	PID2 feedback input switching	All	Exxxx	Cannot set analog input repeatedly

8-2 Conflict & Interference Error

Setting function code			Error code	Description
No.	Name	Setting		
3201	PID control action selection	Beyond 0	E1001	PID control action can only be used in V/f control or speed control
			E1901	Simple energy-saving mode and PID control operation cannot be used together
		1	E3203	Same PID control cannot be used both internally and externally
		2	E3203	Same PID control cannot be used both internally and externally
		4, 5	E3203	Same PID control cannot be used both internally and externally
		All	Exxxx	Cannot set analog input repeatedly
3203	External PID control selection	1	E3203	Same PID control cannot be used both internally and externally
		2	E3203	Same PID control cannot be used both internally and externally
		4, 5	E3203	Same PID control cannot be used both internally and externally
		All	Exxxx	Cannot set analog input repeatedly
5001	Motor poles, voltage and capacity	All	Exxxx	The motor is not applicable when its capacity has a large difference with inverter capacity
		All	Exxxx	Vector control mode is only applicable to 2-, 4- and 6-pole motors
			E1007/E1316/E1317	Exceed the possible upper frequency limit
5011	Motor primary inductance	All	E5013	Mutual inductance should be smaller than primary inductance
5012	Motor secondary inductance	All	E5013	Mutual inductance should be smaller than secondary inductance
5013	Motor mutual inductance	All	E5011	Mutual inductance should be smaller than primary inductance
			E5012	Mutual inductance should be smaller than secondary inductance
6002	Torque limiter analog input function (power running)	All	Exxxx	Cannot set analog input repeatedly
6004	Torque limiter analog input function (brake)	All	Exxxx	Cannot set analog input repeatedly
6015	Lower frequency limit for motor vibration reduction function	All	E6016	Cannot exceed the upper frequency limit
6016	Upper frequency limit for motor vibration reduction function	All	E6015	Cannot exceed the lower frequency limit
6101	Torque command selection	All	Exxxx	Cannot set analog input repeatedly
6103	Positive upper value of torque command	All	E6104	Cannot exceed the lower limit value
6104	Positive lower value of torque command	All	E6103	Cannot exceed the upper limit value
6105	Negative upper value of torque command	All	E6106	Cannot exceed the lower limit value
6106	Negative lower value of torque command	All	E6105	Cannot exceed the upper limit value

***Exxxx represents analog input repetition function code.**

8-3 Warning Status

- This warning status alerts you that the protection function of the inverter has been activated. However, the inverter keeps on running. If the inverter runs for a long time in this status, the inverter may enter the alarm status and stop running.
- In the status display mode, details of the warning and the status indication alternate on the display when a warning has occurred. When the status display mode is not selected, the alternating display appears on the display if the warning is still active after the status display mode is resumed.
- All keys are valid during the warning status because the inverter continues to run.

8-3-1 List of warnings

8-3 List of warnings

Warning display	Warning content	Description
SC	Current limiting during acceleration / deceleration	Acceleration (deceleration) time too short
SCn	Current limiting during constant speed operation	Load too heavy, output frequency too high
Su	During overvoltage prevention	Deceleration time too short
oL	Overload warning	Load too heave, continuous operation will cause an inverter shutdown.
tH	Radiator temperature warning	Temperature of the radiator is rising. Check the ambient temperature and operation of the cooling fan. The warning is issued at a temperature 10℃ below the abnormal radiator fin temperature (OH) (The abnormal radiator fin temperature differs depending upon the output frequency, output current and other factors)
dboH	Overheating of brake resistor	Brake resistor capacity too low. (%ED is small) Brake resistor stops to prevent heat damage.
FbEr	Disconnection of feedback cable	I.e. feedback circuit abnormality. Please check feedback value and feedback signal.
CtLEr	Motor rotation direction	Since an operation command unallowed by the specified rotation direction has been input, please confirm the setting of motor rotation direction.
oPtEr	Option error	Two mounted option boards are conflicting with each other. (The option board mounted on OPT2 will be invalid.)
u iEr	Conflict warning for analog input setting	Set voltage input and current input for same analog input channels. Please confirm the function code selected by analog input.
PGnG	PG line error detection	A reverse direction is detected by PG feedback. Please confirm the phase of PG pulse.

8-4 Alarm Status

- The alarm status occurs when the protection function stops the inverter.
- During alarm status, all values on the display (Hz, A, rpm, %, M) flash indicating the alarm status.
- When Status Display mode is selected, details of the alarm are indicated on the 7-segment display. If the Status Display mode is not selected, details of the alarm are indicated on the 7-segment display if the alarm status continues after the Status Display mode is resumed. Details of the alarm cannot be deleted.

8-4-1 List of alarms

Table 8-4-1 List of alarms

7-segment monitor display	Alarm description	Check points	Actions
AL 1 ※2	Memory abnormality	Turn off the power and wait until the CHARGE lamp turns off, turn the power on again and check the alarm.	Contact your supplier.
AL 2 ※1 AL 3 ※1	System abnormality	Excessive external noise? Are signal and power lines separated far enough?	Install a noise collector or filter Keep the signal line far away from the power line
AL 4 ※2	System abnormality	Abrupt capacitor discharge? Turn off the power so the CHARGE lamp turns off, turn the power on again and check the alarm.	Reconfirm the modified code data. Turn the power on and off several times. If the alarm cannot be cancelled, reset the system using F1604=1 and then turn the power off and on again. All the function data is initialized to the factory presets.
AL 5 ※2 AL 9 ※2	System abnormality	Excessive external noise? Are signal and power lines separated far enough?	Install a noise collector or filter Keep the signal line far away from the power line
AL 10	System abnormality	Abrupt capacitor discharge? Turn off the power so the CHARGE lamp turns off, turn the power on again and check the alarm.	Contact your supplier.
ACEr	Overload prevention during acceleration	Setting for output current limiting function (F1701) too small?	Increase the setting value of F1701 Prolong acceleration and deceleration time
CnEr	Overload prevention during constant speed		
dCEr	Overload prevention during deceleration		
ES	External thermal alarm	Motor overheated? Function settings are correct?	Reduce the load Re-set the function codes correctly (F1413)

7-segment monitor display	Alarm description	Check points	Actions
oH	Radiator temperature abnormality	Fan stopped? Ambient temperature too high?	Check fan operation Increase the ventilation
LuA	Undervoltage during acceleration	Does power supply satisfy conditions? Has the voltage dropped?	Examine/improve power supply conditions.
Lun	Undervoltage during constant speed		
Lud	Undervoltage during deceleration		
oCH	Main switch element temperature abnormality	Fan stopped? Ambient temperature too high?	Check fan operation Increase the ventilation
oCA ※3	Overcurrent during acceleration	Abrupt acceleration / deceleration rate? Output short-circuited or ground fault? Main switch elements abnormality?	Prolong acceleration and deceleration time. Correct short-circuit or ground fault. Contact your supplier when alarms are issued repeatedly.
oCn ※3	Overcurrent during constant speed		
oCd ※3	Overcurrent during deceleration		
oCPA	Momentary overload during acceleration	Excessive acceleration rate? Setting for current limiting function (F1701) too high?	Prolong acceleration time Decrease the setting value
oCPn	Momentary overload during constant speed	Abrupt change (increase) in load? Setting for current limiting function (F1701) too high?	Eliminate the abrupt change (increase) Decrease the setting value
oCPd	Momentary overload during deceleration	Excessive deceleration rate with a GD^2? Setting for current limiting function (F1701) too high?	Prolong acceleration time Decrease the setting value
oLA	Overload during acceleration	Motor operated with an excessive load? Electrothermal level set properly? Load GD^2 too large?	Reduce the load Increase the capacity of the inverter and motor
oLn	Overload during constant speed		
oLd	Overload during deceleration		
ouA	Overvoltage during acceleration	Did start-up occur during idle run?	Flying start.
oun	Overvoltage during constant speed	Is motor being turned by other force?	Redesign the system so that the motor is not driven by external force. Use a brake resistor with a larger capacity.
oud	Overvoltage during deceleration	Excessive deceleration?	Prolong the deceleration time (so that GD^2 of the load is met)
ouP	Brake resistor overvoltage protection	Braking frequency too high?	Reduce the braking frequency Increase the brake resistor capacity
GAL 1	Disconnection of feedback signal cable (during PID control action)	Feedback signal cable disconnected? Feedback signal correct? Gain frequency correct? （F1402, F1404, F1406）	Check feedback signal cable and connect securely. Set gain frequency properly （F1402, F1404, F1406）

8-4 Alarm Status

7-segment monitor display	Alarm description	Check points	Actions
GAL 2	Overspeed	Over-shoot or under-shoot happened?	Confirm speed command value or torque command value
GAL 3	Modbus communication timeout	Communication cable disconnected?	Confirm communication cables are connected securely
PonG ※2	Power supply abnormality	+24V power supply output from the control circuit overloaded or shorted?	Check the +24V output power supply for load conditions
oPn o	Missing output phase	Missing an output phase?	Connect the output cables securely
oPn 1	Missing input phase	Missing an input phase?	Check and improve the input current
Gnd F	Check grounding short-circuit current	Short-circuited when grounding?	Confirm output cable and motor insulation performance
PGEr	Disconnection of PG pulse feedback signal cable Position deviation counter abnormality	Feedback signal cables are well connected? Is motor being driven by other force?	Connect the feedback signal cable securely Redesign the system so that the motor is not driven by external force.
FAn L	Cooling fan abnormality	Cooling fan is working?	Check the fan performance
rYoFF	Main relay abnormality	Turn off the power and wait until the CHARGE lamp turns off, turn the power on again and check the alarm.	Contact the supplier

*1: **Since all function data are initialized to the factory presets, settings will need to be input again.**
*2: **After several times of power on/off, contact your supplier if the alarm is displayed again.**
*3: **Even though a protective function against short-circuit of the main switch element is installed, repeated short-circuiting may cause deterioration of the elements and lead to damages to the inverter. Therefore the inverter can only be restarted after checking and removing the cause of the problem.**
* **If the display on the operation panel goes out for some reason, turn off power supply to the inverter to check the wiring; then turn the power on after CHARGE lamp has gone out. (Short-circuiting caused by improper connection of control terminals and so on)**

9. Fault Analysis

<table>
<tr><th>Problem</th><th></th><th>Check points</th></tr>
<tr><td rowspan="4">Motor does not rotate</td><td>Main circuit</td><td>● Voltages at input terminals R, S and T are normal?
● Is the motor wired correctly?</td></tr>
<tr><td>Load side</td><td>● Load too heavy?
● Motor locked?</td></tr>
<tr><td>Operator panel</td><td>● Starting frequency setting too high (F1103)?
● Operation start frequency (F1104) setting too high?
● Is operation command selected for control by external signal (F1102=2)?
● Upper frequency limit set too low (F1007)?
● 2nd upper frequency limit (F1316) and 3rd upper frequency limit selected by multi-function input signal are setting too low?
● Check if no setting is specified for the direction of rotation of motor (F1109)?</td></tr>
<tr><td>Input signal</td><td>● Are operation signals (FR, RR) being input?
● FR and RR signals are input simultaneously?
● Idle run stop signal input (MBS)?
● Analog signal for frequency setting is zero?</td></tr>
<tr><td>Rotation direction different from what it should be</td><td colspan="2">Wrong wiring of output terminals U, V and W?
Is the wiring for forward and reverse run mixed up?</td></tr>
<tr><td>Rotation speed does not increase</td><td colspan="2">● Upper frequency limit (F1007) activated?
● Output current limiting function activated? → Is setting of F1701 too low? → Torque boost (F1004) too high?
● Load too heavy?
● PG sensor connected correctly?</td></tr>
<tr><td>Rotation is not constant</td><td colspan="2">● Load fluctuating?
● Frequency setting (analog) signal fluctuating?
● Are the capacity and number of poles appropriate for the inverter capacity specified for use in the sensorless vector control mode?
● PG sensor set correctly?</td></tr>
<tr><td>Acceleration / deceleration is not constant</td><td colspan="2">● Acceleration / deceleration time too short?
● Output current limiting function activated?
● Load too heavy?</td></tr>
<tr><td>Motor heating up</td><td colspan="2">● Wrong setting for V/f mode?
● Torque compensation too high?</td></tr>
<tr><td>Rotation speed changes abnormally during operation</td><td colspan="2">● Is the load fluctuating?
● Output current limiting function activated?
Is setting of F1701 too low?</td></tr>
<tr><td>No display on the interface of operator panel</td><td colspan="2">● Voltages at input terminals R, S and T are normal?
● Connection between inverter and operator panel satisfies the standard?</td></tr>
</table>

10. Maintenance & Inspection

■ **Never touch the internal parts.**
Failure to obey may result in electrical shock, personal injury and other dangers.

Careful checking and maintenance are essential to ensure that the SAMCO-SVC06 general-purpose inverter can operate correctly with a long service life.

10-1 Precautions on Checking and Maintenance

- Capacitors retain a high voltage charge for a while after the power is turned off. Before carrying out inspection, please firstly make sure that the CHARGE lamp is off, then make sure that the voltage across terminals P and X is lower than DC30V using a circuit tester.

10-2 Inspection Items

- The motor works as expected;
- The cooling system is free from any problems (such as abnormal heating);
- There is no abnormality at the location of installation; and
- There is no abnormal vibration or noise.

Table 10-1 Inspection must be carried out following the periodic inspection list.

Table 10-1 Periodic inspection list

Inspection item		Inspection details	Method & Instrument	Criteria
General	Ambient environment	• Ambient temperature, relative humidity • Confirm operating environment	• Visual inspection, measuring instrument • Thermometer & hygrometer	• Satisfy standard specifications
	Power supply voltage	• Power supply voltage of the inverter is normal.	• Measure interphase voltage of R, S and T input terminals. • Use tester and multimeter	• Satisfy standard specifications of input
	Appearance Structural parts	• No abnormal vibration or noise • No loosening of bolts • No deformation or breakage • No adhesion of dust or dirt	• Tighten bolts • Visual inspection	• No abnormal
Main Circuit	General	• Megger check • No loosening of bolts • No adhesion of dust or dirt	• Tighten bolts • Visual inspection	• No abnormal
	Connection conductors and wires	• No deformation or dirt • No discoloration because of overheating	• Visual inspection	• No abnormal
	Main module	• Check resistance between terminals	• Disconnect the main wiring of the inverter and measure each terminal with tester (x1 range) • Use analog tester	• Refer to Table 10-2 Main circuit power module checklist

Inspection item		Inspection details	Method & Instrument	Criteria
Main Circuit	**Terminal board**	• No burning or breakage	• Visual inspection	• No abnormal
Main Circuit	**Main electrolytic capacitor**	• No liquid leakage • No loosening of safety valve	• Visual inspection	• No leakage, deformation or crack • No action of the safety valve
Main Circuit	**Relay electromagnetic contactor**	• No chatter during operation • No rough surface on the contact • No abnormal noise when the switch is ON	• Visual and hearing inspection	• No abnormal
Main Circuit	**Resistor**	• No disconnection • No odor or crack because of overheating	• Odor and visual inspection • Remove one-end and check with tester • Use tester or multimeter	• No abnormal • Within ±10% of indicated resistance value
Main Circuit	**Transformer**	• No abnormal beat sound or odor	• Odor, visual and hearing inspection	• No abnormal
Control circuit display	**Connector**	• No loosening of connectors • No crack, breakage or deformation	• Visual inspection	• No abnormal
Control circuit display	**Capacitor**	• No leakage, breakage or deformation	• Visual inspection	• No abnormal
Control circuit display	**Board**	• No discoloration or dirt	• Visual inspection	• No abnormal
Control circuit display	**Display**	• No break in the LED lamp on operation panel • No abnormality in key operation • Favorable display of characters on LCD panel	• Visual inspection	• Make sure the lamp lights up. • Make sure operations.
Cooling system	**Fan**	• No abnormal vibration or noise • No OH alarm • No loosening of bolts, wiring or connectors	• Visual and hearing inspection • Tighten bolts, wiring and connectors.	• No abnormal
Cooling system	**Ventilation flue**	• No blockage in cooling fan inlet and outlet or contamination adhesion of foreign objects.	• Visual inspection • Tactile inspection	• No abnormal
Cooling system	**Fin**	• No abnormal heating	• Tactile inspection or check the temperature • Use thermometer	• No abnormal
Motor	**General**	• No abnormal vibration or noise	• Visual and hearing inspection	• No abnormal
Motor	**Insulation resistance**	• Megger check	• Disconnect the inverter output wiring U, V and W, then make an inspection • Use megger tester	• Higher than 5MΩ

Table 10-2 Main circuit power module checklist

Input/Output	Terminals		Measured value
	Multimeter +	Multimeter -	
Input (R, S, T)	P	R、S 、T	Conducted
	R 、S、 T	P	Not conducted
	X	R、 S 、T	Not conducted
	R 、S 、T	X	Conducted
Output (U, V, W)	P	U、 V、 W	Conducted
	U 、V 、W	P	Not conducted
	X	U、 V、 W	Not conducted
	U 、V 、W	X	Conducted

10-3 Part Replacement

When replacing a part, please contact your supplier or our sales department.

10-3-1 Fan Replacement

When cooling fan is used continuously under the environments with high temperature (40℃ and above) and plenty of dust, the service life will be shortened obviously. Therefore, the fan must be checked regularly. Furthermore, the fan should be replaced duly when there is an abnormal vibration or sound.

- **Turn OFF the power for replacement. Make sure that the fan is stopped before making a replacement.**
  Failure to obey may result in personal injury or electric shock.

（1） Steps for replacing fan of SVC06-0015 - 0075
The fan is on the top of the device.

Step 1 Remove one screw (M3).
Step 2 Hook the cover board with a finger and pull to remove it.
Step 3 Pull out the fan and remove the connector, then make a replacement.
After the replacement, reinstall the fan with a sequence of 3 →2→ 1.

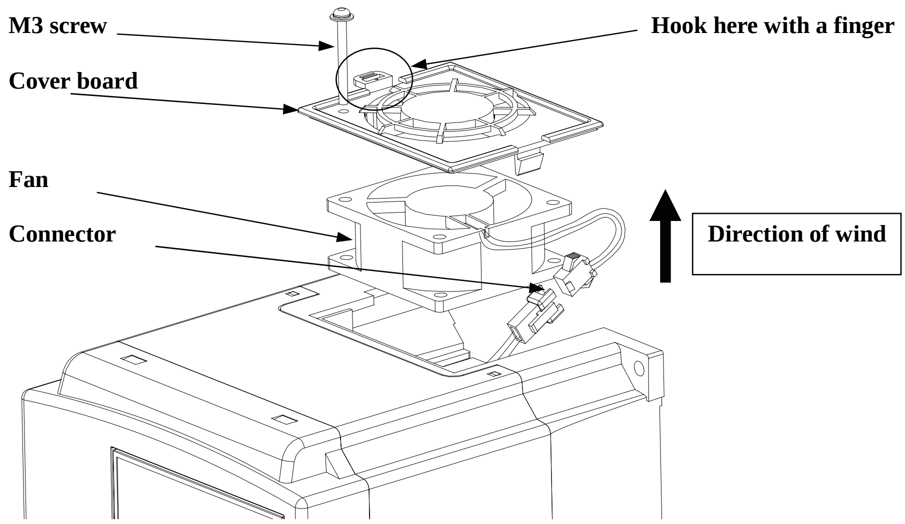


Figure 10-1 **Replacement steps of fan**（SV06-0015 - 0075）

（2） Steps for replacing fan of SVC06-0110 - 0150

The fan is on the top of the device.

Step 1 Remove two screws (M3).
Step 2 Hook the cover board with a finger and pull to remove it.
Step 3 Pull out the fan and remove the connector, then make a replacement.
After the replacement, reinstall the fan with a sequence of 3 →2→ 1.

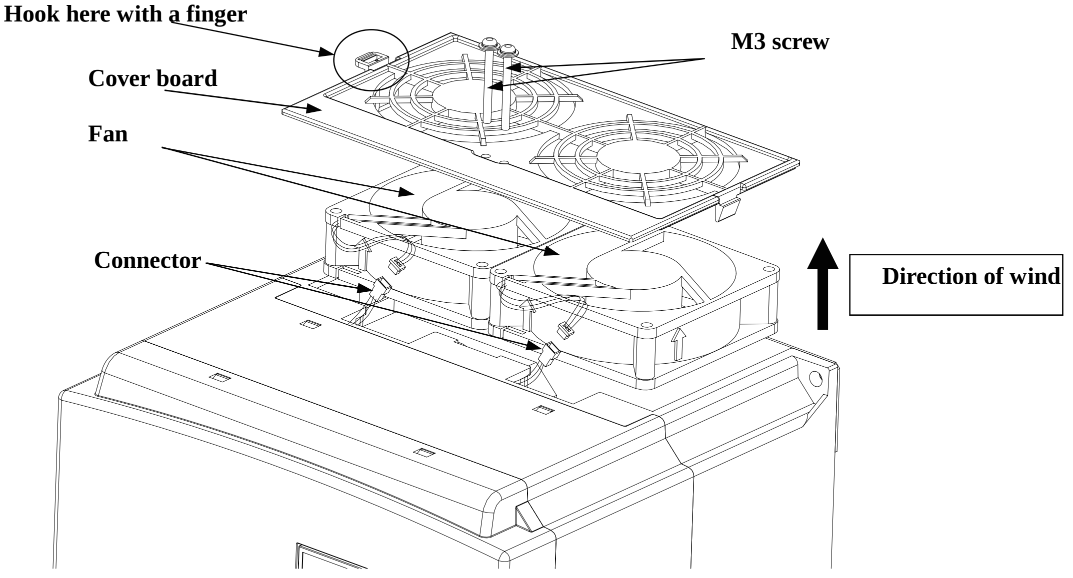


Figure 10-2 **Replacement steps of fan**（SV06-0110 - 0150）

（3）Steps for replacing fan of SVC06-0185 - 0750

The fan is on the top of the device.
Step 1 Remove four screws (M4×8).
Step 2 Pull out the cover board with a finger.
Step 3 Remove four screws (M4×45).
Step 4 Pull out the fan and remove the connector, then make a replacement.
After the replacement, reinstall the fan with a sequence of 3 →2→ 1.

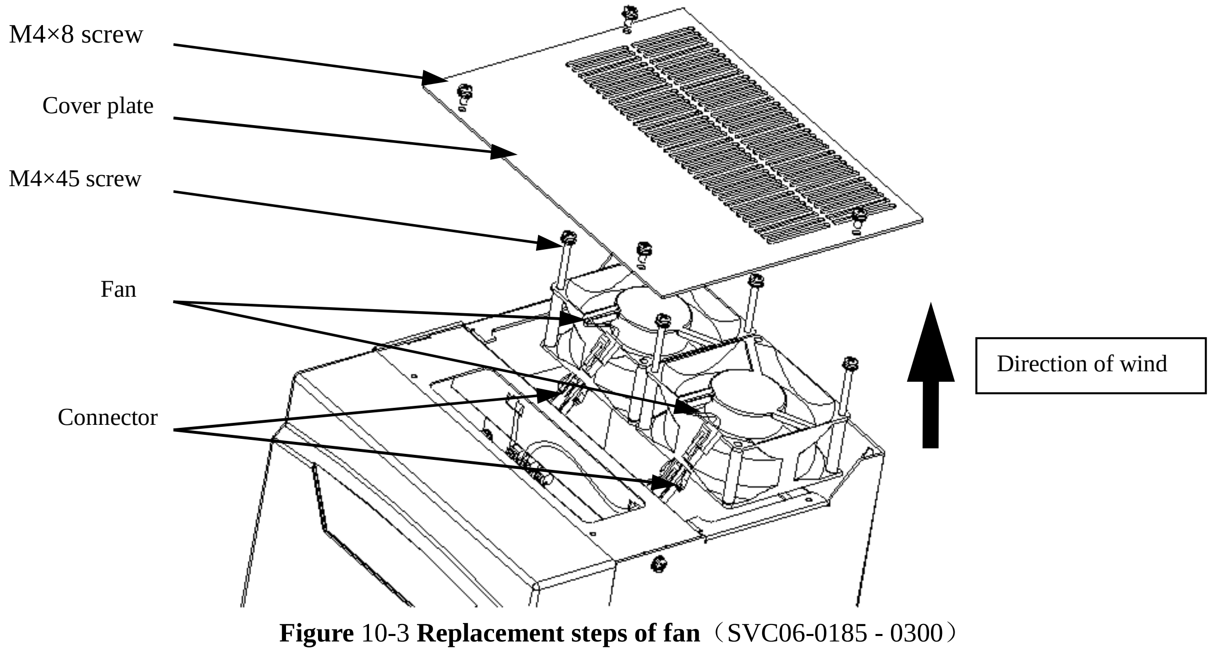


Figure 10-3 **Replacement steps of fan**（SVC06-0185 - 0300）

Chapter 10

(4) Steps for replacing fan of SVC06-0370 - 0450

The fan is on the top of the device.

Step 1 Remove four screws (M4×8).
Step 2 Pull out the cover board with a hand.
Step 3 Remove two screws (M4×60).
Step 4 Pull out the fan and remove the connector, then make a replacement.
After the replacement, reinstall the fan with a sequence of 4→3 →2→ 1.

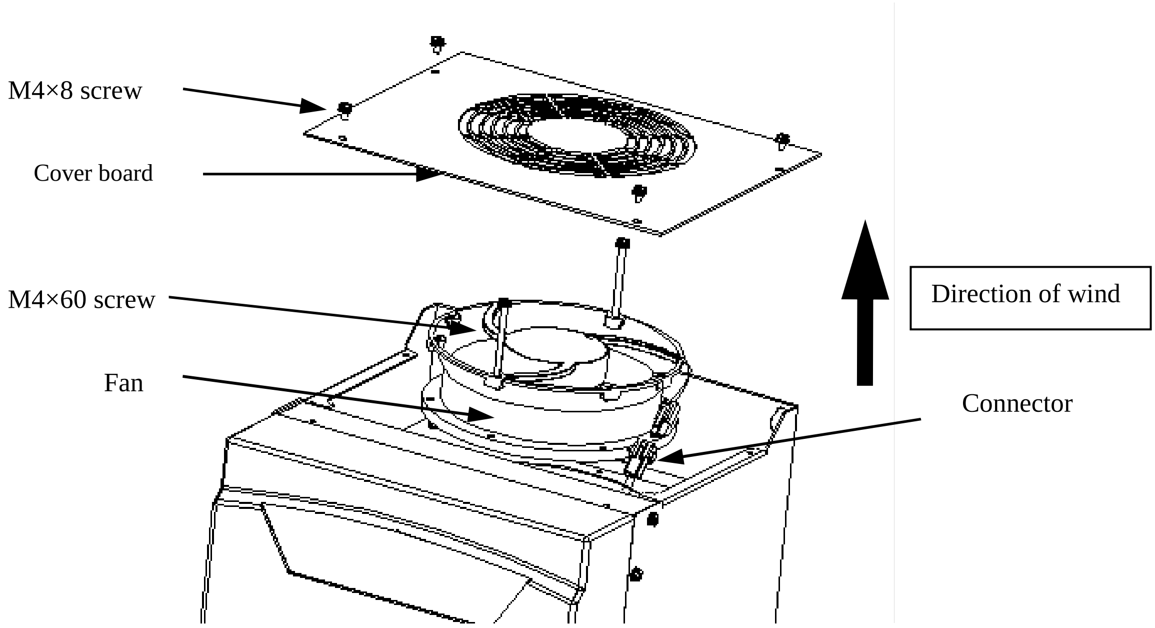


Figure 10-4 **Replacement steps of fan**（SVC06-0370 - 0450）

(5) Steps for replacing fan of SVC06-0550 - 0750

The fan is on the top of the device.
Step 1 Remove four screws (M4×8).
Step 2 Pull out the cover board with a hand.
Step 3 Remove four screws (M4×60).
Step 4 Pull out the fan and remove the connector, then make a replacement.
After the replacement, reinstall the fan with a sequence of 4→3 →2→ 1.

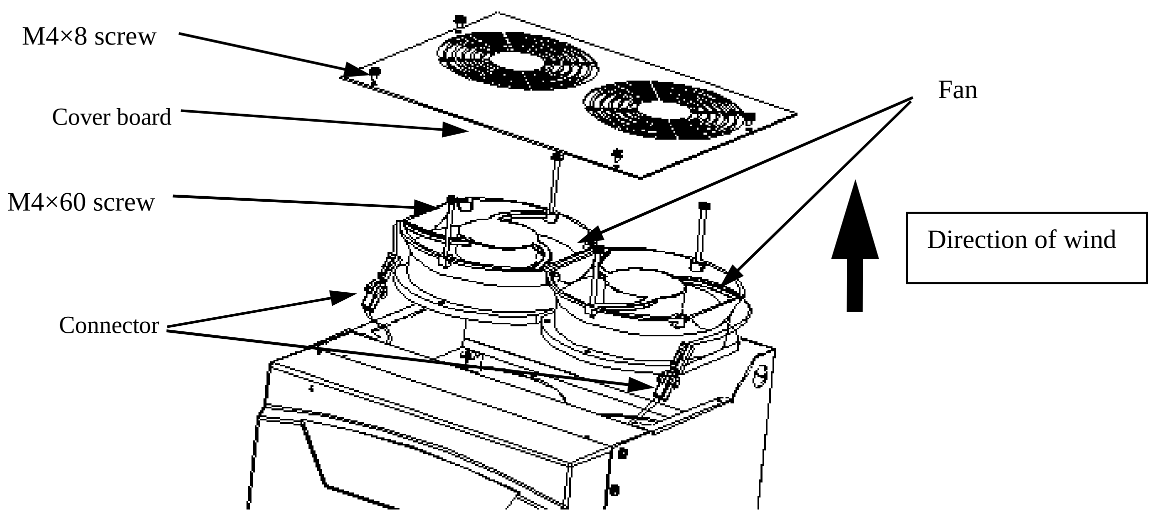


Figure 10-5 Replacement steps of fan（SVC06-0550 - 0750）

（6）Steps for replacing fan of SVC06-0900 - 2500
The fan is on the top of the device.
Step 1 Remove the screws (M4).
Step 2 Pull out the cover board with a hand.
Step 3 Remove the screws and the connector.
After the replacement, reinstall the fan with a sequence of 3 →2→ 1.

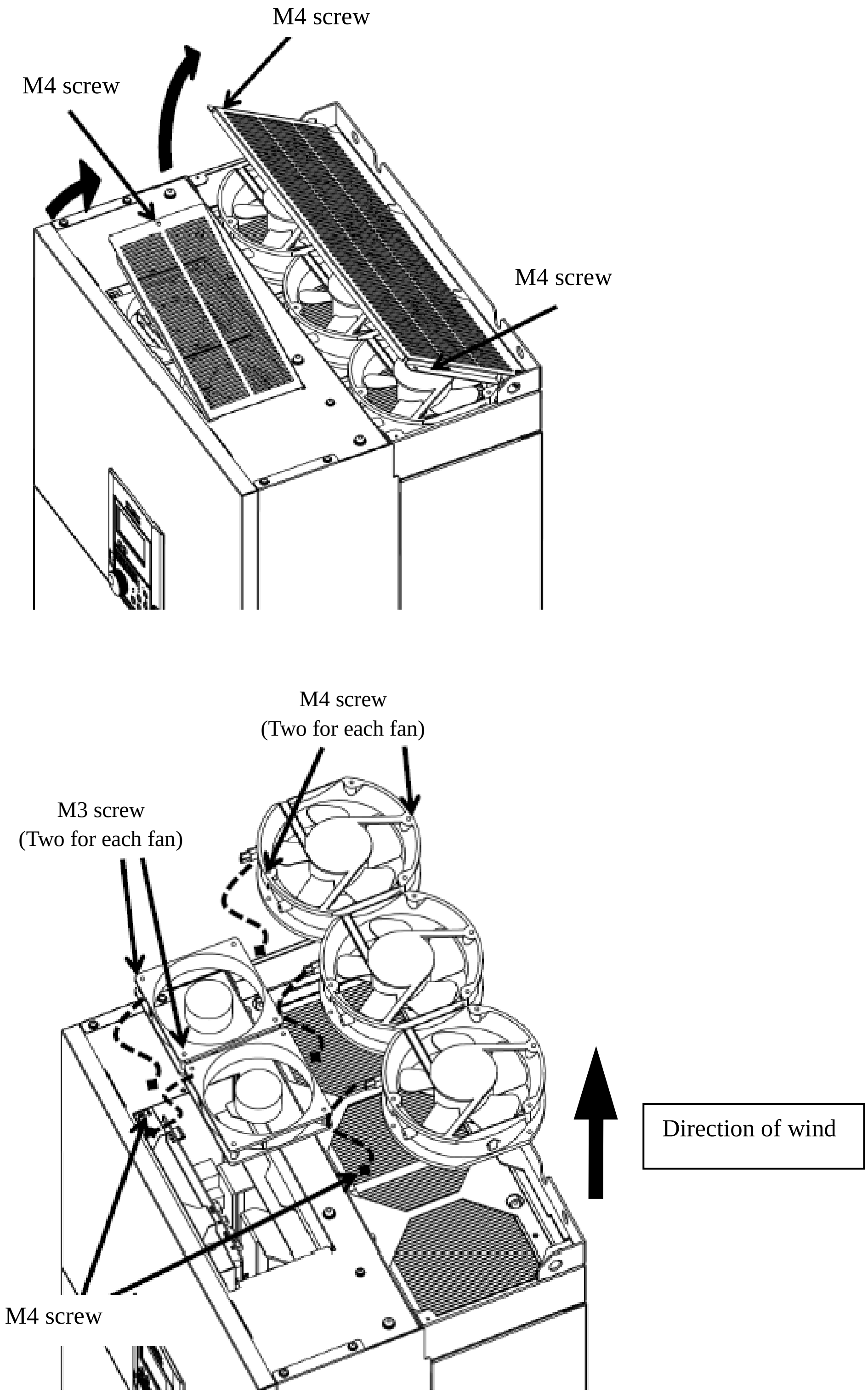


Figure 10-6　Replacement steps of fan（SVC06-0900 - 2500）

10-3-2 Smoothing Capacitors

Aluminum electrolytic capacitors for smoothing deteriorate over time. It must be replaced approximate every ten years. Since the service life varies greatly depending on the ambient temperature, load and using frequency, this time period is only an approximate limit rather than a guaranteed limit.
When used continuously in a high temperature (averagely 40℃ and above), the service life will be shortened.
The inverter must receive transmitted electricity at least once a year when it is stored and not energized.
The capacitors must be inspected at least once a year, and once in 6 months when they are near the end of their lifetime.

10-4 Megger Test

- When performing a megger test on the motor and the sequential circuit, be careful not to apply the test voltage to the inverter.
- For the inverter itself, perform the megger test only on the main circuit as shown below. Do not conduct a megger test on the control circuit.

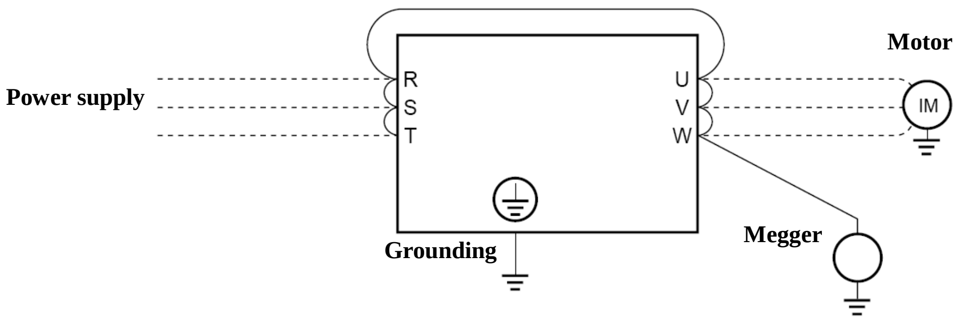


Figure 10-3 **Circuit diagram for megger test**

⃠	**Use a multimeter (high resistance range) for continuity testing of the control circuit. Do not use the testing instruments such as megger or buzzer.**

Note: Use a megger for measurement when the connector status is OFF (in 4-4EMC filter).

10-5 Electrical measurement of main circuit

- Since the voltages and currents of the main inverter circuit at the input (power supply) and output (motor) contain harmonic components, measured values may differ depending on the meter used. When using a commercial frequency meter, select one of the types listed in the table below.
- The power factor cannot be measured with a commercial power-factor meter that measures the phase difference between voltage and current. Measure the voltage, current and power separately at input/output and calculate the power factor using the following formula:

$$\text{Power factor [\%]} = \frac{\text{Power [kW]}}{\sqrt{3} \times \text{Voltage [V]} \times \text{Current [A]}} \times 100$$

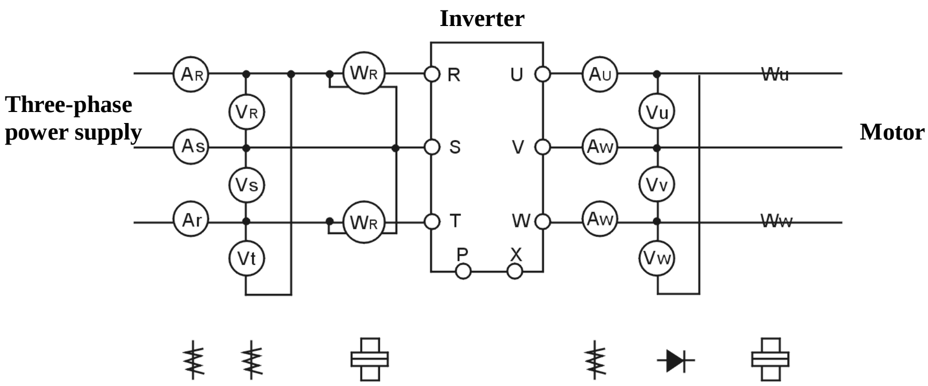
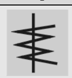
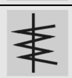
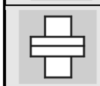
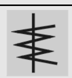
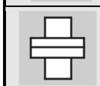


Figure 10-4 **Power measurement circuit for main circuit**

Table 10-4 **Main circuit measuring instruments**

Symbol	Item	Measuring instruments
	Power supply current	Moving-iron type AC ammeter
	Power supply voltage	Moving-iron type AC voltmeter
	Power supply power	Electrodynamic single-phase power meter or Digital power meter
	Power supply power factor	Digital power meter (can be calculated with the measured power supply voltage, current and power)
	Output voltage	Rectifier type AC voltmeter or digital power meter
	Output current	Moving-iron type AC ammeter or digital power meter
	Output power	Electrodynamic single-phase power meter or Digital power meter
	Output power factor	Digital power meter (can be calculated with the measured power supply voltage, current and power)

Chapter 10

11. Specification

11-1 Standard specification

400V

Item			Specification						
Model（SVC06-□□□□-**4）			0015	0022	0040	0055	0075	0110	0150
Output specification	Mode A Heavy load	Standard applicable motor [KW]	1.5	2.2	4	5.5	7.5	11	15
		Rated capacity [KVA] *1	2.8	4.2	6.2	8.7	11.8	17.3	22.2
		Rated current [A] *2	4	6	9	12.6	17	25	32
		Overload current rating *3	150%-1min						
		Output frequency range *4	0.05-600Hz（Starting frequency 0.05-60Hz variable）						
	Mode B Light load	Standard applicable motor [KW]	2.2	4	5.5	7.5	11	15	18.5
		Rated capacity [KVA] *1	4.2	6.2	8.7	11.8	17.3	22.2	26.3
		Rated current [A] *2	6	9	12.6	17	25	32	38
		Overload current rating *3	120%-1min						
		Output frequency range *4	0.05-240Hz（Starting frequency 0.05-60Hz variable）						
	Rated output voltage *5		3φ 380V-460V						
Input power supply	Voltage & Frequency		3φ 380V-460V 、 50/60Hz						
	Allowable fluctuation		Voltage: -15%、+10% Frequency: ±5% Voltage unbalance: within 3%						
	Power supply impedance		1% and above（Use optional reactor if less than 1%）						
	Mode A Heavy load	Required power capacity [KVA] *6	2.5	3.7	5.6	7.9	10.7	16.9	21.7
		Input current [A] *7 With DCL	3.6	5.5	8.2	11.5	15.5	24.5	31.4
		Input current [A] *7 Without DCL	5.6	8.4	12.6	17.6	23.8	35	44.8
	Mode B Light load	Required power capacity [KVA] *6	3.7	5.6	7.9	10.7	16.9	21.7	25.7
		Input current [A] *7 With DCL	5.5	8.2	11.5	15.5	24.5	31.4	37.2
		Input current [A] *7 Without DCL	8.4	12.6	17.6	23.8	35	44.8	53.2
Protective structure			Totally enclosed（IP20）						
Cooling method			Forced air cooling						
Approximate weight *8			4kg	4kg	4kg	6kg	6kg	7kg	7kg
Carrier frequency			Sine wave PWM（carrier frequency 1k-14kHz）□9						
DC reactor			option						

*1 **Rated capacity at the output voltage of 400V**
*2 **When input voltage is 400VAC and above, the rated current will be decreased according to the output power**
*3 **One minute is allowed every 10 minutes**
*4 **During vector control, PG sensorless is 0.25Hz-240Hz /PG sensor is 0.05Hz-240Hz (depends on the number of poles)**
*5 **Output voltage cannot exceed power supply voltage**
*6 **Vary with the impedance changes of the power supply including a DC reactor**
*7 **Vary with the impedance of the power supply**
*8 **When an EMC filter is embedded**
*9 **The maximum value of carrier frequency varies with the inverter capacity mode and operation status.**

Item				Specification						
Model（SVC06-□□□□-**4)				0185	0220	0300	0370	0450	0550	0750
Output specification	Mode A Heavy load	Standard applicable motor [KW]		18.5	22	30	37	45	55	75
		Rated capacity [KVA] *1		26	32	42	51	62	76	102
		Rated current [A] *2		38	46	61	74	90	110	147
		Overload current rating *3		150%-1min						
		Output frequency range *4		0.05-600Hz（Starting frequency 0.05-60Hz variable)						
	Mode B Light load	Standard applicable motor [KW]		22	30	37	45	55	75	90
		Rated capacity [KVA] *1		31	41	51	62	76	98	120
		Rated current [A] *2		46	61	74	90	110	147	173
		Overload current rating *3		120%-1min						
		Output frequency range *4		0.05-240Hz（Starting frequency 0.05-60Hz variable)						
	Rated output voltage *5			3φ 380V-460V						
Input power supply	Voltage & Frequency			3φ 380V-460V, 50/60Hz						
	Allowable fluctuation			Voltage: -15%、+10% Frequency: ±5% Voltage unbalance: within 3%						
	Power supply impedance			1% and above（Use optional reactor if less than 1%）						
	Mode A Heavy load	Required power capacity [KVA] *6		25.4	30.3	40.4	48.1	58.5	72.4	95.4
		Input current [A] *7	With DCL	36.7	43.8	58.3	69.5	84.5	104.5	137.8
			Without DCL							
	Mode B Light load	Required power capacity [KVA] *6		30.3	40.4	48.1	58.5	72.4	95.4	110.5
		Input current [A] *7	With DCL	43.8	58.3	69.5	84.5	104.5	137.8	159.5
			Without DCL							
Protective structure										
Cooling method										
Approximate weight *8				25kg			35kg		45kg	
Carrier frequency										
DC reactor				Embedded						

***1 Rated capacity at the output voltage of 400V**
***2 When input voltage is 400VAC and above, the rated current will be decreased according to the output power**
***3 One minute is allowed every 10 minutes**
***4 During vector control, PG sensorless is 0.25Hz-240Hz /PG sensor is 0.05Hz-240Hz (depends on the number of poles)**
***5 Output voltage cannot exceed power supply voltage**
***6 Vary with the impedance changes of the power supply including a DC reactor**
***7 Vary with the impedance of the power supply**
***8 When an EMC filter is embedded**
***9 The maximum value of carrier frequency varies with the inverter capacity mode and operation status.**

11-1 Inverter Standard Specification

Item			0900	1100	1320	1600	1850	2000	2200	2500
Model（SVC06-□□□□-**4）			0900	1100	1320	1600	1850	2000	2200	2500
Output specification	Mode A Heavy load	Standard applicable motor [KW]	90	110	132	160	185	200	220	250
		Rated capacity [KVA] *1	120	146	175	211	249	267	295	327
		Rated current [A] *2	173	211	253	304	360	386	426	472
		Overload current rating *3	150%-1min							
		Output frequency range *4	0.05-400Hz（Starting frequency 0.05-60Hz variable)							
	Mode B Light load	Standard applicable motor [KW]	110	132	160	200	220	250	280	315
		Rated capacity [KVA] *1	146	180	211	267	295	327	374	409
		Rated current [A] *2	211	253	304	386	426	472	540	590
		Overload current rating *3	120%-1min							
		Output frequency range *4	0.05-200Hz（Starting frequency 0.05-60Hz variable)							
	Rated output voltage *5		3φ 380V-460V							
Input power supply	Voltage & Frequency		3φ 380V-460V, 50/60Hz							
	Allowable fluctuation		Voltage: -15%、+10% Frequency: ±5% Voltage unbalance: within 3%							
	Power supply impedance		1% and above（Use optional reactor if less than 1%）							
	Mode A Heavy load	Required power capacity [KVA] *6	111	135	163	196	232	248	274	304
		Input current [A] *7 With DCL	161	196	235	283	335	359	396	439
		Input current [A] *7 Without DCL								
	Mode B Light load	Required power capacity [KVA]*6	135	163	196	248	274	304	348	380
		Input current [A] *7 With DCL	196	235	283	359	396	439	502	549
		Input current [A] *7 Without DCL								
Protective structure										
Cooling method										
Approximate weight *8			62kg		110kg			140kg		
Carrier frequency										
DC reactor			Standard							

***1 Rated capacity at the output voltage of 400V**
***2 When input voltage is AC400V and above, the rated current will be decreased according to the output power**
***3 One minute is allowed every 10 minutes**
***4 During vector control, PG sensorless is 0.25Hz-240Hz /PG sensor is 0.05Hz-240Hz (depends on the number of poles)**
***5 Output voltage cannot exceed power supply voltage**
***6 Vary with the impedance changes of the power supply including a DC reactor**
***7 Vary with the impedance of the power supply**
***8 When an EMC filter is embedded**
***9 The maximum value of carrier frequency varies with the inverter capacity mode and operation status.**

11-2 Inverter general specification

400V

Control mode			Vector control／sensorless vector control／V/f control
Driving performance *1	Speed control range	With PG sensor	0.05Hz-240Hz（1：1000/50Hz reference） *5
		Without PG sensor	0.25Hz-240Hz（1：200/50Hz reference） *5
	Speed Response/precision	With PG sensor	Response characteristic: 250rad/sec Precision: ±0.01%
		Without PG sensor	Response characteristic: 100rad/sec Precision: ±0.5%
	Torque control range	With PG sensor	1：50（rated torque ratio）
		Without PG sensor	1：20（rated torque ratio）
	Torque precision	With PG sensor	±10%（of rated torque）
		Without PG sensor	±20%（of rated torque）
Control specification	Frequency setting resolution	Digital setting	0.01Hz
		Analog setting	0.05%（12bit0-10V，4-20mA）, 0.1%（11bit0-5V）of the maximum output frequency
	Frequency precision	Digital setting	±0.01% of output frequency（at -10-40℃）
		Analog setting	±0.2% of the maximum output frequency（at 25℃±10℃） *2
	PG input		Open collector, push-pull mode (power supply voltage 24V) Max. number of pulses: 491.52kHz *3
	DC braking		Starting frequency (0.05-20Hz), operation time (0.1-10s), braking force (1-10 grades)
	Additional functions		Restart after momentary power failure, speed tracking start, multi-speed operation, frequency jump, auto alarm recovery, PID control operation, simple scheduled operation, energy-saving operation and others
Operation specification	Start/stop setting		Operation panel, serial communication (RS485, Mod-bus), control circuit terminals
	Frequency command setting	Digital setting	Operation panel, serial communication (RS485, Mod-bus), step setting from terminal board
		Analog setting	3 channels, 0-5V, 0-10V, 4-20mA, potentiometer (5kΩ, 0.3W and above)
	Input signal		Frequency command, forward run command, reverse run command, acceleration/deceleration time setting, idle-run stop/alarm reset, emergency stop, jogging selection, step frequency setting, operation signal hold and others [Digital input: 8 channels (arbitrary allocation)], [Analog input: 3 channels for current and voltage]
	Output signal	Contact output	Alarm batch and multifunctional contact output (1C contact, 250VAC, 0.3A)
		Monitor signal	Operating, frequency matching, overload alarm, undervoltge, frequency approach and etc. [Open-collector output: 3 channels (arbitrary allocation), Analog output: 2 channels]
LED display			Frequency, output current, speed, load factor, no unit: (output voltage, power and etc.), operating, alarm
LCD display			Various status, code, alarm, message display (English, Japanese, Chinese)
Communication I/F			RS485、Mod-bus-RTU
External power supply output			DC24V、150mA（control terminal board）
Protection function			Current limiting, overcurrent shutoff, motor overload, external thermal alarm, undervoltage, overvoltage, momentary power failure, fin overheat, missing phase
Warning function			Overvoltage prevention, current limiting during acceleration/deceleration, brake resistor overheat, overload, overheating of radiator fins
Environment	Ambient temperature		-10℃-+50℃（no frost）; heavy load, -10℃-+40℃（no frost）; light load
	Storage temperature		-20℃-+65℃（short-term storage during transportation）*4
	Relative humidity		95%RH or less（no condensation）
	Elevation		3000m or lower（Decrease the current when higher than 1000m）
	Vibration		$5.9m/s^2$（0.6G） or less（JIS C 60068-2-6 standard; IEC60068-2-6）
	Gas medium		Indoor (no corrosive or inflammable gases, oil mist, or dust)

*1 **Vary with the environment, condition, motor in use or sensor.**
*2 **The maximum output frequency is at 5V, 10V, and 20mA.**
*3 **An optional board is required for linear driver input.**
*4 **Applicable temperature for medium-term and long-term transportation.**
*5 **When 2-pole motor is set, the maximum value of frequency setting range is 120Hz.**

11-3 Communication function specification

Electrical characteristics	RS485 communication	
Communication protocol	SANKEN protocol	Modbus-RTU communication protocol
Communication type	4-wire / 2-wire bus type （RS485 standard）	
Transmission distance	Total 500m, terminal resistor is required	
Number of units connected	Max. 32	Max. 247 *Note
Connection cable	Shielded twisted-pair cable recommended	
Communication type	Full-duplex / Half-duplex	
Communication speed [bps]	57600/38400/19200/9600/4800/2400/1200 selectable	
Synchronization	Asynchronous start/stop	
Data format	ASC□ code or BINARY	BINARY
Data length	8bit	
Stop bit length	1bit or 2bit selectable	
Parity check	Yes (odd, even), No, Selectable	
Error check	SUM check	CRC code check
Message end code — ASC□	CR+LF/CR selectable	No
Message end code — BINARY	No	

*** Note: A relay is required when exceeding 32**

11-4 Storage Environment

Storage environments of SAMCO-SVC06 are as follows:

Table 11-1 Storage environment

Item	Description	Remark
Storage temperature	-20-65℃	Short term during transportation
Relative humidity	95%RH or lower	
Gas medium	No corrosive, gases, oil mist, dripping, dust or direct sunlight	
Gas pressure	86-106Pa	

(1) Temporary storage

① Never place it directly on the ground.

② If equipment is stored in an environment which is worse than above mentioned, pack and seal the equipment with polyvinyl resin plastic film, add an internal desiccant to prevent humidity.

(2) Long-term storage

① When storage time exceeds 3 months, in order to prevent the deterioration of the electrolytic capacitors caused by temperature, please adjust the ambient temperature to -10-+35℃.

② Use desiccant, and keep the relative humidity in the package lower than 70%.

12. External Dimension

12-1 Master dimension

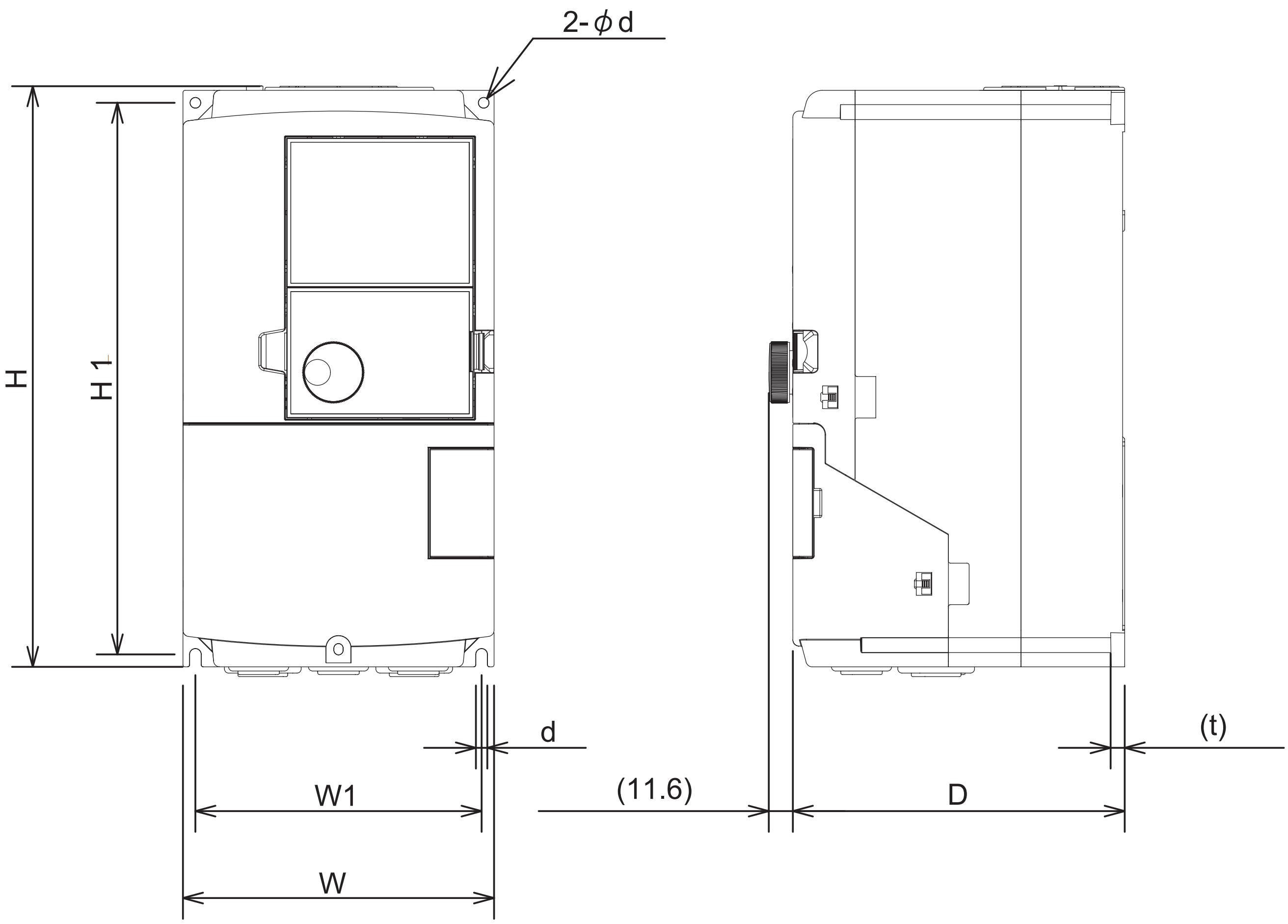


Table 12-1 List of overall dimension

Capacity	H	H1	W	W1	D	d	t
SVC06-0015-**4	280	266	150	138	160	5	7
SVC06-0022-**4							
SVC06-0040-**4							
SVC06-0055-**4	300	286	200	187	195	5.5	7
SVC06-0075-**4							
SVC06-0110-**4	330	316	220	208	195	5.5	7
SVC06-0150-**4							

Chapter 12

12-1 Master Dimension

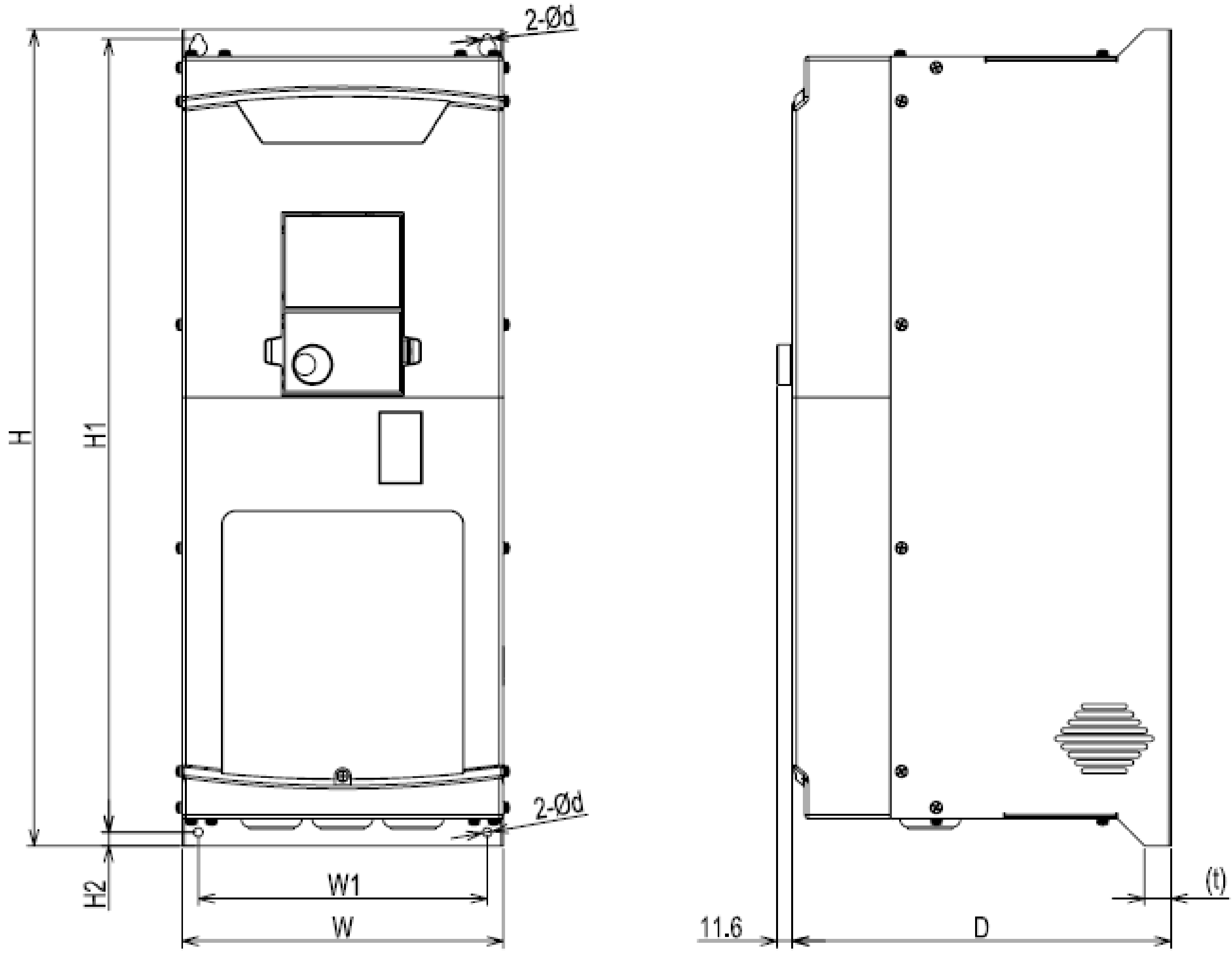


Table 12-2 List of overall dimension

Capacity	H	H1	H2	W	W1	D	d	t
SVC06-0185-**4 SVC06-0220-**4 SVC06-0300-**4	610	593	10	240	216	283	7	20
SVC06-0370-**4 SVC06-0450-**4	740	722	10	280	256	295	8	20
SVC06-0550-**4 SVC06-0750-**4	810	786	12	320	296	318	12	30

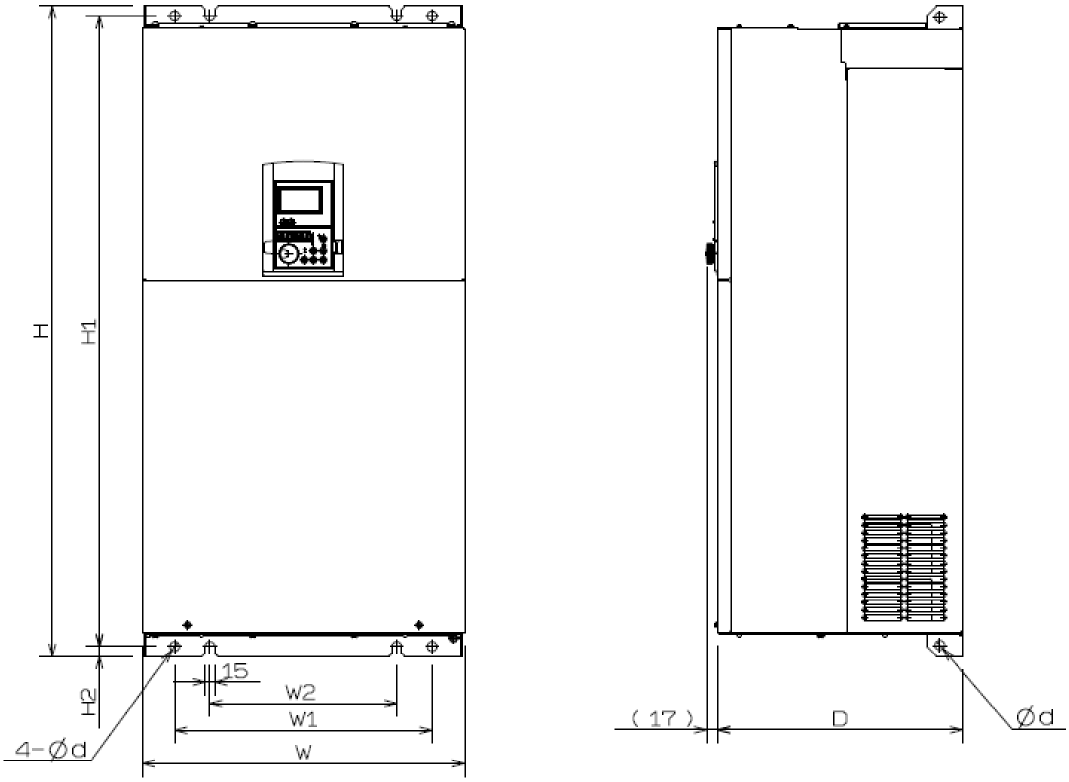
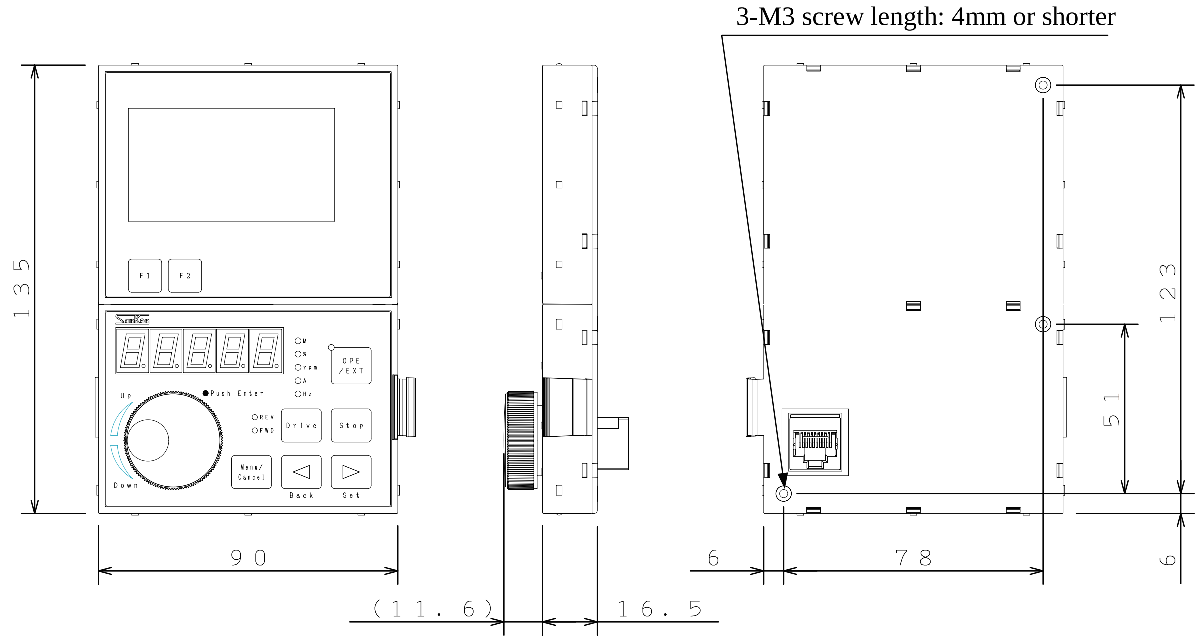


Table 12-3 List of overall dimension

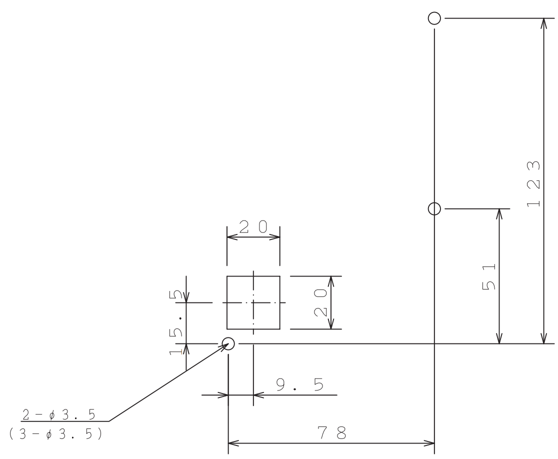
Capacity	H	H1	H2	W	W1	W2	D	d
SVC06-0900-**4	900	870	15	350	250	140	340	15
SVC06-1100-**4								
SVC06-1320-**4	1010	980	15	500	400	290	380	15
SVC06-1600-**4								
SVC06-1850-**4								
SVC06-2000-**4	1010	980	15	680	580	470	380	15
SVC06-2200-**4								
SVC06-2500-**4								

12-2 Operation panel

(1) Operation panel



(2) External installation of operation panel: Dimensional diagram of opening hole



13. Peripheral Equipments & Options

> ■ **Please work on the equipment only when the safety precautions are confirmed.**
> Failure to observe may result in personal injury and fire.

The followings are options for SAMCO-SVC06 series. Please configure the peripheral equipments (including options) according to the situation and purpose.

Table 13-1 **Options of peripheral mechanical equipments**

Name	Details of purposes
□ AC reactor / DC reactor	Purposes include: • to improve the input power factor of the inverter • to reduce the influence of interphase unbalance for power supply voltage • to prevent the inverter trip caused by open/close action of phase-lead compensating capacitor in the system • Large power supply capacity (500kVA or above) ■ Model name • AC reactor S□-ACL-●●K • DC reactor S□-DCL-●●K □：400 series F, 200V series T
□ zero-sequence reactor Transmission interference filter	Reduce the cable interference influence caused by wiring into the inverter power supply system. We recommend that these elements are installed near the inverter as possible. ■ Model name RC5078 RC5096[SOSHIN motor (company) product]
□ Radio noise filter	Used to restrain the radiation of radio noise to the inverter power supply. ■ Model name 200V grade: 3XYEB-105.104 400V grade: 3XYHB-105.104 【OKAYA motor (company) product】
□ Noise filter *Note 1	Reduce the cable interference influence caused by wiring into the inverter power supply system. We recommend that these elements are installed near the inverter as possible. ■ EMC filter recommended (consult separately)
□ Braking resistance	P-PR terminal used to connect inverter; it will consume the regenerated energy by a resistor. ■ Please consult separately.

□1 **Input power supply / transformer**
- **When system power voltage and inverter rated input voltage are required to be suited, please set according to the requirements.**
- **When several inverters are used simultaneously, it must be configured to reduce the influence of higher harmonic current to other loaded equipments.**

□2 **Wiring breaker or leakage breaker protective switch**
- **Please connect it with the protection or overload protection circuit of power supply system.**
- **When a leakage breaker protection switch is required, please select corresponding higher harmonic products.**

□3 **Electromagnetic contactor**
- **A surge absorber must be configured on the winding.**
- **Please install a surge absorber to restrain the surge caused by open/close actions of electromagnetic contactor or controlling relay.**

* **Note** 1: **When an internal EMC filter is used, please set the selector switch to ON.**

■ The following optional boards built into the inverter are available.

Table 13-2 Option Card

Option Name	Type	Function	Applicable inverter
PG Option card	SC-PG1	Detect and feedback the motor speed with the detector (PG), to operate speed control function and position control function. ・ Line driver output corresponding to PG ・ Pulse (differential pulse) input for phase A & B ・ Pulse monitoring output ・ PG power supply: +5V or 12V	SVC06 all models
	SC-PG2	Detect and feedback the motor speed with the detector (PG), to operate speed control function and position control function. ・ Open-collector/push-pull output corresponding to PG ・ Pulse input for phase A & B ・ Pulse monitoring output ・ PG power supply: +12V	
	SC-PG3	Detect and feedback the motor speed with the detector (PG), to operate speed control function and position control function. ・ Open-collector/push-pull output corresponding to PG ・ Pulse input for phase A & B ・ Pulse monitoring output ・ PG power supply: +24V	
PROFIBUS communication board	SC-PB	The inverter can be used as a slave-station of PROFIBUS with this option, therefore realizing the monitor and control of inverter parameter setting and status by the upper master station through the PROFIBUS bus.	

■ The inverter can mount 2 optional boards simultaneously.
There are two slots in the inverter; each optional board must be plugged into the specified slot because different optional boards have different shapes.
Furthermore, the combination status of the optional boards may also influence the installation or function.
For details of each option, please refer to the instructions for each optional board.

Optional board compatibility sheet

Table 13-3 Option card combination compatibility

Slot 2 \ Slot 1	Not plugged	SC-PG1	SC-PG2	SC-PG3	SC-PB
Not plugged	-	○	○	○	○
SC-PG1	○	×	×	×	○
SC-PG2	○	×	×	×	○
SC-PG3	○	×	×	×	○
SC-PB	○	○	○	○	×

○: Available ×: Not available

Memorandum

SANKEN ELECTRIC CO., LTD.

Address: 1−11−1 Nishi-Ikebukuro,Toshima-ku,Tokyo
Phone:+81-3-3986-6701 Fax:+81-3-3986-2650

Published in Aug 2010 Corresponding software version: VER-2.20 or later

TEX48203-704A