Caution for UL/cUL requirements

- The Hyundai Heavy Industry N700 inverter UL file number is E205705. Confirmation of UL listing can be found on the UL website: www.ul.com

- Do not connect or disconnect wiring, or perform signal checks while the power supply is turned ON.

- There are live parts inside the inverter. Never touch the printed wiring board(PWB) while the power supplies turned ON.

- [Warning] The bus capacitor discharge time is 5minutes. Before starting wiring or inspection, switch power off, wait for more than 5 minutes, and check for residual voltage between terminal P(+) and N(-) with a meter etc., to avoid hazard of electrical shock.

- [Short circuit rating] This inverter is not suitable for use on a circuit capable of delivering more than 5,000Arms symmetrical amperes, 480 volts and 240 volts maximum.

- [Over speed protection] This inverter does not provide over speed protection.

- [Over load protection] This inverter provides motor over load protection.

- Over load protection level is 50~200% of full load current. The protection level is 50~200% of full load current. The protection level may be adjusted by code b031. Refer to the N700 user guide or catalogue.

- [Over Tempurature] Motor overtemperature sensing is not provided by the drive.

[Environment]

Surrounding Air temperature	Max. 50℃(5.5~55kW), 40℃ (75~110kW)
Ambient humidity	90% RH or less(no condensing)
Storage temperature	-20 ~ 60℃
Vibration	5.9㎧ (0.6G) (5.5~22kW), 2.94 ㎧(0.3G) (30~110kW)
Altitude	Altitude 1000m or less
Ambience	Indoors (No corrosive and flammable gases, oil mist, dust and dirt)
Pollution Degree	5.5~22kW : Pollution Degree 2

SAFETY

For the Best Results with N700 Series inverter, read this manual and all of the warning sign attached to the inverter carefully before installing and operating it, and follow the instructions exactly. Keep this manual handy for your quick reference.

Definitions and Symbols

A safety instruction (message) is given with a hazard alert symbol and a signal word, **WARNING** or **CAUTION**. Each signal word has the following meaning throughout this manual.

This symbol means hazardous high voltage. It used to call your attention to items or operations that could be dangerous to you or other persons operating this equipment. Read these messages and follow these instructions carefully.

This is the "Safety Alert Symbol" This symbol is used to call your attention to items or operations that could be dangerous to you or other persons operating this equipment. Read these messages and follow these instructions carefully.

WARNING   Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION   Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage of product.
The matters described under ⚠ **CAUTION** may, if not avoided, lead to serious results depending on the situation. Important matters are described in **CAUTION** (as well as **WARNING**), so be sure to observe them.

NOTE   Notes indicate an area or subject of special merit, emphasizing either the product's capabilities or common errors in operation or maintenance.

HAZARDOUS HIGH VOLTAGE

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there might be exposed components with cases or protrusions at or above line potential. Extreme care should be taken to product against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on an electronic controller or rotating electrical equipment.

PRECAUTION

WARNING : This is equipment should be installed, adjusted and serviced by qualified electrical maintenance personal familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could results in bodily injury.

WARNING :The user is responsible for ensuring that all driven machinery, drive train mechanism not supplied by HYUNDAI and process line material are capable of safe operation at an applied frequency of 150% of the maximum selected frequency range to the AC motor. Failure to do so can result in destruction of equipment and injury to personnel should a single point failure occur.

WARNING : For protection, install an earth leakage breaker with a high frequency circuit capable of large currents to avoid an unnecessary operation. The ground fault protection circuit is not designed to protect personal injury.

WARNING : Separate motor overcurrent, overload and overheating protection is required to be provided in accordance with the safety codes required by jurisdictional authorities.

WARNING : Dangerous voltage exists until charge lamp is off. Risk of electric shock. Ensure proper earth connection. Before opening the cover, wait at least 5 minutes until DC bus capacitors are discharge.

CAUTION : Heavy object. To avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing.

CAUTION : These instructions should be read and clearly understood before working on N700 series equipment.

CAUTION : Proper grounds, disconnecting devices and other safety devices and their location are the responsibility of the user and are not provided by HYUNDAI.

CAUTION : Be sure to connect a motor thermal switch or overload devices to the N700 series controller to assure that inverter will shut down in the event of an overload or an overheated motor.

CAUTION : Rotating shafts and above ground electrical potentials can be hazardous. Therefore, it is strongly recommended that all electrical work conform to the National Electrical Codes and local regulations. Only qualified personnel should perform installation, alignment and maintenance. Factory recommended test procedures, included in the instruction manual, should be followed. Always disconnect electrical power before working on the unit.

NOTE : POLLUTION DEGREE 2

The inverter must be used in the environment of the pollution degree 2.
Typical constructions that reduce the possibility of conductive pollution are,

1) The use of an unventilated enclosure

2) The use of a filtered ventilated enclosure when the ventilation is fan forced that is, ventilation is accomplished by one more blowers within the enclosure that provide a positive intake and exhaust.

Cautions for EMC (Electromagnetic Compatibility)

To safety the EMC directive and to comply with standard, follows the check list below.

WARNING
This equipment should be installed, adjusted, and serviced by qualified personal familiar with construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.

1. The power supply to N700 inverter must meet these specifications

      a. Voltage fluctuation ±10% or less.
      b. Voltage imbalance ±3% or less.
      c. Frequency variation ±4% or less.
      d. Voltage distortion THD = 10% or less.

2. Installation measure :

      a. Use a filter designed for N700 inverter

3. Wiring

      a. Shielded wire (screened cable) is required for motor wiring, and the length must be less than 20 meters.
      b. The carrier frequency setting must be less than 5kHz to satisfy EMC requirements.
      c. Separate the main circuit from the signal/process circuit wiring.
      d. In case of remote operating with connector cable, the inverter does not conform to EMC.

4. Environmental conditions - when using a filter, follow these guidelines:

      a. Ambient air temperature : -10 - +50℃(5.5~55kW), -10 - +40℃(75~110kW).

      b. Humidity : 20 to 90% RH(non-condensing)

      c. Vibration : 5.9 m/s^2 (0.6 G) 10 - 55Hz (N700-5.5~22kW)

            2.94 m/s^2 (0.3 G) 10 - 55Hz (N700-30~110kW)

      d. Location : 1000 meters of less altitude, indoors (no corrosive gas or dust)

Conformity to the Low Voltage Directive (LVD)

The protective enclosure must conform to the Low Voltage Directive.

The inverter can conform to the LVD by mounting into a cabinet or by adding covers as follows.

1. Cabinet and Cover

The inverter must be installed into a cabinet which has the protection degree of Type IP2X.

In addition the top surfaces of cabinet are easily accessible shall meet at least the requirements of the protective Type IP4X, or which is constructed to prevent small objects from entering inverter.
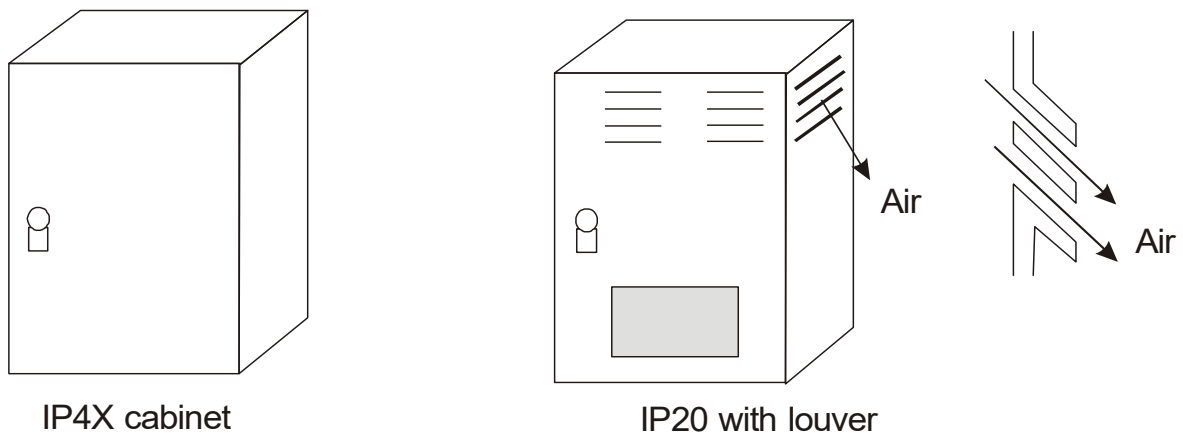
IP4X cabinet

IP20 with louver

Air

Air

Fig 1. Inverter Cabinet

UL Warnings and Cautions Manual for N700 series

This auxiliary instruction manual should be delivered to the end user.

1. Wiring warnings for Electrical Practices and Wire Specifications

⚠ **WARNING** : "Use Copper Conductor Only, 75℃ with a torque rating.

⚠ **WARNING** : "Suitable for use on a circuit capable or delivering not more than 5,000 Arms symmetrical amperes, 240V maximum.

⚠ **WARNING** : "Suitable for use on a circuit capable or delivering not more than 5,000 Arms symmetrical amperes, 480V maximum.

2. Tightening Torque and Wire Range

⚠️ **WARNING** : Tightening torque and wire range for field wiring terminals are marked adjacent to the terminal or on the wiring diagram.

Model Name	Tightening Torque [in·lb]	Wire Range	
N700-055LF	26.5 [in·lb]	10	AWG
N700-075LF	26.5 [in·lb]	8	AWG
N700-110LF	26.5 [in·lb]	6	AWG
N700-150LF	40 [in·lb]	6 ‖ 6	AWG
N700-185LF	40 [in·lb]	6 ‖ 6	AWG
N700-220LF	53.06 [in·lb]	2	AWG
N700-300LF	132.7 [in·lb]	2	AWG
N700-370LF	132.7 [in·lb]	2	AWG
N700-450LF	132.7 [in·lb]	2	AWG
N700-550LF	265.5 [in·lb]	2	AWG
		300	kcmil

* Recommended ring terminal size(UL listed) for 055LF~110LF: Maximum wide 12 mm

Model Name	Tightening Torque [in·lb]	Wire Range	
N700-055HF	26.5 [in·lb]	12	AWG
N700-075HF	26.5 [in·lb]	12	AWG
N700-110HF	26.5 [in·lb]	10	AWG
N700-150HF	40 [in·lb]	8	AWG
N700-185HF	40 [in·lb]	6	AWG
N700-220HF	40 [in·lb]	6	AWG
N700-300HF	53.06 [in·lb]	4	AWG
N700-370HF	53.06 [in·lb]	2	AWG
N700-450HF	53.06 [in·lb]	1	AWG
N700-550HF	132.7 [in·lb]	2/0	AWG
N700-750HF	132.7 [in·lb]	4/0	AWG
N700-900HF	132.7 [in·lb]	300	kcmil
N700-1100HF	88.5 [in·lb]	350	kcmil

* Recommended ring terminal size(UL listed) for 055HF~110HF : Maximum wide 12 mm

3. Circuit Breaker / Fuse Size

⚠ **WARNING** : Distribution fuse/circuit breaker size marking is included in the manual to indicate that the unit shall be connected with an UL Listed inverse time circuit breaker, rated 600V with the current ratings or an UL Listed BCP(Branch Circuit Protection) type fuse as shown in the table below.

Model Name	Circuit Breaker [A]	Fuse [A]
N700-055LF	30	30
N700-075LF	40	40
N700-110LF	60	60
N700-150LF	80	80
N700-185LF	100	100
N700-220LF	125	125
N700-300LF	150	150
N700-370LF	200	200
N700-450LF	250	250
N700-550LF	300	300

Model Name	Circuit Breaker [A]	Fuse [A]
N700-055HF	15	15
N700-075HF	20	20
N700-110HF	30	30
N700-150HF	40	40
N700-185HF	50	50
N700-220HF	60	60
N700-300HF	80	80
N700-370HF	100	100
N700-450HF	125	125
N700-550HF	150	150
N700-750HF	200	200
N700-900HF	250	250
N700-1100HF	300	300

4. Others

⚠️ **WARNING** : "Field wiring connection must be made by an UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.", or equivalent wording included in the manual.

Terminal (Ring lug)

Cable support

Cable
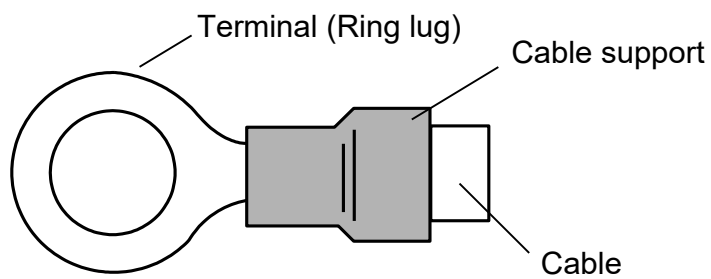
General Safety Information

DEFINITIONS AND SYMBOLS

A safety instruction (message) includes a hazard alert symbol and a signal word, DANGER or CAUTION. Each signal word has the following meaning :

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words : DANGER or CAUTION, as described below.

⚠ **DANGER** : Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ **CAUTION** : Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product.

The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as DANGER), so be sure to observe them.

NOTE : Indicates an area or subject of special merit, emphasizing either the product's capabilities or common errors during operation or maintenance.

General Safety Information

1. Installation

⚠ CAUTION

- Be sure to install the unit on flame resistant material such as metal.
  Otherwise, there is a danger of fire.

- Be sure not to place anything highly flammable in the vicinity.
  Otherwise, there is a danger of fire.

- Do not carry unit by top cover, always carry by supporting base of unit.
  There is a risk of falling and injury.

- Be sure not to let foreign matter enter inverter such as cut wire refuse, spatter from welding, iron refuse, wire, dust, etc.
  Otherwise, there is a danger of fire.

- Be sure to install inverter in a place which can bear the weight according to the specifications in the text. (Chapter 6. Specifications)
  Otherwise, it may fall and there is a danger of injury.

- Be sure to install the unit on a perpendicular wall which is not subject to vibration
  Otherwise, the inverter may fall and cause injury to personnel.

- Be sure not to install and operate an inverter which is damaged or has parts which are missing.
  Otherwise, there is a danger of injury.

- Be sure to install the inverter in an area which is not exposed to direct sunlight and is well ventilated. Avoid environments which tend to be high in temperature, high in humidity or to have dew condensation, as well as places with dust, corrosive gas, explosive gas, highly flammable gas, grinding-fluid mist, salt damage, etc.
  Otherwise, there is a danger of fire.

General Safety Information

2. Wiring

⚠WARNING

- Be sure to ground the unit.
  Otherwise, there is a danger of electric shock and/or fire.

- Wiring work should be carried out by qualified electricians.
  Otherwise, there is a danger of electric shock and/or fire.

- Implement wiring after checking that the power supply is off.
  Otherwise, there is a danger of electric shock and/of fire.

- After installing the main body, carry out wiring.
  Otherwise, there is a danger of electric shock and/or injury.

- Do not remove the rubber bushing where wiring connections are made.
  Due to the possibility that a wire may be damaged, shorted or may have a ground   fault with the edge of the wiring cover.

⚠CAUTION

- Make sure that the input voltage is:
  Three phase 200 to 240V 50/60Hz
  Three phase 380 to 480V 50/60Hz

- Be sure not to single phase the input.
  Otherwise, there is a danger of fire.

- Be sure not to connect AC power supply to the output terminals(U, V, W).
  Otherwise, there is a danger of injury and/or fire and/or damage to unit.

- Be sure not to connect a resistor to the DC terminals(PD, P and N) directly.
  Otherwise, there is a danger of fire and/or damage to unit.

- Be sure to install an earth leakage breaker or the fuse(s) which is(are) the same phase as the main power supply in the operation circuit.
  Otherwise, there is a danger of fire and/or damage to unit.

- As for motor leads, earth leakage breakers, and electromagnetic contactors, be sure to use equivalent ones with the specified capacity(rated).
  Otherwise, there is a danger of fire and/or damage to unit.

- Do not stop operation by switching off the electromagnetic contactors on the primary or secondary sides of the inverter.
  Otherwise, there is a danger of injury and/or machine breakage.

- Fasten the screws to the specified torque. Check so that there is no loosening of screws.
  Otherwise, there is a danger of fire and/or injury to personnel.

General Safety Information

3. Control and operation

⚠️**WARNING**

● While the inverter is energized, be sure not to touch the main terminal or to check the signal or add or remove wires and/or connectors.
Otherwise, there is a danger of electric shock.

● Be sure to turn on the power supply with the front case is closed.
While the inverter is energized, be sure not to open the front case.
Otherwise, there is a danger of electric shock.

● Be sure not to operate the switches with wet hands.
Otherwise, there is a danger of electric shock.

● While the inverter is energized, be sure not to touch the inverter terminals even while the unit is not running.
Otherwise, there is a danger of electric shock.

● If the retry mode is selected, it may suddenly restart during the trip stop.
Be sure not to approach the equipment. (Be sure to design the equipment so that personnel safety will be secured even if equipment restarts.)
Otherwise, there is a danger of injury.

● Be sure not to select retry mode for equipment running up and down or traversing because there is output free-running mode in term of retry.
Otherwise, there is a danger of injury and/or machine breakage.

● Even if the power supply is cut for a short period of time, the inverter may restart operation after the power supply is restored if the operation command is given.
If a restart may incur danger to personnel, be sure to make a circuit so that it will not restart after power recovery.
Otherwise, there is a danger of injury.

● The stop key is valid only when a function is on. Ensure that there is a hard wired emergency stop that is separate from the stop key of the inverter.
Otherwise, there is a danger of injury.

● With the operation command on, if the alarm reset is ordered, the inverter can restart suddenly. Be sure to set the alarm reset after checking the operation command is off.
Otherwise, there is a danger of injury.

● Be sure not to touch the inside of the energized inverter or to put a shorting bar into it.
Otherwise, there is a danger of electric shock and/or fire.

General Safety Information

⚠ CAUTION

- The cooling fins will have a high temperature. Be sure not to touch them.
  Otherwise, there is a danger of getting burned.
- Low to high speed operation of the inverter can be easily set. Be sure to operate it after checking the tolerance of the motor and machine.
  Otherwise, there is a danger of injury.
- Install an external breaking system if needed.
  Otherwise, there is a danger of injury.
- If a motor is operated at a frequency outside of the standard setting value (50Hz/60Hz), be sure to check the speeds of the motor and the equipment with each manufacturer, and after getting their consent, operate them.
  Otherwise, there is a danger of equipment breakage.
- Check the following before and during the test run.
  Was the direction of the motor correct?
  Did the inverter trip for on acceleration or deceleration?
  Were the RPM and frequency motor correct?
  Were there any abnormal motor vibrations or noises?
  Otherwise, there is a danger of machine breakage.

4. Maintenance, inspection and part replacement

⚠ WARNING

- After turning off the input power supply, do not perform the maintenance and inspection for at least 10 minutes.
  Otherwise, there is a danger of electric shock.
- Make sure that only qualified persons will perform maintenance, inspection and/or part replacement.
  (Before starting the work, remove metallic objects(wristwatch, bracelet, etc.) from a worker.
  (Be sure to use insulated tools.)
  Otherwise, there is a danger of electric shock and/or injury.

5. Others

⚠ WARNING

- Never modify the unit.
  Otherwise, there is a danger of electric shock and/or injury.

⚠ CAUTION

- Heavy object(over 15kg).
  To avoid muscle strain or back injury, use lifting aids and proper lifting techniques when removing or replacing.

CONTENTS

1. GENERAL DESCRIPTION

1.1 Inspection upon Unpacking

1.1.1 Inspection of the unit

Please open the package, remove the inverter, please check the following items.

If you discover any unknown parts or the unit is damaged, please contact HYUNDAI.

(1) Make sure that the package contains one operation manual for the inverter.

(2) Make sure that there was no damage (broken parts in the body) during transportation of the unit.

(3) Make sure that the product is the one you ordered by checking the label specification.
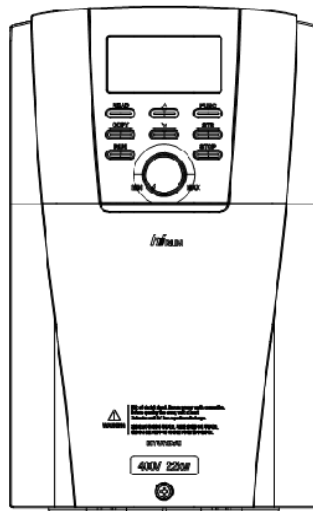
Fig. 1-1   Outlook of N700 inverter

Inverter Model
Maximum applicable motor
Input ratings
Output ratings
Manufacturing number

MODEL	N700-110HF
POWER	kW/(hp) 11/(15)
INPUT	50/60Hz, 380~480V~ 3ph
OUTPUT	0.1~400Hz, 380~480V~ 3ph 23A
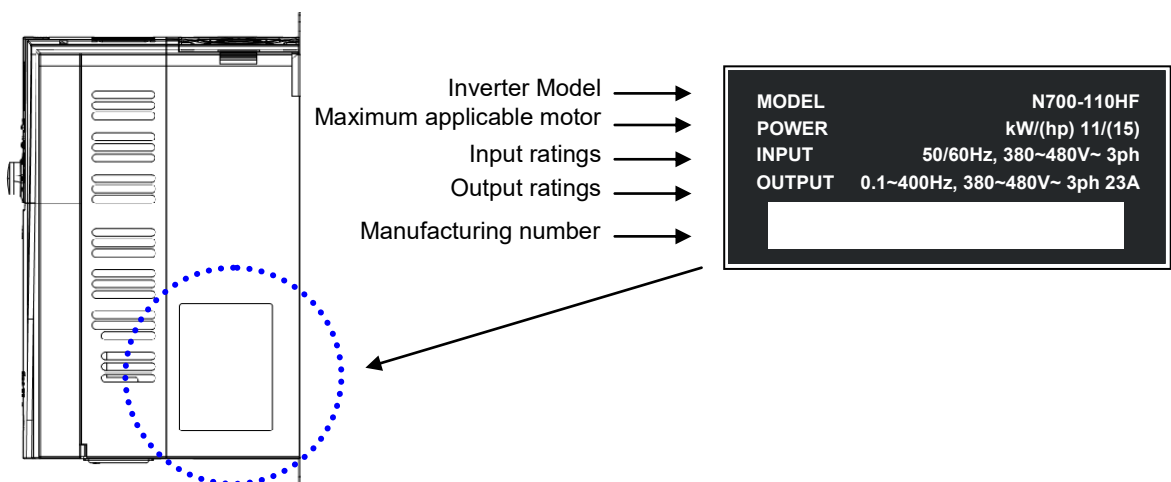
Fig. 1- 2 Contents of specification label

1.1.2 Instruction manual

This instruction manual is the manual for the N700 inverters.

Before operation of the inverter, read the manual carefully. After reading this manual, keep it on hand for future reference.

1.2 Questions and Warranty of the Unit

1.2.1 Questions on Unit

If you have any questions regarding damage to the unit, unknown parts or for general inquiries, please contact your LOCAL HYUNDAI BRANCH with the following information.

(1) Inverter Model

(2) Production Number (Serial No.)

(3) Date of purchase

(4) Reason for Calling

    ① Damaged part and its condition etc.

    ② Unknown parts and their contents etc.

1.2.2 Warranty for the unit

(1) The warranty period of the unit is one year after the purchase date. However the warranty will be void if the fault is due to;

    ① Incorrect use as directed in this manual, or attempted repair by unauthorized personnel.

    ② Any damage sustained other than from transportation (Which should be reported immediately).

    ③ Using the unit beyond the limits of the specifications.

    ④ Natural Disasters : Earthquakes, Lightning, etc

(2) The warranty is for the inverter only, any damage caused to other equipment by malfunction of the inverter is not covered by the warranty.

(3) Any examination or repair after the warranty period (one-year) is not covered. And within the warranty period any repair and examination which results in information showing the fault was caused by any of the items mentioned above, the repair and examination costs are not covered. If you have any questions regarding the warranty, please contact either your Local HYUNDAI Branch.

1.3   Appearance

Mounting plate

FAN cover

Digital Operator

Bottom cover

Bolting hole
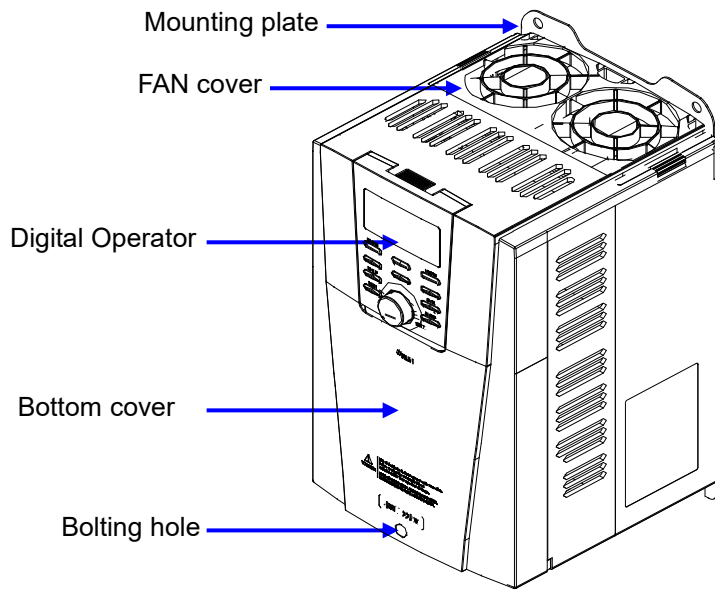
Fig. 1-3   Appearance from the front

Control circuit terminals

Main circuit terminals

Specification label

Wiring blind cover
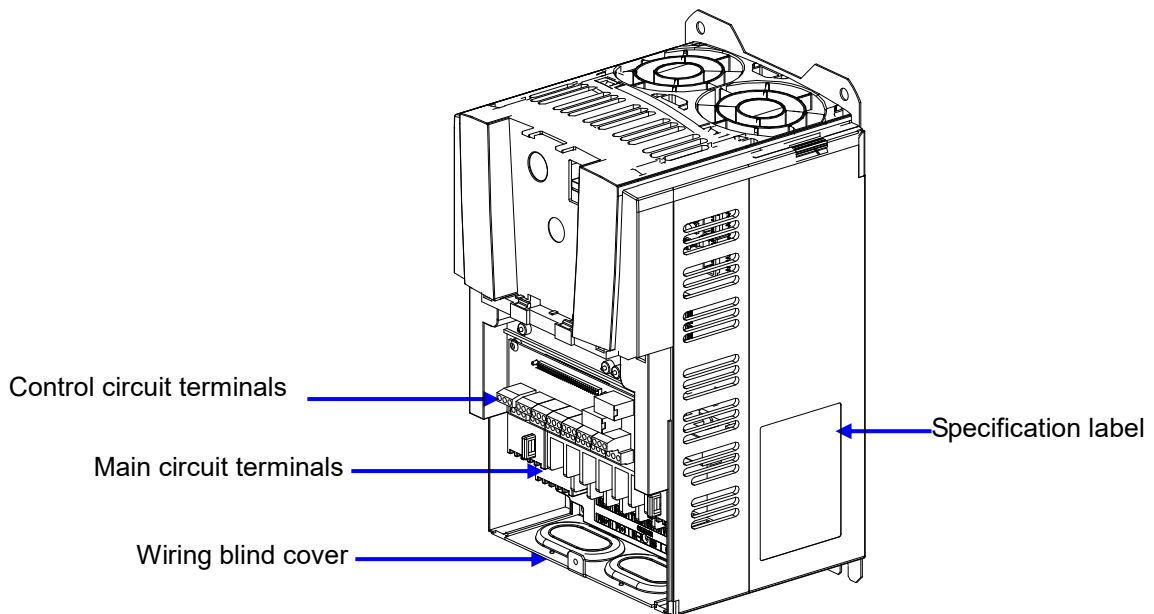
Fig. 1-4   Front cover removed

(Note) When you use cables for remote operation, please remove the connector.

2.   INSTALLATION AND WIRING

2.1   Installation

⚠ **CAUTION**

- Be sure to install the unit on flame resistant material such as metal.
  Otherwise, there is a danger of fire.

- Be sure not to place anything flammable in the vicinity.
  Otherwise, there is a danger of fire.

- Do not carry the unit by the top cover, always carry by supporting the base of unit.
  There is a risk of falling and injury.

- Be sure not to let foreign matter enter such as cut wire refuse, spatter from welding, iron refuse, wire, dust, etc.
  Otherwise, there is a danger of fire.

- Be sure to install the inverter in a place which can bear the weight according to the specifications in the text. (Chapter 17. Specification)
  Otherwise, it may fall and result in possible injury.

- Be sure to install the unit on a perpendicular wall which is not subject to vibration.
  Otherwise, the inverter may fall and cause injury to personnel.

- Be sure not to install and operate an inverter which is damaged or parts of which are missing.
  Otherwise, there is a danger of injury.

- Be sure to install the inverter in an area which is not exposed to direct sunlight and is well ventilated. Avoid environments which tend to be high in temperature, high in humidity or to have dew condensation, as well as places with dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist, salt damage, etc.
  Otherwise, there is a danger of fire.

2.1.1   Installation

(1)   Transportation

This inverter has plastic parts. So handle with care.

Do not over tighten the wall mounting fixings as the mountings may crack, causing is a risk of falling.

Do not install or operate the inverter if there appears to be damaged or parts missing.

(2)   Surface for the mounting of inverter

The temperature of the inverter heatsink can become very high reaching approx up to 150℃ (302°F).

The surface, to which the inverter will be mounted, must be made of a non-flammable material(i.e steel) due to the possible risk of fire. Attention should also be made to the air gap surrounding the inverter. Especially, when there is a heat source such as a breaking resistor or reactor.
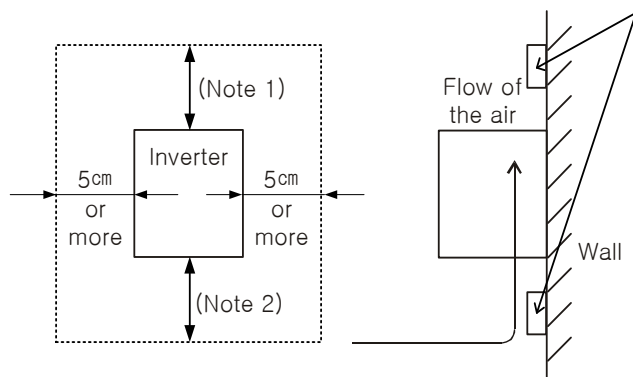
Ensure proper spacing for ventilation to prevent the unit from overheating.

(Note1)
10cm or more for 5.5^{kW} to 55^{kW} inverter
30cm or more for 75^{kW} to 132^{kW} inverter

(Note2)
10cm or more for 5.5^{kW} to 55^{kW} inverter
30cm or more for 75^{kW} to 132^{kW} inverter

Before exchanging the DC bus capacitors that are in need of repair, please observethe following distances.
10cm or more for 5.5^{kW} to 11^{kW} inverter
22cm or more for 15^{kW} to 22^{kW} inverter
30cm or more for 75^{kW} to 132^{kW} inverter

Fig. 2- 1 Surface for the mounting of inverter

(3)   Operating Environment-Ambient Temperature

The ambient temperature surrounding the inverter should not exceed the allowable temperature range (14 to 122°F, -10 to 50℃).

The temperature should be measured in the air gap surrounding the inverter, shown in the diagram above. If the temperature exceeds the allowable temperature, component life will become shortened especially in the case of the Capacitors.

(4)   Operating Environment-Humidity

The humidity surrounding the inverter should be within the limit of the allowable percentage range (20% to 90% / RH).

Under no circumstances should the inverter be in an environment where there is the possibility of moisture entering the inverter.

Also avoid having the inverter mounted in a place that is exposed to the direct sunlight.

(5)   Operating Environment-Air

Install the inverter in a place free from dust, corrosive gas, explosive gas, combustible gas, mist of coolant and sea damage.

(6)　Mounting Position

Mount the inverter in a vertical position using screws or bolts. The mounting surface should also be free from vibration and can easily hold the weight of the inverter.

Fig. 2- 2 Mounting Position

(7)　Ventilation within an Enclosure

If you are installing one or more inverters in an enclosure a ventilation fan should be installed. Below is a guide to the positioning of the fan to take the airflow into consideration. The positioning of inverter, cooling fans and air intake is very important.

If these positions are wrong, airflow around the inverter decreases and the temperature surrounding the inverter will rise. So please make sure that the temperature around is within the limit of the allowable range.

(Good example)　　　(Very good example)　　　(Poor example)
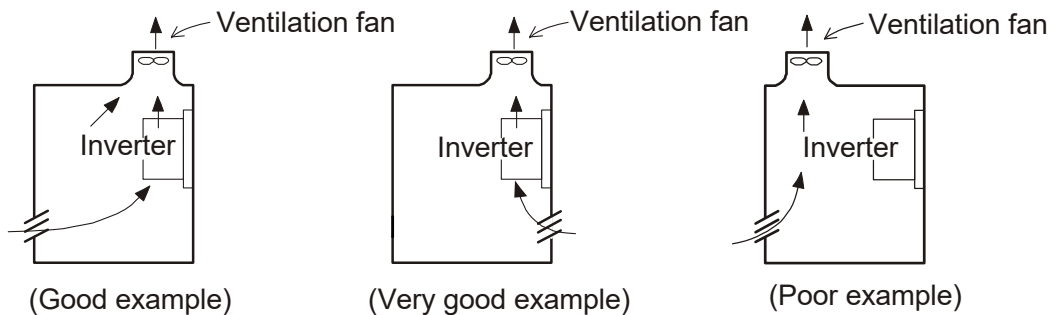
Fig. 2- 3 Ventilation within an Enclosure.

(8)　External cooling of inverter

It is possible to install the inverter so that the heatsink is outside of the back of the enclosure. This method has two advantages, the cooling of the inverter is greatly increased and the size of the enclosure will be smaller.

To install it with the heatsink outside of the enclosure, a metal fitting option is required to ensure heat transfer. Do not install in a place where water, oil, mist, flour, and/or dust etc. can come in contact with the inverter as there are cooling fans fitted to the heatsink.

(9) Approximate loss for each capacity

At surrounding temperature 40ºC, Air pressure 1.07kg/m³, Air specific heat 0.24kcal/kg·ºC

Inverter capacity(kW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132
70% of rated output(W)	242	312	435	575	698	820	1100	1345	1625	1975	2675	3375	3900	4670
100% of rated output(W)	325	425	600	800	975	1150	1550	1900	2300	2800	3800	4800	5550	6650
100% of rated output / efficiency(%)	95.4	96.3	96.1	96.0	96.0	96.4	–	–	–	–	–	–	–	–

Table 2- 1 Approximate loss for each capacity

2.1.2   Blind cover of wiring parts

(1) Cable entry through Rubber Bushings

The wiring should be done after making a cut in the rubber bushings with nippers or cutters.

If you want to use the conduit, after taking out the rubber bushings, connect the conduit.

Rubber bushings
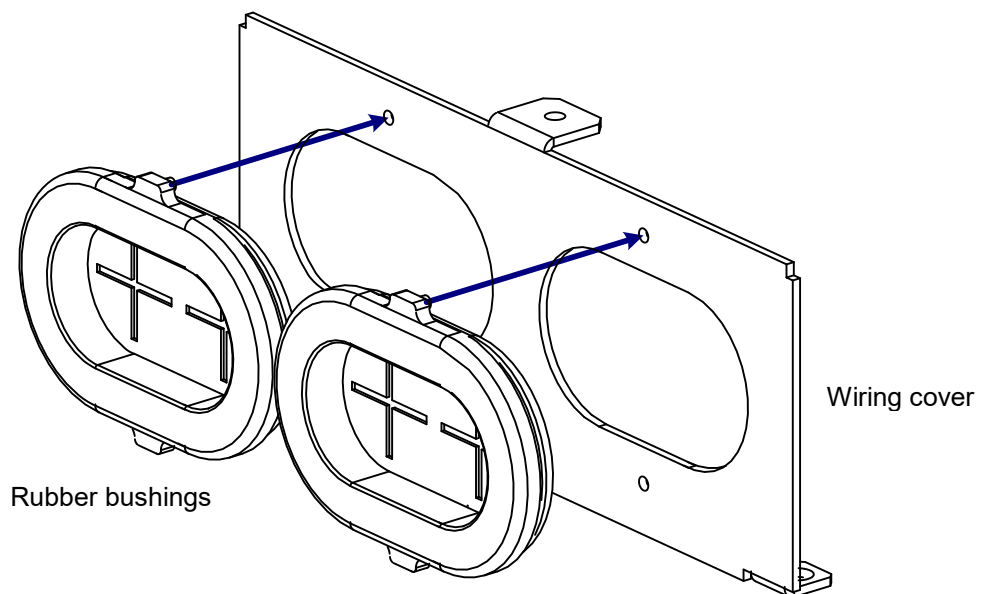
Wiring cover

Fig. 2- 4 Cable entry through Rubber Bushings

Note) Except for when connecting conduit, do not remove the rubber bushings.

In the event of the possibility of wiring insulation breakdown, there is the potential of a possible earth fault.

2.2   Wiring

⚠ WARNING

- Be sure to ground the unit.
  Otherwise, there is a danger of electric shock and/or fire.

- Wiring work should be carried out by qualified electricians.
  Otherwise, there is a danger of electric shock and/or fire.

- Implement wiring after checking that the power supply is off.
  Otherwise, there is a danger of electric shock and/of fire.

- After mounting the inverter, carry out wiring.
  Otherwise, there is a danger of electric shock and/or injury.

- Do not remove the rubber bushings where wiring connections are made.
  (5.5 to 132^{kW}) Due to the possibility that a wire may be damaged, shorted
  or may have a ground fault with the edge of the wiring cover.

⚠ CAUTION

- Make sure that the input voltage is:
  Three phase 200 to 240V 50/60Hz(Model : N700-055LF thru 550LF)
  Three phase 380 to 480V 50/60Hz(Model : N700-055HF thru 1320HF)

- Be sure not to power a three-phase-only inverter with single phase power.
  Otherwise, there is a danger of fire.

- Be sure not to connect AC power supply to the output terminals(U, V, W).
  Otherwise, there is a danger of injury and/or fire and/or damage to unit.

- Be sure not to connect a resistor to the DC terminals(PD, P and N) directly.
  Otherwise, there is a danger of fire and/or damage to unit..

- Be sure to set a earth leakage breaker or the fuse(s) which is(are) the same
  phase as the main power supply in the operation circuit.
  Otherwise, there is a danger of fire and/or damage to unit..

- As for motor leads, earth leakage breakers, and electromagnetic contactors,
  be sure to use equivalent ones with the specified capacity(rated).
  Otherwise, there is a danger of fire and/or damage to unit..

- Do not stop operation by switching off the electromagnetic contactors on the
  primary or secondary sides of the inverter.
  Otherwise, there is a danger of injury and/or machine breakage.

- Fasten the screws to the specified torque. Check so that there is no loosening of
  screws.
  Otherwise, there is a danger of fire and/or damage to unit..

2.2.1 Terminal Connection Diagram (sink type)
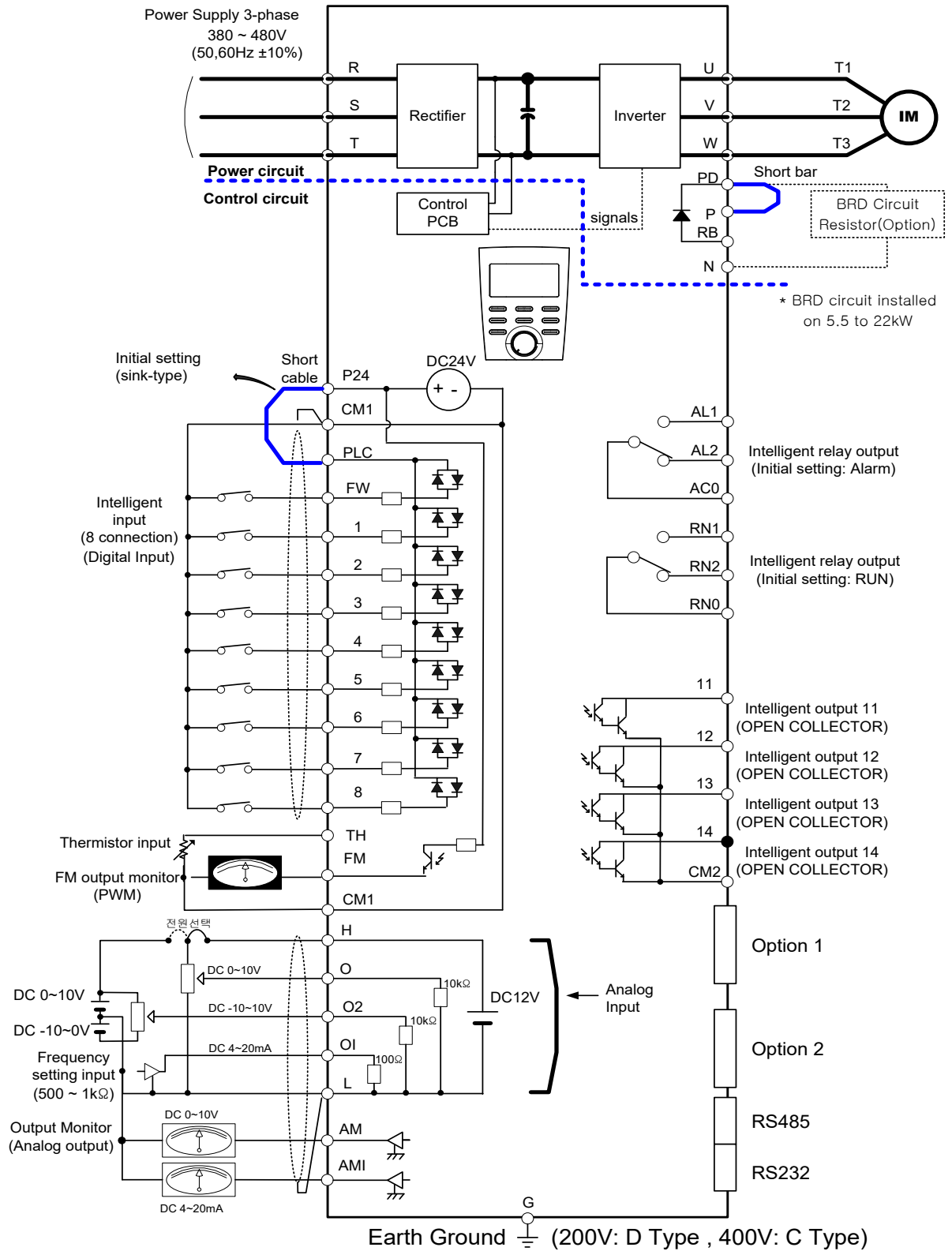
Fig. 2- 5 Terminal Connection Diagram (sink type)

(1) Explanation of main circuit terminals

Symbol	Terminal Name	Explanation of contents
R, S, T (L1,L2,L3)	Main power	Connect alternating power supply. When using regenerative converter and RG series, don't connect.
U, V, W (T1,T2,T3)	Inverter output	Connect three−phase motor.
PD, P (+1,+)	D.C.reactor	Remove the short bar between PD and P, connect optional Power factor reactor (DCL−XX).
P, RB (+,RB)	External braking resistor	Connect optional External braking resistor. (Please install the optional External braking resistor for 5.5~22 kW model.)
P, N (+,−)	External regenerative braking unit	Connect optional External regenerative braking unit.
G	Inverter earth terminals	Grounding terminal.

Table 2- 2 Explanation of main circuit terminals

(2) Explanation of control circuit terminal

		Symbol	Terminal Name	Explanation of contents	
Analog	Power Source	L	Analog power common	It is common terminal of frequency command signal (O, O2, OI) and analogue output(AM, AMI). Do not connect to ground.	
		H	Frequency power	It is the DC+10V power for terminals.	Allowable load current 20mA
	Frequency setting	O	Frequency command power terminal (voltage)	When inputting DC 0 ~ 10V, the maximum frequency goes with 10V.	Input Impedance 10k ohm Allowable maximum voltage DC -0.3~+12V
		O2	Frequency command support (voltage)	When inputting DC 0 ~ ±10V, this signal is added to frequency command of 0 or 0I terminal.	Input Impedance 10k ohm Allowable maximum voltage DC 0~±12V
		OI	Frequency command Terminal (current)	When inputting DC 4 ~ 20mA, 20mA is maximum frequency. When only 'AT' terminal is ON, this input signal is effective.	Input Impedance 100 ohm Allowable maximum current 24mA
	Monitor	AM	Analog monitor (voltage)	DC 0~10V output voltage, DC 4~20mA output current : Output one selected from monitor item, output frequency, output current, torque, output voltage, input electric power, electric thermal rate, LAD frequency	Allowable maximum current 2mA
		AMI	Analog monitor (current)		Allowable output less than Impedance 250 ohm
Digital (connection)		FM	Digital monitor (voltage)	DC 0~10 voltage output(PWM output mode) : Output the output frequency with digital besides above monitor.	Allowable maximum current 1.2mA Maximum frequency 3.6kHz
	Power Source	P24	Interface power	It is DC24V power for connection input signal. When selecting source logic, it's for connection input common.	Allowable maximum output current 100mA
		CM1	Interface power common	The common terminal is FW terminal, 1 - 8 terminal, TH terminal, FM terminal. Do not connect to earth ground.	

	Symbol		Terminal Name	Explanation of contents	
Digital (connection)	Input signal	OP.	FW	Forward command	About FW signal, ON is Forward and OFF is stop command.	When use external electric power source: (The voltage between input and PLC) more than DC 18V
		Operation/Function Selection etc	1(RS) 2(AT) 3(JOG) 4(FRS) 5(2CH) 6(CF2) 7(CF1) 8(REV)	Input intelligent	Select 8 functions from 39 functions, and divide between 1 terminal and 8 terminals. REV(Reverse), CF1~CF4(Multi-speed bit 1~4), JOG(jogging), DB(External dc braking), SET2(2nd control), 2CH(2nd acceleration), 3CH(3rd acceleration), FRS(free-run stop), EXT(external trip), USP(USP function), SFT(software lock), AT(analog input change), RESET(reset), STA(3 wire run), STP(3wire keep), F/R(3wire direction selection), PID(PID selection valid/invalid), PID_C(PID integrating reset), UP(remote control, up function), DOWN(remote control down function), UDC(remote control data clear), OPE(compulsion operation), OLR(Overload restriction change), TL(torque limit exist or no), TRQ1(torque limit change1), TRQ2(torque limit change2), PPI, BOK(brake confirmation), ORT(orientation),} LAC(LAD cancel), PCLR(position deviation clear), STAT(90 degrees the phase difference permission), XT1, XT2, XT3 (Multi-step acceleration/deceleration time 1~3)	Input interface: (Between input and PLC) 4.7kΩ Allowable maximum voltage: (The voltage between input and PLC) 27V
			PLC	Intelligent input common	Change sink type and source type by short bar on control terminals. P24-PLC : Sink type CM1-PLC :Source type	
	Input signal	Condition/Alarm	11(FA1) 12(RUN) 13(OL) 14(OTQ)	Output intelligent	Open collect output 4 terminal RUN(Signal during run), FA1(Frequency arrival type 1 signal), FA2(Frequency arrival type 2 signal), OL(Overload advance notice signal), OD(Output deviation for PID control), ALM(Alarm signal), FA3(Arrival signal for only setting frequency), OTQ(Over torque), IP(Instantaneous stop signal), UV(Under voltage signal), TRQ(Torque limit), RNT(RUN time over), ONT(ON time over), THM(Thermal caution), BRK(Brake opening), BER(Brake error), ZS(Zero speed detect signal), DSE(Speed deviation excessive), POK(Positioning completion), FA4(Arrival signal for over setting frequency2), FA5(Arrival signal for only setting frequency2), OL2(Overload advance notice signal2), IPALM(Instantaneous power failure alarm signal), UVALM(Under voltage alarm signal)	Allowable maximum voltage DC27V Current 50mA(0.2W) Between 11~14teminal and CM2: Under 4V when ON.
			CM2	Output intelligent common	Common terminal for intelligent output 11~14 terminal. External electric power source common terminal.	
			AL0,RN0	AL Relay common RN Relay common	AL0 ; AL Relay common contact, RN0 ; RN Relay common contact	Allowable maximum AL1-AL0, RN1-RN0: AC250V, 2A(Resister), 0.2A(Induction)
			AL1,AL2	Alarm Relay output terminal	Assign output function. Output is C-contact.	AL2-AL0, RN2-RN0: AC250V, 1A(Resister), 0.2A(Induction)
			RN1,RN2	RUN Relay output terminal		
Analogue	Sensor		TH	Thermistor input terminal	When a thermistor is connected to terminals TH and CM1,the inverter checks for over-temperature and will cause trip event and turn off output to motor.	Allowable minimum Thermistor Power 100mW

Table 2- 3 Explanation of control circuit terminal

2.2.2   Main circuit wiring

(1)   Warning on wiring

When carrying out work on the inverter wiring make sure to wait for at least ten minutes before you remove the cover. Be sure to verify that the charge lamp is not illuminated.

A final check should always be made with a voltage meter.

After removing the power supply, there is a time delay before the capacitors will dissipate their charge.

① Main power terminals (R, S and T)
- Connect the main power terminals (R, S and T) to the power supply through an electromagnetic contactor or an earth-leakage breaker.
  N700 recommends connecting the electromagnetic contactor to the main power terminals, because when the protective function of the inverter operates, it isolates the power supply and prevents the spread of damage and accident.
- This unit is for a three-phase power supply. Be sure not to power a three-phase only inverter with single phase power. Otherwise, there is the possibility of damage to the inverter and the danger of fire.
- If you require a single phase power supply unit, please contact your local HYUNDAI Branch.
- The inverter enters into the following condition at the occurrence of open phase if it is selected open phase protection is valid :
    - R phase, S phase or T phase, open phase condition:
      It becomes single-phase operation condition. Trip operation, such as a deficiency voltage or over current, may occur.
- Don't use it under open phase condition. A converter module may be damaged as a result of the following conditions. Use caution when
    - an unbalance of the power supply voltage is more than 3%
    - Power supply capacity is more than 10 times of the capacity of inverter and case beyond 500kVA.
    - A drastic change in the power supply
  (Example)   Turning on/off of the power supply should not be done more than three times in one minute. It has the possibility of damaging the inverter.

② Inverter output terminals (U, V, and W)
- Using a heavier gauge wire can prevent the voltage drop. (refer to page 15)
  Particularly when outputting low frequencies, the torque of the motor will be reduced by the voltage drop of the wire.
  Do not install power factor correction capacitors or a surge absorber to the output.
  The inverter will trip or sustain damage to the capacitors or the surge absorber.
- In the case of the cable length being more than 65 feet, it is possible that a surge voltage will be generated and damage to the motor is caused by the floating capacity or the inductance in the wire. When an EMC filter is to be installed, please contact your local HYUNDAI branch.
- In the case of two or more motors, install a thermal relay to each motor.

- Make the RC value of the thermal relay the value of 1.1 times of motor rated electric current.

③ Direct current reactor (DCL) connection terminals (PD, P)
- These are the terminals to connect the current reactor DCL (optional) to help improve the power factor.
- The short bar is connected to the terminals when shipped from the factory, if you are to connect a DCL you will need to disconnect the short bar first.
- When you do not use a DCL, do not disconnect the short bar.

④ External braking resistor connection terminals (P, RB)
- The regenerative braking circuit (BRD) is built-in as standard up to the 22^{kW}(30HP) inverter.
- When braking is required, install an external-braking resistor to these terminals.
- The cable length should be less than 16 feet, and twist the two connecting wires to reduce inductance.
  Do not connect any other device other than the external braking resistor to these terminals.
- When installing an external braking resistor make sure that the resistance is correctly rated to limit the current drawn through the BRD.

⑤ Regenerative breaking unit connection terminals (P, N)
- The Inverters rated more than 30^{kW} don't contain a BRD circuit. If regenerative braking is required an external BRD circuit (Option) is required along with the resistor (Option).
- Connect external regenerative braking unit terminals (P, N) to terminals (P, N) on the inverter.
- The braking resistor is then wired into the External Braking unit and not directly to the Inverter.
- The cable length should be less than 5 meters, and twist the two connecting wires to reduce inductance.

⑥ Earth Ground (G)
- Make sure that you securely ground the inverter and motor for prevention of electric shock.
- The inverter and motor must be connected to an appropriate safety earth ground and follow all local electrical codes.
- In case connecting 2 or more inverters, use caution not to use a loop which can cause some malfunction of the inverter.
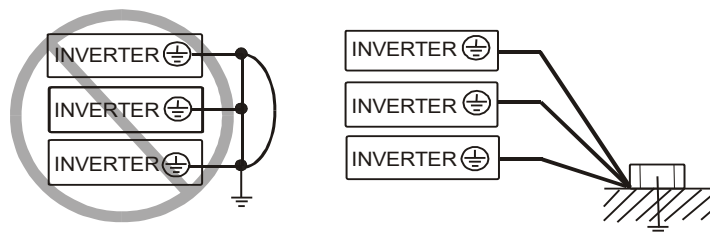
Fig. 2- 6 Earth Ground (G)

(2) Wiring of main circuit terminals

The wiring of main circuit terminals for the inverter are in the following pictures.

Wiring of terminals	Corresponding type
R (L1) **S** (L2) **T** (TI) **U** (TI) **V** (T2) **W** (T3) **PD** (+1) **P** (+) **N** (-) **RB** **G** ⊥ **G** ⊥ Short bar →	N700− 055LF/075LF/110LF 055HF/075HF/110HF ＊ Screw size：M5
R (L1) **S** (L2) **T** (L3) **PD** (+1) **P** (+) **N** (-) **RB** **U** (T1) **V** (T2) **W** (T3) **G** ⊥ Short bar →	N700− 150LF/185LF/ 150HF/185HF/220HF ＊ Screw size：M6
R (L1) **S** (L2) **T** (L3) **PD** (+1) **P** (+) **N** (-) **RB** **U** (T1) **V** (T2) **W** (T3) Short bar →	N700− 220LF ＊ Screw size：M8
R (L1) **S** (L2) **T** (L3) **PD** (+1) **P** (+) **N** (-) **U** (T1) **V** (T2) **W** (T3) Short bar →	N700− 300LF/370LF/450LF 300HF/370HF/450HF/ 550HF/750HF/900HF ＊ Screw size：M8
	N700− 550LF N700− 1100HF～1320HF ＊ Screw size：M10

Table 2- 4 Wiring of main circuit terminals

(3) Applicable Tools

Three phase Power supply

MCCB

(1)

(2)

MC

(3)

(4)

R S T PD
INVERTER
P
RB
N

U V W

(5)

(6)

(7)

(8)

(9)
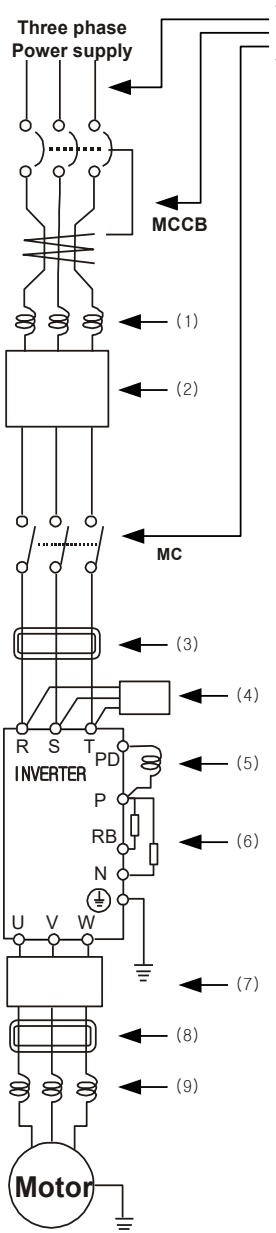
Motor

Refer to the "Table 2-7 Common Application Tools" on page 16.

(Note1)　The applicable tools indicate for standard four-pole squirrel-cage Motor.

(Note2)　Select applicable tools for breakers examining the capacity of breakers.(Use Inverter type.)

(Note3)　Power lines should be used a heavier gauge wire, if the distance exceeds 20m.

(Note4)　Use earth-leakage breakers (ELB) for safety.

Separate by the sum(wiring distance from Inverter to power supply, from inverter to motor for the sensitive current of leak breaker (ELB).

Wiring distance	Sensitive Current(mA)
100m and less	50
300m and less	100

Table 2- 5 Sensitive current according to wiring distance

(Note5)　Use 0.75mm^2 for AL Relay and RN Relay.

(Note6)　When using CV line and wiring by rigid metal conduit, leak flows.

(Note7)　IV line is high dielectric constant. So the current increase 8 times.

Therefore, use the sensitive current 8 times as large as that of the left list. And if the distance of wire is over 100m, use CV line.

	Name	Function
(1)	Input reactor (harmonic control, electrical coordination, power-factor improvement)	This part is used when the unbalance voltage rate is 3% or more and power supply is 500 kVA or more, and there is a rapid change in the power supply. It also improves the power factor.
(2)	Radio noise filter (zero-phase reactor)	Using the inverter may cause noise on the peripheral radio through the power lines. This part reduces noise.
(3)	Noise filter for Inverter	This part reduces common noise generated between the power supply and the ground, as well as normal noise. Put it in the primary side of inverter.
(4)	Input radio noise filter (capacitor filter)	This part reduces radiation noise emitted from wire at the input.
(5)	Direct reactor	This part control harmonic from inverter.
(6)	Breaking resistor Regenerative breaking unit	This part is used for applications that need to increase the brake torque of the inverter or to frequently turn on and off and to run high inertia load.
(7)	Output noise filter	This part reduces radiation noise emitted from wire by setting between inverter and motor. And it reduces wave fault to radio and TV, it is used for preventing malfunction of sensor and measuring instruments.
(8)	Radio noise filter(zero-phase reactor	This part reduces noise generated at the output of the inverter. (It is possible to use for both input and output.)
(9)	Output alternation reactor Reducing vibration, thermal Relay, preventing misapplication	Running motors with the inverter generates vibration greater than that with commercial power supply. This part installed between the inverter and motor reduces torque ripple. When the cable length between the inverter and motor is long (10m or more), a countermeasure for a malfunction of the thermal relay by harmonic due to switching on inverter is taken by inserting reactor. There is the way to use current sensor in stead of thermal relay.
	LCR filter	Sine-wave filter at the output.

Table 2- 6 Optional accessories for improved performance

(4) Common applicable tools

Class	Motor Output kW(HP)	Inverter model	Power lines R,S,T U,V,W, P,PD,N (㎟)	External resister between P and RB (㎟)	Screw size of Terminal	Torque (N•m)	Applicable Tools Leak breaker (MCCB)		Electromagnetic Controller (MC)
200V class	5.5(7.5)	N700−055LF	More than 6	6	M5	3.0	UCB100R	50A	HiMC32
	7.5(10)	N700−075LF	More than 10	6	M5	3.0	UCB100R	50A	HiMC32
	11(15)	N700−110LF	More than 16	6	M5	3.0	UCB100R	75A	HiMC50
	15(20)	N700−150LF	More than 25	16	M6	4.5	UCB100R	100A	HiMC65
	18.5(25)	N700−185LF	More than 30	16	M6	4.5	UCB250S	150A	HiMC80
	22(30)	N700−220LF	More than 35	16	M8	6.0	UCB250S	150A	HiMC110
	30(40)	N700−300LF	More than 25X2	–	M8	6.0	UCB250S	200A	HiMC130
	37(50)	N700−370LF	More than 35X2	–	M8	6.0	UCB250S	225A	HiMC150
	45(60)	N700−450LF	More than 35X2	–	M8	6.0	UCB400S	250A	HiMC220
	55(75)	N700−550LF	More than 70X2	–	M10	10.0	UCB400S	300A	HiMC220
400V class	5.5(7.5)	N700−055HF	More than 40이상	4	M5	3.0	UAB30C	30A	HiMC18
	7.5(10)	N700−075HF	More than 4	4	M5	3.0	UAB30C	30A	HiMC18
	11(15)	N700−110HF	More than 6	6	M5	3.0	UCB100R	50A	HiMC32
	15(20)	N700−150HF	More than 10	10	M6	4.5	UCB100R	50A	HiMC40
	18.5(25)	N700−185HF	More than 16	10	M6	4.5	UCB100R	75A	HiMC40
	22(30)	N700−220HF	More than 25	10	M6	4.5	UCB100R	75A	HiMC50
	30(40)	N700−300HF	More than 25	–	M8	6.0	UCB100R	100A	HiMC65
	37(50)	N700−370HF	More than 35	–	M8	6.0	UCB250S	100A	HiMC80
	45(60)	N700−450HF	More than 35	–	M8	6.0	UCB250S	150A	HiMC110
	55(75)	N700−550HF	More than 70	–	M8	6.0	UCB250S	175A	HiMC130
	75(100)	N700−750HF	More than 35X2	–	M8	6.0	UCB400S	250A	HiMC180
	90(125)	N700−900HF	More than 35X2	–	M8	6.0	UCB400S	250A	HiMC220
	110(150)	N700−1100HF	More than 50X2	–	M10	10.0	UCB400S	350A	HiMC260
	132(200)	N700−1320HF	More than 80X2	–	M10	10.0	UCB400S	350A	HiMC300

Table 2- 7 Common applicable tools

2.2.3   Terminal connection diagram

(1) Terminal connection diagram

① The control circuit terminal of inverters is connected with the control board in unit.
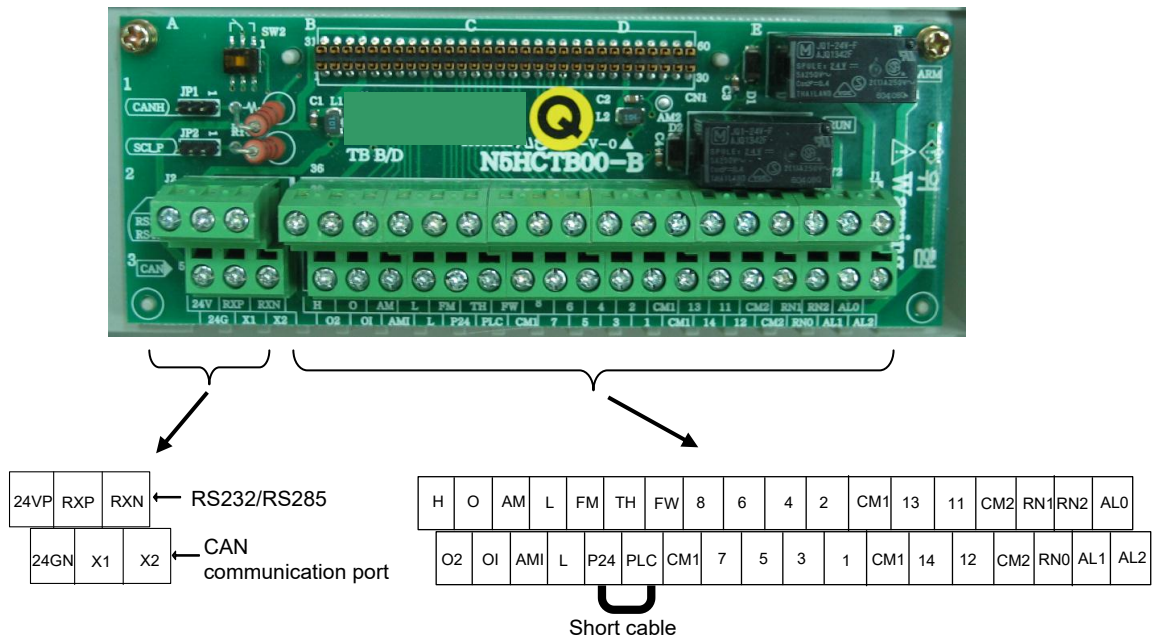
Fig. 2- 7 Terminal connection diagram

(2) Wiring

① Both the CM1 and L terminals are insulated to both the common terminal of the input and output signals.

Do not short or connect to ground these common terminals.

② Use twisted screened cable, for the input and output wires of the control circuit terminals. Connect the screened cable to the common terminal.

③ Limit the connection wires to 65 feet.

④ Separate the control circuit wiring from the main power and relay control wiring.
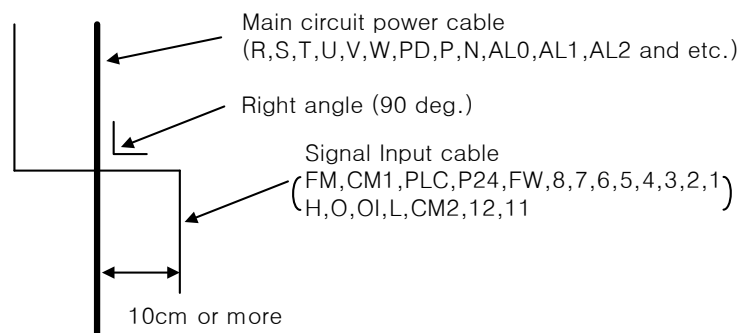
⑤ When using relays for the FW terminal or an intelligent input terminal use a control relay that is designed to work with 24Vdc.

⑥ When a relay is used as an intelligent output, connect a diode for surge protection parallel to the relay coil.

⑦ Do not short the analog voltage terminals H and L or the internal power terminals PV24 and all CM1's. Otherwise there is risk of Inverter damage.

⑧ When connecting a thermistor to the TH and all CM1's terminal, twist the thermistor cables and separate them from the rest. Limit the connection wires to 65 feet.

(3) Change of input logic type

The logic type of intelligent input terminals is on the following list (Factory Default).

N700 Inverter(5.5ᵏᵂ ~ 132ᵏᵂ)	Sink TYPE

The input logic type can be changed by changing the Short bar connection of control terminal.

Sink type	Between P24 and PLC on the control terminal.
Source type	Between PLC and CM1 on the control terminal.

(4) The connection to the input programmable logic controller (sequencer)
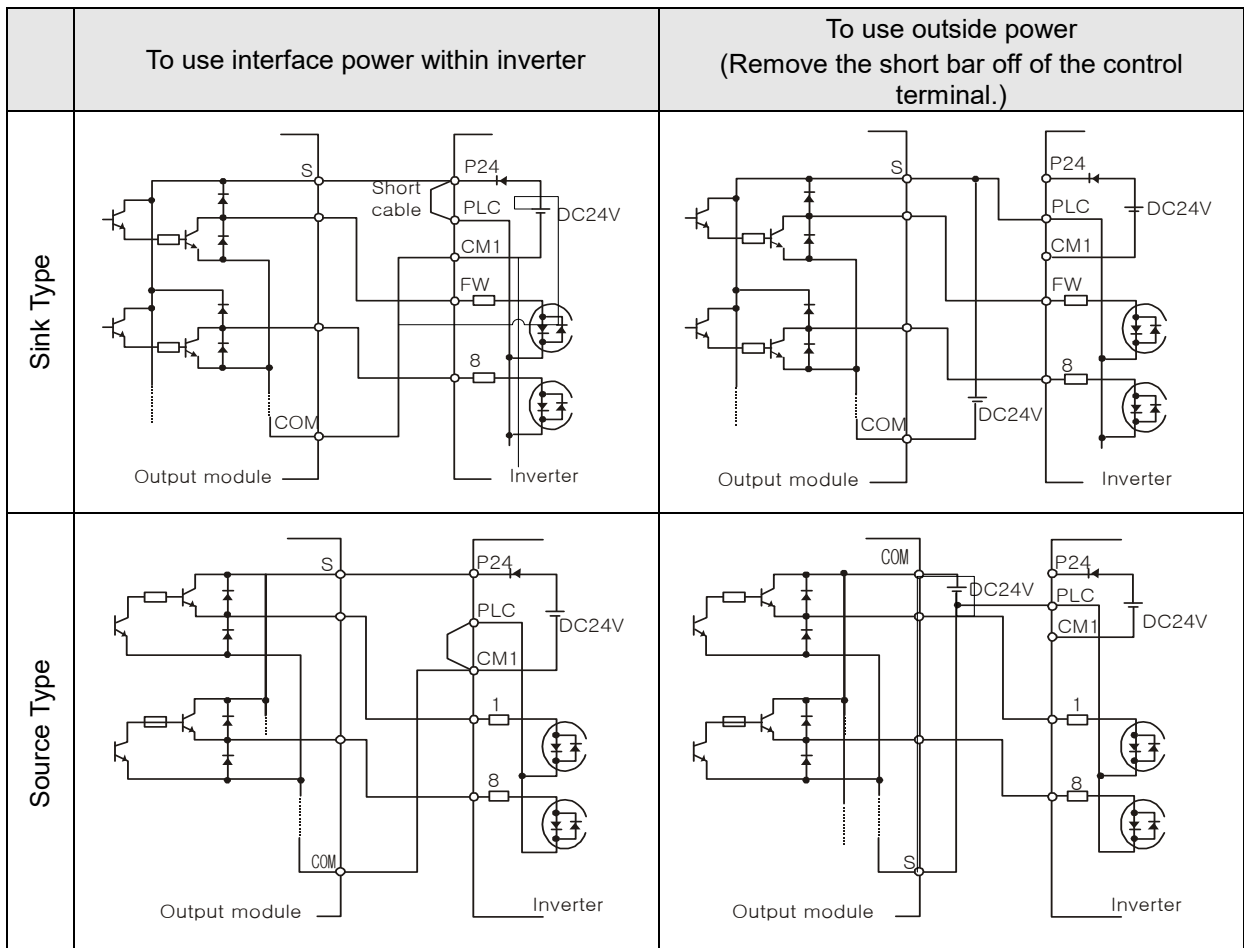
(5) The connection to the output programmable logic controller (sequencer)
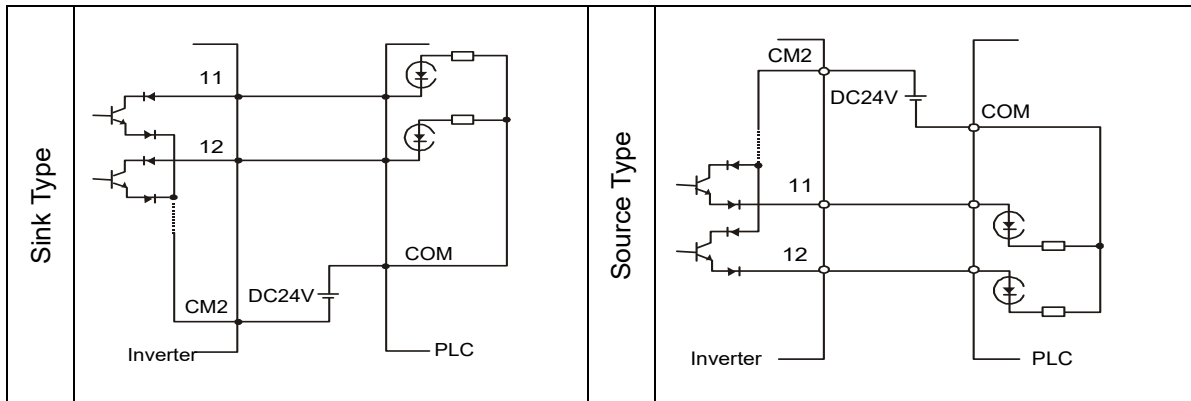
2.2.4   Digital operator wiring

For operating this inverter, it can use digital operator OPE- N7.

For remote operation, remove the digital operator from the inverter and use the optional connector NOP1-1A(4.9feet) or NOP1-3A(10 feet) to connect the digital operator cable. When using connector cable, be sure to use less than 10 feet long. Otherwise, there is a danger of malfunction.

3.   OPERATION

⚠WARNING

- Be sure not to touch the main terminal or to check the signal add or remove wires and/or connectors.
  Otherwise, there is a danger of electric shock.

- Be sure not to turn the input power supply on until after front case is closed.
  While the inverter is energized, be sure not to remove the front cover.
  Otherwise, there is a danger of electric shock.

- Be sure not to operate the switches with wet hands.
  Otherwise, there is a danger of electric shock.

- While the inverter is energized, be sure not to touch the inverter terminals even while the unit is not running.
  Otherwise, there is a danger of electric shock.

- If the retry mode is selected, it may suddenly restart during the trip stop.
  Be sure not to approach the equipment.(Be sure to design the equipment so that personnel safety will be secured even if equipment restarts.)
  Otherwise, there is a danger of injury.

- Be sure not to select retry mode for up and down equipment or traveling equipment, because there is an output free-running mode in term of retry.
  Otherwise, there is a danger of injury and/or machine breakage

- Even if the power supply is cut for a short period of time, the inverter may restart operation after the power supply is restored if the operation command is given.
  If a restart may incur danger to personnel, be sure to make a circuit so that it will not restart after power recovery.
  Otherwise, there is a danger of injury.

- The stop key is valid only when a function is on. Ensure that there is a hard wired emergency stop that is separate from the stop key of the inverter.
  Otherwise, there is a danger of injury.

- With the operation command on, if the alarm reset is ordered, the inverter can restart suddenly. Be sure to set the alarm reset after checking the operation command is off.
  Otherwise, there is a danger of injury.

- Be sure not to touch the inside of the energized inverter or to put a bar into it.
  Otherwise, there is a danger of electric shock and/or fire.

⚠ CAUTION

- The cooling fins will have high temperature. Be sure not to touch them.
  Otherwise, there is a danger of getting burned.

- Low to high speed operation of the inverter can be easily set. Be sure to operate it after checking the tolerance of the motor and machine.
  Otherwise, there is a danger of injury.

- Install an external breaking system if needed.
  Otherwise, there is a danger of injury.

- If a motor is operated at a frequency higher than standard setting value(50Hz / 60Hz), be sure to check the speeds of the motor and the machine from their manufacturers. After getting their consent, operate them.
  Otherwise, there is a danger of machine breakage.

3.1   Operating

This inverter requires two different signals in order for the inverter to operate correctly. The inverter requires both an operation setting and a frequency setting signal.

The following indicates the details of each method of operation and necessary instructions for operation.

3.1.1   Operation setting and a frequency setting by the terminal control.
(1) This is the method which controls the inverter by connecting the control circuit terminals with signals from the outside(the frequency setting, the starting switch etc.).
(2) The operation is started when the operation setting (FW, REV) is turned ON while the input power is turned ON.
   (Note) The methods of setting the frequency with the terminal are the voltage setting and the current setting. Both are selective. The control circuit terminal list shows necessary things for each setting.
   ① The operation setting : switch, relay, etc.
   ② The frequency setting: signals from volume or external (DC 0∼10V, DC 0∼±10V, 4∼20mA etc.)

3.1.2   Operation setting and frequency setting with the digital operator.
(1) This is the method of operation from the digital operator, which is supplied with the inverter as standard, or the optional remote operator keypad (OPE. KEYPAD) and volume (OPE. VOL).
(2) When the inverter is being controlled by digital operator, the terminals (FW, REV) are not available. Frequency can be also controlled by digital operator.

3.1.3   Operation setting and frequency setting from both the digital operator and the terminal operator
(1) This is the method of inverter operating from both of the above two operating methods.
(2) The operation setting and the frequency setting can be done through the digital operator and the terminal operator.

3.2   Test Run

This is an example of a common connection. Please refer to 4.1 Digital Operator, for the detailed use of the digital operator (OPE-N7).

3.2.1   To input the operation setting and the frequency setting from the terminal control.
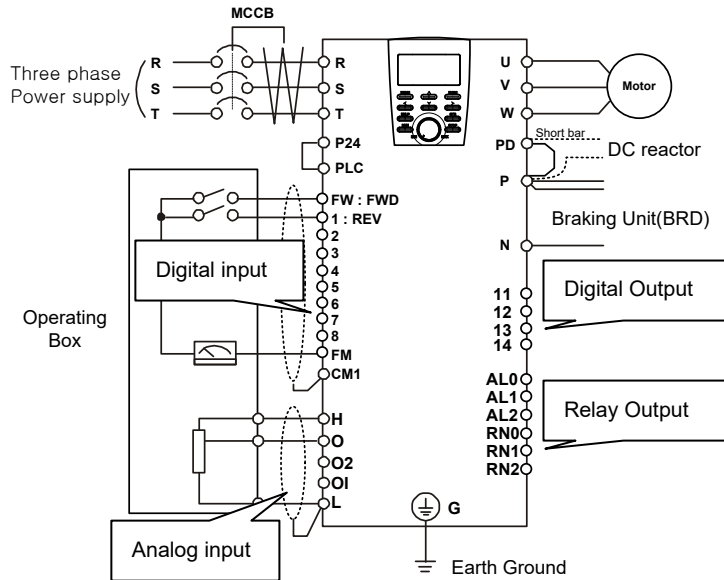
Fig. 3- 1 Setting diagram from the terminal control

(Procedure)

(1) Please make sure that the connections are secured correctly.

(2) Turn the MCCB on to supply power to the inverter.
(The LED "POWER" on the operator should illuminate)

(3) Set the terminal with the frequency setting selection.
Set F010 as the indication code, press the (FUNC) key once. (Code values are shown)
Set 1(Terminal) with (UP/DOWN) key, press the (STR) key once to set the frequency setting for the operator.(Indication code turns back to F010.)

(4) Set terminal with the operation setting selection.
Set F011 as indication code, press the (FUNC) key once.
Set 1(terminal) with the (UP/DOWN) key, press the (STR) key once to set the frequency setting for the operator.(Indication code turns back to F011.)

(5) Set Monitor mode
When monitoring the output frequency, set indication code to d001, and press the (FUNC) key. Or when monitoring the operation direction, set indication code to d002, and press the (FUNC) key.

(6) Input starting operation setting.
Turn ON between [FW] and [CM1] of terminal.
Apply voltage [O] and [L] of terminal to start operation.

(7) Input ending operation setting.
Turn OFF between [FW] and [CM1] to slowly stop.

3.2.2   Operation setting and the frequency setting from the digital operator
(Remote operator is also same use.)
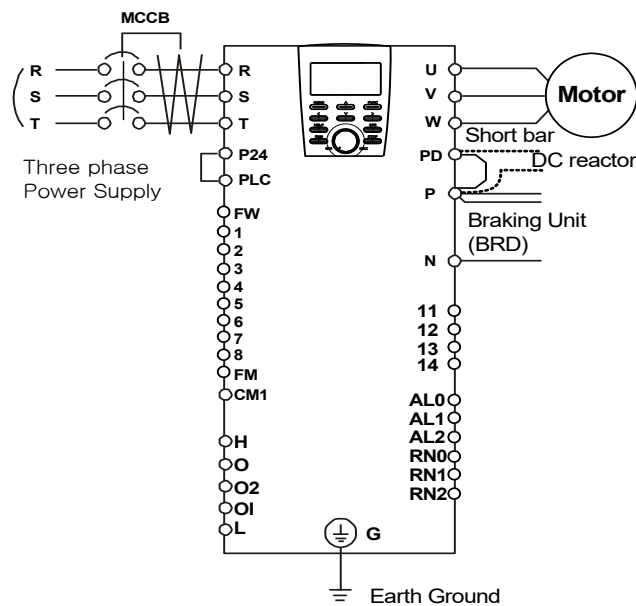
Fig. 3- 2 Setting diagram from the digital operator

(Procedure)

(1) Please make sure that connection is right.

(2) Turn the MCCB on to supply power to the inverter.
(The LED "POWER" on the operator should   illuminate)

(3) Set the operator with the frequency setting selection.
① Set F010 as indication code, press the (FUNC) key once.
(Code values are shown)

② Set 2(OPE KEYPAD) with (UP/DOWN) key, press the (STR) key once to set the frequency setting for the operator. (Indication code turns back to F010.) [Setting method by OPE-N7]

(4) Set the operator with the operation setting selection.
Set F011 as the indication code, press the (FUNC) key once.
Set 2(OPE) with (UP/DOWN) key, press the (STR) key once to set the frequency setting for the operator. (Indication code turns back to F011.)

(5) Set the output frequency
① Set F001 as indication code, by pressing the (FUNC) key once. (Code values are shown.)
② Set to the desired output frequency with the (UP/DOWN) key, press the (STR) key once to store it.

(6) Set Monitor mode
① When monitoring the output frequency, set indication code to d001, and press the (FUNC) key once.
② Or when monitoring the operation direction, set indication code to d002, press the (FUNC) key once.

(In the case of OPE-N7, indication codes are Forward, Reverse, or Stop.)

(7) Press the ⟨ RUN ⟩ key to start operating.

  (The "RUN" lamp turns on a light, and the indication changes in response to the monitor mode set.)

(8) Press the ⟨ STOP ⟩ key to decelerate to a stop.
  (When the frequency returns to 0, the RUN lamp light will switch off.)

⚠ **CAUTION**
● Make sure that the direction of the motor is correct. Otherwise, there is danger of injury or equipment damage.
● Make sure there is no abnormal noise and vibration. Otherwise this is a danger of injury or equipment damage.

Make sure that the inverter does not trip during the acceleration and deceleration and check that the revolutions per minute and the frequency reading are correct.

When overcurrent tripping or overvoltage tripping occurs during the test run, increase the acceleration time or the deceleration time.

4. PARAMETER CODE LIST

4.1 About Digital Operator

The inverter operates by using the digital operator OPE-N7, which is fitted as standard.

4.1.1 Name and contents of each part of Standard-type digital operator (OPE-N7)

(1) Part name

[OPE-N7 Part name]   [OPE-N7 External]
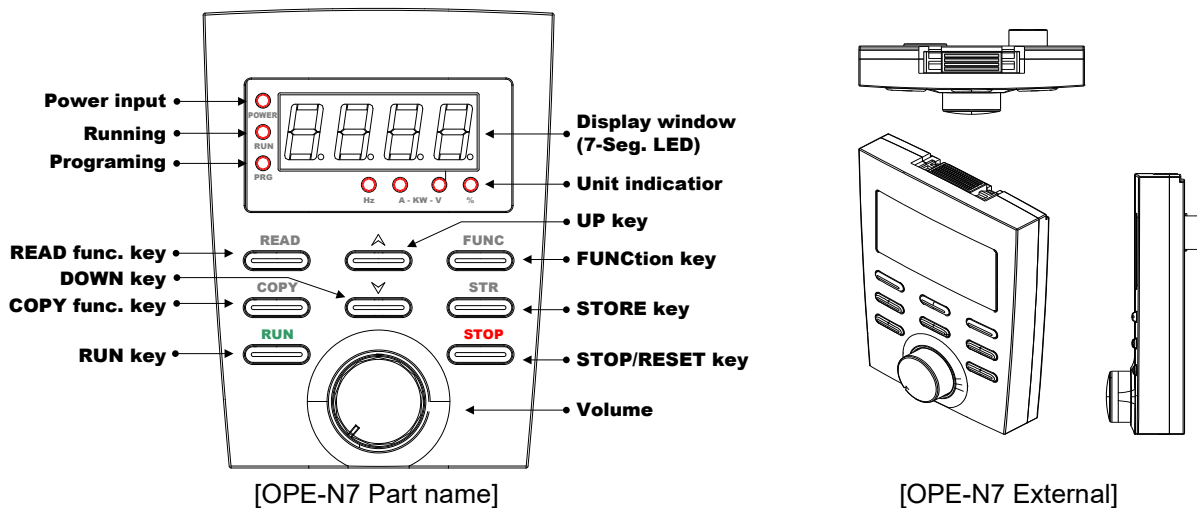
Fig. 4- 1   OPE-N7 Part name and External View

The front panel controls and indicators are described as follows:

Name	Indication	Contents
Display window	7-Segment	A 4-digit, 7 segment display for parameters and function codes
POWER LED (Power lamp)	POWER	This LED is ON when the power input to the inverter is on.
RUN LED (Running lamp)	RUN	ON when the inverter output is on and the motor is developing torque, and OFF when the inverter output is off (STOP Mode).
PRG LED (Programming lamp)	PRG	This LED is ON when the inverter is ready for parameter editing(Program mode). It is normally OFF when the parameter display is monitoring data(Monitor mode).
Monitor indicator (Monitor lamp)	Hz/A/V/kW/%	Lamp that marks monitor department's indication state Hz : Frequency, V : Voltage, A : Current, kW : Electric power (both V and A LED will be ON), % : Rate
READ function key	READ	The key to read the inverter parameter to the operator.
COPY function key	COPY	The key to copy the operator parameter to the inverter
UP/DOWN key	$\wedge$ $\vee$	The key to change extension mode, function mode and set value.
FUNCTION key	FUNC	The key containing monitor mode, basic setting mode, extension functions mode.
STORE key	STR	The key to store the data setting values.(On changing a set

Name	Indication	Contents
		value, must be pushed or value is lost.)
RUN key	RUN	Run command to start the motor. But this is only valid when operation command is from the operator. (Be sure that the operation command display lamp is illuminated)
STOP/RESET key	STOP	This key is used to stop the motor, or reset an alarm.
Volume	-	Allows an operator to directly set the motor speed when the potentiometer is enabled for output frequency setting method.

(2) Operation Method

① keypad navigation map (Method to display monitor mode, basic setting mode, extension function mode)

■ Mode change   ■ Parameter setting
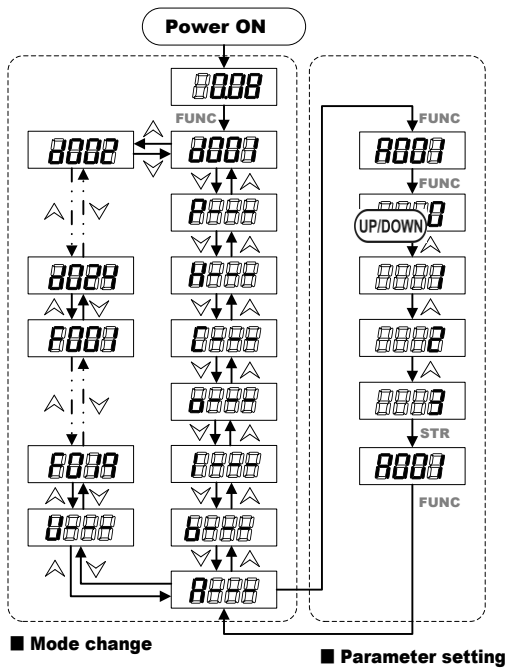
1) Initial value :
- Display of monitor contents set when power is turned on.
- Display output frequency d001 : 0.00 [Hz]

2) Changing between function mode
- Function mode is changed using the (FUNC) key and the (UP/DOWN) key.
- display monitor code No.(Display d001)
  (ex: 0.00 → push the (FUNC) key 1 times → d001)
  Monitor mode is displayed by pushing the (FUNC) key once
  when display of monitor mode is NO.
- display extension function mode(Display A--)
  (ex : A001 → push the (FUNC) key 1 times → A---)
  Except the monitor mode and F-Group.
- extension function mode display in order of A↔b↔I↔o↔C↔H↔P.

When power is turned off while the basic setting mode or the extension setting mode is displayed, the display will be different from the above when the power is restored.

It is possible to shift to other extension function modes, monitor modes and basic modes in [A--, b--, I--, o--, C--, H--, P--] state.

② Key explanation

[Function key (FUNC)]   : This key is used to navigate through the lists of parameters and functions for setting and monitoring parameter values.
If this key is pressed, mode is changed as below
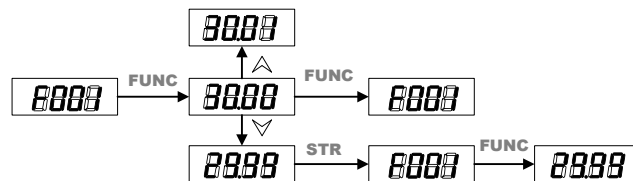
Note1) Please press the (STR) key to write the new value to the memory after data modification.

Note2) To edit the parameters, the inverter must be in Program mode(PRG LED will be ON).

[UP/DOWN key($\wedge$/$\vee$)]	: Use these keys alternately to move up or down the lists of parameters and functions shown in the display, and increase/decrease values.
[Run key(RUN)]	: Press this key to run the motor. Parameter F009 determines the rotor direction of the motor (FWD or REV).
[Stop key(STOP)]	: Press this key to stop the motor when it is running. This key will also reset an alarm that has tripped.

③ keypad navigational map 2(Setting method of function and code values)
Changes operation command parts and sets the output frequency value.
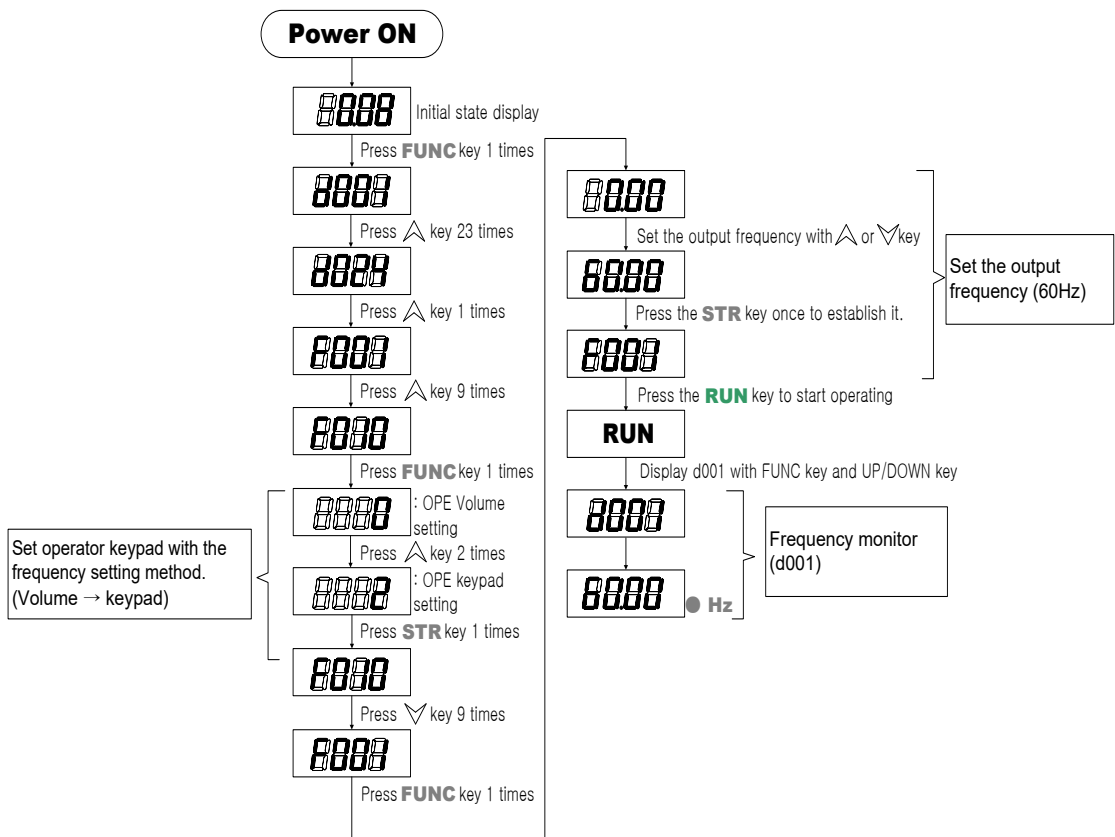
4.2　Code List

4.2.1　Monitor mode(d-group)

Code	Function name	Setting range	Initial Data	Change mode on run	Page
d001	Output frequency monitor	0~99.99/100.0~400.0[Hz]	0.00	-	44
d002	Driving direction monitor	F(forward), r(reverse), o(stop)	o	-	44
d003	Output current monitor	0.0~999.9[A]	0.0	-	44
d004	Output voltage monitor	0.0~999.9[V]	0.0	-	44
d005	DC link voltage monitor	0.0~999.9[V]	--	-	44
d006	Motor input power monitor	0.0~999.9[kW]	0.0	-	44
d007	Output torque monitor	-300~300[%]	0	-	45
d008	Number of motor rotation	0~9999[RPM]	0	-	45
d009	PID Feedback monitor	0~9999 (= PID F/B × C026) [%]	0.00	-	45
d010	Intelligent input terminal monitor	Display the state of the intelligent input terminals	-	-	45
d011	Intelligent output terminal monitor	Display the state of the intelligent output terminals	-	-	45
d012	Frequency conversion monitor	0~99.99/100.0~400.0 (=d001xb009)	0.00	-	46
d013	Accumulated time monitor during RUN(Hr)	0~9999./1000~6553[Hr]	0	-	46
d014	Accumulated time monitor during RUN (Min)	0~59[Min]	0	-	46
d015	Power on time monitor(Hr)	0~9999./1000~6553[Hr]	0	-	46
d016	Power on time monitor(Min)	0~59[Min]	0	-	46

Table 4- 1 Basic Display

4.2.2　Trip & Warning monitor mode(d-group)

Code	Function name	Setting range	Initial Data	Change mode on run	Page
d017	IGBT temperature monitor	0~9999[℃]	--	-	46
d018	Trip counter	Display the number of inverter trips.	0	-	46
d019	Trip monitor 1	Display the details for the last six protective trips. Trip code, frequency[Hz], current[A], the direct voltage (between P and N) on tripping[V].	--	-	46
d020	Trip monitor 2		--	-	46
d021	Trip monitor 3		--	-	46
d022	Trip monitor 4		--	-	46
d023	Trip monitor 5		--	-	46
d024	Trip monitor 6		--	-	46

Table 4- 2 Trip & Warning monitor

4.2.3 Fundamental functions(F-group)

Code	Function name	Setting range	Initial Data	Change mode on run	Page
F001	Output frequency setting	0~99.99/100.0~400.0[Hz]	0.00	○	48
F201	Output frequency setting, 2nd motor	0~99.99/100.0~400.0[Hz]	0.00	○	48
F002	Base frequency setting	30.00~99.99/100.0~400.0, up to max. frequency[Hz]	60.00	x	48
F202	Base frequency, 2nd motor	30.00~99.99/100.0~400.0, up to max. frequency[Hz]	60.00	x	48
F003	Maximum frequency setting	30.00~99.99/100.0~400.0, from base frequency[Hz]	60.00	x	49
F203	Maximum frequency setting, 2nd motor	30.00~99.99/100.0~400.0, from base frequency[Hz]	60.00	x	49
F004	Starting frequency setting	0.10~10.0[Hz]	0.50	○	50
F005	Frequency upper limit	0~99.99/100.0~400.0[Hz] Frequency min. ~ Max. frequency	0.00	○	50
F205	Frequency upper limit, 2nd motor	0~99.99/100.0~400.0[Hz] Frequency min. ~ Max. frequency	0.00	○	50
F006	Frequency lower limit	0~99.99/100.0~400.0[Hz] Starting frequency ~ Max. frequency	0.00	○	50
F206	Frequency lower limit, 2nd motor	0~99.99/100.0~400.0[Hz] Starting frequency ~ Max. frequency	0.00	○	50
F007	Accelerating time setting	0.1~999.9,1000.~3600.[sec]	30.0	○	51
F207	Accelerating time setting, 2nd motor	0.1~999.9,1000.~3600.[sec]	30.0	○	51
F008	Decelerating time setting	0.1~999.9,1000.~3600.[sec]	30.0	○	51
F208	Decelerating time setting, 2nd motor	0.1~999.9,1000.~3600.[sec]	30.0	○	51
F009	Driving direction selection	0(FWD), 1(REV)	0	x	52
F010	Frequency source selection	0(OPE VOL), 1(TERMINAL), 2(OPE KEYPAD), 3(COM), 4(CAN), 5(OPT2)	0	x	52
F011	RUN command source selection	1(TERMINAL), 2(OPE), 3(COM), 4(CAN), 5(OPT2)	2	x	53
F012	Motor control method	0(VC), 1(VP1), 2(VP2), 3(FREE V/f), 4(SLV-I), 5(SLV-D) 6(V2), 7(0Hz-V2)	0	x	54
F212	Second motor control method	0(VC), 1(VP1), 2(VP2), 3(FREE V/f), 4(SLV-I), 5(SLV-D)	0	x	54
F013	Motor voltage selection (Motor rated voltage)	200/215/220/230/240[V] 380/400/415/440/460/480[V]	220 (440)	x	56
F014	Output voltage gain	20~100[%]	100	○	56
F015	Motor capacity selection (Motor rated capacity)	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/ 30/37/45/55/75/90/110/132/160 [kW]	Factory setting	x	56
F215	2nd Motor capacity selection (Second motor rated capacity)	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/ 30/37/45/55/75/90/110/132/160 [kW]	Factory setting	x	56
F016	Motor pole selection	2/4/6/8/10/12[Pole]	4	x	57
F216	Second motor pole selection	2/4/6/8/10/12[Pole]	4	x	57
F017	Motor rated current setting	0.0~999.9[A]	Factory setting	x	57
F217	Second motor rated current	0.0~999.9[A]	Factory setting	x	57
F018	Speed/Torque mode selection	0(Speed control mode)/1(Torque control mode)	0	x	57
F019	SLV control method selection	0(Normal operation mode), 1(0Hz operation mode)	0	x	57

Table 4- 3 Fundamental functions(F-group)

4.2.4 User setting functions(U-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
U001	User 1 selection	No/d001~P024	F013	○	-
U002	User 2 selection	No/d001~P024	F015	○	-
U003	User 3 selection	No/d001~P024	F016	○	-
U004	User 4 selection	No/d001~P024	F017	○	-
U005	User 5 selection	No/d001~P024	F010	○	-
U006	User 6 selection	No/d001~P024	F011	○	-
U007	User 7 selection	No/d001~P024	F001	○	-
U008	User 8 selection	No/d001~P024	F007	○	-
U009	User 9 selection	No/d001~P024	F008	○	-
U010	User 10 selection	No/d001~P024	F012	○	-
U011	User 11 selection	No/d001~P024	d001	○	-
U012	User 12 selection	No/d001~P024	d002	○	-
U013	User 13 selection	No/d001~P024	d003	○	-
U014	User 14 selection	No/d001~P024	d004	○	-
U015	User 15 selection	No/d001~P024	d005	○	-
U016	User 16 selection	No/d001~P024	d008	○	-

Table 4- 4 User setting functions(U-group)

4.2.5 Operating curve setting(A-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
A001	Acceleration pattern	0(Line), 1(S_Curve), 2(U_Curve), 3(RU_Curve)	0	x	58
A201	Acceleration pattern, 2nd motor	0(Line), 1(S_Curve), 2(U_Curve), 3(RU_Curve)	0	x	58
A202	Deceleration pattern, 2nd motor	0(Line), 1(S_Curve), 2(U_Curve), 3(RU_Curve)	0	x	58
A002	Deceleration pattern	0(Line), 1(S_Curve), 2(U_Curve), 3(RU_Curve)	0	x	58
A003	Acceleration curvature	1~10	8	x	58
A004	Deceleration curvature	1~10	8	x	58
A005	Acceleration stop frequency	0.00~Max. Frequency[Hz]	0.00	○	59
A006	Acceleration stop time	0~60.00[sec]	0.00	○	59
A007	Acceleration /Deceleration selection 2	0(2 Channel), 1(A010/A011)	0	x	59
A207	Acceleration /deceleration 2 selection, 2nd motor	0(2 Channel), 1(A010/A011)	0	x	59
A008	Acceleration time 2	0.1~999.9,1000.~3600.[sec]	30.0	○	59
A208	Acceleration time 2, 2nd motor	0.1~999.9,1000.~3600.[sec]	30.0	○	59
A009	Deceleration time 2	0.1~999.9,1000.~3600.[sec]	30.0	○	59
A209	Deceleration time 2, 2nd motor	0.1~999.9,1000.~3600.[sec]	30.0	○	59
A010	Acceleration frequency 2	0.00~99.99/100.0~400.0[Hz]	0.00	x	59

Operating curve setting (A-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
A210	Acceleration frequency 2, 2nd motor	0.00~99.99/100.0~400.0[Hz]	0.00	x	59
A011	Deceleration frequency 2	0.00~99.99/100.0~400.0[Hz]	0.00	x	59
A211	Deceleration frequency 2, 2nd motor	0.00~99.99/100.0~400.0[Hz]	0.00	x	59
A012	Acceleration /Deceleration Selection 3	0(3 Channel), 1(A015/A016)	0	x	60
A013	Acceleration time 3	0.1~999.9,1000.~3600.[sec]	30.0	○	60
A014	Deceleration time 3	0.1~999.9,1000.~3600.[sec]	30.0	○	60
A015	Acceleration frequency 3	0.00~99.99/100.0~400.0 [Hz]	0.00	x	60
A016	Deceleration frequency 3	0.00~99.99/100.0~400.0 [Hz]	0.00	x	60
A027	Multi-speed frequency 0	F001 same setting value, 0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A028	Multi-speed frequency 1	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A029	Multi-speed frequency 2	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A030	Multi-speed frequency 3	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A031	Multi-speed frequency 4	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A032	Multi-speed frequency 5	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A033	Multi-speed frequency 6	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A034	Multi-speed frequency 7	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A035	Multi-speed frequency 8	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A036	Multi-speed frequency 9	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A037	Multi-speed frequency 10	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A038	Multi-speed frequency 11	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A039	Multi-speed frequency 12	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A040	Multi-speed frequency 13	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A041	Multi-speed frequency 14	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62
A042	Multi-speed frequency 15	0.00~99.99/100.0~400.0[Hz] Start frequency ~ Max. frequency	0.00	○	62

Operating curve setting (A-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
A043	Multi-speed 1 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A044	Multi-speed 1 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A045	Multi-speed 2 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A046	Multi-speed 2 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A047	Multi-speed 3 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A048	Multi-speed 3 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A049	Multi-speed 4 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A050	Multi-speed 4 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A051	Multi-speed 5 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A052	Multi-speed 5 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A053	Multi-speed 6 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A054	Multi-speed 6 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A055	Multi-speed 7 acceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A056	Multi-speed 7 deceleration time	0.1~999.9,1000.~3600.[sec]	30.0	○	62
A059	Free V/F frequency 1	0~99.99/100.0~400.0[Hz]	0.00	x	63
A060	Free V/F voltage 1	0.0~999.9[V]	0.0	x	63
A061	Free V/F frequency 2	0~99.99/100.0~400.0[Hz]	0.00	x	63
A062	Free V/F voltage 2	0.0~999.9[V]	0.0	x	63
A063	Free V/F frequency 3	0~99.99/100.0~400.0[Hz]	0.00	x	63
A064	Free V/F voltage 3	0.0~999.9[V]	0.0	x	63
A065	Free V/F frequency 4	0~99.99/100.0~400.0[Hz]	0.00	x	63
A066	Free V/F voltage 4	0.0~999.9[V]	0.0	x	63
A067	Free V/F frequency 5	0~99.99/100.0~400.0[Hz]	0.00	x	63
A068	Free V/F voltage 5	0.0~999.9[V]	0.0	x	63
A069	Free V/F frequency 6	0~99.99/100.0~400.0[Hz]	0.00	x	63
A070	Free V/F voltage 6	0.0~999.9[V]	0.0	x	63
A071	Free V/F frequency 7	0~99.99/100.0~400.0[Hz]	0.00	x	63
A072	Free V/F voltage 7	0.0~999.9[V]	0.0	x	63

Operating curve setting (A-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
A073	Jogging frequency	0.00~10.00[Hz]	0.00	○	64
A074	Jogging stop mode	0(FRS), 1(DEC), 2(DCBR)	0	○	64
A075	Jump frequency min. 1	0.00 ~ Max. frequency [Hz]	0.00	○	65
A076	Jump frequency max. 1	0.00 ~ Max. frequency [Hz]	0.00	○	65
A077	Jump frequency min. 2	0.00 ~ Max. frequency [Hz]	0.00	○	65
A078	Jump frequency max. 2	0.00 ~ Max. frequency [Hz]	0.00	○	65
A079	Jump frequency min. 3	0.00 ~ Max. frequency [Hz]	0.00	○	65
A080	Jump frequency max. 3	0.00 ~ Max. frequency [Hz]	0.00	○	65
A081	DC braking selection	0(Disable), 1(Enable)	0	○	66
A082	DC braking frequency	0.00~60.00[Hz]	0.50	○	66
A083	DC braking wait time	0.0~5.0[sec]	0.0	○	66
A084	DC braking force	0~100[%]	0	○	66
A085	DC braking time	0.00~60.00[sec]	0.00	○	66
A086	DC braking edge/level selection	0(Edge), 1(Level)	1	○	66
A087	DC braking force for starting	0~100[%]	0	○	66
A088	DC braking time for starting	0.00~60.00[sec]	0.00	○	66
A089	Acceleration /Deceleration time reference selection	0(MaxFreq), 1(ComdFreq)	0	x	68
A090	Speed control loop gain	1~300	120	○	70
A091	Speed control loop constant	1~120	30	○	70
A092	Speed control proportion gain setting	0~1000[%]	100	○	70
A093	Speed control integration gain setting	0~1000[%]	100	○	70
A094	Load Selection	0(Normal), 1(Lift), 2(Wahsing Machine), 3(Press), 4~5(Reserved mode)	0	x	71

Table 4- 5 Operating curve setting(A-group)

4.2.6   Operating condition setting(b-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
b001	Operation direction restrict	0(All Enable), 1(FW Enable), 2(REV Enable)	0	○	72
b002	Auto-Carrier Frequency	0(Invalid), 1(Valid)	0	○	72
b003	Reduced voltage start selection	0(start reduced voltage, short time) ~ 6(start reduced voltage, long time)	0	○	73
b004	Instantaneous power failure/under-voltage retry time selection	0(Restart until 16th), 1(Restart freely)	0	○	73
b005	Stop key enable	0(valid), 1(invalid)	0	○	73
b006	Stop mode selection	0(Decel. Stop), 1(FRS), 2(DCBR)	0	x	73
b007	FRS selection	0(ZERO Hz), 1(Fmat (at FRS function setting))	0	○	73
b008	AVR selection	0(ALWAYS EN), 1(ALWAYS DIS), 2(Decel. Dis)	0	x	74
b009	Frequency scaling conversion factor	0.1~99.9	1.0	○	74
b010	Carrier frequency	0.5~10.0[kHz]	5.0	x	75
b011	Cooling fan control	0(ALWAYS EN), 1(OPR. EN)	0	x	76
b012	Debugger mode selection	0~100	0	x	-
b013	Ground fault	0(invalid), 1(valid)	0	x	76
b014	Initialize mode	0(TRIP ONLY), 1(DATA ONLY), 2(TRIP+DATA)	0	x	76
b015	Country code for initialization	0(LOCAL), 1(EC), 2(USA)	0	x	77
b016	Retry selection	0(TRIP), 1(ZERO Hz), 2(FREQ MAT), 3(F-D-TRIP)	0	○	77
b017	Allow under-voltage power failure time	0.3~1.0[sec]	1.0	○	77
b018	Retry wait time	0.3~100.0[sec]	1.0	○	77
b019	Instantaneous power failure/ under-voltage trip during stop	0(Invalid), 1(Valid), 2(ST/DEC Dis), 3(Always Invalid: P-N DC)	0	○	77
b020	Frequency setting to match	0~99.99/100.0~400.0[Hz]	0.00	○	77
b021	Non-stop function section at Instantaneous power failure	0(invalid), 1(valid)	0	x	77
b022	Starting voltage of non-stop function at Instantaneous power failure	0.0~999.9[V]	0.0	x	77
b023	Non-stop instantaneous power failure LADSTOP level	0.0~999.9[V]	0.0	x	77
b024	Non-stop deceleration time at instantaneous power failure	0.1~99.99/100.0~999.9/1000~3600[sec]	1.0	x	77
b025	Starting deceleration width at instantaneous power failure	0.00~10.00[Hz]	0.00	x	77

Code	Function name	Setting range	Initial data	Change mode on run	Page
b026	Open phase protection selection	0(Invalid), 1(Input open-phase detection always), 2(Output open-phase detection at power on), 3(Input open-phase detection always/Ouput open-phase detection at power on), 4(Output open-phase detection during run), 5(Input open-phase detection always/Ouput open-phase detection during run), 6(Ouput open-phase detection at power on/ Output open-phase detection during run), 7(Input open-phase detection always/ Ouput open-phase detection at power on/ Output open-phase detection during run)	0	○	82
b027	Electronic thermal level	0.0~999.9[A]	Irate	○	82
b227	Electronic thermal level, 2nd motor	0.0~999.9[A]	Irate	○	82
b028	Electronic thermal characteristic selection	0(DECEL TORQ.), 1(CONST TOQR.)	1	○	82
b228	Electronic thermal characteristic selection, 2nd motor	0(DECEL TORQ.), 1(CONST TOQR.)	1	○	82
b029	Electronic thermal warning level	0~100[%]	80	○	82
b030	Overload restriction selection	0(Disable), 1(ACCEL/CONST), 2(CONST), 3(ACCEL/CST(RE))	1	○	84
b031	Overload restriction level	Inverter rated current*0.5 ~ 2.0[times]	1.5	○	84
b032	Overload restriction limit constant	0.1~30.0[sec]	3.0	○	84
b033	Overload advance notice signal output mode	0(Accel/Decel/Const), 1(Const)	0	○	84
b034	Thermistor selection	0(Disable), 1(PTC), 2(NTC)	0	○	85
b035	Thermistor error level	0~9999[Ω]	3000	○	85
b036	Thermistor adjustment	0.0~999.9	105.0	○	85
b037	Data command selection	0(OPERATOR), 1(RS485), 2(CAN), 3(OPT2), 4(RS232)	0	✗	86
b038	Communicating transmission speed	0(2400BPS), 1(4800BPS), 2(9600BPS), 3(19200BPS), 4(38400BPS)	2	✗	86
b039	Communication code	1~32	1	○	86
b040	Communication bit	7(BIT), 8(BIT)	8	○	86
b041	Communication parity	0(NO Parity), 1(Even Parity), 2(Odd Parity)	0	○	86
b042	Communication stop bit	1(1Bit), 2(2itT)	1	○	86
b043	Stop method when communication trip	0(FRS), 1(Decel. Stop) - Always Valid 2(FRS), 3(Decel. Stop) - Valid when inverter running	0	○	86

Code	Function name	Setting range	Initial data	Change mode on run	Page
b044	Time out setting for commnucation trip	0.0~600.0sec	0.0	○	86
b045	Power on display setting	0~18	0	○	87
b046	Forward/Reverse re-start setting	0(Speed detection for command direction, 1(Spped detection for forward/reverse directon)	0	x	87
b047	CAN communication speed	0(100KBPS), 1(125KBPS), 2(250KBPS), 3(500KBPS), 4(1Mbps)	0	x	-

Table 4- 6 Operating curve setting(b-group)

4.2.7   Intelligent input terminal setting (I-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
I001	Intelligent input 1 setting	Intelligent input setting reference	17	○	90
I002	Intelligent input 2 setting		16	○	90
I003	Intelligent input 3 setting		6	○	90
I004	Intelligent input 4 setting		11	○	90
I005	Intelligent input 5 setting		9	○	90
I006	Intelligent input 6 setting		3	○	90
I007	Intelligent input 7 setting		2	○	90
I008	Intelligent input 8 setting		1	○	90
I009	Intelligent input 1 selection	Intelligent input setting (a/b contact setting) 0 (N.O.), 1(N.C.)	0	○	91
I010	Intelligent input 2 selection		0	○	91
I011	Intelligent input 3 selection		0	○	91
I012	Intelligent input 4 selection		0	○	91
I013	Intelligent input 5 selection		0	○	91
I014	Intelligent input 6 selection		0	○	91
I015	Intelligent input 7 selection		0	○	91
I016	Intelligent input 8 selection		0	○	91
I017	FW input terminal selection	0 (N.O.), 1(N.C.)	0	○	91
I018	O input span calibration	0~9999	Factory setting	○	110
I019	O input zero calibration	0~9999	Factory setting	○	110
I020	O start frequency	0~99.99/100.0~400.0[Hz]	0.00	○	110
I021	O end frequency	0~99.99/100.0~400.0[Hz]	0.00	○	110
I022	O start voltage	0~100[%]	0	○	110
I023	O end voltage	0~100[%]	100	○	110
I024	O start selection	0(EXT. FREQ.), 1(ZERO HZ)	1	○	110
I025	OI input span calibration	0~9999	Factory setting	○	111
I026	OI input zero calibration	0~9999	Factory setting	○	111
I027	OI start frequency	0~99.99/100.0~400.0[Hz]	0.00	○	111
I028	OI end frequency	0~99.99/100.0~400.0[Hz]	0.00	○	111
I029	OI start voltage	0~100[%]	0	○	111
I030	OI end voltage	0~100[%]	100	○	111
I031	OI start selection	0(EXT. FREQ.), 1(ZERO HZ)	1	○	111
I032	O2 input span calibration	0~9999	Factory setting	○	112
I033	O2 input zero calibration	0~9999	Factory setting	○	112
I034	O2 start frequency	0.0~99.9/100~400[Hz]	0.0	○	112
I035	O2 end frequency	0.0~99.9/100~400[Hz]	0.0	○	112
I036	O2 start voltage	-100~100[%]	-100	○	112
I037	O2 end voltage	-100~100[%]	100	○	112

Code	Function name	Setting range	Initial data	Change mode on run	Page
I038	O2 start selection	0(SINGLE), 1(AUX. NO REV), 2(AUX. REV) , 3(INVALID)	3	x	112
I046	Analog input filter factor	1~30	8	○	113
I047	Software lock mode selection	0 (All parameters except I047 are locked when SFT is on), 1 (All parameters except I047, F001 are locked when SFT is on), 2 (All parameters except I047, F001 and User group are locked when SFT is on), 3 (All parameters except I047 are locked), 4 (All parameters except I047, F001 are locked), 5 (All parameters except I047, F001 and User group are locked)	1	○	101
I048	Up/Down Selection	0(Data conservation radish), 1(Data conservation existence)	0	○	105
I049	AT terminal selection	0(O/OI), 1(O/O2)	0	x	102
I050	Reset selection	0(TRIP (On)), 1(TRIP (Off)), 2(ONLYTRIP (On))	0	○	104
I051	Reset frequency matching selection	0(Zero HZ), 1(Frequency matching)	0	○	104

Table 4- 7 Intelligent input terminal setting (I-group)

4.2.8   Intelligent output terminal setting (o-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
o001	Intelligent output 1 setting	Intelligent output setting reference	1	○	115
o002	Intelligent output 2 setting		0	○	115
o003	Intelligent output 3 setting		3	○	115
o004	Intelligent output 4 setting		7	○	115
o005	Intelligent output 1 selection	Intelligent output contact setting (0 : N.O., 1 : N.C.)	0	○	116
o006	Intelligent output 2 selection		0	○	116
o007	Intelligent output 3 selection		0	○	116
o008	Intelligent output 4 selection		0	○	116
o009	FM output selection	0(FREQ_OUT), 1(CURR_OUT), 2(TORQ_OUT), 3(DFREQ_OUT), 4(VOL_OUT), 5(POW_IN), 6(LOAD RATE), 7(FREQ_LAD), 8(Motor Speed)	0	○	126
o010	FM offset	-3.00~10.00	-3.00	○	126
o011	FM adjustment	0.0~255.0	71.0	○	128
o012	AM output selection	0(FREQ_OUT), 1(CURR_OUT), 2(TORQ_OUT), 3(VOL_OUT), 4(POW_IN), 5(LOAD RATE), 6(FREQ_LAD), 7(Motor Speed)	0	○	128
o013	AM offset	0.00~10.00	0.96	○	128

Code	Function name	Setting range	Initial data	Change mode on run	Page
o014	AM adjustment	0.0~255.0	100.0	○	128
o015	AMI output selection	0(FREQ_OUT), 1(CURR_OUT), 2(TORQ_OUT), 3(VOL_OUT), 4(POW_IN), 5(LOAD RATE), 6(FREQ_LAD), 7(Motor Speed)	0	○	128
o016	AMI offset	0.00~20.00	4.00	○	128
o017	AMI adjustment	0.0~255.0	100.0	○	128
o018	Frequency arrival setting for acceleration	0~99.99/100.0~400.0[Hz]	0.00	○	120
o019	Frequency arrival setting for deceleration	0~99.99/100.0~400.0[Hz]	0.00	○	120
o020	Frequency arrival setting for acceleration 2	0~99.99/100.0~400.0[Hz]	0.00	○	120
o021	Frequency arrival setting for deceleration 2	0~99.99/100.0~400.0[Hz]	0.00	○	120
o022	Over-torque level 1	0~200[%]	100	○	123
o023	Over-torque level 2	0~200[%]	100	○	123
o024	Over-torque level 3	0~200[%]	100	○	123
o025	Over-torque level 4	0~200[%]	100	○	123
o026	Overload advance notice level 1	Rated current*0.0~2.0[times]	1.0	○	121
o027	Overload advance notice level 2	Rated current *0.0~2.0[times]	1.0	○	121
o028	RUN/ON time-over setting	0~9999	0	○	124
o029	PID deviation setting level	0.0~100.0[%]	3.0	○	122
o030	Zero speed detection level setting	0.00~99.99[Hz]	0.00	○	125
o031	AL relay output definition	Refer to the intelligent output setting	5	○	116
o032	RN relay output definition		0	○	116
o033	AL relay output selection	Intelligent output contactor setting 0 : N.O, 1: N.C	0	○	116
o034	RN relay output selection		0	○	116

Table 4- 8 Intelligent output terminal setting (o-group)

4.2.9   Advanced control function setting (C-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
C001	O/V Stall selection	0(Valid, 1(Invalid)	0	X	129
C002	VF stability adjust	0.0~300.0[%]	100	○	129
C003	Torque boost selection	0(Manual), 1(Automatic)	0	x	129
C203	Torque boost selection, 2nd motor	0(Manual), 1(Automatic)	0	x	129
C004	Manual torque boost value	0.0~20.0[%]	(note1)	○	129

Code	Function name	Setting range	Initial data	Change mode on run	Page
C204	Manual torque boost value, 2nd motor	0.0~20.0[%]	(note1)	○	129
C005	Manual torque boost break point	0.0~50.0[%]	50.0	○	129
C205	Manual torque point boost frequency, 2nd motor	0.0~50.0[%]	50.0	○	129
C006	Torque limit selection	0(4 Guad mode), 1(TER. OPR), 2(Analog IN), 3(CAN), 4(OPT2)	0	○	131
C007	Torque limit 1	0~200[%]	160	○	131
C008	Torque limit 2	0~200[%]	160	○	131
C009	Torque limit 3	0~200[%]	160	○	131
C010	Torque limit 4	0~200[%]	160	○	131
C011	Torque LAD Stop selection	0(Disable), 1(Enable)	0	○	131
C012	Braking control function selection	0(Disable), 1(Enable)	0	○	133
C013	Waiting time for braking releasing confirmation	0.00~5.00[sec]	0.00	○	133
C014	Waiting time for acceleration	0.00~5.00[sec]	0.00	○	133
C015	Waiting time for stop	0.00~5.00[sec]	0.00	○	133
C016	Waiting time for signal conformation	0.00~5.00[sec]	0.00	○	133
C017	Releasing frequency	0~99.99/100.0~400.0[Hz]	0.00	○	133
C018	Releasing current	Rated current x (0.0~2.0)[times]	1.0	○	133
C019	BRD selection	0(INVALID), 1(VAL. Exclude ST), 2(VAL. Include ST)	0	○	136
C020	BRD ON level	330~380/660~760	360 (720)	○	136
C021	BRD using ratio	0.0~100 %	0.0	○	136
C022	PID selection	0(Disable), 1(Enable, propotional), 2(Enable, inverse propotional)	0	○	136
C023	PID-P gain	0.0~5.0	2.0	○	136
C024	PID-I gain	0~3600[sec]	1	○	136
C025	PID-D gain	0.0~100.0[sec]	0.0	○	136
C026	PID-Feedback gain	0.00~99.99[times]	1.00	○	136
C027	PID Feedback selection	0(4~20mA), 1(0~10V), 2(-10~10V), 3(-10~10V), 4(4~20mA), 5(0~10V)	0	○	136
C028	PID reference level	0.00~100.0 [%]	0	○	136
C029	PID Feedforward selection	0(not used), 1(O), 2(OI), 3(O2 irreversible), 4(C030 * F003), 5(C030 * F001)	0	○	136
C030	PID Feedforward gain	0.0~100.0(%)	100	○	136
C031	PID output reverse	0(Invalid), 1(Valid)	0	○	136
C032	Sleep frequency	0.00~400.0[Hz]	0	○	136

Code	Function name	Setting range	Initial data	Change mode on run	Page
C033	Sleep frequency check time	0.0~99.9[sec]	0.0	○	136
C034	Wakeup level	0.0~99.9[%]	0.0	○	136
C035	Frequency band on torque limit	0.00~99.99[Hz]	0.0	○	143

Table 4- 9 Advanced control function setting (C-group)

* LAD: Linear Acceleration Deceleration

* BRD : Regenerative Breaking Circuit

(Note1) Manual torque boost value for each capacity.

Capacity	Manual torque boost
5.5~11kW	3.3[%]
15~22kW	3.1[%]
30~55kW	1.5[%]
75~132kW	1.0[%]

4.2.10   Motor constant setting (H-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
H001	Autotuning selection	0(INVALID), 1(VALID NOT ROT.), 2(VALID IN ROT.)	0	x	147
H002	Motor constant selection	0(MOTOR DATA), 1(AT DATA), 2(AT ONLINE DATA)	1	x	147
H202	Motor constant selection, 2nd motor	0(MOTOR DATA), 1(AT DATA), 2(AT ONLINE DATA)	1	x	147
H003	1st motor constant R1	0.000~9.999[Ω]	R1std	x	147
H203	2nd motor constant R1	0.000~9.999[Ω]	R1std	x	147
H004	1st motor constant R2	0.000~9.999[Ω]	R2std	x	147
H204	2nd motor constant R2	0.000~9.999[Ω]	R2std	x	147
H005	1st motor constant leakage inductance(LI)	0.00~99.99[mH]	LIstd	x	147
H205	2nd motor constant leakage inductance(LI)	0.00~99.99[mH]	LIstd	x	147
H006	1st motor constant Io	0.0~999.9[A]	Istd	x	147
H206	2nd motor constant Io	0.0~999.9 [A]	Istd	x	147
H007	1st motor constant J	0.00~99.99/100.0~655.3[kg·m2]	Jstd	x	147
H207	2nd motor constant J	0.00~99.99/100.0~655.3[kg·m2]	Jstd	x	147
H008	1st motor constant L	0.0~999.9 [mH]	Lstd	x	147
H208	2nd motor constant L	0.0~999.9 [mH]	Lstd	x	147
H009	1st motor constant R1 (Autotuning data)	0.000~9.999[Ω]	R1std	x	147
H209	2nd motor constant R1 (Autotuning data)	0.000~9.999[Ω]	R1std	x	147
H010	1st motor constant R2 (Autotuning data)	0.000~9.999[Ω]	R2std	x	147
H210	2nd motor constant R2 (Autotuning data)	0.000~9.999[Ω]	R2std	x	147
H011	1st motor constant leakage inductance(LI) (Autotuning data)	0.00~99.99[mH]	LIstd	x	147
H211	2nd motor constant leakage inductance(LI) (Autotuning data)	0.00~99.99[mH]	LIstd	x	147
H012	1st motor constant Io (Autotuning data)	0.00~99.99/100.0~999.9[A]	Istd	x	147
H212	2nd motor constant Io (Autotuning data)	0.00~99.99/100.0~999.9[A]	Istd	x	147
H013	1st motor constant J (Autotuning data)	0.00~99.99/100.0~655.3[kg·m^2]	Jstd	x	147
H213	2nd motor constant J (Autotuning data)	0.00~99.99/100.0~655.3[kg·m^2]	Jstd	x	147
H014	1st motor constant L (Autotuning data)	0.0~999.9 [mH]	Lstd	x	147
H214	2nd motor constant L (Autotuning data)	0.0~999.9 [mH]	Lstd	x	147

Table 4- 10 Motor constant setting (H-group)

4.2.11   Option function setting (P-group)

Code	Function name	Setting range	Initial data	Change mode on run	Page
P001	Option 1 operation selection on error	0(TRIP), 1(RUN)	0	○	-
P002	Operation on wire cutoff	0(Invalid), 1(Valid)	0	○	-
P003	Position error selection	0(INVALID), 1(VALID)	0	x	-
P004	Control mode selection	0(ASR), 1(APR)	0	x	-
P005	Encoder pulse number setting	128~9999[PPR]	1024	x	-
P006	Pulse train input mode selection	0(MODE 0), 1(MODE 1)	0	x	-
P007	Orientation stop position setting	0~4095	0	○	-
P008	Orientation speed setting	0.00~99.99/100.0~120.0[Hz]	0.00	○	-
P009	Orientation direction setting	0(FORWARD), 1(REVERSE)	0	x	-
P010	Orientation completion range setting	0~9999	5	○	-
P011	Orientation completion delay time setting	0.00~9.99[sec]	0.00	○	-
P012	Electronic gear position selection	0(FEEDBACK), 1(REFERENCE)	0	○	-
P013	Electronic gear numerator of ratio setting	0~9999	1024	○	-
P014	Electronic gear denominator of ratio setting	0~9999	1024	○	-
P015	Position control feed-forward gain setting	0.00~9.99	0.00	○	-
P016	Position control loop gain setting	0.00~99.99	0.50	○	-
P017	Orientation stop RPM	0~100	0	○	-
P018	Over-speed detect level setting	100.0~150.0[%]	135.0	○	-
P019	Speed-error over detect level setting	100.0~120.0[Hz]	0.00	○	-
P021	Stop position setting for orientation input mode selection	0(OPE), 1(O1), 2(O2), 3(Communication)	0	x	-
P022	Torque reference	-200(-200%)~200(200%)	0	○	-
P023	Max. Torque reference	0(0%)~200(200%)	150.0	○	-
P024	Torque offset	-200(-200%)~200(200%)	0	○	-
P025	P gain at PPI switching	0.00~10.00 (0.00 :Disable)	1.00	○	-

Table 4- 11 Option function setting (P-group)

NOTE) This functions are explained in the feedback option card manual.

5.   EXPLANATION OF D-GROUP

5.1   Output frequency monitor (d001)

(1) Indication code d001 displays output frequency to motor.
(2) The data is displayed as follows.
     When d001 is displayed, the monitor lamp "Hz" is illuminated.
     ① 0.00 ~ 99.99 : Display is in 0.01Hz unit.
     ② 100.0 ~ 400.00 : Display is in 0.1Hz unit.
(3) It is displayed to value that is set in output frequency setting (F001) in running condition.
(4) In case that frequency setting method (F010) is operator keypad setting parameter(2), output frequency is adjustable in this code d001.

5.2   Motor rotation direction monitor (d002)

(1) Indication code d002 displays the direction that the Inverter output is rotating.
     Forward, reverse or stop.
     ① Forward : F
     ② Reverse : r
     ③ Stop : o
(2) On operating the inverter (in case of CW(FWD) or CCW(REV)), the RUN lamp will illuminate.

5.3   Output current monitor (d003)

(1) Indication code d003 displays the output current value.
(2) The data is displayed as follows.
     0.0 ~ 999.9 : Display is in 0.1 A unit.
     In case of displaying d003, the monitor lamp "A" is illuminated.
(3) The output current is displayed in RMS value according to the load current.

5.4   Output voltage monitor (d004)

(1) This inverter displays the output voltage of the inverter converted into the alternating voltage.
     0.0 ~ 999.9 : Display is in 0.1V unit.
(2) In case of displaying d004, the monitor lamp "V" is illuminated.

5.5   DC link voltage monitor (d005)

(1) Indication code d005 displays the DC link voltage of the inverter.
     0.0 ~ 999.9 : Display is in 0.1V unit.

5.6   Motor input power monitor (d006)

(1) Display output electric power from inverter.
     0.0 ~ 999.9 : Display is in 0.1^{kW} unit.
(2) In case of displaying d006, the monitor lamp "V" and "A" ("^{kW}") is illuminated.

5.7   Output torque monitor (d007)

(1) This inverter displays the output torque estimation value.

(2) In case of displaying d007, the monitor lamp "%" is illuminated.

　　　-300 ~ 300 : Display is in 1% unit

　　　Note) Display substitutes only at the time of SLV, V2, and 0Hz-V2 mode control.

5.8   Number of motor rotation monitor (d008)

(1) This inverter displays the rotation of motor at revolution per minute

　　　(RPM : Rotational speed Per Minute).

　　　0~9999 : Display is in 1 RPM unit.

　　　Note) d008 is displayed the calculated RPM with motor poles setting (F016).

5.9   PID Feedback monitor (d009)

(1) When you select PID function (01) in C022, the inverter displays the feedback value changed

　　　by C026 (PID scale).

　　　"Display of monitor part"   =   " Feedback quantity"   x   "PID scale"

　　　　　　　　　　　　　　　(frequency command value)   (C026)

　　　0.00 ~ 99.99   : Display is in 0.01% unit.

　　　100.0 ~ 999.9   : Display is in 0.1% unit.

　　　1000 ~ 9999   : Display is in 1% unit.

5.10   Intelligent input terminal monitor (d010)

(1) The LED display will monitor the state of the intelligent inputs.

　　　Example)   FW and Input intelligent terminal   1, 2, 7 : ON

　　　　　　　　　Input intelligent terminal   3, 4, 5, 6, 8 : OFF
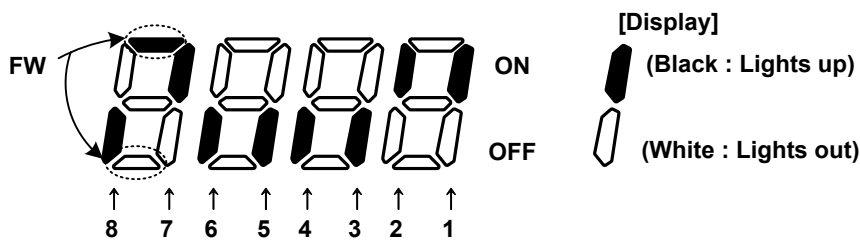
5.11   Intelligent output terminal monitor (d011)

(1) The LED display will monitor the state of the intelligent outputs.

　　　Example)   Output intelligent terminal 11, 12 : ON

　　　　　　　　　Output alarm AL, Relay output RUN, and Output intelligent terminal 13, 14: OFF
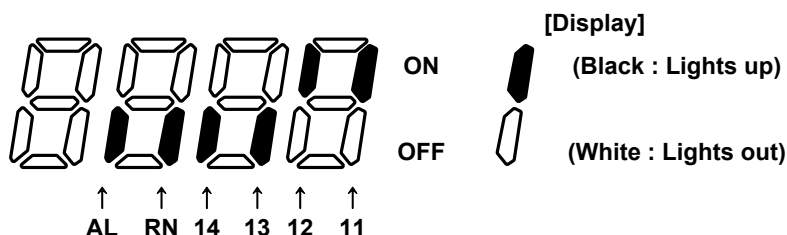
5.12   Frequency conversion monitor (d012)

(1) This inverter displays the value changed by the inverter output frequency and the value set in b009 on the monitor part.

"Display of monitor part " = "Output frequency(d001)" x "Output frequency factor(b009)"

(2) 0.00 ~ 99.99 : Display is in 0.01 unit.

100.0~400.0 : Display is in 0.1 unit.

Note)   Output frequency of FM terminal becomes same as d012 at the time of setting up the digital output frequency to the FM terminal. (FM output setting (o009) = 3)

5.13   Accumulated time monitor during RUN (d013)

(1) The operation time of inverter is accumulated and the value is displayed.

(2) 0 ~ 9999 : Display is in 1 hour units.

When the value is more than 10,000 hours, the last point added in the LED display. (1000. ~ 6553.) The maximum value is '6553.'.

5.14   Accumulated time monitor during RUN (d014)

(1) The operation time of inverter is accumulated and the value is displayed.

(2) 0 ~ 59 : Display is in 1 min. Units.

5.15   Power ON time monitor (d015)

(1) This accumulates the time running to the inverter and displays the value.

(2) 0 ~ 9999 : Display is in 1 hour units. When the value is more than 10,000 hours, the last point added in the LED display. (1000. ~ 6553.) The maximum value is '6553.'.

5.16   Power ON time monitor (d016)

(1) This accumulates the time running to the inverter and displays the value.

(2) 0 ~ 59 : Display is in 1 min. units.

5.17   IGBT Power Module Temperature monitor (d017)

(1) This monitor function displays the sensing temperature of IGBT Power Module.

(2) 0 ~ 9999 : Display is in 1 ℃ units.

5.18   Trip count(d018)

(1) This displays the number of inverter trips.

(2) 0 ~ 9999 : Display is in 1 units.

5.19   Trip monitor 1 to 6(d019~d024)

(1) This displays the details for the last six protective trips.

(2) The trip monitor 1 displayed the details of the last trip.

① Trip code

② Output frequency on tripping (Hz)

③ Output current on tripping (A)

④   The direct voltage (between P and N) on tripping (V)

Note) Please refer to the protection function list for detailed Trip monitor display.

6. EXPLANATION OF F-GROUP

6.1 Output frequency setting (F001/F201)

(1) Setting the output frequency of the motor.
(2) The output frequency is set by F001, when frequency source setting (F010) is set to 0 or 2.
(3) Please refer to frequency source setting (F010) about other methods of frequency setting.
(4) When a frequency is set in F001, the same value is automatically set in 1st multi-stage zero speed.
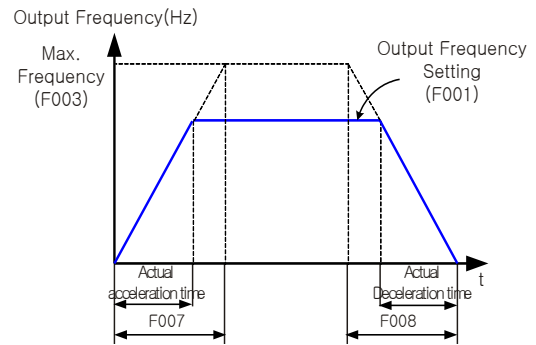
Fig. 6- 1 Output frequency setting curve

Code	Function name	Initial value	Unit	Setting range	Contents
F001	Output frequency setting	0.00	Hz	0.0, F004～F003	0.00~99.00 : By 0.01Hz setting 100.0 ~ 400.0 : setting by 0.1Hz
F201	Output frequency setting of 2nd motor	0.00	Hz	0.0, F004～F203	0.00~99.00 : By 0.01Hz setting 100.0 ~ 400.0 : setting by 0.1Hz

Table 6- 1 Output frequency setting (F001, F201)

6.2 Base frequency setting (F002/F202)

(1) Base frequency and motor voltage
  ① On selection of base frequency and motor voltage, set the output of the inverter (frequency voltage) to the motor rating.
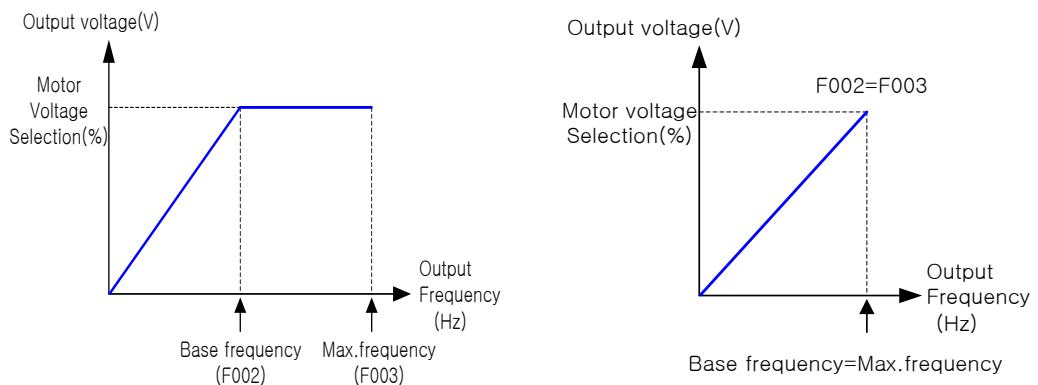
Fig. 6- 2 Base frequency and motor voltage curve

  ② The base frequency is the nominal frequency of the motor, this value can be found on the nameplate of the motor. It is important to match the base frequency (F002) to this nominal value or there is risk of damage to the motor.
  ③ If a motor has a base frequency higher than 60Hz, it is considered to be a special motor.

In this situation, it is important to make sure the maximum output current of the inverter is higher than the full load current of the motor.

④ The Motor Voltage selection is the nominal voltage of the motor, this value can be found on the name plate of the motor. It is important to match the motor voltage to this nominal value or there is risk of damage to the motor.

Code	Function name	Initial value	Unit	Setting range	Contents
F002	Base frequency setting	60.00	Hz	30.00~F003	30.00~99.00 : Setting by 0.01Hz 100.0~400.0 : Setting by 0.1Hz
F202	2nd motor base frequency Setting	60.00	Hz	30.00~F203	30.00~99.00 : Setting by 0.01Hz 100.0~400.0 : Setting by 0.1Hz

Table 6- 2 Base frequency setting (F002, F202)

6.3   Maximum frequency setting (F003/F203)

(1) Set the maximum frequency value of the inverter.

(2) This set value is the maximum frequency that the inverter will achieve when it receives top speed reference from the control terminals or the digital operator.

(3) The inverter output voltage from the base frequency to the maximum frequency is the same level as the voltage selected on the motor voltage selection.

Code	Function name	Initial value	Unit	Setting range	Contents
F003	Maximum frequency setting	60.00	Hz	30.00~400.0	30.00~99.00 : Setting by 0.01Hz 100.0~400.0 : Setting by 0.1Hz
F203	Maximum frequency setting, 2nd motor	60.00	Hz	30.00~400.0	30.00~99.00 : Setting by 0.01Hz 100.0~400.0 : Setting by 0.1Hz

Table 6- 3 Maximum frequency setting (F003, F203)

(4) The inverter output operation follows the constant V/f curve until it reaches the full-scale output voltage. This initial straight line is the constant-torque part of the operating characteristic. The horizontal line over to the maximum frequency serves to let the motor run faster, but at a reduced torque. This is the constant-horsepower part of the characteristic.
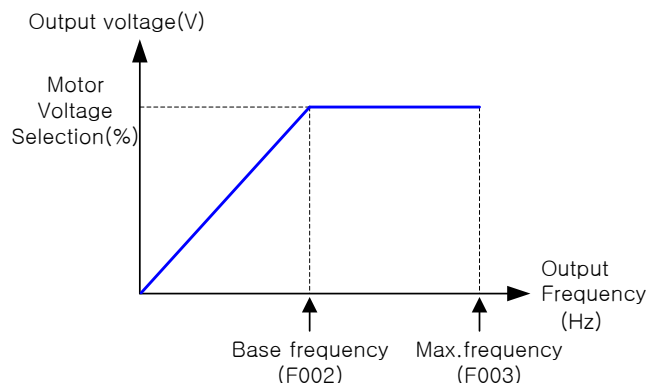
Fig. 6- 3 Maximum frequency setting curve

Note)   Base frequency should be set to be same or smaller than maximum frequency.
(F002 ≤ F003)

6.4   Starting frequency setting (F004)

(1) This frequency is the value the operator must set before the Inverter will give an output.

(2) Mainly use when an operator adjusts the starting torque.

(3) By setting the start frequency higher, direct starting is caused and the starting current increases.

(4) Therefore an overload is within the restriction range and the inverter has a tendency to trip on over-current protection

Code	Function name	Initial value	Unit	Setting range	Contents
F004	Starting frequency setting	0.50	Hz	0.10~10.00	0.10~10.00 : Setting by 0.01Hz

Table 6- 4 Starting frequency setting (F004)
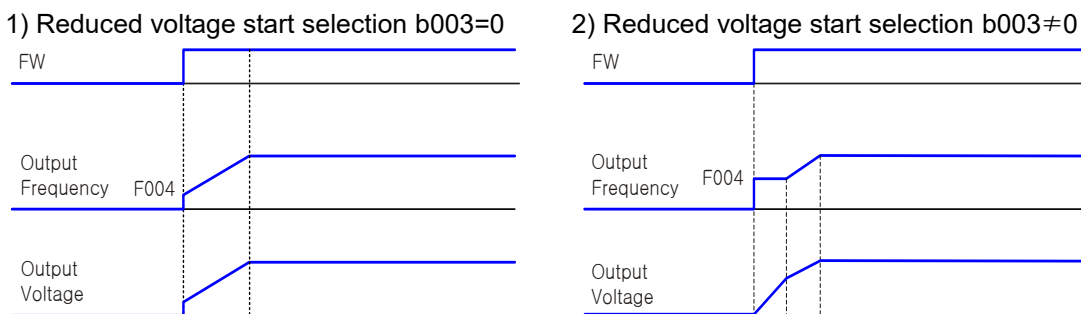
Fig. 6- 4 Starting frequency setting curve

6.5   Frequency limit (F005/F205 ~ F006/F206)

● This function can set a upper and lower limit of the output frequency.

● Even if a frequency command exceeds the upper and lower limit, the inverter will ignore this value and stop at the values set.

● Set first upper limit on setting.

● Be sure that the upper limit (F005) ≥ lower limit (F006).

● The upper and lower limit will not operate if 0Hz is set.

Code	Function name	Initial value	Unit	Setting range	Contents
F005	Frequency Upper limit	0.00	Hz	0.00, F006~F003	0.00 : Frequency limitation setting is unavailable 0.00~99.99 : Unit 0.01Hz 100.0~400.0: Unit 0.1Hz
F006	Frequency Lower limit	0.00	Hz	0.00, F004~F005	0.00 : Frequency limitation setting is unavailable 0.00~99.99 : Unit 0.01Hz 100.0~400.0: Unit 0.1Hz
F205	Frequency upper limit, 2nd motor	0.00	Hz	0.00, F206~F203	0.00 : Frequency limitation setting is unavailable 0.00~99.99 : Unit 0.01Hz 100.0~400.0: Unit 0.1Hz
F206	Frequency lower limit, 2nd motor	0.00	Hz	0.00, F004~F205	0.00 : Frequency limitation setting is unavailable 0.00~99.99 : Unit 0.01Hz 100.0~400.0: Unit 0.1Hz

Table 6- 5 Frequency limit (F005/F205 ~ F006/F206)

(1)   In use O-L, OI-L case

 When frequency command is control terminal (Terminal), by setting lower limit, even if 0V(4mA) is input, it is not possible to output less than the frequency set with lower limit.
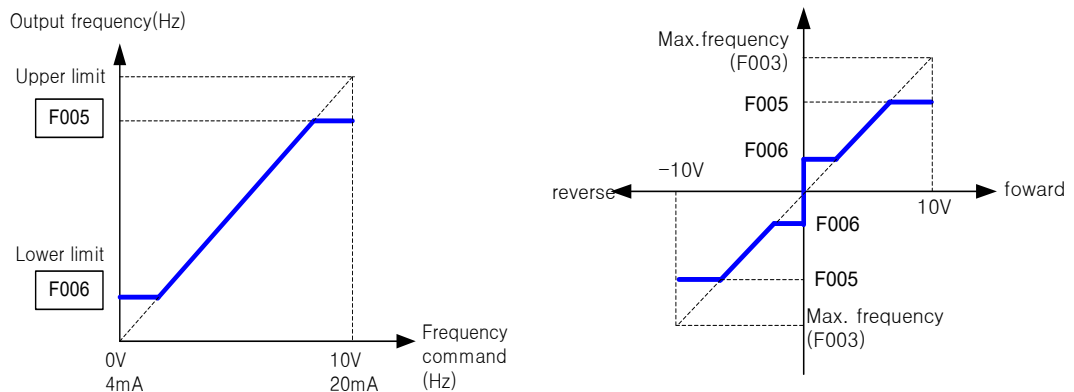
Fig. 6- 5 Frequency limit curve (In use O-L, OI-L case)

(2) In use O2-L case

 When using the lower frequency limit and 0V is inputted into O2 terminal, F006 applies to both forward and reverse directions.

(a) When operation command is control terminal
  (F011=1)

Terminal	Revolution when O2 is 0V
FW(ON)	F006 on forward side
REV(ON)	F006 on reverse side

(b) When operation command is operator
  (F011=2)

F009	Revolution when O2 is 0V
0	F006 on forward side
1	F006 on reverse side

6.6   Adjustable time setting (F007/F207, F008/F208)

(1)   The acceleration and deceleration time can be set.

 Set a long time to accelerate or decelerate slowly or set a short time to accelerate or decelerate quickly.

(2) The time setting is the time it takes to accelerate from 0Hz to the maximum frequency(F003) and to decelerate from the maximum frequency to 0Hz.

Code	Function name	Initial value	Unit	Setting range	Contents
F007	Acceleration time setting	30.0	Sec.	0.01~3600	0.1~999.9 : Unit 0.1s 1000~3600 : Unit 1s
F008	Deceleration time setting	30.0	Sec.	0.01~3600	0.1~999.9 : Unit 0.1s 1000~3600 : Unit 1s
F207	Acceleration time, 2nd motor	30.0	Sec.	0.01~3600	0.1~999.9 : Unit 0.1s 1000~3600 : Unit 1s
F208	Deceleration time, 2nd motor	30.0	Sec.	0.01~3600	0.1~999.9 : Unit 0.1s 1000~3600 : Unit 1s

Table 6- 6 Adjustable time setting (F007/F207, F008/F208)

(3) Even if you set the adjustable time shorter, the adjustable time of the actual motor can't be shorter than the shortest adjustable time determined by the inertial Effect J of the mechanical system and motor torque.

(4) If you set the time shorter than the shortest adjustable time, a protection trip of OC or OV may occur.

Acceleration time t_S : $t_S = \dfrac{(J_L + J_M) \times N_M}{9.55 \times (T_S - T_L)}$

Deceleration time t_B : $t_B = \dfrac{(J_L + J_M) \times N_M}{9.55 \times (T_B + T_L)}$

J_L :	J of the load converter into motor shaft (kg. m^2)
J_M :	J of the motor (kg. m^2)
N_M :	Motor revolving (r/min)
t_S :	The maximum motor acceleration torque on inverter driving(N·m)
t_B :	The maximum motor deceleration torque on inverter driving(N·m)

6.7   Driving direction selection (F009)

(1) This is effective when the operating command is set by the digital operator.
(2) If F010=1 and supply -10V~0V to O2-L terminal, inverter will run reverse direction.
(3)

Code	Function name	Initial value	Unit	Setting range	Contents
F009	Driving direction selection	0	-	0	Forward
				1	Reverse

Table 6- 7 Driving direction selection (F009)

6.8   Frequency source setting (F010)

(1) Select the method of frequency command.
(2) When -10~0Vdc is inputted to the frequency command by 02-L terminal, the operating direction of motor is reversed.

Code	Function name	Initial value	Unit	Setting range	Contents
F010	Frequency source setting	0	-	0	OPE VOL : Potentiometer(Setting frequency with the potentiometer the digital operator has.)
				1	Ter : Setting frequency with control terminals (Terminals: O-L, O1-L, O2-L)
				2	OPE Keypad : Setting frequency with digital operator (F001), remote operator
				3	COM : Setting frequency with RS485 terminals for communication
				4	CAN : Setting frequency with option board 1.
				5	OPT2 : Setting frequency with option board 2.

Table 6- 8 Frequency source setting (F010)

6.9   RUN command source setting (F011)

(1)   Select the control of RUN/STOP commands.

(2)   Operate start/stop with RUN key/STOP key on the digital operator when operating from digital operator.

Code	Function name	Initial value	Unit	Setting range	Contents
F011	RUN command source setting	2	-	1	Ter : Start/stop with control terminals (Terminals: FW, REV)
				2	OPE : Start/stop with digital operator (F001)
				3	COM : Start/stop with RS485 terminals for communication
				4	CAN : Setting frequency with option board 1.
				5	OPT2 : Setting frequency with option board 2.

Table 6- 9 RUN command source setting (F011)

(3)   Operation command from the control terminals (Terminal) start/stop by ON/OFF of control terminals.

(4)   Put 01(REV) to an intelligent input terminal. When using the FW terminal, it is possible the change the contact from NO to NC by setting a or b (respectively) in I009~I017.
   * Forward : FW-CM1 terminal
   * Reverse : REV-CM1 terminal
   Note) Refer to the input terminal function setting reference.

(5)   When forward command and reverse command entered simultaneously, operation command becomes stop command.
   Ex.) The setting method of operation command on intelligent input terminals
      F011=1(TER), I008=1(REV) Setting

| P24 | CM1 | PLC | 1 | ... | 8 | FW |
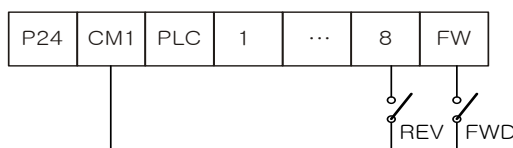
Inverter control terminal block

The composition of external contacts

REV   FWD

6.10 Motor Control method (F012/F212)

- Set V/f (output voltage/ output frequency) characteristic
- To change 1st / 2nd control system (V/f characteristic), set 8(SET2) to an intelligent input terminal and switch it ON. (Refer to chapter 9. Explanation of I-Group Function)

Code	Function name	Initial value	Unit	Setting range	Contents
F012	Motor control method	5	-	0	VC : Constant torque characteristic
				1	VP1 : Reduced torque characteristic (VP1.7 power)
				2	VP2 : Reduced torque characteristic (VP2.0 power)
				3	Free V/f : Free setting V/f characteristic
				4	SLV-I : Indirect Sensorless vector control
				5	SLV-D : Direct Sensorless vector control
				6	V2 : Sensored vector control
				7	0Hz-V2 : 0Hz-Sensored vector control
F212	Second Motor control method	5	-	0	VC : Constant torque characteristic
				1	VP1 : Reduced torque characteristic (VP1.7 power)
				2	VP2 : Reduced torque characteristic (VP2.0 power)
				3	Free V/f : Free setting V/f characteristic
				4	SLV-I : Indirect Sensorless vector control
				5	SLV-D : Direct Sensorless vector control

Table 6- 10 Motor Control method (F012/F212)

(1) Constant torque characteristic (VC)

Output voltage outputs proportionally to the output frequency.

Output voltage outputs proportionally from 0 to the base frequency, but the output voltage from the base frequency to the maximum frequency is constant regardless of frequency.

< Constant torque characteristic >   < Reduced torque characteristic >
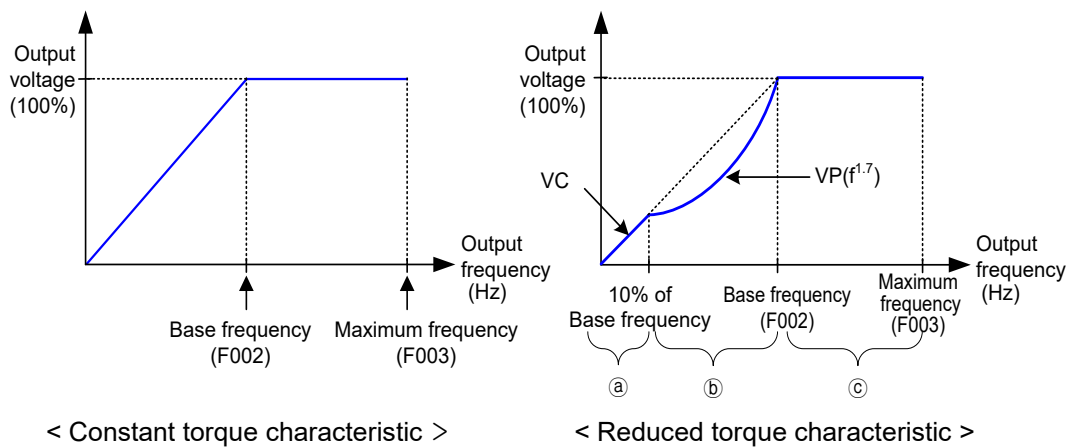
Fig. 6- 6 Constant torque characteristic Curve (VC)

(2) Reduced torque characteristic (VP1.7 power)

This characteristic can be used when a large starting torque isn't required.

At low speeds, it can cause the improvement of efficiency, low noise and low vibration because of lowering the output voltage. V/f characteristic is as follows.

Section ⓐ : The limit from 0 to 10% of the base frequency is the constant characteristic.

(ex) If the base frequency is 60Hz, the limit from 0 to 6Hz is constant characteristic.

Section ⓑ : The limit from 10% of the base frequency to the base frequency is reduced torque characteristic. The voltage outputs in the curved of 1.7 power for the frequency.

Section ⓒ : The voltage is constant from the base frequency to the maximum frequency.

(3) Reduced torque characteristic (VP2.0 power)

The voltage outputs in the curved of 2.0 power for the frequency.

(4) Free V/f setting

The free V/f setting represents optional V/f characteristics by setting the voltage and frequency in seven parts. (A059~A072)

(5) Sensorless vector control

① When this function is performed, raised torque running is possible at 0.5Hz above range by the original torque control.

② This function is the method that the revolution of motor and output torque are estimated by output current, voltage of the inverter and motor constant of setting. It is possible to operate with high starting torque and high accuracy at low frequency.

③ In the case of using this function, please select the suitable motor constant of using the motor according to the parameter of "selection of motor constant".

④ If this inverter operates less than twice capacity for the maximum adopted motor, the full

⑤ performance may not be demonstrated.

Note) Please refer to the part of sensorless vector control for details.

(6) Sensored vector control / 0Hz-Sensored vector control

① It is possible to make a motor get the high efficient operation by motor speed signal.

② Please use the feedback option card for using this function.

Note) Please refer to the feedback option card manual for details.

6.11   Motor voltage selection (F013)

Please select the value of motor voltage to the nominal voltage of the motor, this value can be found on the nameplate of the motor. If the motor voltage exceeds the nominal voltage of the motor, there is a risk of damage to the motor.

Code	Function name	Initial value	Unit	Setting range	Contents
F013	Motor voltage selection (the motor rated voltage)	220	V	200/215/220/230/240	200V(LF - model) : When inverter is 200 V class, selection is possible.
		440		380/400/415/440/460/480	400V(HF - model) : When inverter is 400 V class, selection is possible.

Table 6- 11 Motor voltage selection (F013)

6.12   Output voltage gain (F014)

Regarding the voltage selected on F013 motor voltage selection as 100%, set the rate of the voltage which the inverter outputs for the selected voltage.

Code	Function name	Initial value	Unit	Setting range	Contents
F014	Output voltage gain	100	%	20~100	Unit : %

Table 6- 12 Output voltage gain (F014)
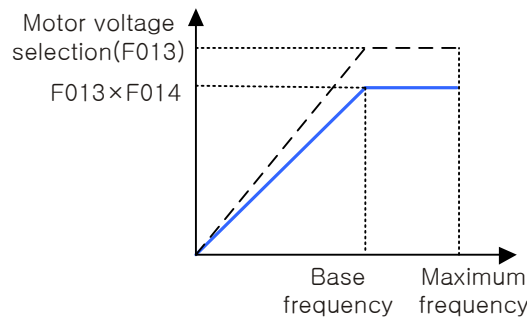
Fig. 6- 7 Output voltage gain curve

6.13   Motor capacity selection (F015/F215)

Setting the motor capacity to run by an inverter.

Code	Function name	Initial value	Unit	Setting range	Contents
F015	Motor capacity selection (motor rated capacity)	According to Inverter capacity	kW	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/30/37/45/55/75/90/110/132/160	Setting according to the number of motor poles (200V class/400V class)
F215	2nd motor capacity selection	According to Inverter capacity	kW	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/30/37/45/55/75/90/110/132/160	Setting according to the number of motor poles (200V class/400V class)

Table 6- 13 Motor capacity selection (F015/F215)

6.14　Motor pole selection (F016/F216)

Selection the number of poles for the motor.

Code	Function name	Initial value	Unit	Setting range	Contents
F016	Motor pole selection	4	Pole	2/4/6/8/10/12	Setting according to pole selection
F216	Motor pole selection, 2nd motor	4	Pole	2/4/6/8/10/12	Setting according to pole selection

Table 6- 14 Motor pole selection (F016/F216)

6.15　Motor rated current setting (F017/F217)

Setting the rated current value of the motor.

Code	Function name	Initial value	Unit	Setting range	Contents
F017	Motor rated current setting	Factory setting	A	0.0~999.9	Units : 0.1 A
F217	Motor rated current setting, 2nd motor	Factory setting	A	0.0~999.9	Units : 0.1 A

Table 6- 15 Motor rated current setting (F017/F217)

Note) The motor rated current of F017 is set to the setting value at factory automatically.

Note) Motor rated current is set automatically when changing motor capacity.

6.16　Speed/Torque mode selection (F018)

Code	Function name	Initial value	Unit	Setting range	Contents
F018	Speed/Torque mode selection	0	-	0~1	0 : Speed control mode
					1 : Torque control mode

Table 6- 16 Speed/Torque mode selection (F018)

Please, use a feedback option card for using this function.

Set the F012/F212 to 6 or 7.

Note) This function is explained in the feedback option card manual.

6.17　SLV control mode selection (F019)

Code	Function name	Initial value	Unit	Setting range	Contents
F019	SLV control mode selection	0	-	0~1	0 : Normal Operation
					1 : 0Hz Operation

Table 6- 17 SLV control mode selection (F019)

(1)　Below 1Hz, the speed sensorless control can make a high torque with 0Hz operation mode

(2)　Set the start frequency to 0.1Hz(F004=0.1)

(3)　An electrical acoustic noise can be produced in 0Hz operation mode

(4)　In the case of using this function, please set surely the suitable motor constant of using the motor according to the parameter of "selection of motor constant [H**]"

7. EXPLANATION OF A-GROUP

7.1 Acceleration and deceleration pattern (A001/A201, A002/A202)

(1) Selection of pattern

① Pattern of acceleration and deceleration speed is possible to set up corresponding to each system.

② Select the pattern of acceleration and deceleration with A001, A002.

Please set acceleration and deceleration pattern of the 2nd motor setting in each A 201, A202.
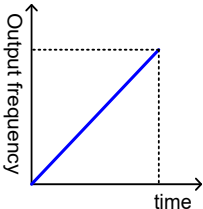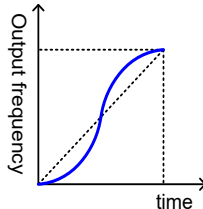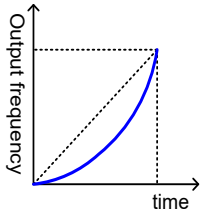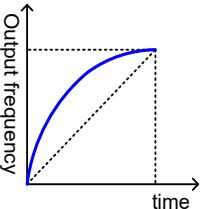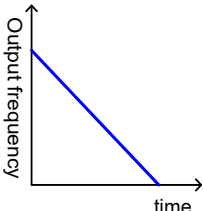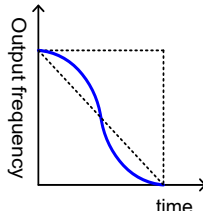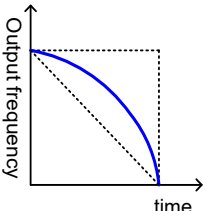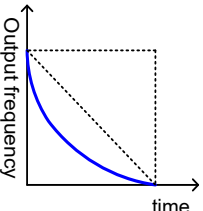
Set value	0	1	2	3
Curve	Line	S-shape	U-shape	Reverse U-shape
[A001] Acceleration curve Selection				
[A002] Deceleration curve selection				
Contents	Accelerate and decelerate in line frequency set value. (linear with time)	Collapsing the cargo such as the going up and down machine, conveyor it uses it for prevention	Cutting the tension control, rolled book such as the volume collector machine it uses it for prevention	

Table 7- 1 Acceleration and deceleration pattern (A001/A201, A002/A202)

7.2 Acceleration and Deceleration curvature (A003~A004)

(1) When rise the value of A003(A004), the s-curvature is bigger. In the case, the acceleration and deceleration time can be modified. The curvature variable in this formula limits.

[Acceleration time(Sec.) × curvature ≤ 60]

Code	Function name	Initial value	Unit	Setting range	Contents
A003	Acceleration curvature	8	-	1~10	The curvature is bigger by rising of setting value
A004	Deceleration curvature	8	-	1~10	

Table 7-2 Acceleration and deceleration curvature function (A003, A004)
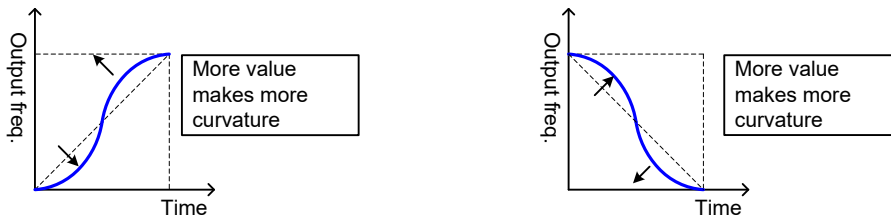
Fig 7-1 Acceleration and decleration curvature

7.3 Acceleration stop function (A005~A006)

When the moment of inertia for the load is high, this is the function to wait until the slip of the motor on starting becomes smaller.

Use when the over current trip occurs on starting.

Code	Function name	Initial value	Unit	Setting range	Contents
A005	Acceleration stop frequency	0.00	Hz	0.00~F003	0.00~99.99 : Setting in units of 0.01Hz 100.0~400.0 : Setting in units of 0.1Hz Set the frequency to be held.
A006	Acceleration stop time	0.00	Sec	0.00~60.00	Setting in units of 0.01 seconds Set the time to hold the frequency.

Table 7- 3 Acceleration stop function (A005~A006)
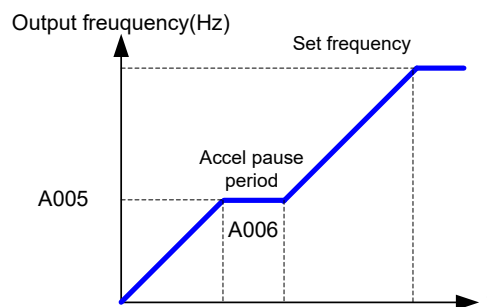
Fig. 7- 1 Acceleration stop function curve

7.4 Two-stage acceleration and deceleration functions (A007~A011)

(1) By setting this function, it is possible to change the rate of acceleration and deceleration.

(2) As methods to change the rate of acceleration and deceleration, you can select the method of changing by intelligent input terminal and automatically changing by optional frequency.

(3) In case of changing by intelligent input terminal, assign 09(2CH) to an intelligent input terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
A007	Two-stage acceleration and deceleration selection	0	-	0	Changing by Intelligent input terminal 09 (2CH) (Ex.1)
				1	Changing by two-stage acceleration and deceleration frequency (A 010/A11) (Ex.2)
A008	Acceleration time 2	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A009	Deceleration time 2	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600

A010	Acceleration Frequency 2	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 It is valid when two-stage acceleration and deceleration selection (A007) is 01. (Ex.2)
A011	Deceleration frequency 2	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 It is valid when two-stage acceleration and deceleration selection (A007) is 01. (Ex.2)

Table 7- 4 Two-stage acceleration and deceleration functions (A007~A011)

(Ex.1) In to set A007 to 0 case   (Ex.2) In to set A007 to 1 case
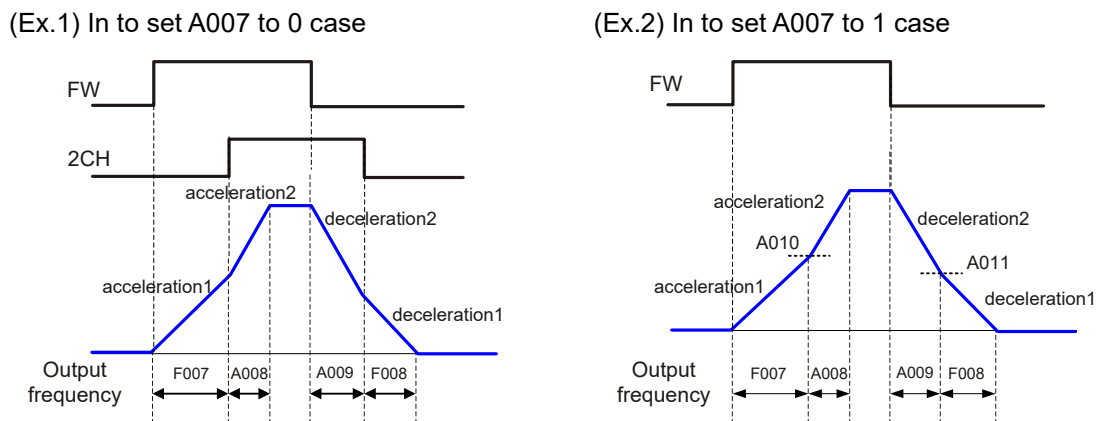
Fig. 7- 2 Two-stage acceleration and deceleration function curve

7.5   Three-stage acceleration and deceleration function (A012~A016)

(1) By setting this function, it is possible to change the rate of acceleration and deceleration.

(2) As methods to change the rate of acceleration and deceleration, you can select the method of changing by intelligent input terminal and automatically changing by optional frequency.

(3) In case of changing by intelligent input terminal, assign 10(3CH) to an Intelligent input terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
A012	Three-state acceleration and deceleration selection	0	-	0	Changing by Intelligent input terminal 10 (3CH) (Ex.1)
				1	Changing by Three-stage acceleration and deceleration frequency (A 015/A016) (Ex.2)
A013	Acceleration time 3	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A014	Deceleration time 3	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A015	Acceleration frequency 3	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 It is valid when Three-stage acceleration and deceleration selection (A012) is 01. (Ex.2)
A016	Deceleration frequency 3	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 It is valid when Three-stage acceleration and deceleration selection (A012) is 01. (Ex.2)

Table 7- 5 Three-stage acceleration and deceleration function (A012~A016)

(Ex.1) In to set A012 to 0 case   (Ex.2) In to set A012 to 1 case
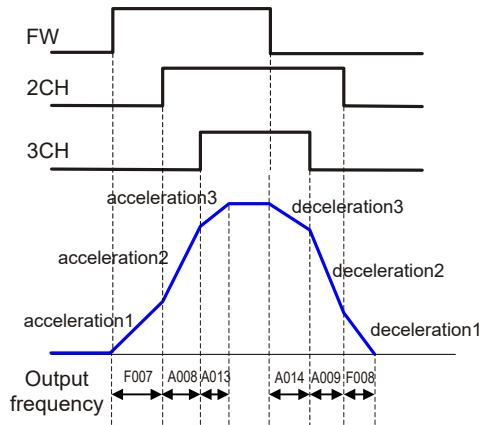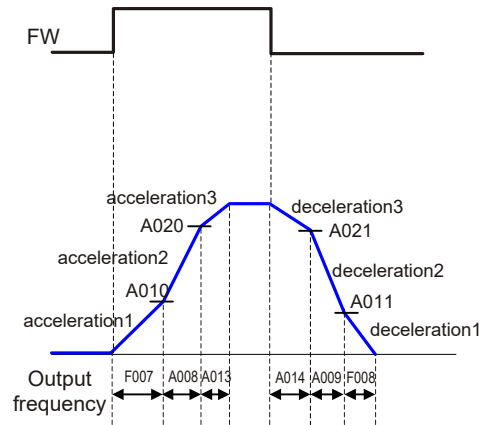
Fig. 7- 3 Three-stage acceleration and deceleration function curve

7.6   Multi-speed frequency setting (A027~A042)

(1) It is possible to set multi-speed 0 to 15 by selecting 2 to 5 (CF1 to CF4) on the intelligent input terminals.

(2) Set frequency setting for speed 1 to 15 with A028-A042.

(3) Set 0 speed with F001 when frequency command is an operator.

(4) When frequency command is control terminal (Terminal), set with O, OI terminal.

| Code	Function name	Initial value	Unit	Setting range	Contents
A027	Multi Speed 0	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 0 setting
A028	Multi Speed 1	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 1 setting
A029	Multi Speed 2	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 2 setting
A030	Multi Speed 3	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 3 setting
A031	Multi Speed 4	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 4 setting
A032	Multi Speed 5	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 5 setting
A033	Multi Speed 6	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 6 setting
A034	Multi Speed 7	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 7 setting
A035	Multi Speed 8	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 8 setting
A036	Multi Speed 9	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 9 setting
A037	Multi Speed 10	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 10 setting
A038	Multi Speed 11	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 11setting
A039	Multi Speed 12	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 12 setting
A040	Multi Speed 13	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 13 setting
A041	Multi Speed 14	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 14 setting
A042	Multi Speed 15	0.00	Hz	0.00, F004~F003	0.00~99.99/100.0~400.0,Multi Speed 15 setting

Table 7- 6 Multi-speed frequency setting (A027~A042)

Note) Please refer to multistage function (CF1~CF4) at intelligent input terminal for Multi-stage speed driving function.

7.7   1st~7th aceel/decel time setting (A043~A056)

(1) It is possible to set acceleration and deceleration time of multi-stage from 1st to 7th.

(2) Use the intelligent terminal function XT1, XT2, and XT3.

Code	Function name	Initial value	Unit	Setting range	Contents
A043	1st Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A044	1st deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A045	2nd Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A046	2nd deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A047	3rd Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A048	3rd deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A049	4th Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A050	4th deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A051	5th Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600

Code	Function name	Initial value	Unit	Setting range	Contents
A052	5th deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A053	6th Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A054	6th deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A055	7th Acceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600
A056	7th deceleration time	30.0	Sec.	0.1~3600	0.1~999.9/1000~3600

Table 7- 7 1st~7th aceel/decel time setting (A043~A056)

7.8   Free V/f setting (A059~A072)

(1)   The free V/f setting represents the optional V/f characteristics by setting the voltage and frequency in seven parts.(A059-A072)

(2)   This function provides a way to define a multi-segment V/f curve that best suits your application.

(3)   The setting of free V/f setting always operates to be $1 \leq 2 \leq 3 \leq 4 \leq 5 \leq 6 \leq 7$.
      Please set first free V/f setting 7 because the initial value is all 0Hz.

(4)   When the free V/f setting is valid, the function of torque boost (C003), base frequency (F002), maximum frequency(F003) is invalid. (Free V/f frequency 7 is same as the maximum frequency.)

Code	Function name	Initial value	Unit	Setting range	Contents
A059	Free V/F frequency 1	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F1 frequency setting
A060	Free V/F voltage 1	0.0	V	0.0~999.9	Voltage of V1 setting
A061	Free V/F frequency 2	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F2 frequency setting
A062	Free V/F voltage 2	0.0	V	0.0~999.9	Voltage of V2 setting
A063	Free V/F frequency 3	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F3 frequency setting
A064	Free V/F voltage 3	0.0	V	0.0~999.9	Voltage of V3 setting
A065	Free V/F frequency 4	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F4 frequency setting
A066	Free V/F voltage 4	0.0	V	0.0~999.9	Voltage of V4 setting
A067	Free V/F frequency 5	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F5 frequency setting
A068	Free V/F voltage 5	0.0	V	0.0~999.9	Voltage of V5 setting
A069	Free V/F frequency 6	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F6 frequency setting
A070	Free V/F voltage 6	0.0	V	0.0~999.9	Voltage of V6 setting
A071	Free V/F frequency 7	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 F7 frequency setting
A072	Free V/F voltage 7	0.0	V	0.0~999.9	Voltage of V7 setting

Table 7- 8 Free V/f setting (A059~A072)
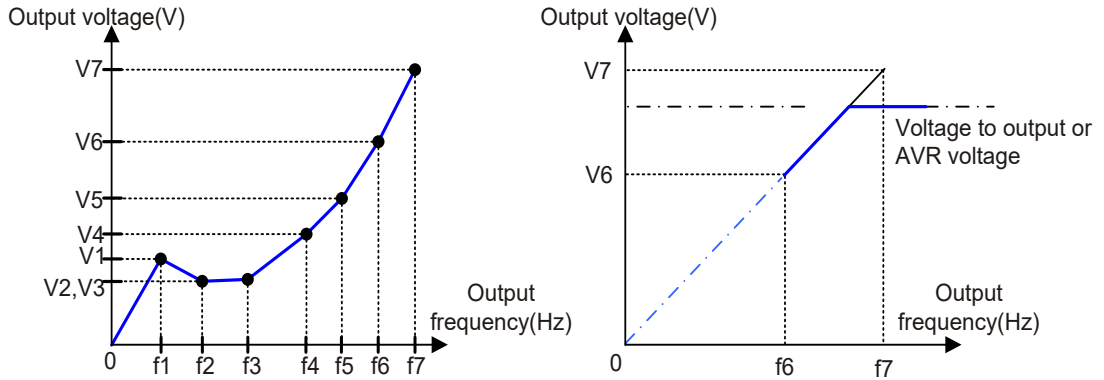
Fig. 7- 4 Free V/f setting curve

Note) Even if you set 800V for free V/f voltage 1-7, the output of inverter can't be more than input voltage or the AVR setting voltage.

7.9   Jog operation setting (A073~A074)

(1) This function can be used to rotate the motor in small steps to allow fine-tuning.

(2) When an intelligent input terminal is set to 06(JG) and operation command is entered from the terminal, the jogging operation is started.

Code	Function	Initial value	Unit	Setting range	Contents
A073	Jogging frequency	0.00	Hz	0.00, Starting frequency~10.00	Jogging frequency Setting
A074	Jogging stop selection	0	-	0	FRS : free run stop on jogging stop
				1	DEC : deceleration stop on jogging stop
				2	DCBR : direct braking on jogging stop

Table 7- 9 Jog operation setting (A073~A074)

(3) The jogging operation does not use acceleration, therefore it would be advisable to set the jogging frequency to limit the starting current to prevent the inverter trip error. Adjust A073 to the jogging frequency required.
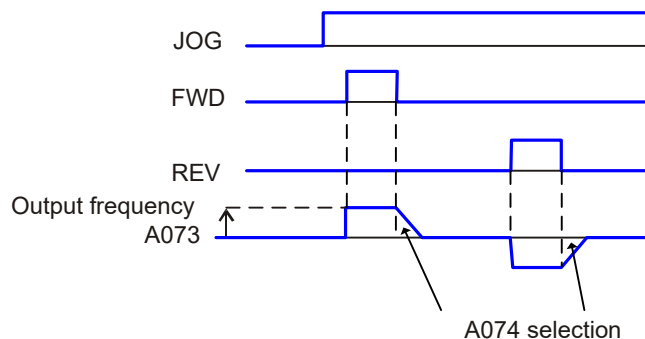
Fig. 7- 5 Jog operation curve

(4) Jogging operation selection

Note) When using the jogging function, turn FW terminal or RV terminal ON after the JG terminal is turned ON. (It is the same when the operation command point is from the operator.)
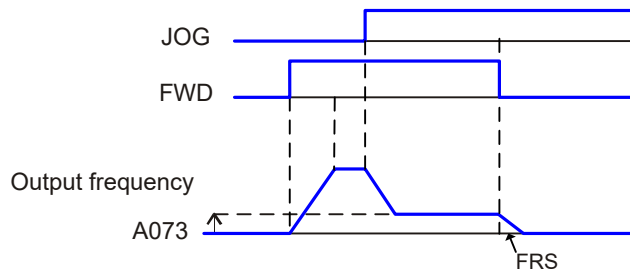
Fig. 7- 6 Jog operation selection curve

Note) In the case that the setting of A074 is 02, data setting of DB(DC braking) is necessary.

(5) Please set 6(JOG) to intelligent input terminals(I001~I008). (Initial value : set I003 =6)
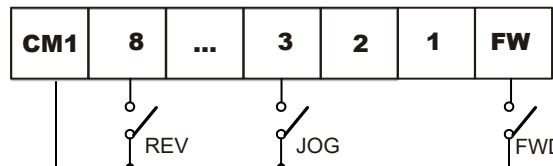
Fig. 7- 7 Intelligent input terminal setting (I003=6)

7.10   Jump frequency setting (A075~A080)

(1) Jump frequency can be used to avoid resonance points on machinery.
(2) The output frequency is changed continuously according to the acceleration and deceleration time.
(3) It is possible three different points are set for the jump frequency.

Code	Function name	Initial value	Unit	Setting range	Contents
A075	Jump frequency 1 lower limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 Lower limit frequency setting with jump frequency 1
A076	Jump frequency 1 upper limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 upper limit frequency setting with jump frequency 1
A077	Jump frequency 2 lower limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 Lower limit frequency setting with jump frequency 2
A078	Jump frequency 2 upper limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 upper limit frequency setting with jump frequency 2
A079	Jump frequency 3 lower limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 Lower limit frequency setting with jump frequency 3
A080	Jump frequency 3 upper limit	0.00	Hz	0.00~F003	0.00~99.99/100.0~400.0 upper limit frequency setting with jump frequency 3

Table 7- 10 Jump frequency setting (A075~A080)
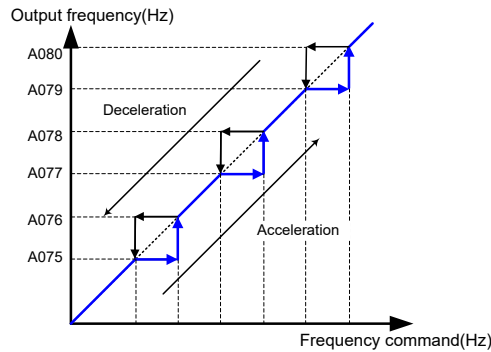
Fig. 7- 8 Jump frequency setting curve

7.11   DC braking setting (A081~A088)

- A dc voltage can be applied to the motor windings in order to lock the motor shaft and avoid overrun at low speeds.
- There are two methods of activating the dc braking. One is the external method which uses the intelligent input terminals, the other is the internal method which is automatically started at a specific frequency.

Code	Function name	Initial Value	Unit	Setting range	Contents
A081	DC braking selection	0	-	0	Internal DC braking : invalid
				1	Internal DC braking : valid
A082	DC braking frequency	0.50	Hz	0.00~60.00	When the output reaches the set frequency and Internal DC braking is valid, DC braking is started.
A083	DC braking wait time	0.0	Sec.	0.0~5.0	After DC braking time is reached, or DB terminal is ON, the late time is a delay before DC braking is started.
A084	DC braking force	0	%	0~100	Weak (Zero current)~Strong (Range is from 0 to 80%)
A085	DC braking time	0.00	Sec.	0.00~60.00	The DC braking is stopped after this time delay has elapsed. The time is started when the late time has elapsed.
A086	DC braking edge/level selection	1	-	0	Edge movement
				1	Level movement
A087	DC braking force for starting	0	%	0~100	Weak (Zero current)~Strong (Range is from 0 to 80%)
A088	DC braking time for starting	0.00	Sec.	0.00~60.00	The DC braking is stopped after this time delay has elapsed. The time is started when the late time has elapsed.

Table 7- 11 DC braking setting (A081~A088)

(1) External DC braking

    ① Please set 7 (DB) to an intelligent input terminal.

    ② DC braking can be activated according to ON/OFF switching of DB terminal irrespective of DC braking selection A081.

    ③ Set the strength of DC braking power with A084.

    ④ If DC braking late time A083 is set, the inverter output is cut off for this time period, the motor will be free running. After the late time passes, DC braking is started.

    ⑤ Please set DC braking time A085 or DC braking time by DB terminal paying attention to the heat of the motor.

⑥ After level action or edge action are selected with A086, set each setting in accordance with the system.

(a) Edge operation (A086=0)		(b) Level operation (A086=1)	
Example 1.1	FW ⎯⎯⎯⎯⎯⎯⎯ DB ‾‾‾‾‾‾‾ Output frequency — DC braking ← A085 →	Example 1.2	FW ⎯⎯⎯⎯⎯⎯⎯ DB ‾‾‾‾‾‾‾ Output frequency — DC braking
Example 2.1	FW ‾‾‾‾‾‾‾ DB ‾‾‾‾‾‾‾ Output frequency ← A085 →	Example 2.2	FW ‾‾‾‾‾‾‾ DB ‾‾‾‾‾‾‾ Output frequency
Example 3.1	FW ‾‾‾‾‾‾‾ DB ‾‾‾‾‾‾‾ Output frequency — Free-run A083 A085	Example 3.2	FW ‾‾‾‾‾‾‾ DB ‾‾‾‾‾‾‾ Output frequency — Free-run A083
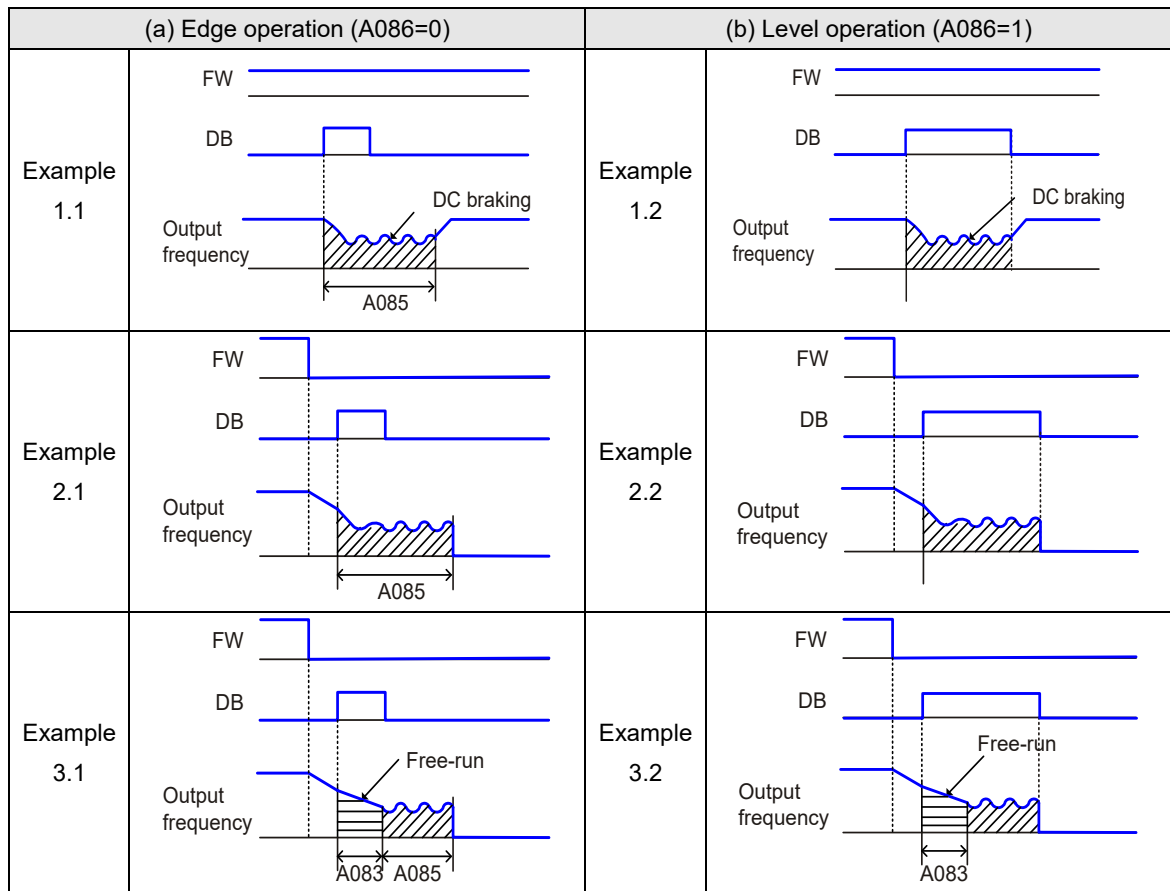
Fig. 7- 9 External DC braking curve

Note) If On switching time of DB terminal is longer than DC braking time (A085), DC braking keep up for On time if DB terminal.

(2) Internal DC braking
① When the inverter starts and stops, it is possible to operate DC braking without terminal operation.
② When using internal DC braking, the DC braking selection A081 should be set 01.
③ Set the starting frequency of the DC braking with A082.
④ If DC braking late time A083 is set and the dc braking frequency is reached, the operating command (FW) is switched OFF. The inverter cuts the output and for the set time of A083, free running of the motor will occur. After finishing the set time in A083, DC braking is started.
⑤ Starting DC braking power is set with A087, DC braking time at starting is set with A088.
⑥ To the braking power setting except starting time, set with A084.
⑦ The ON/OFF change selection for the operation command of Edge/Level operation when using inside DC braking is different.

Edge operation : Give priority to A085 DC braking action time, operate DC braking according to A085 set time. After turning operating command (FW) OFF, when output frequency reaches the set value of A082, DC braking is run during the setting time of A085. Even if operation command is turned ON during the setting time of A085, DC braking is run. (Example 5.1), (Example 6.1)

Level operation : Give priority to operating command, ignore DC braking time A085 and move to normal operation. When operation command is turned ON during DC braking, set time of A085 is ignored and normal operation is restored. (Example 5.2), (Example 6.2)
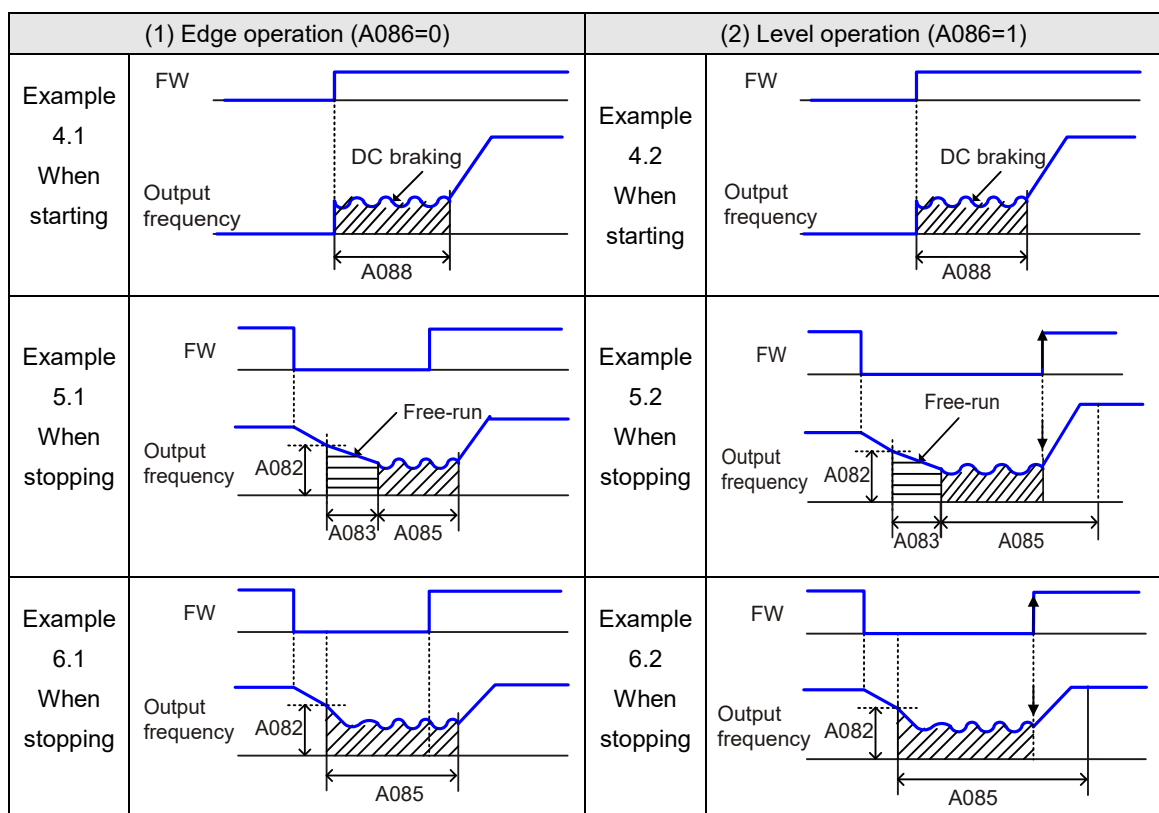
Fig. 7- 10 Internal DC braking curve

7.12 Acceleration and deceleration reference setting (A089)

It is possible to set the standard of acceleration and deceleration in A089.

Code	Function name	Initial value	Unit	Setting range	Explanation
A089	Accel/decel time reference setting	0	-	0	Maximum frequency (Ex.1) Acceleration and deceleration time is time to maximum frequency
				1	Setting frequency (Ex.2) Acceleration and deceleration time is time to order frequency

Table 7- 12 Acceleration and deceleration reference setting

(1) in case of A089 = 0 :

The standard of acceleration time and deceleration time is set by maximum frequency(F003) standard. That is, if the acceleration time(F007) which reaches to maximum frequency(F003) 60Hz is set to 30 seconds, the arrival time to 30Hz becomes 15 seconds.
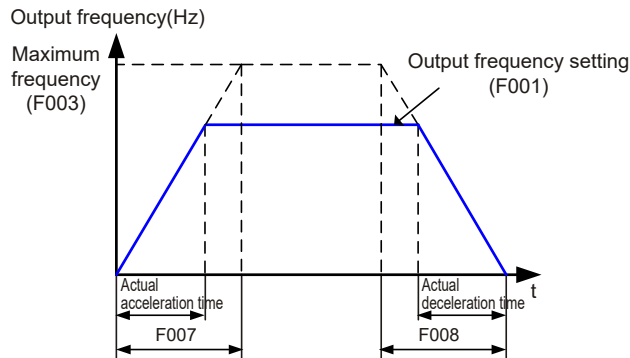
Fig. 7- 11 Acceleration and deceleration setting curve (A089=0)

(2) in case of A089 = 1 :

The arrival time to setting value of output frequency is accelerating time regardless of maximum frequency.

That is, if output frequency(F001) is set to 30Hz when maximum frequency is 60Hz and accelerating time is 30 seconds, the arrival time to 30Hz becomes 30 seconds.

But it is valid when the acceleration and deceleration pattern is linear.
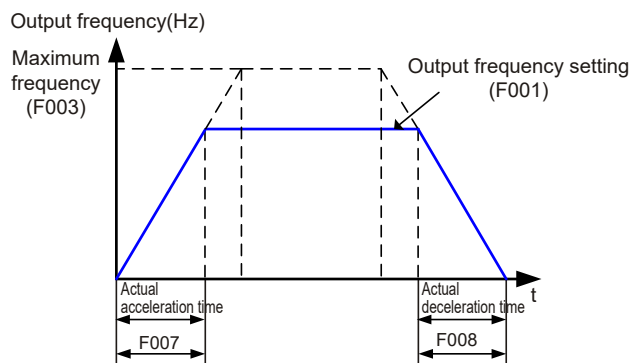
Fig. 7- 12 Acceleration and deceleration setting curve (A089=1)

7.13   Speed control setting (A090~A093)

(1) It is possible to set loop gain, loop constant, proportion gain and integral gain in the speed control.

Code	Function name	Initial value	Unit	Setting range	Contents
A090	Speed control loop gain	120	-	1~300	Lopp gain setting for the speed controller
A091	Speed control loop constant	30	-	1~120	Loop constant setting for the speed controller
A092	Speed control proportion gain setting	100	%	0~1000	Proportion gain setting for speed controller
A093	Speed control integral gain setting	100	%	0~1000	Integral gain setting for speed controller

Table 7- 13 Speed control setting
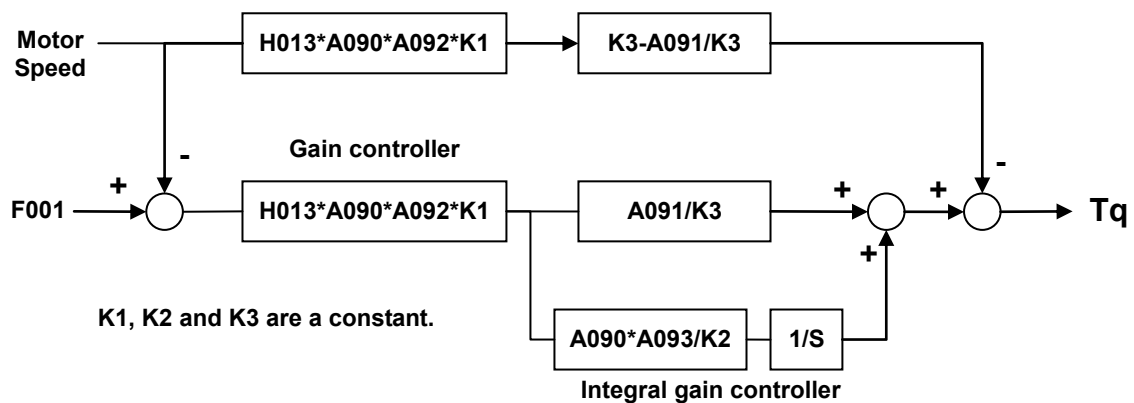
Fig. 7- 13 Control logic diagram for the speed control setting

(2) A090, A092 :

If the frequency can't reach the setting frequency in the acceleration / deceleration time setting value, make a value of the A090 and A092 lager, and, if a vibration is occured, make a value of the A090 and A092 lager.

(3) A091,A093 :

If an over-voltage or a speed over-shoot is occurred, make a value of the A091 and A093 smaller.

If you want to shot a deceleration time using the BRD, make a value of the A091 and A093 lager.

7.14   Load selection by speed control setting (A094)

Code	Function name	Initail value	Unit	Setting ragne	Contents
A094	Load Selection by speed control	0	-	0~5	0 : Normal load (A090=120, A091=60, A092=100, A093=100, Inertia=x1, L=initial value)
					1 : Lift load (A090=160, A091=100, A092=100, A093=500, Inertia=x1, L=initial value)
					2 : Wahsing machine (A090=180, A091=20, A092=100, A093=50, Inertia=x2.5, L=x0.9)
					3 : Press (A090=120, A091=60, A092=100, A093=100, Inertia=x2, L=Initial value)
					4~5: Reserved mode (A090=120, A091=30, A092=100, A093=100, Inertia =x1, L=Initial vlaue)

Table 7- 14 Speed control setting for each loads

8.   EXPLANATION OF b-GROUP

8.1   Operation limit (b001)

(1) Rotational direction restriction (b001)
   ① The direction of the motor can be restricted in this function.
   ② This is effective when the operating command is set by the digital operator or the terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
b001	Rotational direction restriction	0	-	0	Forward driving and reverse driving are valid
				1	Forward driving is valid
				2	Reverse driving is valid

Table 8- 1 Rotational direction restriction

8.2   Auto-Carrier Frequency (b002)

(1) Carrier Frequency automatically changes under 10 Hz region regardless of b010 setting..
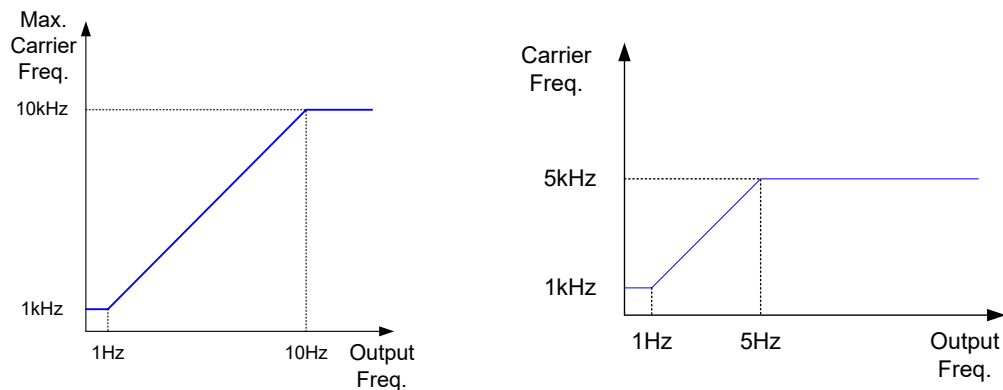
Fig. 8- 1 Max. Carrier Freq base on output Freq. & Example at b010=5kHz

(2) Setting this code when user wants smooth starting or increase starting torque in low Hz.
(3) This function can not accept following cases.
   ① F012/F212 = 6 or 7
   ② During Autotuning
   ③ During restarting

Code	Fucntion name	Initial value	Unit	Setting range	Contents
b002	Auto-Carrier Freq.	0	-	0	Invalid
				1	Valid

Table 8- 1 Auto-Carrier Freq.

8.3 Starting method setting function (b003~b004)

(1) Reduced voltage start selection (b003)

① This function is to raise the voltage slowly on motor starting.

② In case of raising the motor torque on starting, make the setting value low.
However, the inverter has a tendency of tripping on over-current protection by making this value lower, because of almost direct starting.
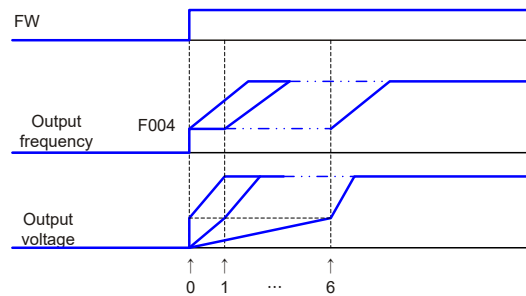
Fig. 8- 1 Reduced voltage start selection curve

Code	Function name	Initial value	Unit	Setting range	Contents
b003	Reduced voltage start selection	0	-	0~6	Short(about 50ms) ~ Long(about 160ms)

Table 8- 3 Reduced voltage start selection (b003)

(2) Retry limitation (b004)

When a retry is selected through b016, where b004 is 0, an instantaneous stop or under-voltage trip makes the inverter try to restart 16 times and then a trip will occur at 17th time. In case an over-current or over-voltage trip occurs, the inverter try to restart 3 times and then a trip will occur at 4th time.

Code	Function name	Initial value	Unit	Setting range	Contents
b004	Instantaneous power failure/under-voltage retry time selection	0	-	0	Restart until 16th.
				1	Restart freely

Table 8- 4 Retry limitation (b004)

8.4 Operation command selection (b005~b007)

(1) STOP key enable (b005)

① When the operation command is set by the external terminal, you can set whether the stop key of an operator is valid or not.

② Even though the control terminals are selected for the operation command, you can stop the inverter by using the stop key of an operator, if the stop key of operator is valid.

③ Trip reset function(Clear operation) by the stop key complies with this setting, too.

Code	Function name	Initial value	Unit	Setting range	Contents
b005	STOP key enable	0	-	0	valid
				1	Invalid

Table 8- 5 STOP key enable (b005)

(2) Selection on stop (b006)

When the stop function is commanded from the digital operator or the control terminals(Terminal), you can select the stop after slowing-down according to slowing-down time or the free run stop.

Code	Function name	Initial value	Unit	Setting range	Contents
b006	Stop mode selection	0	-	0	Deceleration stop
				1	FRS(Free run stop)
				2	DCBR(stop after DC Braking)

Table 8- 6 Selection on stop (b006)

(3) FRS selection (b007)

① The restart operation is performed according to the free run stop selection (b007) when an inverter is restarted during the free-run action.

② Assign 11(FRS) to an intelligent input terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
b007	FRS selection	0	-	0	0Hz : restart from 0Hz
				1	Fmat : restart from frequency detected from actual speed of the motor

Table 8- 7 Selection on stop (b006)

8.5   AVR selection (b008)

(1) Even if the incoming voltage changes, this function keeps the output voltage to the motor constant.

(2) The output voltage to the motor in this function references to the voltage selected on motor voltage selection.

Code	Function name	Initial value	Unit	Setting range	Contents
b008	AVR Function selection	0	-	0	Always ON : This function is effective on acceleration, constant speed, deceleration
				1	Always OFF : This function is ineffective on acceleration, constant speed, deceleration
				2	On decelerating OFF : This increases a loss of motor and reduces the energy regenerated to inverter on decelerating.

Table 8- 8 AVR selection (b008)

8.6   Frequency conversion factor (b009)

(1) This inverter displays the value changed by the output frequency and the value set in b009.

(2) The output frequency of FM terminal becomes same as d012 at the time of setting up the digital output frequency to the FM terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
b009	Frequency conversion factor	1.0	times	0.1~99.9	FM digital output frequency = Output frequency x Frequency conversion factor

Table 8- 9 Frequency conversion factor (b009)

8.7   Carrier frequency (b010)

(1) The carrier frequency of the PWM wave-form output from the inverter is adjustable with b010.
(2) If the carrier frequency is set higher, the audible noise from a motor will be reduced.
      But the RFI (Radio Frequency Interference) noise and the leakage current may be increased.
(3) This function may help to avoid the resonant frequency of the motor and the mechanical system.

Code	Function name	Initial value	Unit	Setting range	Contents
b010	Carrier frequency	5.0	kHz	0.5~10.0	0.1kHz setting by unit Only, the setting range of carrier frequency is different according to the capacity of inverter.

Table 8- 10 Carrier frequency (b010)

Note) The maximum value of the carrier frequency is different depending on the capacity to achieve full output current. When the carrier frequency is raised, the rated output current will be reduced.

Inverter capacity 200V class	Carrier frequency	Inverter capacity 400V class	Carrier frequency
055LF~075LF	10kHz, 100% continuous operation	055HF~110HF	10kHz, 100% continuous operation
110LF~150LF	7kHz, 100% continuous operation	150HF	7kHz, 100% continuous operation
185LF~220LF	5kHz, 100% continuous operation	185HF~220HF	5kHz, 100% continuous operation
300LF~450LF	7kHz, 100% continuous operation	300HF~450HF	7kHz, 100% continuous operation
550LF	5kHz, 100% continuous operation	550HF~1100HF	5kHz, 100% continuous operation
		1320HF	3kHz, 100% continuous operation

Table 8- 11 Carrier frequency for continuous operation

Note) 5.5~55kW : ambient temperature 50℃, 75~132kW : ambient temperature 40℃

8.8   Cooling fan operating selection (b011)

You can select whether the fan operates continuously or operates only when the inverter is in the running operation.

Code	Function name	Initial value	Unit	Setting range	Contents
b011	Cooling fan operating selection	0	-	0	Always ON
				1	Only ON during run

Table 8- 12 Cooling fan operating selection (b011)

8.9   Ground Fault selection (b013)

(1) This is the function to warn when ground fault is occurred.

(2) Note that if this code is 1(valid) only the moment when the power is on, the inverter checks out ground fault between the inverter output and the motor.

(3) If ground fault is detected while running, inverter will stop with another error(overcurrent / overvoltage etc).

Code	Function name	Initial value	Unit	Setting range	Contents
b013	Ground fault selection	1	-	0	Invalid: Don't trip when ground fault is occurred.
				1	Valid: Trip when ground fault is occurred..

Table 8- 13 Ground Fault selection (b013)

8.10   Initialization selection (b014)

(1) It is possible at any time to reinitialize the inverter parameters back to the factory default.

(2) The trip history can also be cleared at any time, however, if problems occur it will be difficult to find fault without the trip history for reference.

(3) RUN time, ON time is not cleared.

(4) Initialization contents are as following.

Code	Function name	Initial value	Unit	Setting range	Contents
b014	Initialization selection	0	-	0	This clears only trip history
				1	This only initializes setting value.
				2	This clears trip history and initializes setting.

Table 8- 14 Initialization selection (b014)

NOTE)   It is not initialized by setting initialization selection (b014).
You can initialize properly by selecting the initialization mode in b014 and then doing the initialization action.

(5) Precautions

① Set the initialization selection (b014) to 1(Only initializes setting value) or 2 (trip history and initializes setting value)

② Push the READ key and STR key together.

③ It is displayed the initializing indication that was appeared when power on.

Namely, it is displayed --xx in digital operator.

④ b014 is displayed after initializing indication --xx, and then initializing the inverter is completed.

NOTE) --xx means the software version information.

8.11 Country code for initialization (b015)

The country code for initialization (b015) is set according to the inverter on factory forwarding.

Code	Function name	Initial value	Unit	Setting range	Contents
b015	Country code for initialization	0	-	0	LOCAL: KOREA version
				1	EC: EUROPE version
				2	USA : US version

Table 8- 15 Country code for initialization (b015)

8.12 Automatic restart mode function (b016~b025)

(1) Instantaneous power failure restart

① You can select whether the inverter trips or retries (restart) when an instantaneous power failure/under-voltage occurs.

② When a retry is selected through b016, where b004 is 0, an instantaneous stop or under-voltage trip makes the inverter try to restart 16 times and a trip will occur at 17th time.

③ When selecting a retry function, set the following related codes.

Code	Function name	Initial value	Unit	Setting range	Contents
b016	Retry selection	0	-	0	TRIP : TRIP
				1	0Hz : Restart from 0Hz on retry.
				2	Fmat : Start equaling frequency on retry.
				3	Fmat-Dec-Trip : Start f-equaling and stop decelerating on retry. After stop, start trip. (Note 1)
b017	Allowable under-voltage power failure time	1.0	Sec.	0.3~1.0	If the instantaneous power failure time is shorter than the set time, a restart will occur. (Ex.1) If the instantaneous stop time is longer than set time, trip. (Ex.2)
b018	Retry wait time	1.0	Sec.	0.3~100.0	Delay before motor restart time.
b019	Instantaneous power failure/under-voltage trip during stop	0	-	0	Invalid : Trip isn't caused and alarm isn't output
				1	Valid : Trip is caused and alarm is output
				2	Invalid : Trip isn't caused and alarm isn't output during stop and deceleration by stop command.
				3	Always Invalid : Trip isn't caused and alarm isn't output during use DC power source at P-N terminal. (Applicable only instantaneous power failure)
b020	Frequency setting to match	0.00	Hz	0.00~400.0	When the frequency of the motor during free-run is less than this set frequency, restart with 0Hz is caused.(Ex. 3,4)

Table 8- 16 Instantaneous power failure restart (b016~b020)

Frequency matching start : The inverter reads the motor RPM and direction and restarts the inverter to match these readings without motor stop.

NOTE 1)   When trip of the over voltage or over current occurs in the deceleration time, an instantaneous power failure (E016) is displayed and the inverter goes into free-run. In this case, make the deceleration time long.

④   When a retry function (b016) value is set to 2, the timing chart is following.
        t0 : Instantaneous stop power failure
        t1 : Allowable under-voltage power failure time(b017)
        t2: Retry wait time(b018)
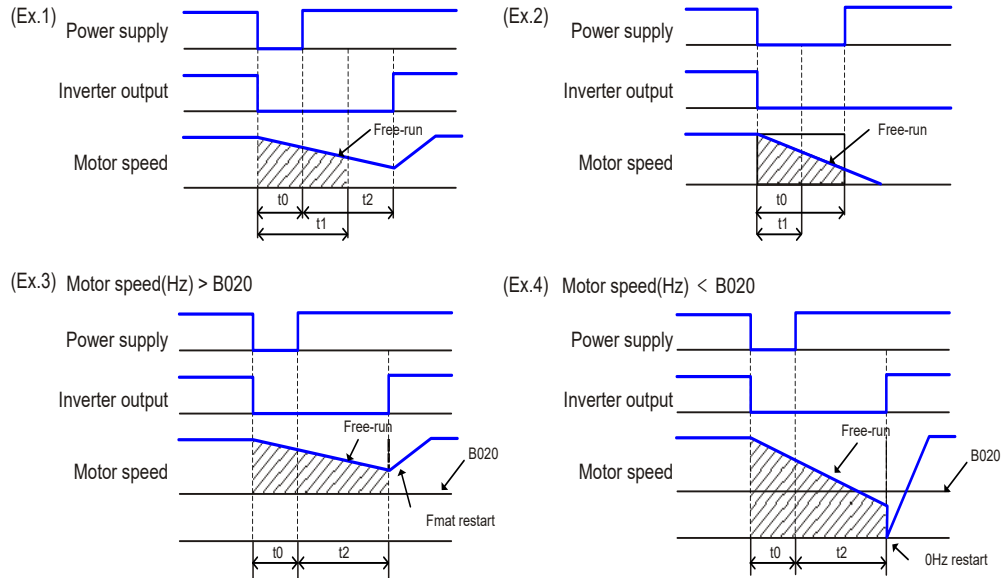
Fig. 8- 2 Example of frequency matching start

⚠ Warning	• if over-voltage or over-current tirp happen when f-match starting, try to increase b018 value. (it's invalid lower than 2 sec for 22~55kW, 5 sec for 75~132kW) • This function are depends on the machine and load conditions. Before using this function, user must perform verification test.

(2) Instantaneous power failure/under voltage alarm output during stop

① b019 decides whether alarm generates or not when instantaneous power failure or under-voltage occurs.

② Alarm occurs while control power of inverter remains.

③ The waveform of alarm outputs at an instantaneous power failure and under-voltage during stop is following.

When b016 is set to 0,
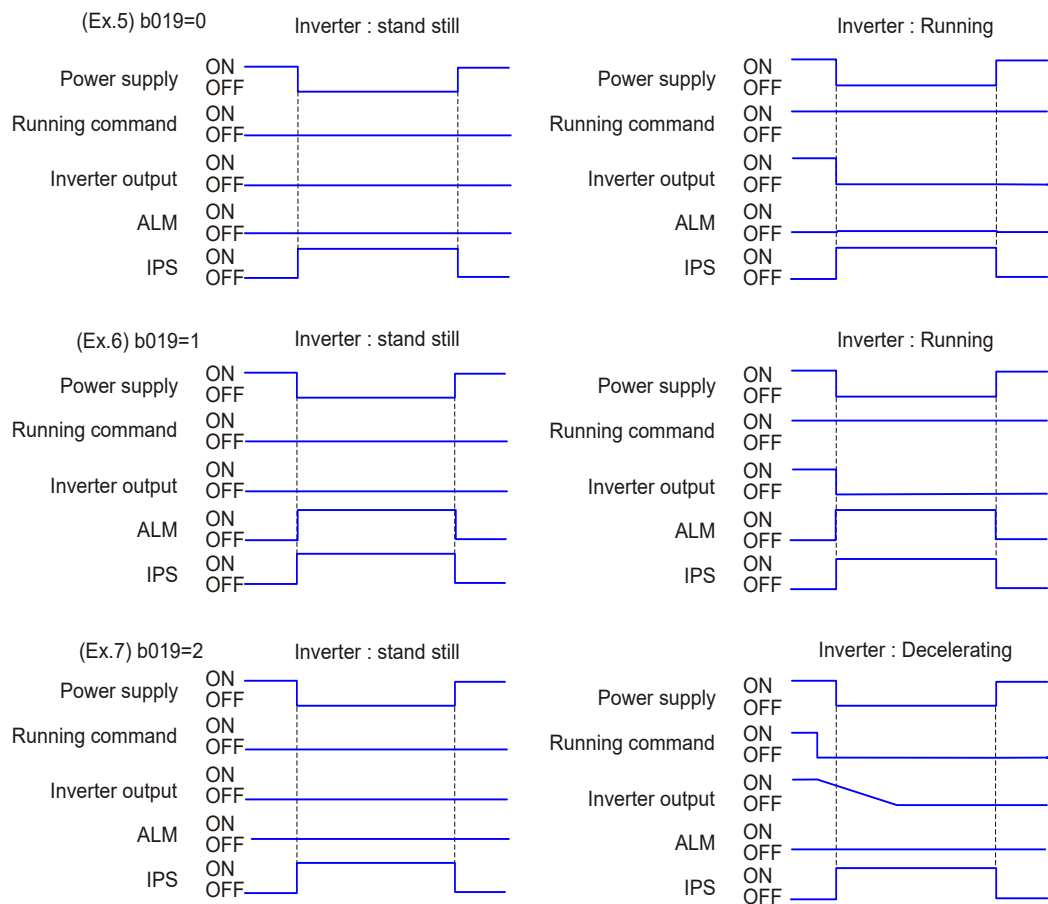
Fig. 8- 3 The waveform of alarm outputs at instantaneous power failure/under voltage alarm output during stop (b016=0)

④ It is possible to use an output by assigning the signal (IP=08) during instantaneous stop, by setting (UV=09) during under-voltage to an intelligent output terminal 11-14(o001-o004) or alarm relay   output terminal.

⑤ Refer to the reset description in case of the power failure for more than 1 second.

When b016 is set to 1 or 2 and instantaneous power failure time is less than b017 second.
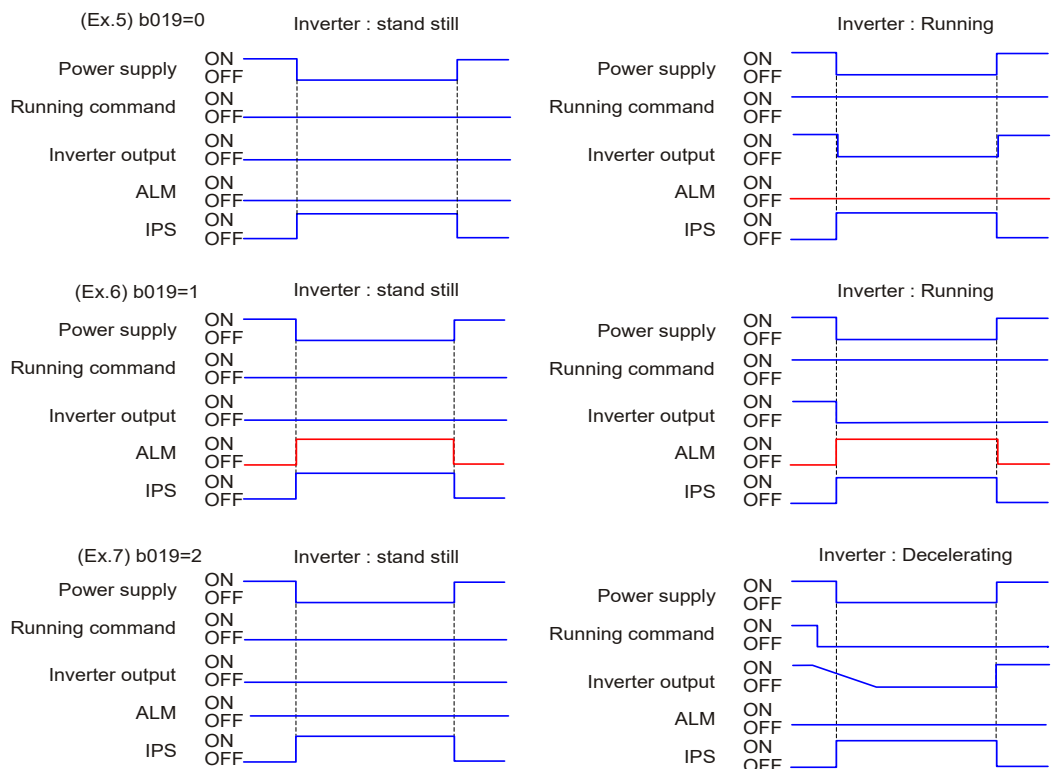
Fig. 8- 4The waveform of alarm outputs at instantaneous power failure/under voltage alarm output during stop (b016=1 or 2)

When b016 is set to 1 or 2 and instantaneous power failure time is more than b017 second.
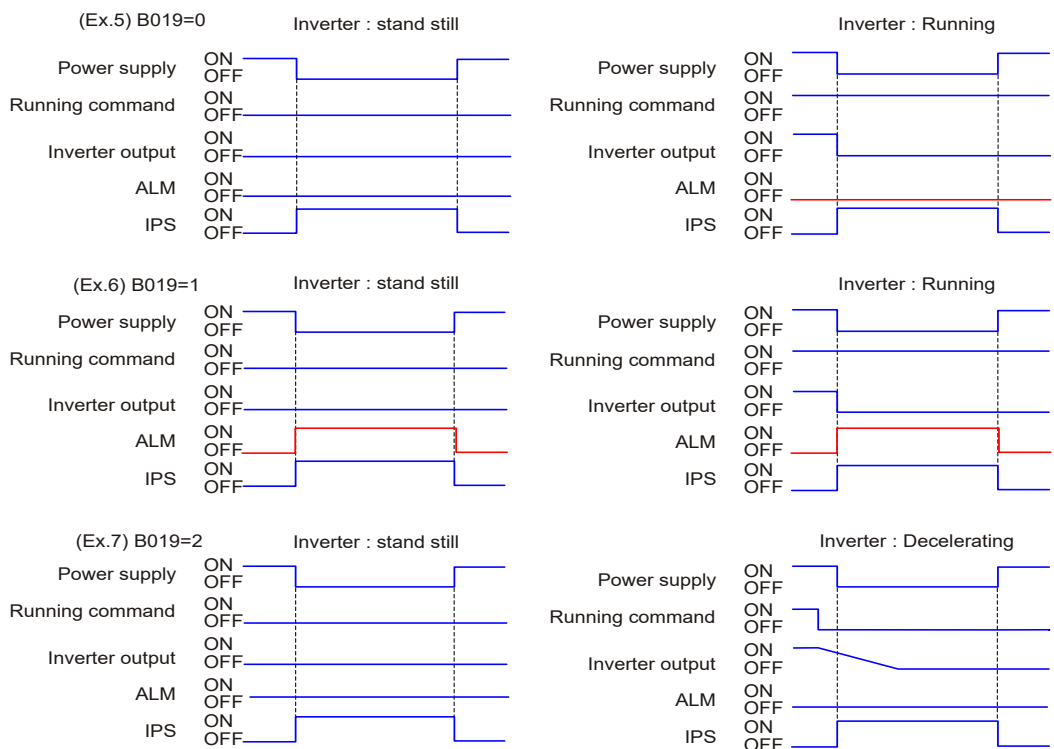
Fig. 8- 5 The waveform of alarm outputs at instantaneous power failure/under voltage alarm output during stop (b016=1 or 2)

(3) Non-stop selection at instantaneous power failure (Stopping deceleration at power OFF)
   ① This is a function that decelerates and stops the inverter not to exceed over voltage level (0V-LADSTOP : b023) where power is off while running.
   ② When selection of non-stop function at instantaneous power failure is valid (b021), if power stop during running and at voltage less than starting voltage of non-stop function at instantaneous power failure, at first the inverter would decelerate at width of starting deceleration at non-stop instantaneous power failure (b025) in width of frequency, and then it would decelerate at non-stop deceleration time at instantaneous power failure (b024). If it becomes over voltage due to generating during deceleration (more than non-stop 0V-LADSTOP level at instantaneous power failure : b022), the condition would be in LAD stop until over voltage is released.

Code	Function name	Initial value	Unit	Setting range	Contents
b021	Non-stop function selection at instantaneous power Failure	0	-	0	Non-stop function at instantaneous power failure invalid
				1	Non-stop function at instantaneous power failure valid
b022	Starting voltage of non-stop function at instantaneous power failure	0.0	V	0.0~999.9	
b023	Non-stop instantaneous power failure LADSTOP level	0.0	V	0.0~999.9	
b024	Non-stop deceleration time at instantaneous power failure	1.00	Sec.	0.01~3600	0.01~99.99/100.0~999.9/1000~3600
b025	Starting deceleration width at instantaneous power failure	0.00	Hz	0.00~10.00	

Table 8- 17 Non-stop selection at instantaneous power failure
(Stopping deceleration at power OFF) (b021~b025)
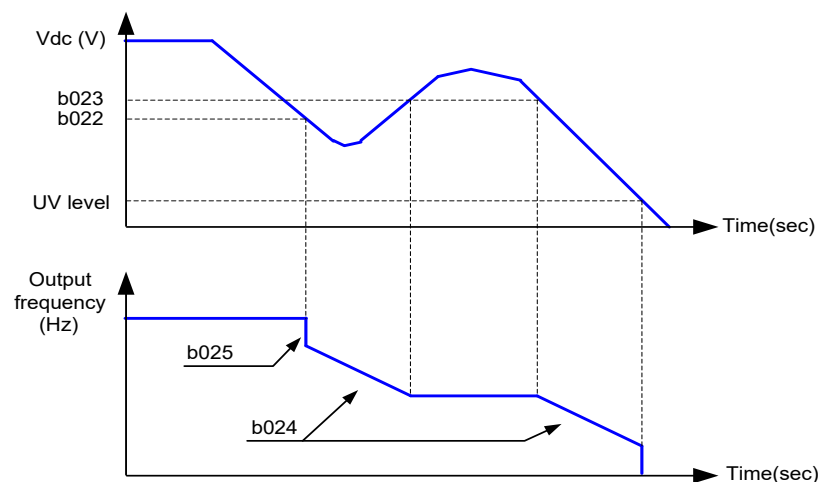
Fig. 8- 6 The waveform for Non-stop selection at instantaneous power failure

8.13   Open phase protection function selection (b026)

This is the function to warn when the input supply for the inverter opens.

Code	Function name	Initial value	Unit	Setting range	Contents
b026	Open phase protection selection	0	-	0	Invalid: Do not trip when the input supply opens or output opens.
				1	Input phase loss detection always
				2	Output phase loss detection at power supply
				3	Input phase loss detection always Output phase loss detection at power supply
				4	Output phase loss detection during running
				5	Input phase loss detection always
				6	Output phase loss detection during running
				7	Output phase loss detection at power supply

Table 8- 18 Open phase protection function selection (b026)

NOTE) When an open phase occurs, there is a danger that the inverter could produce one of the following states.

① The ripple current of main capacitor increases and the life of main capacitor shortens remarkably.

② With a load, there is a danger that the capacitors or thyristors inside the inverter may be damaged.

③ There is a risk that the in-rush resistor to limit the current inside the inverter may be burnt out.

8.14   Electronic thermal function (b027~b029)

● Set the inverter according to motor rated current to protect the motor from overloading, overheating and damage. A warning signal can be generated before tripping an electronic thermal protection.

● The frequency characteristic is set in b028.

(1)   Electronic thermal level

Code	Function name	Initial value	Unit	Setting range	Contents
b027	Electronic thermal level	Irate	A	0.0~999.9	Please, set value less than 2 times of motor rated current
b227	2nd motor Electronic thermal level	Irate	A	0.0~999.9	Please, set value less than 2 times of motor rated current

b028	Electronic thermal	1	-	0	Reduction : Reduced torque characteristic
				1	Constant torque : Constant torque characteristic
b228	2nd motor Electronic thermal	1	-	0	Reduction : Reduced torque characteristic
				1	Constant torque : Constant torque characteristic
b029	Electronic thermal Warning level	80	%	0~100	0 : Thermal warning is non-effective Units: %

Table 8- 19 Electronic thermal function (b027~b029)

- When output frequency of general motor decreases cooling function of self-cooled fan will fall in general motor.
- Reduced torque characteristic was programmed according to a Hyundai general motor heat pattern.

  ex) 200V class 15Hp

  Rated current : 46A

  Setting extent : 9.2~55.2A

  electronic thermal level is b027 : 46 A

  The time limit characteristic is right diagram.
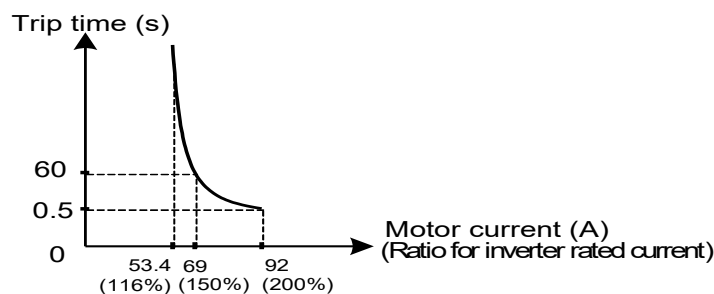
Fig. 8- 7 Time limit characteristic (200V class 15Hp)

① Reduced torque characteristic

To add the time limit characteristic matching with the reduced time rate(b027/b227) of the frequency.

Ex) 200V class 15Hp, b027 = 46A, output frequency=20Hz
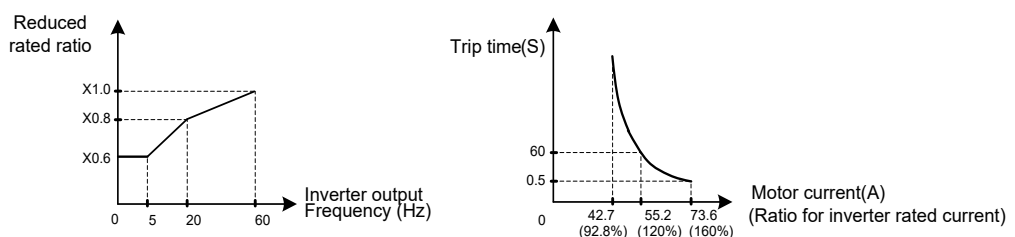
Fig. 8- 8 Reduced torque characteristic (200V class 15Hp)

② Constant torque characteristic

Set this characteristic in case of the use of a constant torque motor.

Ex) 200V class 15Hp, b027 = 46A, output frequency = 2.5Hz
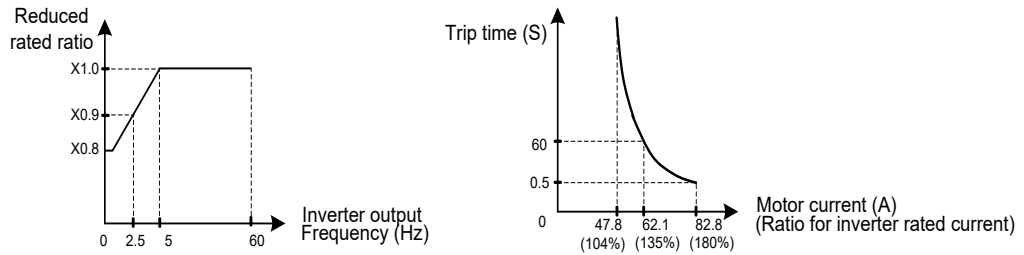
Fig. 8- 9 Constant torque characteristic (200V class 15Hp)

(2) Thermal warning

  ① A warning signal can be generated before overheat protection by the electronic thermal protection occurs. Warning level is set with b029.

  ② Assign 13(THM) to intelligent output terminal 11~14(o001-o004) or the alarm relay output.

8.15 Overload restriction/Overload advance notice (b030~b033)

(1) Overload restriction

  ① The Inverter monitors the motor current at acceleration and constant speed, when the inverter reaches the overload restriction level, the inverter will reduce the output frequency automatically to restrict the overload.

  ② This function prevents an over-current trip by inertia during acceleration or radical changes of load at constant speed.

  ③ The overload restriction level limits the current at which this function operates.

  ④ The overload restriction constant is the time to decelerate from max frequency to 0Hz.

  ⑤ In order to make this function work properly, the acceleration time should be longer than setting time.

  ⑥ If the overload restriction constant is set too short, in spite of accelerating, an over-voltage trip is caused with regenerative energy from the motor at automatic deceleration by this function.

  ⑦ When this function operates while accelerating, the frequency will not reach the goal frequency, the Inverter will adjust in the following way.

       Make an acceleration time longer.

       Raise a torque boost.

       Raise a overload restriction level.

Code	Function name	Initial value	Unit	Setting range	Contents
b030	Overload restriction Selection	1	-	0	Invalid
				1	Acceleration/valid on constant speed
				2	Valid on constant speed
				3	Acceleration/valid on constant speed [speed increasing at regenerating mode]
b031	Overload restriction Level.	1.5	times	0.5~2.0	Rated current x 0.5 to Rated current x 2.0 Current value overload restriction operates.
b032	Overload restriction constant.	3.0	Sec.	0.1~30.0	Deceleration time at overload limitation action

| b033 | Overload advance notice signal output mode | 0 | - | 0 | valid on Constant speed/Acceleration/ Deceleration |
| | | | | 1 | Only, Valid on constant speed |

Table 8- 20 Overload restriction/Overload advance notice (b030~b033)
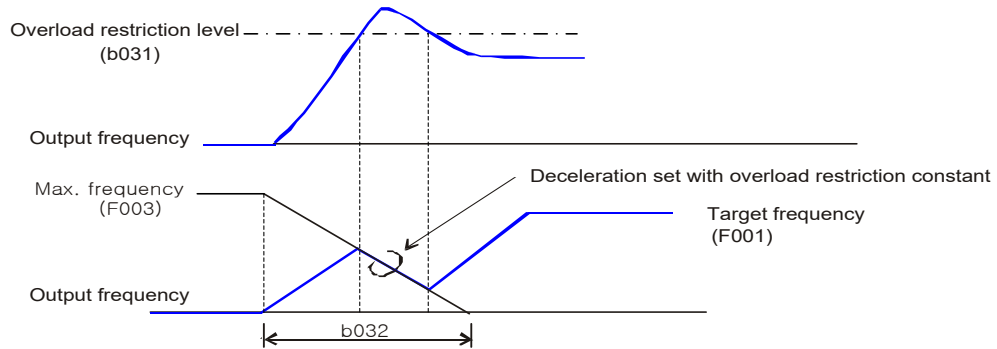
Fig. 8- 10 The waveform for Overload restriction/Overload advance notice

(2) Overload advance notice

① When the load is high, it is possible to adjust the load by outputting an overload advance notice.

It is used to prevent damage to the machine under huge load, i.e. baggage on a conveyor, the Inverter overload protection will operate.

② Assign overload advance notice level 1(OL=3) / overload advance notice level 2(OL2=21) to an intelligent output terminal 11-14 or the alarm relay output terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
o026	Overload advance notice level 1	1.0	times	0.0~2.0	0 ~ Rated current × 2time As load reaches overload advance notice level. OL signal is output.
o027	Overload advance notice level 2	1.0	times	0.0~2.0	0 ~ Rated current × 2time As load reaches overload advance notice level. OL2 signal is output.

Table 8- 21 Overload advance notice (o026, o027)
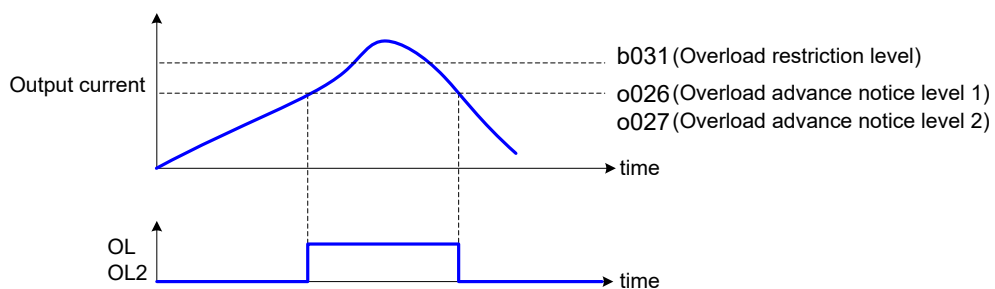
Fig. 8- 11 The waveform for overload advance notice level

8.16 External thermistor (b034~b036)

(1) Temperature protection of the external machine is possible by the use of a thermistor fitted to your motor.

(2) Wire the thermistor between control terminals TH and CM1.

(3) Set the following function according to the thermistor specification.

Code	Function name	Initial value	Unit	Setting range	Contents
b034	Thermistor selection	0	-	0	Invalid : No temperature protection by external thermistor
				1	PTC : Valid normal temperature/factor resistance element (For PTC)
				2	NTC : Valid (For NTC)
b035	Thermistor error level	3000	Ω	0~9999	Set the resistance value of temperature for trip according to thermistor methods.
b036	Thermistor control	105.0	-	0.0~999.9	Use this as gain adjustment

Table 8- 22 External thermistor (b034~b036)

8.17   Communication condition setting (b037~b042)

It is possible to set the detailed condition for the inverter communication.
Refer to the detailed explanation of communication part (Chapter. 13).

Code	Function name	Initial value	Unit	Setting range	Contents
b037	Data command selection	0	-	0~3	0 : Operator 1 : RS485 2 : CAN 3 : OPT2 4 : RS232
b038	Communicating transmission speed	2	-	0~4	0 : 2,400bps, 1 : 4,800bps, 2 : 9,600bps, 3 : 19,200bps, 4 : 38,400bps
b039	Communication code	1	-	1~32	
b040	Communication bit	8	-	7~8	7 : 7bit, 8 : 8bit
b041	Communication parity	0	-	0~2	0 : No parity, 1 : Even parity, 2 : Odd parity
b042	Communication stop bit	1	-	1~2	1 : 1bit, 2 : 2bit

Table 8- 23 Communication condition setting (b037~b042)

8.18   Communication Trip function(b043~b044)

(1) If commnucation connection have some problem when inverter controlled by communication mode(F010/F011=2 or 3), inverter will tirp after b044 setting time.

(2) If b044 = 0, this function will invalid

(3) In b043 code, user can set sensing condition and stop method when trip.

Code	Function name	Initial value	Unit	Setting range	Contents
b043	Stop method when communication trip	0	-	0~3	0 : Always valid, Free-run stop
					1 : Always valid, Deceleration stop
					2 : Valid when inverter running, Free-run stop
					3 : Valid when inveter running, Decelerationstop
b044	Time out setting for commnucation trip	0	Sec	0.0~600.0	-

Table 8- 24 Communication trip function (b043~b044)

8.19   Power on display setting (b045)

(1) It is possible to set the initial display when power on.

Code	Function name	Initial value	Unit	Setting range	Contents
b045	Power on display setting	0	-	0~18	0 : d01 display
					1~18 : d01~d18 display

Table 8- 25 Power on display setting (b045)

8.20   Forward/Reverse re-start setting (b046)

(1) When re-start after free-run or Instantaneous power failure, if motor run reverse direction compared with inverter command direction, inverter can detect speed of motor by setting b046 function.
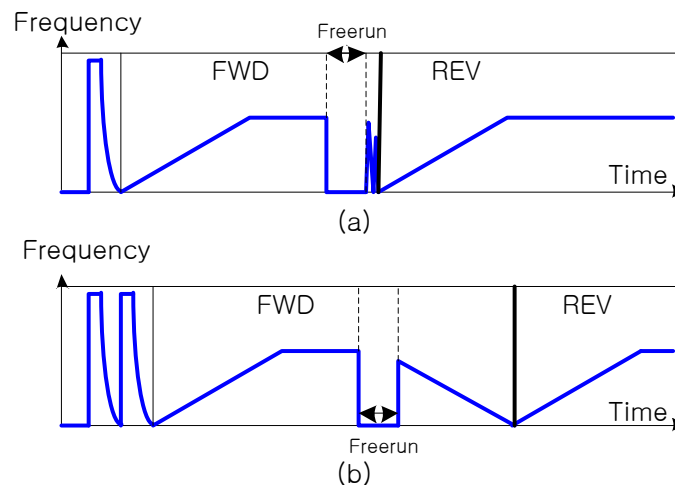

(a)

(b)

Fig. 8-13 (a) Speed detection for command direction (b046=0),
(b) Spped detection for forward/reverse directon (b046=1)

9. EXPLANATION OF I-GROUP

9.1 Intelligent input terminal setting

9.1.1 Arrangement of control circuit terminals

(1) Layout of control circuit terminals
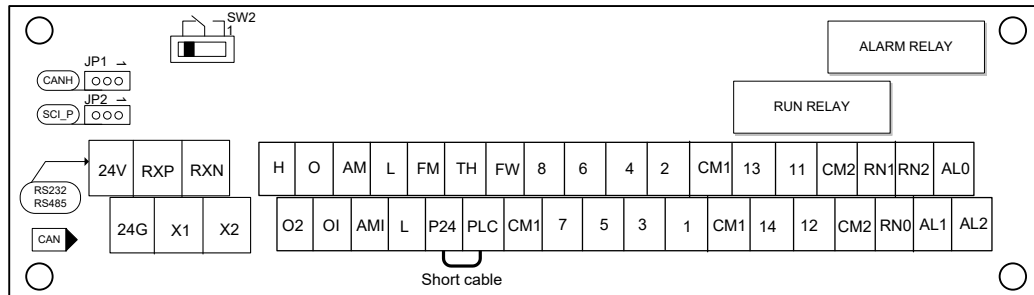
Fig. 9- 1 Layout of control circuit terminals

(2) Explanation of control circuit terminal

Item	Function	Terminal marking	Terminal name	Contents
Analog control terminal	Analog power	H	Frequency power	● It is the DC+10V power for terminals.
		L	Analog power common	● It is common terminal of frequency command signal (O, O2, OI) and analogue output, AM, AMI. Don't earth.
	Frequency setting input	O	Frequency command power terminal (0~10VDC)	● When inputting DC 0 ~10V, it is maximum frequency on 10V. ● When maximum frequency is expected to be on being less then 10V, set with I023.
		O2	Frequency command support (-10~10VDC)	● When inputting DC ±10V, this signal is added to frequency command of O or OI terminal. ● Setting switching O2 terminal individually frequency order possible.
		OI	Frequency command Terminal (4~20mA)	● When inputting DC 4 ~20mA, 20mA is maximum frequency. ● When AT terminal is ON, OI signal is valid.
Digital control terminal	Digital power	P24	Interface power	● It is DC24V power for connection input signal. When selecting source logic, it's connection input common.
		CM1	Interface power common	● The common terminal is FW terminal, 1-8 terminal, ● TH terminal FM terminal, Don't earth.
		PLC	Intelligent input common	● Change sink type and source type by short bar on control terminals. P24-PLC : Sink type CM1-PLC : Source type ● In case of driving the connection input by external power, remove the short cable on the above figure and connect the PLC with external interface circuit.
	Point of contact input	FW	Forward command	● About FW signal, ON is Forward and OFF is stop command.
		1~8	Intelligent input terminal 1~8	● Select 8 functions from 39 functions, and divide between 1 terminal and 8 terminals.
Sensor	Thermistor	TH	Thermistor input terminal	● When a Thermistor connected to terminals TH and CM1, the inverter ● Checks for over-temperature and will cause trip event and turn off output to motor. ● Allowable minimum Thermistor power 100mW ● Impedance under over-temperature : 3kΩ ● Over-temperature detection level : variable(0~9999Ω)

Table 9- 1 List of control circuit terminal

9.1.2   Intelligent input terminal connection

(1) Intelligent input terminal circuit can use 24V through the P24 terminal from the inside of the inverter.

(2) Input circuit is connected to PLC terminal. Therefore, in case of using an internal power, short the circuit like the following. In order to use external power, remove the short line and connect external power to PLC terminal.

(3) In case of using interface power(P24 : DC 24V) from the inside of inverter :
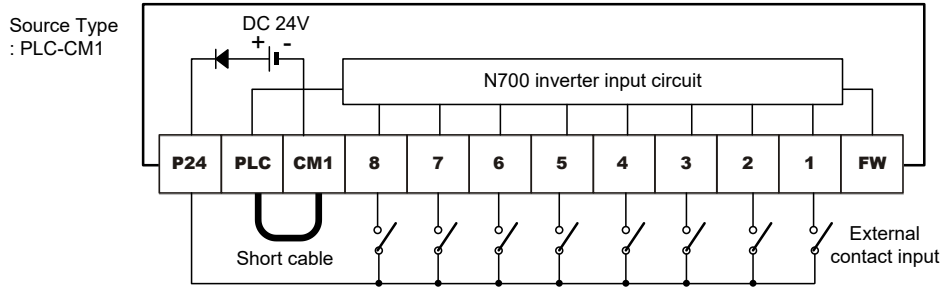

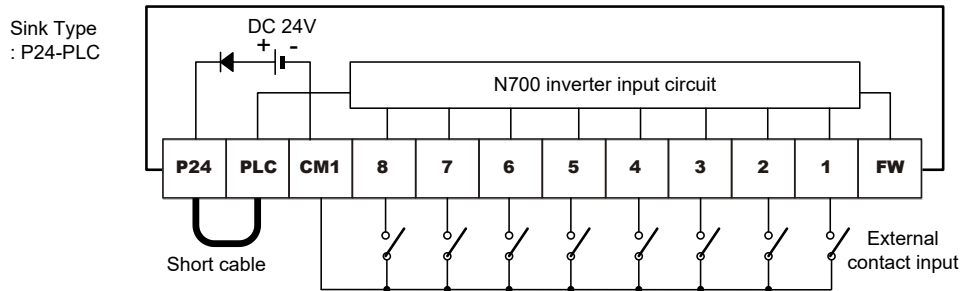**Fig. 9- 2 Intelligent input terminal connection (Source Type:PLC-CM1)**

Fig. 9- 3 Intelligent input terminal connection (Sink Type:P24-PLC)

(4) In case of using external source : (Please take off the short bar of control terminal.)
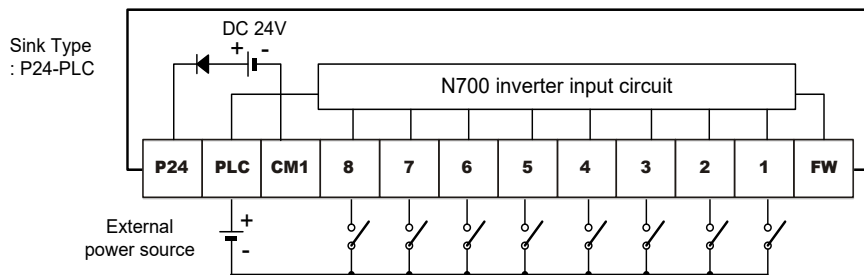
Fig. 9- 4 Intelligent input terminal connection (Sink Type:P24-PLC)
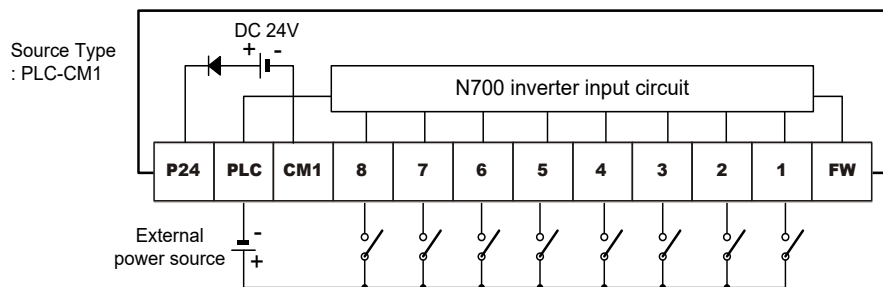
Fig. 9- 5 Intelligent input terminal connection (Source Type:PLC-CM1)

9.1.3   Input terminal function selection (I001~I008)

(1)   It is possible to use functions by assigning those functions to the intelligent input terminals 1-8.

(2)   The intelligent input terminals(1-8) can be set as a NO or a NC contact separately.
      Two or more intelligent input terminals can't be assigned to be the same function.

(3)   If a function tries to be assigned to an intelligent input terminal where another terminal already
      has the function, the new terminal will automatically be restored back to the previous setting.

code	Function name	Code value		Contents	Item
I001 ~ I008	Intelligent input terminals 1~8	1	REV	Reverse driving	Operation command
		2	CF1	Multi-speed 1 (binary operation)	Multi-speed operation function
		3	CF2	Multi-speed 2 (binary operation)	
		4	CF3	Multi-speed 3 (binary operation)	
		5	CF4	Multi-speed 4 (binary operation)	
		6	JOG	Jogging	Jogging operation
		7	DB	External DC braking	DC braking(external DC braking)
		8	SET2	2nd Set of Motor Data	2nd Set of Motor Data
		9	2CH	Two-stage adjustable-speed	Two/Three-stage adjustable-speed function
		10	3CH	Three-stage adjustable-speed	
		11	FRS	Free run stop	Free run stop
		12	EXT	External trip	External trip
		13	USP	Unattended start protection	Unattended start protection function
		15	SFT	Software lock(control terminal)	Software lock
		16	AT	Analog input voltage/current select	Analog external input
		17	RESET	Reset inverter	Reset inverter
		18	STA	3wire start	3wire input function
		19	STP	3wire stop	
		20	F/R	3wire direction(forward/reverse)	
		21	PID	PID selection (valid/invalid)	PID function
		22	PIDC	PID integrating reset	
		24	UP	Remote control UP function	Remote control UP/DOWN function
		25	DOWN	Remote control DOWN function	
		26	UDC	Remote control data clear	
		27	OPE	Force operation start (Operator)	Force operation starting function
		28	TER	Force operation start (Terminal)	
		29	TL	Torque restriction presence	Torque limit function
		30	TRQ1	Torque limit switching 1	
		31	TRQ2	Torque limit switching 2	
		32	PPI	P/PI switching	P/PI switching function
		33	BOK	Brake confirmation	Brake control function
		34	ORT	Orientation	Option function (Refer to feedback function)
		35	LAC	LAD cancel	
		36	PCLR	Position deviation clear	
		37	STAT	Pulse train input permission	
		38	XT1	Multi-step acceleration/deceleration time 1	Multi-step acceleration/deceleration Time function
		39	XT2	Multi-step acceleration/deceleration time 2	

code	Function name	Code value		Contents	Item
		40	XT3	Multi-step acceleration/deceleration time 3	

Table 9- 2 Input terminal function selection (I001~I008)

(4) The initial function setting(I001~I008) for the intelligent input terminal is like the following :

Code	Function name	Initial value	Unit	Set range	Contents
I001	Intelligent 1 Input	17	-	0~40	Initial value is setting by 17 (RESET)
I002	Intelligent 2 Input	16	-	0~40	Initial value is setting by 16(AT)
I003	Intelligent 3 Input	6	-	0~40	Initial value is setting by 6(JOG)
I004	Intelligent 4 Input	11	-	0~40	Initial value is setting by 11(FRS)
I005	Intelligent 5 Input	9	-	0~40	Initial value is setting by 9(2CH)
I006	Intelligent 6 Input	3	-	0~40	Initial value is setting by 3(CF2)
I007	Intelligent 7 Input	2	-	0~40	Initial value is setting by 2(CF1)
I008	Intelligent 8 Input	1	-	0~40	Initial value is setting by 1(REV)

Table 9- 3 The initial function setting(I001~I008) for the intelligent input terminal

Like the following example, each function needed to be set has to be assigned to I001~I008 code directly.

The initial setting value is as following:
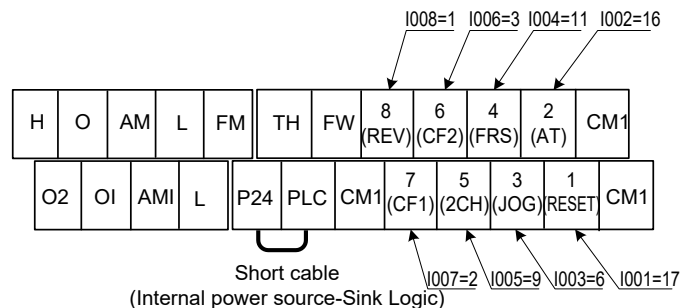
Fig. 9- 6 The initial setting value for (I001~I008)

9.1.4   Input terminal a/b (NO/NC) selection (I009~I017)

It is possible to set to the intelligent input terminals 1-8 and FW terminal as "a-contact input" or "b-contact input" respectively.

Code	Function name	Initial value	Unit	Set range	Contents
I009 ~ I016	Intelligent input 1-8 a/b(ON/NC) selection	0	-	0	N.O.(Normally Open) : a-contact
				1	N.C.(Normally Closed) : b-contact
I017	Input FW a/b(ON/NC) election	0	-	0~1	a/b-contact setting of FW terminal

Table 9- 4 Input terminal a/b (NO/NC) selection (I009~I016)

−   a-contact : ON with Close,OFF with open(Normally open state)

−   b-contact : ON with Open, OFF with close(Normally closed state)

−   RESET terminal can set only a-contact
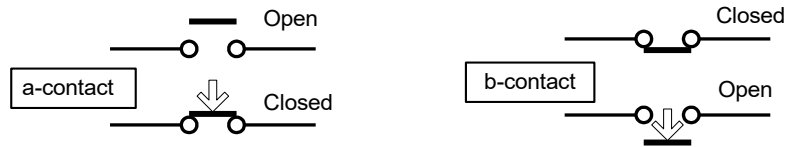
Fig. 9- 7 The operation diagram of a-contact and b-contact

9.2   Intelligent input terminal function

9.2.1   Driving command (FWD/REV : Forward/Reverse)

(1) Please set 0 (FWD) to FW terminal and 1(REV) to an intelligent input terminal 1~8 (function code I001~I008). (The initial setting value of FW terminal is FWD.)

      Forward Driving (FWD) :   FW-CM1 terminal

      Reverse Driving (REV) :   RV-CM1 terminal

(2) When using the FW terminal, it is possible to change the contact type from NO to NC by changing I009~I017 code value respectively.

(3) If forward command and reverse command are ordered simultaneously, command becomes stop command.

(4) In case of setting to a-contact, stop command is OFF (0=LOW) when Run command is ON (1=HIGH).

Code	Function name	Output status	Contents
0	FWD Forward Run /stop	OFF	Inverter is STOP mode , Motor: STOP
0	FWD Forward Run /stop	ON	Inverter is forward operation mode, Motor: Forward run
1	REV Reverse Run /stop	OFF	Inverter is stop mode, Motor: Reverse run
1	REV Reverse Run /stop	ON	Inverter is Reverse operation mode, Motor: Reverse run

Table 9- 5 Driving command (FWD/REV : Forward/Reverse)

Ex)   The setting method of run command through control terminals.

    –   The setting method of run command, F011=0 (terminal operation), I008=1(REV)

    –   In case of setting to sink type by using internal voltage within inverter (DC+24V)
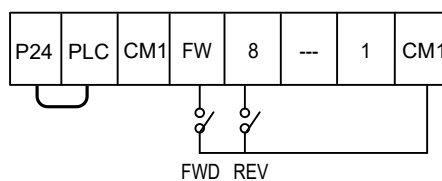
Fig. 9- 8 Driving command (FWD/REV) in the control terminal

⚠**DANGER**

- If RUN command has been set ON, it is dangerous because motor start to run at once when the power is ON. Please confirm whether driving signal was not inputted.
- In case of setting FWD/REV command to "b contact", it is dangerous because motor runs simultaneously when the power is ON.
- Please be careful when setting run command to "b contact".

9.2.2　Multi-speed operation function (CF1~CF4)

(1) Please set 2(CF1), 3(CF2), 4(CF3), 5(CF4) to Intelligent input terminals 1~8 (function code I001~I008).

(2) Multi-speed operation can be selected by binary operation (max.16 speeds) with 4 terminals. (2^4=16)

(3) Use A028-A042 to set frequency setting for speed-1 to speed-15.

(4) Set speed-0 with F001 when the method of frequency command is set as an operator. Or when the method of frequency command is set as control terminal (Terminal), use O and OI terminal.

Ex.)　The setting method of Multi-speed operation in control terminals
- Setting by F011=1(Ter), I001=2(CF1), I002=3(CF2), I003=4(CF3), I004=5(CF4).
- Multi-speed1 ~ 15 is set with A028~A042.
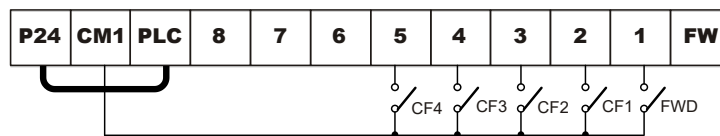
Fig. 9- 9 Multi-speed operation function (CF1~CF4) in the control terminal

Multi speed	Signal Input for the terminal				Setting Frequency	
	CF4	CF3	CF2	CF1	Function Code	Setting Value
0 speed	OFF	OFF	OFF	OFF	A027	0 Hz
1 speed	OFF	OFF	OFF	ON	A028	5 Hz
2 speed	OFF	OFF	ON	OFF	A029	10 Hz
3 speed	OFF	OFF	ON	ON	A030	20 Hz
4 speed	OFF	ON	OFF	OFF	A031	30 Hz
5 speed	OFF	ON	OFF	ON	A032	25 Hz
6 speed	OFF	ON	ON	OFF	A033	20 Hz
7 speed	OFF	ON	ON	ON	A034	15 Hz
8 speed	ON	OFF	OFF	OFF	A035	10 Hz
9 speed	ON	OFF	OFF	ON	A036	40 Hz
10 speed	ON	OFF	ON	OFF	A037	50 Hz
11 speed	ON	OFF	ON	ON	A038	60 Hz
12 speed	ON	ON	OFF	OFF	A039	45 Hz
13 speed	ON	ON	OFF	ON	A040	40 Hz
14 speed	ON	ON	ON	OFF	A041	35 Hz
15 speed	ON	ON	ON	ON	A042	30 Hz
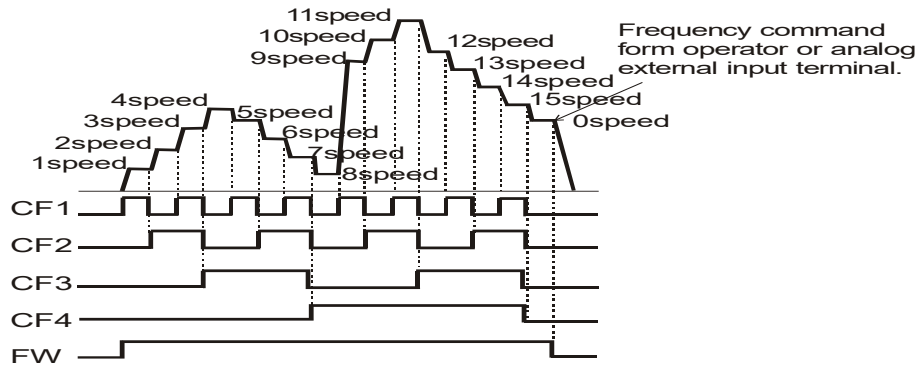
Fig. 9- 10 Example of the multi-speed operation function

9.2.3   Jogging driving (JOG : Jogging Operation)

(1) Jogging operation is activated when an intelligent input terminal is set to JOG(16) ON and a RUN command is ordered from the terminal.

(2) This function can be used to rotate the motor in small steps to allow fine-tuning.

Code	Function name	Output state	Contents
6	JOG Jogging driving	OFF	Jog operation: Invalid
		ON	Jogging operation at jogging frequency (A073).

Table 9- 6 Jogging driving (JOG : Jogging Operation)

Note)   When the Jogging frequency is set to the start frequency(F004) or 0Hz, jogging operation is not valid.
When using JOG function, confirm whether the motor stops.

Code	Function name	Initial value	Unit	Setting range	Contents
A073	Jogging frequency	0.00	Hz	0.00~10.00	Jogging frequency setting
A074	Jogging stop selection	0	-	0	FRS : Free-run on jogging stop
				1	DEC : Decelerating stop on jogging stop
				2	DCBR : Direct braking on jogging stop.

Table 9- 7 Jogging frequency (A073) and Jogging stop selection (A074)

(3) The jogging operation does not use acceleration, therefore it would be advisable to set the jogging frequency to limit the starting current to a minimum, otherwise a trip may occur. Adjust A073 to the jogging frequency required.
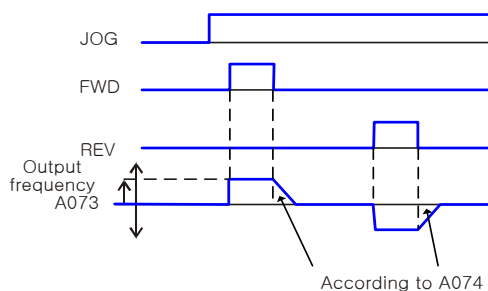
Fig. 9- 11 Jogging frequency(A073) setting

(4)   Jogging operation selection

Note)   When using the jogging function, turn FW terminal or RV terminal ON after the JG terminal is turned ON. (It is the same when the operation command point is from the operator.)
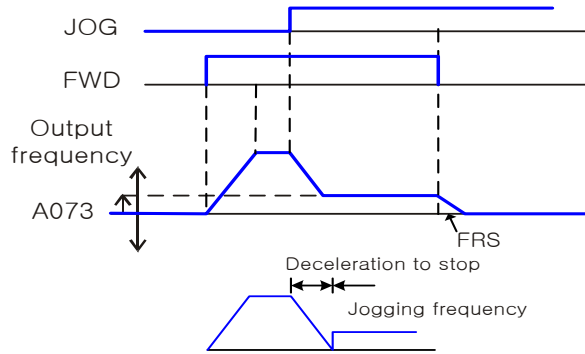
Fig. 9- 12 Jogging operation selection (When setting of A039 is 03, 04 or 05 and FW terminal is turned ON beforehand, the inverter operates jogging.)

Note) In the case that the setting of A074 is 02, data setting of DB is necessary.

(5)   Set an intelligent input terminal(I001~I008) to 06 (JG). (Initial value : I003 =6)
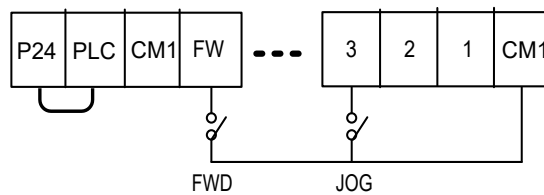
Fig. 9- 13 Jogging operation selection in the intelligent input terminal

9.2.4   Direct current braking (DB : External DC Braking)

(1)   Please set 7 (DB) to an Intelligent input terminal.

(2)   DC braking is then switched by ON/OFF of DB terminal irrespective of DC braking selection A081.

(3)   Set DC braking force with A084.

(4)   If DC braking time A083 is set, the Inverter output is cut off for this time period, the motor will be free-running. After the setting time passes, DC braking is started.

(5)   Please set DC braking time A085 or DC braking time by DB terminal paying attention to the heat of the motor.

Note) Please refer to 7.10 (DC braking setting) for details.

9.2.5   Second control function (SET2)

(1)   Please set 8 (SET 2) to Intelligent input terminals 1~8 (function code I001~I008).

(2)   By assigning 08 (SET 2) to an intelligent input terminal and turning SET2 terminal ON/OFF you can switch between two different inverter set-ups.

The functions which can change with SET terminal are as following.

Group	Code Value	Code name
F Group	F001/F201	1ST/2nd Motor output frequency setting
	F002/F202	1ST/2nd Motor base frequency
	F003/F203	1ST/2nd Motor maximum frequency
	F005/F205	1ST/2nd Motor frequency upper limit
	F006/F206	1ST/2nd Motor frequency low limit
	F007/F207	1ST/2nd Motor accelerating time
	F008/F208	1ST/2nd Motor deceleration time
	F012/F212	1ST/2nd Motor control system
	F015/F215	1ST/2nd Motor capacity (rated capacity)
	F016/F216	1ST/2nd Motor pole
	F017/F217	1ST/2nd Motor rated current
A Group	A001/A201	1ST/2nd Motor acceleration pattern
	A002/A202	1ST/2nd Motor deceleration pattern
	A007/A207	1ST/2nd Motor A/deceleration 2 selection
	A008/A208	1ST/2nd Motor acceleration 2 time
	A009/A209	1ST/2nd Motor deceleration 2 time
	A010/A210	1ST/2nd Motor acceleration 2 frequency
	A011/A211	1ST/2nd Motor deceleration 2 frequency
b Group	b027/b227	1ST/2nd Motor electronic thermal level
	b028/b228	1ST/2nd Motor electronic thermal characteristic
C Group	C003/C203	1ST/2nd Motor torque boost selection
	C004/C204	1ST/2nd Motor passivity torque boost amount
	C005/C205	1ST/2nd Motor passivity torque boost frequency
H Group	H002/H202	1ST/2nd Motor constant selection
	H003/H203	1ST/2nd Motor stator resistance
	H004/H204	1ST/2nd Motor rotator resistance
	H005/H205	1ST/2nd Motor leakage inductance
	H006/H206	1ST/2nd Motor no-load current
	H007/H207	1ST/2nd Motor inertia
	H008/H208	1ST/2nd Motor inductance
	H009/H209	1ST/2nd Motor auto-tuning stator resistance
	H010/H210	1ST/2nd Motor auto-tuning rotor resistance
	H011/H211	1ST/2nd Motor auto-tuning leakage inductance
	H012/H212	1ST/2nd Motor auto-tuning no-load current
	H013/H213	1ST/2nd Motor auto-tuning inertia
	H014/H214	1ST/2nd Motor auto-tuning inductance

Table 9- 8 List of second control function (SET2)
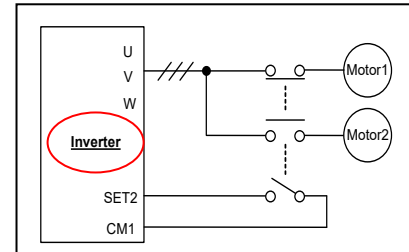
● Display isn't differentiated between the 1ST/2nd control functions during setting. So confirm it in the state of ON/OFF of terminal.

● Please execute SET2 in the stop state.

9.2.6   Acceleration/ deceleration 2 (2CH)

(1) In case of changing by intelligent input terminal, assign 09(2CH) to an Intelligent input terminal.

(2) By setting this function, it is possible to change the rate of acceleration and deceleration.

(3) As methods to change the rate of acceleration and deceleration, you can select the method of changing by intelligent input terminal and the method of automatic changing by optional frequency.

(4) While the state of a setting terminal [2CH]-[CM1] is ON, the inverter runs in 2 step acceleration/deceleration time.

     If the terminal is set OFF, return to the initial acceleration/deceleration time (acceleration /deceleration time 1).

(5) When Acceleration/Deceleration select(A007) is set to 0, this function is valid.

(6) When A007 is set to 1, the frequency is switched by the frequency setting value of A010, A011.
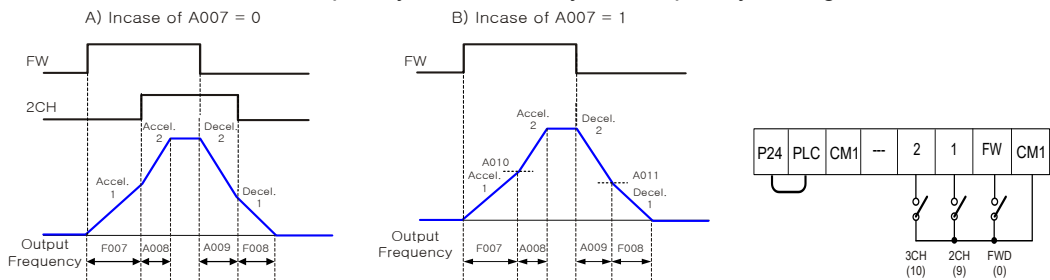
Fig. 9- 14 In case of setting 2 step acceleration/deceleration function to 9 for the input terminal 1(I001)

9.2.7   Three-Stages acceleration/deceleration (3CH)

(1) In case of changing by intelligent input terminal, assign 10(3CH) to an Intelligent input terminal.

     By setting this function, it is possible to change the rate of acceleration and deceleration.

(2) As methods to change the rate of acceleration and deceleration, you can select the method of changing by intelligent input terminal and the method of automatic changing by optional frequency.

(3) While the state of a setting terminal [3CH]-[CM1] is ON, the inverter runs in 3 step acceleration/deceleration time.

     If the terminal is set OFF, return to the initial acceleration/deceleration time (acceleration/ deceleration time 1).

(4) When Acceleration/Deceleration select (A012) is set to 0, this function is valid.

     When A012 is set to 1, the frequency is switched by the frequency setting value of A015, A016.
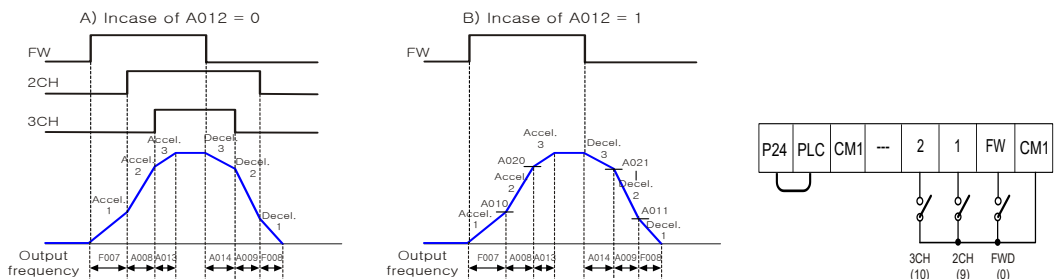
Fig. 9- 15 In case of setting 3 step acceleration/deceleration function to 10 for the input terminal 2(I002)

9.2.8   Free-Run Stop (FRS : Free-Run Stop)

(1)   By operating the free-run stop (FRS) function, the inverter output is cut off.

(2)   The motor wills free wheel under its own momentum.

(3)   This function is used when the motor is to be stopped by the use of a brake, like an electromagnetic brake.

(4)   If you stop the motor with a machine brake while the inverter is still outputting to the motor an over-current trip may occur.

(5)   Assign 11(FRS) to the intelligent input terminal.

(6)   This free-run stop function will operate when the FRS terminal is ON.

(7)   If you turn FRS terminal OFF the inverter will restart after the retry wait time b003 passes.

(8)   However when the operation command selection F011 is set to control terminal (1), the inverter restarts during free-running.

(9)   This function will only operate when the FW terminal is ON.

(10) On restart it is possible to select 0Hz start or matching frequency start as output methods with the free-run stop selection b007. (Example 1), (Example 2)

(11) When you set the frequency setting to match (b007) and the frequency detected is under this setting

(12) when the free-run stop is released, the inverter is restarted from 0Hz.

(13) The setting of this function is valid for selection b006 on stopping.

Code	Function name	Initial value	Unit	Setting range	Contents
b007	FRS selection	0	-	0	0Hz : Start (Ex1) in 0Hz
				1	Equaling frequency start (Ex2)
b018	Retry wait time	1.0	Sec.	0.3~100.0	Time until restart after FRS terminal is OFF. (This is also used for Instantaneous restart.)
b020	Frequency setting to match	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0 This sets the level to match frequency. (Refer to item of instantaneous stop and restart).

Table 9- 9 Free-Run Stop (FRS)
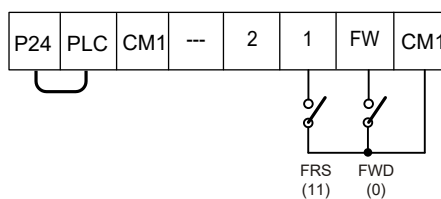
Fig. 9- 16Occasion that set FRS by 11 in input terminal 1 (I001)

(Ex1) 0Hz start   **(Ex2) Frequency matching start**
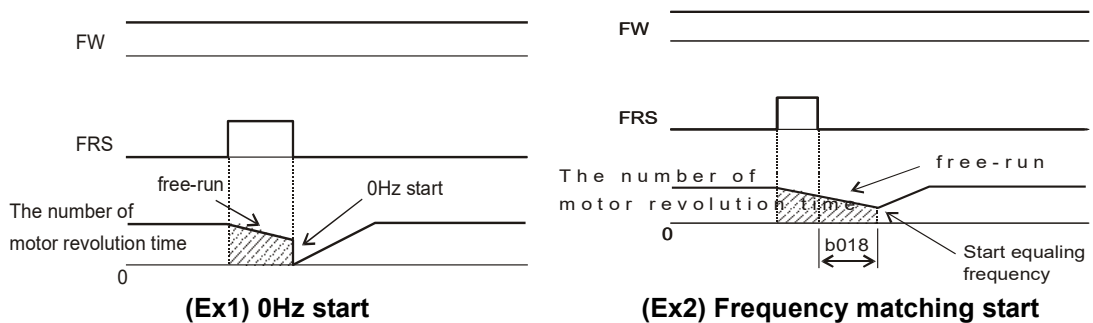
Note) Start at 0Hz regardless of the motor speed.

On 0Hz start, the retry wait time is disregarded.

When 0Hz start is used and the motor speed iIs still high there is the possibility of over-current trips.

Note) After FRS terminal is switched OFF, the Inverter reads the frequency of the motor and when it reaches the value of the motor and when it reaches the value in b007 the inverter will begin to RUN again.

On frequency matching start if an over-current trip occurs, try extending the retry time.

9.2.9 External trip(EXT : External Trip)

(1) This function can be used to force the Inverter into a trip situation which is switched by an external input, i.e. PLC or relay contact.

(2) When the EXT terminal is switched ON, the inverter trips E12(EXTERNAL) and the outputs switched OFF.

(3) Assign 12(EXT) to an intelligent input terminal.

(4) The trip will not be canceled when the terminal is turned OFF.

(5) To cancel the trip, the reset signal must be applied or the Inverter switched OFF and ON again at the supply.
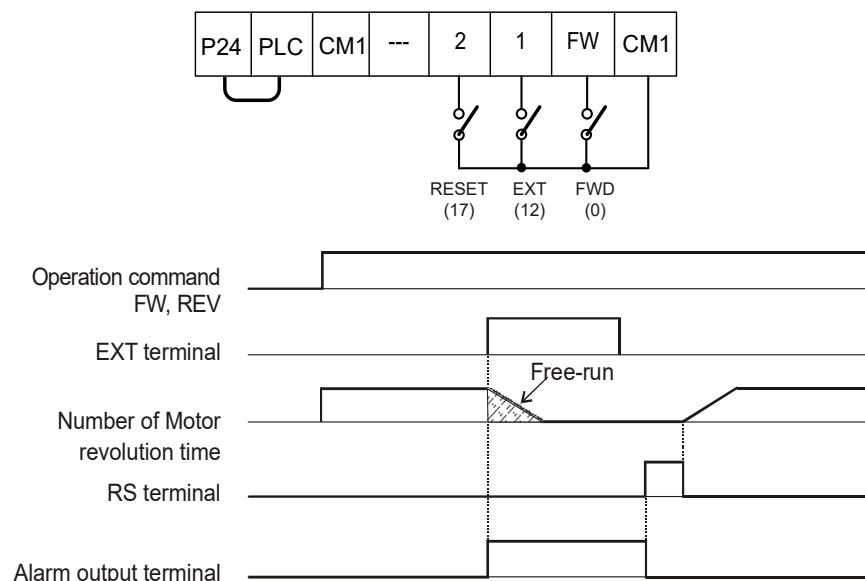
Fig. 9- 17 In case of setting EXT to an input terminal 1(I001=12).

9.2.10 Unattended Start Prevention Function(USP : Unattended Start Prevention)

(1) The USP function is designed as a fail safe to prevent accidental starting of the Inverter if the RUN signal is ON when the power is restored to the Inverter. When this function worked E13(USP) is displayed. Either resetting the Inverter or turning the RUN signal OFF can clear the trip.

(2) This function is able to disarm when the operation command is turned off. (Example 1)

(3) If the trip is cancelled while the RUN signal is still ON, the inverter will restart automatically. (Example 2)

(4) When the operation command is turned on after the power supply input, the inverter drives

normal. (Example 3)

(5) Assign 13(USP) to an intelligent input terminal 1~8(I001~I008). Unattended start protection is shown as follows:

| P24 | PLC | CM1 | --- | 2 | 1 | FW | CM1 |

RESET   USP   FWD
(17)   (13)   (0)

(Example1)	(Example2)	(Example3)
power supply	power supply	power supply
FW	FW	FW
USP	USP	USP
RS	RS	RS
Alarm	Alarm	Alarm
output	output	output
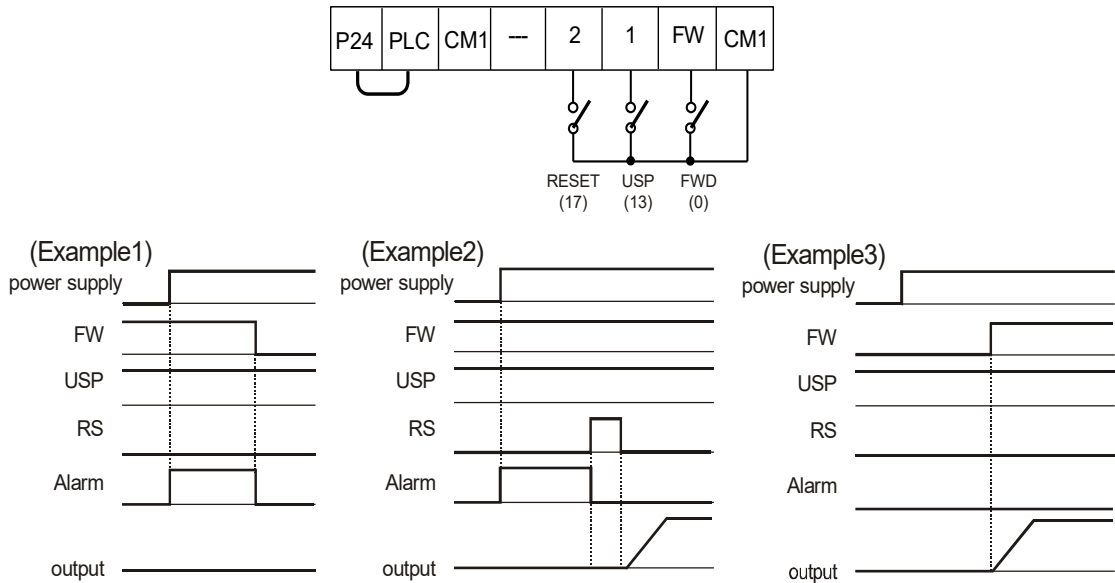
Fig. 9- 18 In case of setting USP function to an input terminal 1(I001=13).

(6) When an error is reset in state that input a driving order in the terminal after USP error occurs, the inverter will restart automatically. Please take care. (Example 2)

9.2.11   Software lock mode selection (SFT : Software Lock)

(1) It is selectable whether the data in a code is changeable in this function.

(2) This function is used to prevent changing data by mistake.

(3) When you want to use an intelligent input terminal 1~8(I001~I008), assign 15(SFT).

Code	Function name	Initial value	Unit	Setting range	Contents
I047	Software lock mode selection	1	-	0	All parameters except I047 are locked when SFT is on
				1	All parameters except I047, F001 are locked when SFT is on
				2	All parameters except I047, F001 and User group are locked when SFT is on
				3	All parameters except I047 are locked)
				4	All parameters except I047, F001 are locked
				5	All parameters except I047, F001 and User group are locked

Table 9- 10 Software lock mode selection (SFT)

9.2.12 Analog input Voltage, electric current Transition [AT : Analog Signal Transition]

This inverter has three kinds of external analog input terminals.

- O-L   :   Direct-current voltage 0~10V Approval
- OI-L   :   Direct current 4~20mA Approval
- 02-L   :   Direct-current voltage -10V ~ +10V Approval

According to the combination AT terminal value(I049) and O2 value(I038), 15 kinds of analog input are selectable.

(1) Analog external signal selection by AT terminal selection:
① AT terminal by electric current input (4~20 mA) of OI-L terminal and O2 - voltage input (0 ~ ±10V) of L terminal do ON analog outside input switching.
② According to AT terminal selection I049's command, I can choose input of O/OI/O2. Note that the value of 02 selection I038 is 0(singleness).

Code	Function name	Initial value	Unit	Setting range	Contents
I049	AT terminal selection	0	-	0	O/OI : O/OI switching by AT terminal.
				1	O/O2 : O/O switching by AT terminal.

Table 9- 11 Analog external signal selection by AT terminal selection

I049	AT	Setting frequency
0	OFF	O-L Validity
	ON	OI-L Validity
1	OFF	O-L Validity
	ON	O2-L Validity

1) ANALOG CURRENT INPUT(OI-L) : DC 4~20mA
2) VOLUME(H-O-L)
3) ANALOG VOLTAGE INPUT(O-L) : DC 0~10V
4) ANALOG VOLTAGE INPUT(O2-L) : DC 0~ ± 10V
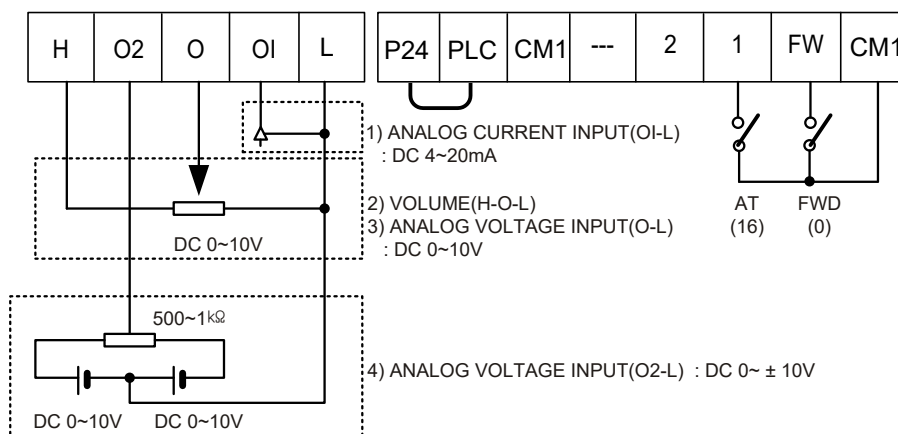
Fig. 9- 19 In case of setting AT function to an input terminal 1(I001=16)

(2) Analog external signal selection by association of AT terminal selection (I049) and 02 selections (I038):
① The following frequency command methods are available by combining I038/I049 with the intelligent input AT terminal.
② In the case that reverse and FW (forward) terminals are ON, the inverter operates reversely when (Main frequency command + Auxiliary frequency command) < 0.

AT Function selection	I038	I049	AT terminal	main frequency command	Existence of auxiliary frequency command (O2-L)	Existence of reverse
Intelligent Input Terminal on Assigning AT	0	0	OFF	O-L	No	No
			ON	OI-L	No	
		1	OFF	O-L	No	
			ON	O2-L	-	Yes
	1	0	OFF	O-L	Yes	No
			ON	OI-L	Yes	
		1	OFF	O-L	Yes	
			ON	O2-L	-	
	2	0	OFF	O-L	Yes	Yes
			ON	OI-L	Yes	
		1	OFF	O-L	Yes	
			ON	O2-L	-	
	3	0	OFF	O-L	No	No
			ON	OI-L	No	
		1	OFF	O-L	No	
			ON	O2-L	No	
Intelligent Input Terminal when don't assign AT	0	-	-	O2-L	-	Yes
	1	-	-	Adding O-L and OI-L	Yes	No
	2	-	-	Adding O-L and OI-L	Yes	Yes
	3	-	-	Adding O-L and OI-L	No	No

Table 9- 12 Analog external signal selection by association of AT terminal selection(I049) and 02 selections(I038).
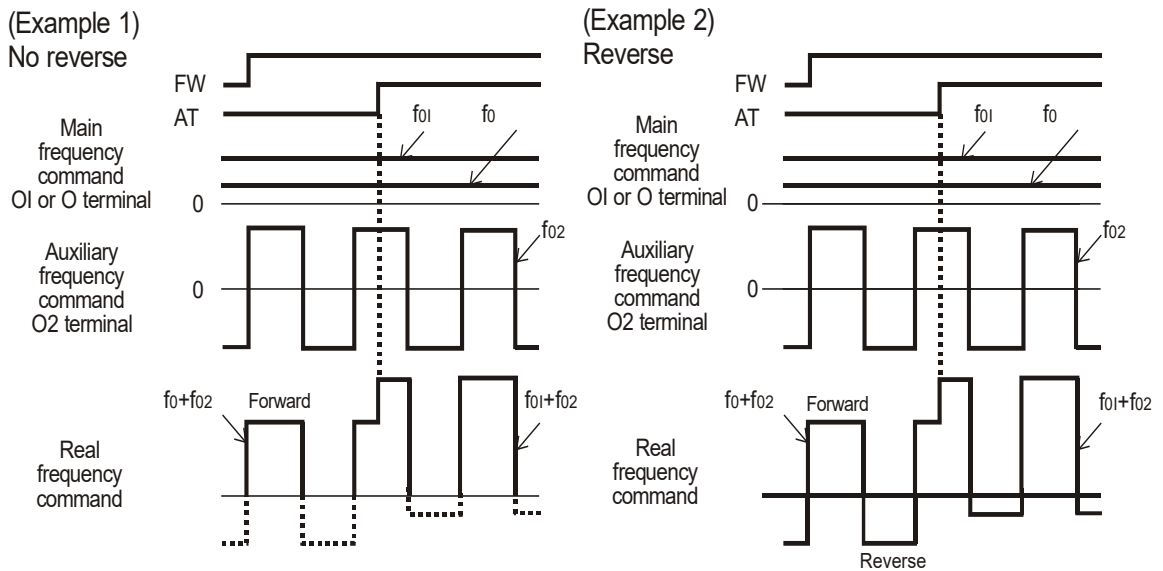
Fig. 9- 20 Example of an analog external signal selection

9.2.13   Reset (RESET)

(1)   This function resets the inverter when a protective trip has occurred.

(2)   The method of reset is to either push the STOP/RESET key on the digital operator or to switch the Reset terminal ON.

(3)   To reset the inverter with the control terminal, assign 17(RESET) to an intelligent input terminal.

(4)   Reset selection I051 selects when the alarm signal is cancelled and whether it is valid or invalid in normal operation.

Code	Function name	Initial value	Unit	Setting range	Contents
I050	Reset selection	0	-	0	At ON, trip cancellation : when is normal, validation (output cutting) (ex 1)
				1	At OFF, trip cancellation : when is normal, validation (output cutting) (ex 2)
				2	At ON, cancellation (when is normal) trip : when is normal, nullity (trip cancellation)
I051	Reset frequency matching selection	0	-	0	0Hz : 0Hz start
				1	Fmat : Frequency matching start (ex 3)

Table 9- 13 Reset selection

(5)   Use the RESET terminal as the a-contact (Normally open). If the RESET terminal is set to b-contact, the inverter is always RESET.
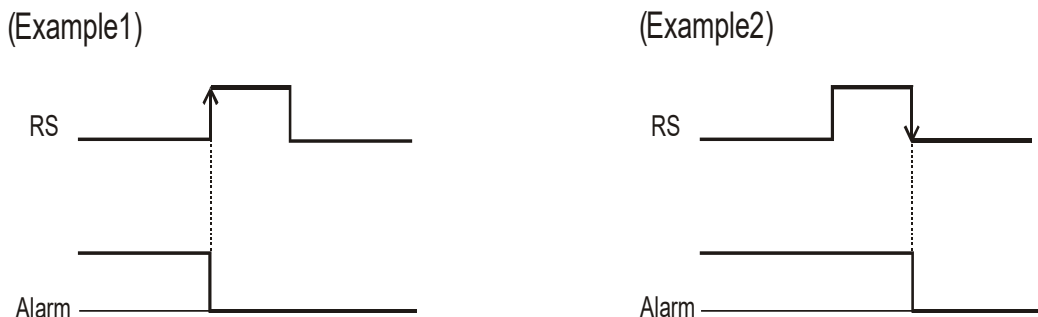
Fig. 9- 21 Example of the reset selection

9.2.14   Wire(3-Wire) input function(STA,STP, F/R)

(1)   This function is used when a momentary push start/stop control is required.

(2)   Set the operation command selection F011 to control terminal (1).

(3)   Assign 18 (STA), 19 (STP) and 20 (F/R) to three of the intelligent input terminals, and the operation becomes possible as follows. When the terminal is assigned STP terminal, FW terminal and also RV terminal become invalid. If all three input are not assigned this function will not operate.

The FW terminal and RV terminal become redundant when the 3 wire control terminal is as follows:

[Setting code value]
    F011=1
    I001=18(STA)
    I002=19(STP)
    I003=20(F/R)
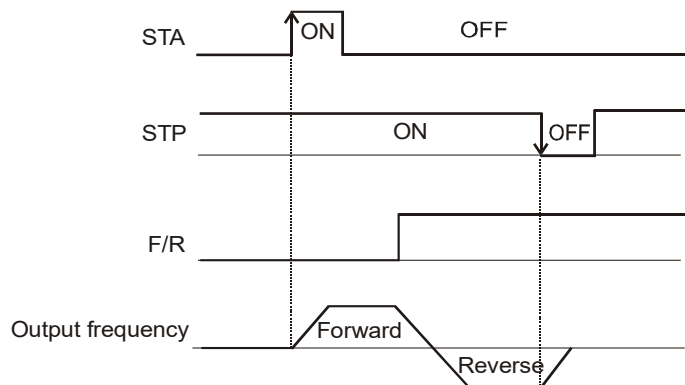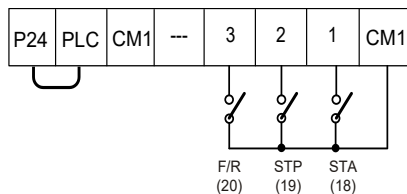
Fig. 9- 22 The output waveform of the 3 Wire(3-Wire) input function

Note) If STP terminal function is set, FW and REVS terminal function is invalid.

9.2.15   PID function selection and PIDC

(1) When using this function turn on the terminal in the case that you invalidate this function after assigned 21 (PID) to intelligent input terminal in the case of switching valid / invalid of this function with the outside signal

(2) PIDC is the function to clear integral value of PID action.

(3) Assign 22(PIDC) to an intelligent input terminal.

(4) It is cleared whenever the PIDC terminal is turned ON.

(5) Don't turn absolutely ON PID terminal during PID action, because there is a possibility of overcurrent trip.

(6) Turn ON PIDC terminal after turning OFF PID action.
    Note) Please refer to PID control part for details.

9.2.16   UP/DOWN function(UP,DOWN,UDC)

(1) The Inverter output frequency can be changed with the UP and DWN intelligent input terminals.

(2) Assign 24 (UP) and 25(DWN), 26(UDC) to two of the intelligent input terminals 1~8.

(3) This function is valid only when the frequency command selection F010 is set to 01 or 02. However, when 01 (control terminal) is set, this can only be used for multi-speed operation.

(4) This function will not operate when the external analog frequency command or the jogging operation is used.

(5) Acceleration time operates according to F007, F008 when UP/DOWN terminal is ON.

(6) To change 1 /2 /3 control, assign 08(SET)/17(SET3) to an input terminal, change with SET/SET3 terminal.

(7) It is possible for the Inverter to retain the frequency setting value from the UP/DOWN terminals.
    Parameter I048 switches the memory ON or OFF. It is also possible to clear the memory and return to the original set frequency.

(8) Assign 26(UDC) to an intelligent input terminal and switch it on to clear the memory.

Code	Function name	Initial value	Unit	Setting range		Contents
I048	UP/DOWN selection	0	-	0	Data conservation radish : The frequency order adjusted by UP/DOWN is not remembered. After power cycle, it is clear last frequency and return to F001 before the adjusted frequency by UP/DOWN.
				1	Data conservation existence: The frequency order adjusted by UP/DOWN is remembered. After power cycle, it keep last frequency adjusted by UP/DOWN.

Table 9- 14 UP/DOWN function(UP,DOWN,UDC)

Code	Function	Output state	Contents
24	UP Remote control UP	OFF	Motor output acts normally.
		ON	Accelerating motor from present frequency. (Output frequency increases.)
25	DOWN Remote control Down	OFF	Motor output acts normally.
		ON	Decelerating motor from present frequency. (Output frequency decreases.)
26	UDC Removing remote control data	OFF	There is no change to UP of memory/DOWN state.
		ON	Removing UP of memory/DOWN state.

Table 9- 15 UP/DOWN function selection code
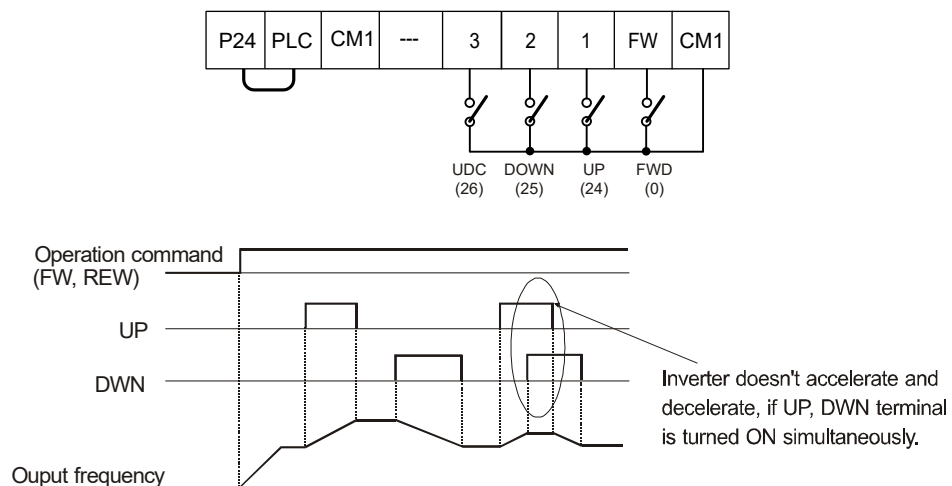
Fig. 9- 23 In case of setting by I016 =24(UP), I002 =25(DOWN), I003 =26(UDC)

9.2.17 Compulsion ON switching (OPE)

(1) This function permits a digital operator interface to override the output frequency setting (F010) and the source of RUN command (F011) when it is configured for a source other than the operator interface.

(2) When the OPE terminal is ON, the digital operator gives an output frequency setting and a Run command to operate the motor.

(3) When changing the OPE state during running (inverter is driving the motor), the inverter will stop the motor. Please stop the inverter to prevent possible injury, then proceed with changing the OPE state. After changes have been made, return the inverter to the run mode.

9.2.18 Torque limitation function (TL, TRQ1, TRQ2)

(1) This function control system F012 function that limit output torque of motor when select sensorless vector control, everlastingness going to zero speed sensorless vector control, Sensorless vector control and everlastingness going to 0 multispeed Sensorless vector control be.

(2) When set 1 (input terminal) to torque limit function C006, This mode sets torque limit in 4 zones, forward driving and regenerating, reverse driving and regenerating. Limits for each quadrant are set with C007~C010 individually. By use of torque limit cutting terminal 1 and 2, this mode changes and uses torque limit 1~4 set in C007~C010.

(3) When this function set a torque an existence and nonexistence function(TL) for Intelligent input terminal, when did the signal to do ON torque limit function becomes validity. torque limit setting of OFF's occasion becomes maximum 200% that nullity is measure, and does torque limitation. Also, torque limitation existence and nonexistence function (TL) in case was not set torque limit function ordinary times validity become.

(4) When select 1(input terminal) in torque limit selection (C006), torque limit 1~4 that can change unusually in torque limit cutting 1, 2 that is set for Intelligent input terminal is set below with picture.

ex) Setting a torque limit cutting 1(30) to the intelligent input terminal 7,
Setting to torque limit cutting 2(31) to the input terminal 8

P24	PLC	CM1	8	7	6	---	FW	CM1

TRQ2 (31) TRQ1 (30) TL (29) FWD (0)
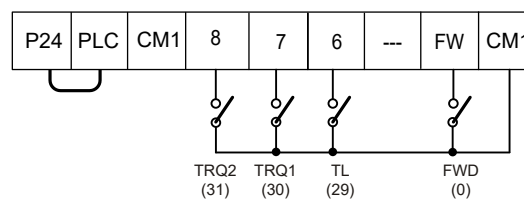
Fig. 9- 24 Torque limitation function selection

Note) For detailed contents, refer to 11.3 chapter torque limit function.

9.2.19 Multi-speed acceleration/deceleration time setting (XT1, XT2, XT3)

(1) It is possible to set acceleration and deceleration time of multi-stage from 1st to 7th.

(2) Use the intelligent terminal function
   XT1, XT2, and XT3

ex) Setting the multi-speed acceleration/deceleration time 1~3(XT1~XT3) to the intelligent input terminal No. 1~3.
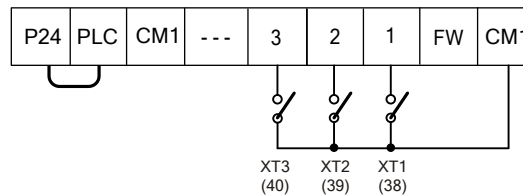
Fig. 9- 25 Multi-speed acceleration/deceleration time setting function selection

Code	Function name	XT3	XT2	XT1	Initial value
A043	1st acceleration time	0	0	1	30.0
A044	1st deceleration time	0	0	1	30.0
A045	2nd acceleration time	0	1	0	30.0
A046	2nd deceleration time	0	1	0	30.0
A047	3rd acceleration time	0	1	1	30.0
A048	3rd deceleration time	0	1	1	30.0
A049	4th acceleration time	1	0	0	30.0
A050	4th deceleration time	1	0	0	30.0
A051	5th acceleration time	1	0	1	30.0
A052	5th deceleration time	1	0	1	30.0
A053	6th acceleration time	1	1	0	30.0
A054	6th deceleration time	1	1	0	30.0
A055	7th acceleration time	1	1	1	30.0
A056	7th deceleration time	1	1	1	30.0

Table 9- 16 Multi-speed acceleration/deceleration time setting code

9.2.20 Force operation starting function (Local/Remote switching)

(1) Command source of frequency(F010) and RUN(F011) is changed by signal of intelligent input terminal.

(2) When 27(OPE) switch is ON, command source will be set by F010=0(OPE VOL) and F011=2(OPE),

When 28(TER) switch is ON, command source will be set by F010=1(TERINAL) and F011=1(TERMINAL)

(3) If, 27(OPE) and 28(TER) are ON the same time, this function is invalid.

| P24 | PLC | CM1 | 8 | 7 | 6 | --- | FW | CM1 |

TER (28)   OPE (27)   FWD (0)
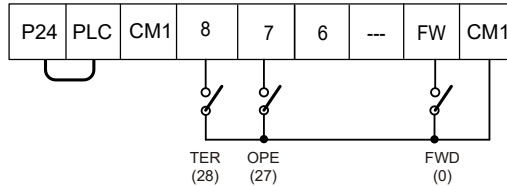
Fig. 9- 261 Force operation starting function (Local/Remote) selection

9.2.1 P/PI switch function

Invereter is control speed by PI control mode, but sometimes it need P control mode.

This function is support switching P and PI control mode by intelligent input terminal.

(1) It is possible tunning P gain by P025 code.

(2) This function is for prevent speed overshoot when sudden change of load with large initia.

| P24 | PLC | CM1 | 8 | 7 | 6 | --- | FW | CM1 |

PPI (32)   FWD (0)
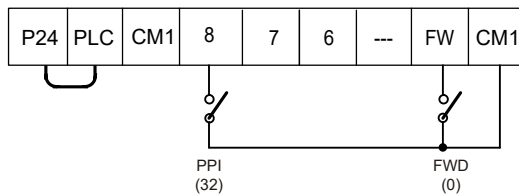
$$Speed\ change\ ratio = \frac{10}{P025}\,(\%)$$

Fig. 9-27 P/PI switch function selection
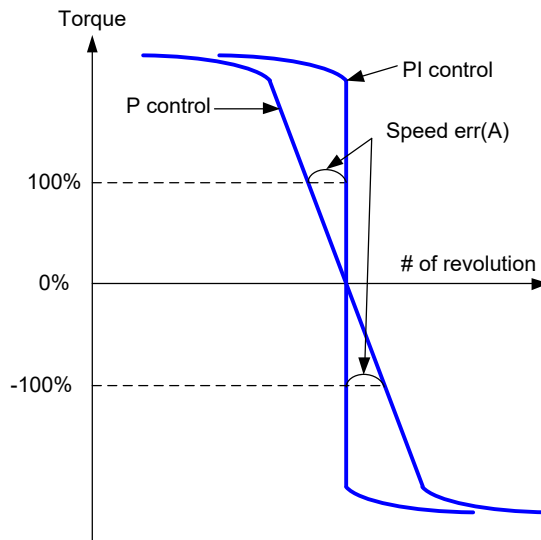
Fig. 9-28   P/PI switch function

9.3   Analog order setting

Set output frequency about external outside analog input signal.

9.3.1   O-L terminal setting

(1) External setting output frequency in case input 0~10 V voltage to external analog input terminal O-L.

Code	Function	Initial value	Unit	Setting range	Contents
I018	O input span calibration	Factory setting	-	0~9999.	Factory setting
I019	O input zero calibration	Factory setting	-	0~9999.	Factory setting
I020	O Start frequency	0.00	Hz	0.00~400.0	Start frequency setting
I021	O End frequency	0.00	Hz	0.00~400.0	End frequency setting
I022	O Start voltage	0	%	0~100	Starting point for the voltage input 0V
I023	O End voltage	100	%	0~100	Ending point for the voltage input 10V
I024	O Start selection	1	-	0	external frequency : 0 ~ I022 output frequency to I020 output
				1	0Hz : 0 ~ I022 value of output frequency to 0Hz is output

Table 9- 17 O-L terminal setting
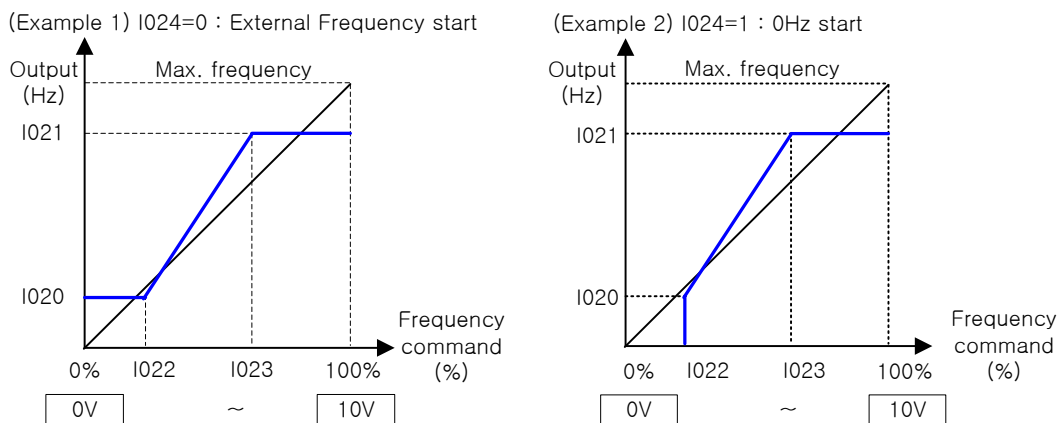
Fig. 9- 26 Start frequency setting in O-L terminal setting

(2) When using 5V for O-L terminal, please setting I023 by 50%.

(3) When an initial value 0 ~ the maximum frequency (F003) does not agree with the input external voltage signal 0~10 V, change correctly I018 and I019.

9.3.2   OI-L terminal setting

(1) External setting output frequency in case input 4~20 mA electric current to analog input terminal OI-L.

Code	Function name	Initial value	Unit	Setting range	Contents
I025	OI input span calibration	Factory setting	-	0~9999.	Factory setting
I026	OI input zero calibration	Factory setting	-	0~9999.	Factory setting
I027	OI Start frequency	0.00	Hz	0.00~400.0	Start frequency setting
I028	OI End frequency	0.00	Hz	0.00~400.0	End frequency setting
I029	OI Start voltage	0	%	0~100	Starting point for the voltage input 4mA
I030	OI End voltage	100	%	0~100	Ending point for the voltage input 20mA
I031	OI Start selection	1	-	0	external frequency : 0~I029 output frequency to I027 output
				1	0Hz : 0 ~ I029 value of output frequency to 0Hz is output

Table 9- 18 OI-L terminal setting
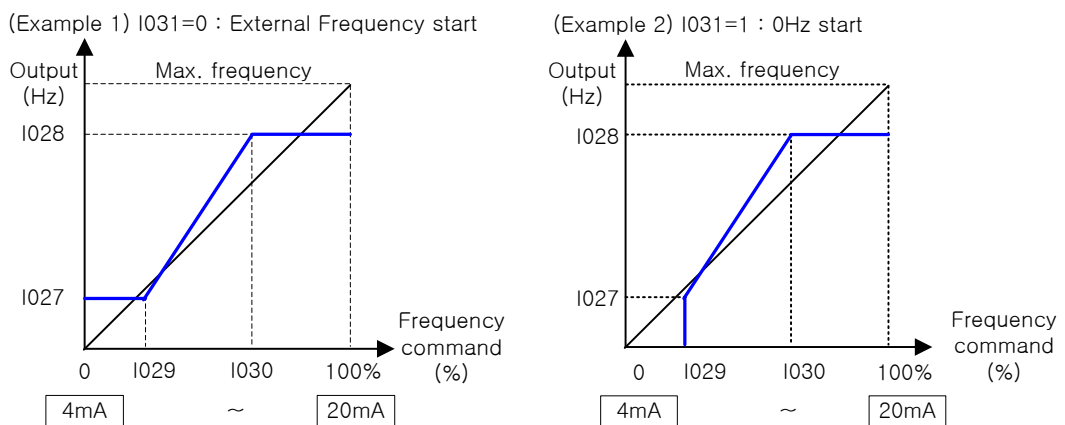
Fig. 9- 27 Start frequency setting in OI-L terminal setting

(2) When an initial value 0 ~ the maximum frequency (F003) does not agree with the input External electric current signal 4~20mA, change correctly I025 and I026.

9.3.3   O2-L terminal setting

(1) External analog input terminal O2 to L -10V can set output frequency in case input +10V voltage.

Code	Function	Initial value	Unit	Setting range	Contents
I032	O2 input span calibration	Factory setting	-	0~9999	Factory setting
I033	O2 input zero calibration	Factory setting	-	0~9999	Factory setting
I034	O2 Start frequency	0.0	Hz	0.0 ~ 99.9 100~400.0	Start frequency setting
I035	O2 End frequency	0.0	Hz	0.0 ~ 99.9 100~400.0	End frequency setting
I036	O2 Start voltage	-100	%	0~100	Starting point for the voltage input -10V
I037	O2 End voltage	100	%	0~100	Ending point for the voltage input +10V
I038	O2 Start selection	0	-	0	Singleness
				1	Assistance, irreversible
				2	Assistance
				3	Invalid

Table 9- 19 O2-L terminal setting

(2) -10V ~ ratio of +10V is as following.
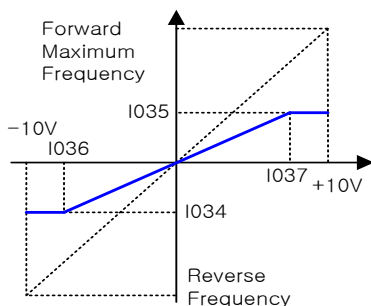
-10V ~ 0   :   -100~0%
0 ~ +10V   :   0~100%
ex)   When you input -5V ~ +5V to O2-L terminal, please set I036 = -50%, I037= 50%.

(3) Setting O2 starts selection I038 by 0(singleness) O2, to use L signal individually, and AT function does not allocate. (Please take care Intelligent input terminal function I002's initial value was set by 16 (AT).)

(4) Or, I038 if input AT signal after set I049 by 1(O/O2) by 0/O2, L Simple cycle operation is available.

(5) The frequency order method can be selectable according to O2 starts selection I038's setting and AT terminal selection I049's association.

(6) For the detailed contents refer to 9.2.13 chapter(analog input voltage, electric current switching).

(7) When an initial value 0 ~ the maximum frequency (F003) does not agree with the input External electric current signal -10~10V, change correctly I032 and I033.

9.4   Other function

9.4.1   Analog input filter

(1) It can be set the internal filter factor of a frequency setting signal for the voltage or electric current input from outside in this function.

(2) The frequency setting circuit is valid to noise removal.

(3) Please adjust output frequency setting value higher or lower in case there is a frequency issue affecting the drive stability due to noise influence.

Code	Function	Initial value	Unit	Setting range	Contents
I046	Analog input filter factor	8	-	1~30	Setting by 1 unit

Table 9- 20 Analog input filter factor

10. EXPLANATION OF O-GROUP

10.1 Intelligent output terminal setting

10.1.1 Intelligent output terminal arrangement

The arrangement and function of intelligent output terminals are as follows.

(1) Layout of control circuit terminals
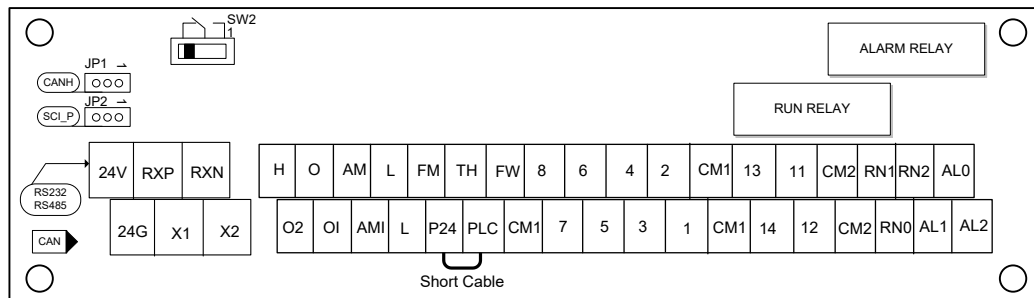
Fig. 10- 1 Layout of control circuit terminals

(2) Output terminal function of N700 inverter control circuit

Item	Function	Terminal marking	Terminal name	Contents
Analog Control terminal	Monitor Output	AM	Analog monitor (voltage)	• DC 0~10 V voltage output • Output to one selected from monitor items.
		AMI	Analog monitor (current)	• DC 4~20 mA electric current output • Output to one selected from monitor items
		L	Analog power rotor termination	• It is rotor termination of output terminal(AM, AMI). Note) Don't earth.
Digital Control terminal	Digital Power	P24	Interface power	• It is DC24V power for connection input signal. When selecting source logic, it's connection input common.
		CM1	Interface power Common	• This is common for DC 24V terminal for interface, thermister input(TH), Digital monitor(FM). • When sink logic is selected, it is a common point of contact.
		PLC	Intelligent Input terminal common	• Change sink type and source type by short bar on control terminals. P24-PLC : Sink type, CM1-PLC : Source type • In case of driving the connection input by external power, remove the short cable and connect the PLC with external interface circuit.
	Monitor Output	FM	Digital monitor (voltage)	• DC 0~10V voltage output(PWM output method) The selected one of the monitoring function is displayed. • Output the output frequency to digital pulse(Duty 50%) above monitor.
Digital Relay	Relay output for the point of contact	AL0 AL1 AL2	Alarm output terminal	• AL : Alarm relay signal • Output is C contact. • It stops output and then output alarm signal at initial status because of inverter protection mode.

Item	Function	Terminal marking	Terminal name	Contents
		RN0 RN1 RN2	RUN signal output terminal	• RN : Run relay signal • Output is C contact. • Output signal during RUN (RUN) at initial status.

Table 10- 1 Output terminal function list of N700 inverter control circuit

10.1.2 Wiring intelligent output terminals

(1) It is possible to use intelligent input terminals by connecting +24V power source to P24 terminal.

(2) Input circuit is connected to PLC terminal for common. Therefore, please short between P24 and PLC to use internal power source like "Fig 10-1 Layout of control circuit terminal" on page 107 if you want to use the +24V power of inverter.

(3) To use the external power, remove the short cable and connect the PLC with an external power.

(4) Refer to "(4) The connection to input programmable logic controller" on page 18.

10.1.3 Output terminal function selection (o001~o004)

Any of the following functions can be assigned to the intelligent output terminals 11-14 (o001~o004).

Function code	Function name	Code value		Contents	Reference item
o001 ~ o004	Intelligent Output terminal 1~4	0	RUN	Signal during run	Signal during run
		1	FA1	Constant speed arrival signal	Frequency arrival signal
		2	FA2	Over setting frequency	
		3	OL	Overload advance notice signal	overload limit
		4	OD	Output deviation for PID control	PID function
		5	ALM	Alarm signal	Protection function
		6	FA3	Arrival signal for only setting frequency	Frequency arrival signal
		7	OTQ	Over torque	Over torque
		8	IP	Instantaneous stop signal	Instantaneous stop /under-voltage
		9	UV	Under voltage signal	
		10	TRQ	Torque limit	Torque limit function
		11	RNT	RUN time over	RUN time over
		12	ONT	ON time over	ON time over
		13	THM	Thermal caution	Electric thermal function
		14	BRK	Brake opening	Brake control function
		15	BER	Brake error	
		16	ZS	Zero speed detect signal	Zero speed detect signal
		17	DSE	Speed deviation excessive	Option function
		18	POK	Positioning completion	
		19	FA4	Arrival signal for over setting frequency 2	Frequency arrival signal
		20	FA5	Arrival signal for over setting frequency 2	
		21	OL2	Overload advance notice signal 2	Overload limit
		22	IPALM	Instantaneous power failure alarm signal	Instantaneous power failure
		23	UVALM	Under voltage alarm signal	Under voltage

Table 10- 2 Output terminal function selection (o001~o004)

It has to be set directly with o001~o004 according to the function which user wants.

The initial setting value is as follows.
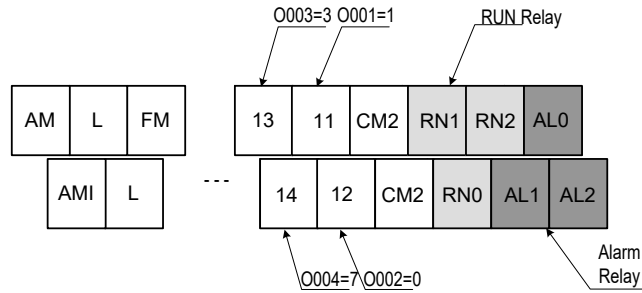
Fig. 10- 2 The initial setting value for the output terminal function

10.1.4   Intelligent output terminal a/b contact (o005~o008) selection

(1)   This sets the intelligent output terminal 11-14 and alarm relay output terminal contact condition to either NO or NC, (a or b). Each output is changeable individually.

(2)   The intelligent output terminals 11-14 are the Open-Collector output and the alarm relay (AL/RN) are all relay outputs.

Code	Function name	Initial value	Unit	Setting range	Contents
o005 ~ o008	Intelligent 1~4 Output setting	0	-	0	N.O . (Normally Open) : a-contact
				1	N.C . (Normally Closed) : b-contact
-	FW terminal input setting	0	-	0~1	Setting a/b-contact of FW terminal

Table 10- 3 Intelligent output terminal a/b contact (o005~o008) selection

- a-contact : Close with 「ON」 , open with 「OFF」
- b-contact : Open with 「ON」 , close with 「OFF」
- RS terminal is set to only a-contact.
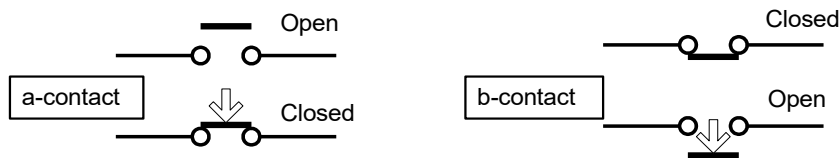
Fig. 10- 3 The operation diagram of a-contact and b-contact

(3) Specification of the intelligent output terminals 1 - 4 : Open collector output (Open-Collector Type)
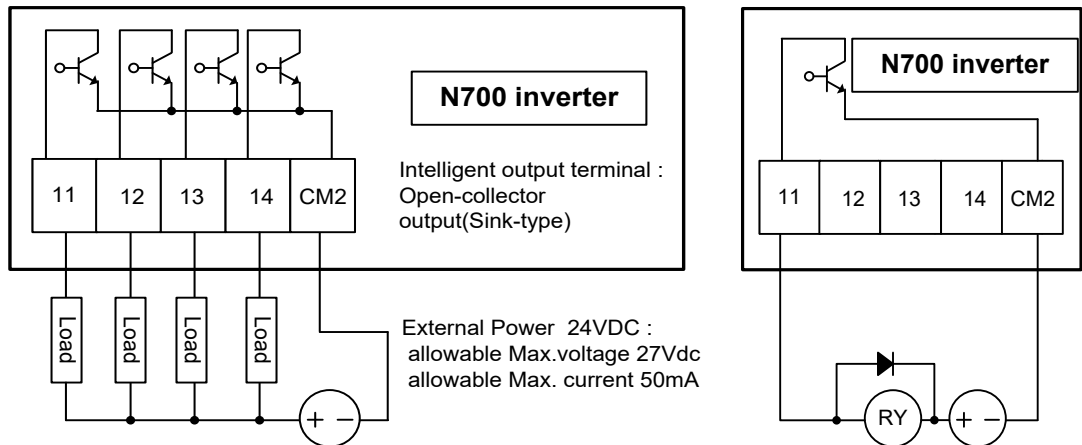
Fig. 10- 4 Specification of the intelligent output terminals 1~4

Note) Please use inverter output terminals to use a small relay if you need output current greater than 50mA.
To reduce the spike voltage across the relay at turn-off, use a diode on both end of a relay-coil or use a solid-state relay instead of a mechanical relay.

(4) Specification of Intelligent output terminals AL 0/AL 1/AL 2, RN 0/RN 1/RN 2 : Relay output (C contact)
(5) The specifications of the alarm relay(AL0/AL1/AL2) and RUN relay is c-contact. The method for an operation is as follows.
(6) The setting value is ALM and RUN signal.
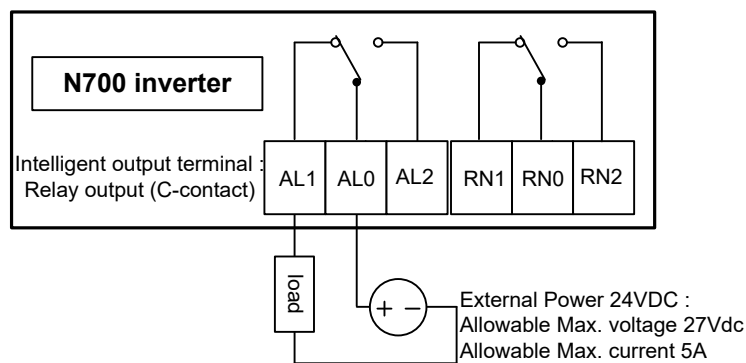
Fig. 10- 5 Specification of Intelligent output terminals

Example on using as alarm :

N.O Contact (o033(ALARM)=0, o034(RUN)=0 : initial value)				N.C Contact (o033(ALARM)=1, o034(RUN)=1 : changed value)			
Normal or Power off		Alarm appearance		Normal		Alarm appearance or Power off	
Point of contact	Power	Running condition	AL1−AL0	AL2−AL0	Point of contact	Power	Running condition	AL1−AL0	AL2−AL0
a− contact (N.O.)	ON	Normal	Open	Closed	b− contact (N.C.)	ON	Normal	Closed	Open
	ON	Trip	Closed	Open		ON	Trip	Open	Closed
	OFF	−	Open	Closed		OFF	−	Open	Closed

Fig. 10- 6 Example on using as alarm

Point of contact specification :

Point of contact	Division	Resistor load	Inductive load
AL1−AL0 RN1−RN0	Maximum contact capacity	AC250V, 2A DC30V, 8A	AC250V, 0.2A DC30V, 0.6A
	Minimum contact capacity	AC100V, 10mA DC5V, 100mA	
AL2−AL0 RN2−RN0	Maximum contact capacity	AC250V, 1A DC30V, 1A	AC250V, 0.2A DC30V, 0.6A
	Minimum contact capacity	AC100V, 10mA DC5V, 100mA	

Table 10- 4 Point of contact specification

10.2   Intelligent output terminal function

10.2.1   Signal during run(RUN)

(1)   This function is to provide an output signal when the Inverter is in a running condition.

(2)   Assign 0(RUN : signal during run) to an intelligent output terminal 11 -14 or the alarm relay output terminal.

(3)   The signal is still outputted when the dc braking operates.

(4)   The timing chart is as follows.
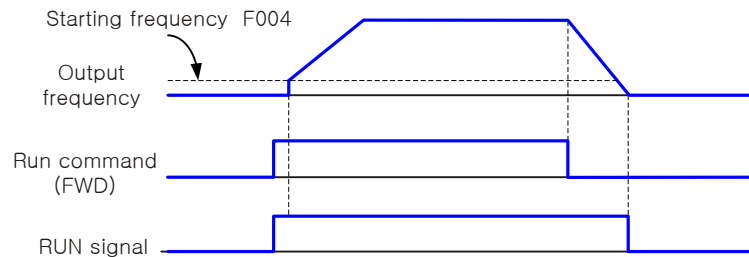
Fig. 10- 7 Timing chart of RUN signal

Code value	Function name	Output state	Contents
0	RUN Signal during running	OFF	The inverter is in the stop mode. (STOP Mode).
		ON	The inverter is in the operation mode. (RUN Mode).

Table 10- 5 RUN signal during running

10.2.2   Frequency arrival signal 1~5 (FA 1 ~ FA 5)

(1)   When the output frequency arrives at the setting frequency, an arrival signal is displayed.

(2)   Assign 01 (FA1 : constant speed arrival signal), 02 (FA2 : over setting frequency), 06 (FA3 : only setting frequency), 19 (FA4 : over setting frequency 2), 20 (FA5 : only setting frequency 2) to an intelligent output terminals 11-14.

Code value	Function name	Output state	Contents
1	FA1 Constant speed arrival signal	OFF	When output frequency doesn't reach the frequency set in F001.
		ON	When output frequency reaches the frequency set in F001.
2	FA2 Over setting frequency arrival signal	OFF	When output frequency reaches below the arrival frequency during the deceleration which is set in o019.
		ON	When output frequency reaches below the arrival frequency during the acceleration which is set in o018.
6	FA3 Only setting frequency arrival signal	OFF	When output frequency doesn't reach below the arrival frequency during the acceleration which is set in o018 or the arrival frequency during the deceleration which is set in o019.
		ON	When output frequency reaches below the arrival frequency during the acceleration which is set in o018 or the arrival frequency during the deceleration which is set in o019.
19	FA4 over setting frequency : Arrival signal 2	OFF	When the output frequency reaches below Deceleration arrival frequency in o021.
		ON	When the output frequency reaches over Deceleration arrival frequency in o020.

Code value	Function name	Output state	Contents
20	FA5 Arrival signal 2 setting frequency	OFF	When the output frequency doesn't reach over Deceleration arrival frequency in o020 or below Deceleration arrival frequency in o021.
		ON	When the output frequency reaches over Deceleration arrival frequency in o020 or below Deceleration arrival frequency in o021.

Table 10- 6 Frequency arrival signal 1~5 (FA 1~FA 5)

(3) Frequency setting during the acceleration and deceleration is as follows.

Code	Function name	Initial value	Unit	Setting range	Contents
o018	Frequency arrival setting for acceleration	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0
o019	Frequency arrival setting for deceleration	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0
o020	Frequency arrival setting for acceleration 2	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0
o021	Frequency arrival setting for deceleration 2	0.00	Hz	0.00~400.0	0.00~99.99/100.0~400.0

Table 10- 7 Frequency setting during the acceleration and deceleration

(4) The hysteresis frequency for the arrival signal is the following.
   ① ON : (Setting frequency - 1% of maximum frequency) (Hz)
   ② OFF : (Setting frequency- 2% of maximum frequency) (Hz)

(5) However in set 06(FA3), 20(FA5) case when inverter accelerates.
   ① ON : (Setting frequency - 1% of maximum frequency) (Hz)
   ② OFF : (Setting frequency+ 2% of maximum frequency) (Hz)

(6) When the inverter decelerates.
   ① ON : (Setting frequency + 1% of maximum frequency) (Hz)
   ② OFF : (Setting frequency- 2% of maximum frequency) (Hz)

(7) Output on constant speed arrival (01 : FA1)
   ① When the arrival at the set frequency with frequency setting(F001) or multi-speed(A027 ~ A042),   the output relay is switched.
   ② The hysteresis of frequency for the arrival signal is as follows.
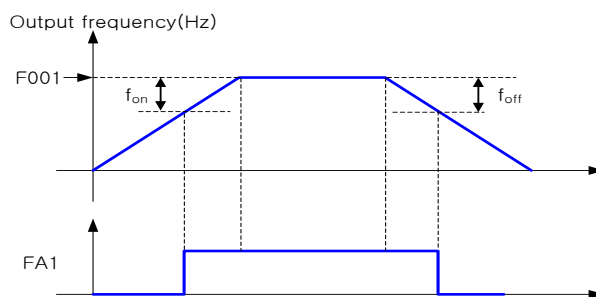
Setting frequency
  f_{on} : 1% of maximum frequency
  f_{off} : 2% of maximum frequency
(ex)
Maximum frequency f_{max} = 120Hz
Setting frequency f_{set} = 60Hz
f_{on} = 120 × 0.01 = 1.2Hz
f_{off} = 120 × 0.02 = 2.4Hz
Accelerate : ON in 60 - 1.2 = 58.8Hz
Decelerate : OFF in 60 - 2.4 = 57.6Hz

Fig. 10- 8 Output on constant speed arrival (01 : FA1)

(8) Output over setting frequency (2 : FA2, 19 : FA4)

When the output is over the arrival frequency set in [o018, o019 (FA 2)], [o020, o021 (FA 4)], on adjustable speed time, the output relay is switched.
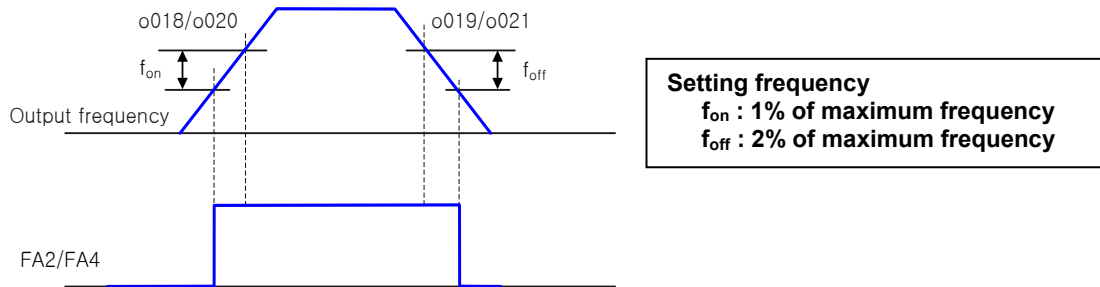
Fig. 10- 9 Output over setting frequency (2 : FA2, 19 : FA4)

(9) Output (6 : FA 3, 20 : FA 5) setting frequency

The signal is switched only when the output frequency matches the arrival frequency set in [o018, o019 (FA 2)], [o020, o021 (FA 4)], on adjustable speed time.
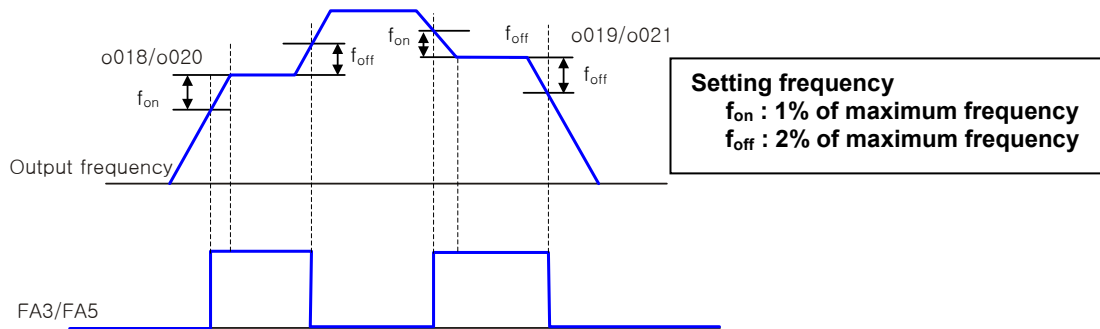
Fig. 10- 10 Output (6 : FA 3, 20 : FA 5) setting frequency

10.2.3 Overload advance notice signal (OL/OL2)

(1) The Inverter monitors the motor current on acceleration and constant speed, when the inverter reaches the overload restriction level, the Inverter will reduce the output frequency automatically to restrict the overload.

(2) When the amount of a load is high, it is possible to adjust the gain by outputting an overload advance notice. It is used to prevent damage to the machine from too much load, i.e. baggage on a conveyor, the Inverter overload protection will operate.

(3) Assign 03(OL) or 21(OL2) to an intelligent output terminal 11-14.

Code value	Function name	Output state	Contents
3	OL Overload advance notice signal	OFF	In case output current is smaller than value that set in overload advance notice level setting (o026)
		ON	In case output current is bigger than value that set in overload advance notice level setting (o026)
21	OL2 Overload advance notice signal 2	OFF	In case output current is smaller than value that set in overload advance notice level (o027)
		ON	In case output current is bigger than value that set in overload advance notice level (o027)

Table 10- 8 Overload advance notice signal (OL/OL2)

(4) Set output current level at overload in overload advance notice level 1 (o026).

Code	Function name	Initial value	Unit	Setting range	Contents
o026	Overload advance notice level 1	1.0	times	0.0~2.0	Inverter rated current × 0. ~ 2.0 times When reach overload advance notice level 1 OL signal output
o027	Overload advance notice level 2	1.0	times	0.0~2.0	Inverter rated current × 0. ~ 2.0 times When reach to overload advance notice level 1 OL signal output

Table 10- 9 Overload advance notice level setting
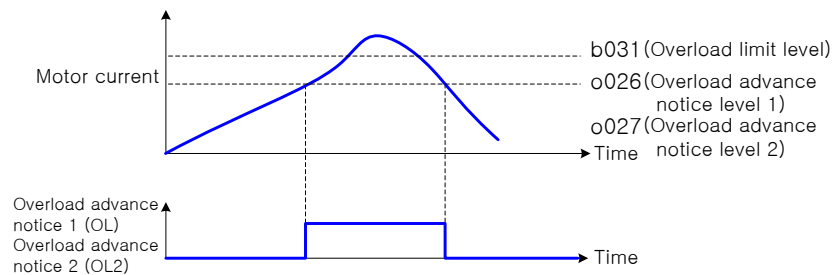
Fig. 10- 11 Overload advance notice level setting

10.2.4   The Maximum PID Deviation Level (OD)

(1) It is possible to establish the maximum deviation level o029 on PID control. When the PID deviation amount reaches the set level o029, it is possible to output OD(PID Max deviation) in an intelligent output.

(2) o029 can be set from 0 to 100.0 % and corresponds with the command : from 0 to maximum value.

Code	Function name	Initial value	Unit	Setting range	Contents
o029	PID deviation setting level	3.0	%	0.0~100.0	Setting deviation range between the set value and feedback value.

Table 10- 10 PID deviation setting level(o029)

(3) Assign 04 (OD) to intelligent output terminal 1~4 (o001~o004)

Code value	Function name	Output status	Contents
4	OD PID deviation	OFF	In case PID error is less than the setting value of deviation signal
		ON	In case PID error is more than the setting value of deviation signal

Table 10- 11 OD PID deviation code value

10.2.5 Alarm signal (ALM)

(1) The alarm signal is active when a fault has occurred and it is in protection function list on page 147.

(2) The most common use of AL Relay is for this function. So, the alarm signal 5 (ALM) is outputted as the initial value on relay output (AL0~AL2) terminals

(3) You can assign to open collector output terminals 11~14.

Code value	Function name	Output state	Contents
5	ALM Alarm signal	OFF	In case alarm doesn't occur since the previous power cycle or the previous alarm reset .
		ON	In case alarm signal is not reset after alarm signal occurs

Table 10- 12 Alarm signal(ALM) code value

(4) There is a delay time to ON the contact point when the alarm output terminal is b-contact. Therefore consider a delay time about 2 sec. (b-contact : The chattering action may occur in power on/off.)
When an error occurs, please add an external inter-lock circuit.

(5) Please take care the difference in an electric specification between the open-collector output and relay output.

(6) Refer to the page from108 to 111 (Specification of the intelligent output terminals 1 – 4, Specification of Intelligent output terminals AL 0/AL 1/AL 2, RN 0/RN 1/RN 2) for details

10.2.6 Over torque signal (OTQ)

(1) This function can detect that estimated value of output torque of motor increase more than optional level and outputs.

(2) When an over torque signal 7(OTQ) is selected in intelligent output terminal 11~14, this function is valid.

(3) This function is valid only when in sensorless vector control, 0Hz domain sensorless vector control, or vector control with sensor is selected. Do not use the OTQ output except for these controls.

(4) Set this signal OPEN for elevators. Set a brake CLOSED by using a frequency arrival signal.

Code	Function name	Initial value	Unit	Setting range	Contents
o022	Over torque level 1	100	%	0~200	Forward driving
o023	Over torque level 2	100	%	0~200	Reverse regenerating
o024	Over torque level 3	100	%	0~200	Reverse driving
o025	Over torque level 4	100	%	0~200	Forward regenerating

Table 10- 13 Over torque signal (OTQ)

10.2.7 Instantaneous during power failure signal (IP) and trip voltage signal (UV)

(1) Select yes/on of alarm output when instantaneous power failure or under-voltage occurs

(2) The alarm signal is displayed during being the control DC voltage (P-N).

(3) It is possible to use an output by assigning the signal 08(IP) during instantaneous stop, by setting 09(UV) during under-voltage to an intelligent output terminal 11-14.

10.2.8 Torque limit signal (TRQ)

(1) When selecting the signal(TRQ) of Intelligent output selection, the signal 10(TRQ) of torque limit is displayed.

(2) For setting the motor control method F012 to sensorless vector control(5), sensored vector control(6), 0Hz domain sensored vector control(7), the output torque of a motor can be limited. The torque limit signal displays that the state is limited.

Note) Please refer to 11.3 torque limit function (TL, TRQ1, TRQ2) for details.

10.2.9 RUN time over (RNT) and ON time over (ONT)

When the accumulated operation time reaches or is over the setting time in o028, RUN time/power ON time over (TNT/ONT) output is switched.

Code	Function name	Initial value	Unit	Setting range	Contents
o028	RUN/ON time over level	0	Hour	0~9999	Over time level setting

Table 10- 14 RUN/ON time over level

(1) RUN time over (RNT)
  ① Assign 11(RNT) to an intelligent output terminal 11 ~ 14.
  ② Set ON time level with o028.

(2) Power ON time over (ONT)]
  ① Assign 12(ONT) to an intelligent output terminal 11 ~14.
  ② Set ON time level with o028.

10.2.10 Thermal warning signal (THM)

(1) Set the inverter according to motor rated current to protect the motor from overloading, overheating and damage. A warning signal is outputted before tripping on electronic thermal protection and it's level can be set in b029.

(2) Set thermal warning signal 13(THM) to intelligent output terminals 11~14(o001~o004).

Code value	Function name	Output statues	Contents
13	THM thermal warning signal	OFF	In case calculation value of electronic thermal is smaller than the setting value.
		ON	In case calculation value of electronic thermal exceeds the setting value.

Table 10- 15 Thermal(THM) warning signal

Note) Refer to chapter 8.13 (Protection function for an electronic thermal) for details.

10.2.11 Brake opening signal (BRK) and brake error signal (BER)

(1) Please set brake opening signal 14 (BRK) and brake error signal 15 (BER) to an intelligent output terminal 11~14.

(2) When using brake control function, please set BRK/BER signal to intelligent output terminal. Set brake opening signal(BRK) for opening the brake to the output terminal. Set brake error signal(BER) to the output terminal to use the signal which occurs under the braking error.

Note) Please Refer to chapter 11.4 (Braking control function) for details.

10.2.12 Zero speed detect signal(ZS)

(1) Please set 16 (ZS) to an intelligent output terminal 11~14 and a relay output terminal. By selecting zero speed signal in an intelligent output selection this function comes into effect.

(2) This function detects that the output of the rotation speed of a motor or the output of LAD fell off from the zero speed detection level(o030) and outputs the ZS signal.

(3) This function acts to the LAD output when the control method is VC, VP1, VP2, SLV. Also, this function acts to the output of the rotation frequency of a motor when control method is vector control with sensor.

Code	Function name	Initial value	Unit	Setting range	Contents
o030	Zero speed detect level	0	Hz	0.00~99.99	Setting the zero speed detect level

Table 10- 16 Zero speed detect level

10.3   Monitor output signals (AM/AMI, FM)

10.3.1   Digital output signals (FM) selection (o009~o011)

(1)   The FM control terminal can monitor the output frequency and output current.

(2)   FM terminal is a PWM (Pulse Width Modulation) output.

Code	Function name	Initial value	Unit	Setting range	Contents	Full Scale Value
o009	FM output Selection	0	-	0	Fo : Output frequency	0~ Maximum frequency (Hz)
				1	Io : Output current	0~200%
				2	To : Output torque	0~200%
				3	Fo.D : Digital output frequency	0~ Maximum frequency (Hz)
				4	Vo : Output voltage	0~100%
				5	Pin : Input delctric power	0~200%
				6	Load : The rate of thermal load	0~100%
				7	Flad : LAD frequency	0~ Maximum frequency (Hz)
				8	RPM : Motor Speed	0~ Maximum frequency (Hz)

Table 10- 17 FM output Selection(o009)

Note)   o009 =2 (output torque) is only outputted when control mode is SLV, SLV2, V2, 0Hz - V2 display.

Note)   o009=8(Motor Speed) is outputted reative value of maxmuim frequency.

When converse to RPM, RPM=t*(60/T)*120/Pole# (T : Period, t : Analog output)

(3)   PWM signal type: o009 = 0, 1, 2, 4, 5, 6, 7

①   PWM (Pulse-Width Modulation) signal is used to run a moving-coil type indicator. PWM signal is expressed by analog value that is AUTO meaning value by moving-coil type indicator.

②   The maximum value of FM signal is 12V. The value is changeable by adjusting in FM control(o011).

Period T : constant(6.4msec)
Duty t/T : change
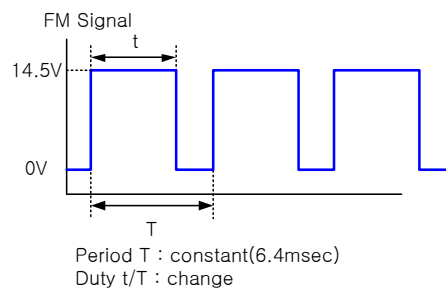
Fig. 10- 12 The waveform of FM signal (o009 = 0, 1, 2, 4, 5, 6, 7)
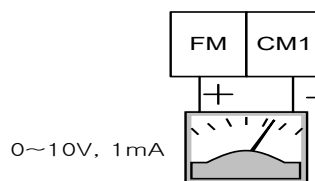
Fig. 10- 13 Method that displaying FM signal by using an analog

Note)   Standard analog signal is displayed through AM and AMI terminal.
Please use the circuit like this picture to output analog signal by using PWM signal of
FM terminal.

(4) FM signal type : o009 =3
① FM (Frequency Modulated: Frequency modulation) signal is able to modulate FM
frequency according to the output frequency.
② When selecting 3 (digital output frequency), please use digital frequency counter meter.
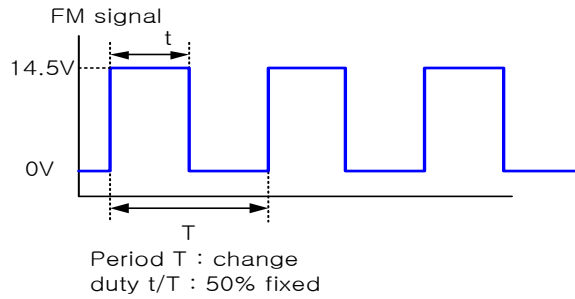
Fig. 10- 14 The waveform of FM signal (o009 = 3)

(5) FM adjustment
It is used to reform a meter that is connected to FM terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
o010	FM offset	-3.00	-	-3.00~10.00	Offset setting
o011	FM adjustment	71.0	-	0.0~255.0	Gain setting

Table 10- 18 FM offset and adjustment

[Adjusting method]
① Connect an input meter for DC 0~10 V to FM - CM1 terminal.
② Adjust FM to read the same meter as the output frequency.
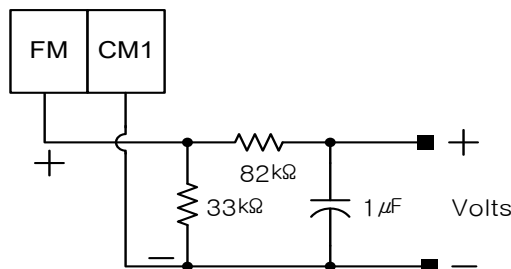
**Fig. 10- 15 When the output frequency is 60Hz, calibrate the value of o011 so that a
meter becomes 60Hz.**

10.3.2 Analog output signals (AM/AMI) selection (o012~o017)

- The AM terminal and the AM1 terminal can monitor the output frequency or the output current.
- The AM terminal has an analog output of 0-10V.
- The AMI terminal has an analog output of 4-20mA.
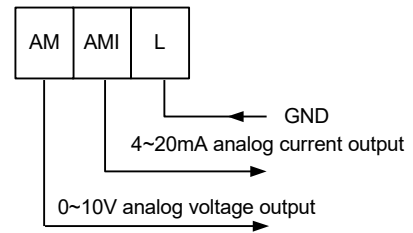
(1) AM/AMI output signals selection

Select a signal to output from the following options.

Code	Function name	Initial value	Unit	Setting range	Explanation	Full Scale Value
o012	AM Output Selection	0	-	0	Fo : Output frequency	0~ Maximum frequency (Hz)
				1	Io : Output current	0~200%
				2	To : Output torque	0~200%
				3	Vo : Output voltage	0~100%
				4	Pin : Input electric power	0~200%
				5	Load : Thermal load ratio	0~100%
				6	Flad : LAD frequency	0~ Maximum frequency (Hz)
				7	RPM : Motor speed	0~ Maximum frequency (Hz)
o015	AMI Output Selection	0	-	0	Fo : Output frequency	0~ Maximum frequency (Hz)
				1	Io : Output current	0~200%
				2	To : Output torque	0~200%
				3	Vo : Output voltage	0~100%
				4	Pin : Input electric power	0~200%
				5	Load : Thermal load ratio	0~100%
				6	Flad : LAD frequency	0~ Maximum frequency (Hz)
				7	RPM : Motor speed	0~ Maximum frequency (Hz)

Table 10- 19 AM/AMI output signals selection

Note) Display o012/o015=2(output torque) only at the time of SLV, SLV2, and V2

Note) o012/o015=7(Motor speed) is outputted reative value of maxmuim frequency.

When converse to RPM, RPM=AM*(60/10)*120/Pole# (AM output)

RPM=AMI*(60/10)*120/Pole# (AMI output)

(2) AM/AMI adjustment

This function is used to calibrate a meter connected to the AM and AM1 terminal.

Code	Function name	Initial value	Unit	Setting range	Contents
o013	AM offset	0.96	-	0.00~10.00	Offset setting
o014	AM adjustment	100.0	-	0.0~255.0	Gain setting.
o016	AMI offset	4.00	-	0.00~20.00	Offset setting
o017	AMI adjustment	100.0	-	0.0~255.0	Gain setting

Table 10- 20 AM/AMI adjustment

11.   EXPLANATION OF C-GROUP

11.1   Over-voltage stall function (C001)

(1)   Prevent possible over-voltage trip when stop the motor.

(2)   User can feel delayed stop time, because stall time is not include deceleration control time(F008/F208).

Code	Function name	Initial value	Unit	Setting range	Contents
C001	Over-voltage stall function	0	–	0~1	0 : Valid
					1 : Invalid

Table 11- 1 Over-voltage stall function(C001)

11.2   VF stability adjust (C002)

(1)   If a motor hunting coccres, adjust the value of C002 code.

Code	Function name	Initial value	Unit	Setting range	Contents
C002	VF stability adjust	100.0	%	0.0~300.0	VF stability adjust setting

Table 11- 2 VF stability adjust (C002)

(2)   If a motor hunting occurs, check the difference between the inverter setting value
(motor capacity : F015/F215, motor pole(F016/F216) and motor
In case you find some difference, correct an error in inverter setting value
In case the motor 1st impedance value is smaller than the standard motor, increase slow the C002 value.

(3)   In addition to VF stability adjust(C002) function, the method to control the motor hunting is as follows
①   Decrease the carrier frequency (b010)
②   Decrease the output voltage gain (F014)

Code	Function name	Initial value	Unit	Setting range
Output voltage gain	F014	20~100	%	Decrease the value of F014 in case of inverter hunting.
Carrier frequency	b010	0.5~10.0	kHz	Decrease the value of b010 in case of motor hunting.
VF stability adjust	C002	0.0~300.0	%	Adjust the value of C002 in case of motor hunting.

Table 11- 3 Motor hunting control function (F014/b010/C002)

11.3   Torque boost function setting(C003 ~ C005)

A correctly installed motor and careful attention to voltage drop in the wiring will improve the motor torque at low speed.

When an automatic torque boost is set to C003, the level of torque boost corresponds to the set of a motor pole selection (F016) and a motor rated current setting (F017).

Code	Function name	Initial value	Unit	Setting range	Contents
C003	Torque boost selection	0	-	0	Manual torque boost
				1	Automatic torque boost
C004	Manual torque boost value	(Note)	%	1.0~20.0	Level corresponding output Voltage (100%)
C005	Manual torque boost break point	50.0	%	5.0~50.0	Level corresponding to base frequency

Table 11- 4 Torque boost function setting (C003 ~ C005)

(Note) manual torque boost value for each model

Model	Manual torque boost value
5.5~11kW	3.3[%]
15~22kW	3.1[%]
30~55kW	1.5[%]
75~132kW	1.0[%]

11.3.1 Manual torque boost

(1) The values set up with C004/C005 are outputted. C004 set a percentage level where motor voltage selection is 100%.

(2) When using the manual torque boost, it should be noted that overuse will cause saturation of the motor and may cause damage.

(3) The manual torque boost break point (C005) sets a percentage level where the base frequency voltage is 100%.

(4) If the reduced voltage start selection(b003) is enabled, the torque boost is not valid. Set the reduced voltage start selection(b003) to 0.
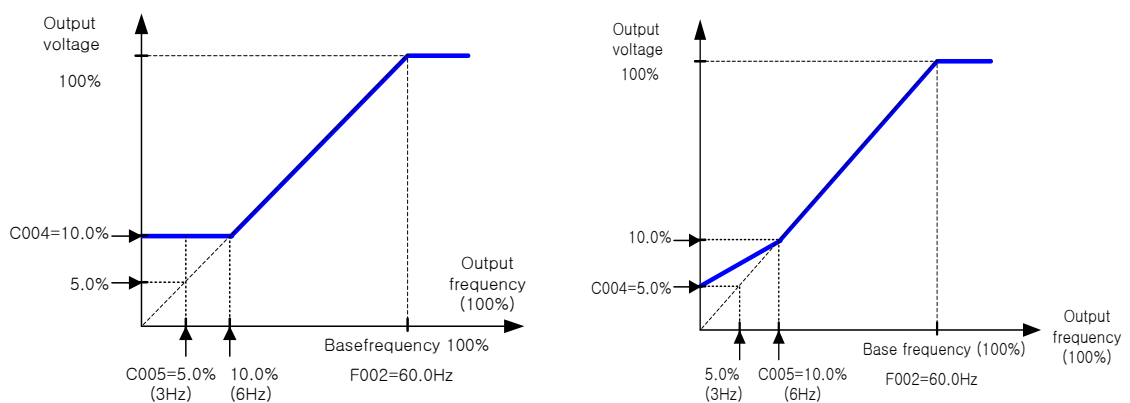
In case of C003 = 0, C004 = 10.0, C005 = 5.0   In case of C003 = 0, C004 = 5.0, C005 = 10.0

Fig. 11- 1 The graph for Manual torque boost

11.3.2　Automatic torque boost

(1) The output voltage is adjusted automatically by condition of the load.

(2) When using automatic torque boost it important that the following two parameters are set correctly.

(3) In case of adding over-current protection at deceleration time, set AVR selection ON(A53=0) all the time.

Code	Function name	Setting range
F015/F215	Motor capacity selection (motor rated capacity)	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/ 30/37/45/55/75/90/110/132/160　[kW]
F016/F216	Motor pole selection	2/4/6/8/10/12
F017/F217	Motor rated current setting	0.0~999.9 [A]

Table 11- 5 Moter function setting for automatic torque boost

11.4　Torque limit function (TL, TRQ1, TRQ2)

(1) This function limits motor output torque when Indirect sensorless vector control(4), Direct sensorless vector control(5), sensored vector control (6), 0Hz domain sensored vector control(7) in vector control with sensor are selected.

(2) In torque limit function method, the following three are selected in C006 torque limit selection screen.

　① 4 quadrant individual setting mode :
　　This mode sets torque limit in 4 quadrant, forward driving and regenerating, reverse driving and regenerating, to digital operator setting code C007-C010 individually.

　② Terminal changing mode :
　　By combination of torque limit changing terminals 1and2, this mode changes and uses torque limit 1-4 set by in digital operator setting. Selected torque limit range is valid in every driving condition.

　③ Analog input mode :
　　This mode sets torque limit value by voltage given to 02 terminal of control Terminal. 0-10V is equal to torque limit value 0-200%. Selected torque limit value is valid in every driving condition.

　④ Option 1, Option 2 : Reserved

Code	Function name	Initial value	Unit	Setting range	Contents
C006	Torque limit selection	0	-	0	Individual setting
				1	Terminal
				2	Analog input :
				3	CAN
				4	OPT2 (Reserved)
C007	Torque limit 1	160	%	0~200	In the case of 4 upper limits individuation setting, forward driving
C008	Torque limit 2	160	%	0~200	In the case of 4 upper limits individuation setting , reverse restoration.
C009	Torque limit 3	160	%	0~200	In the case of 4 upper limits individuation reverse driving

Code	Function name	Initial value	Unit	Setting range	Contents
C010	Torque limit 4	160	%	0~200	In the case of 4 upper limits individuation setting, forward restoration.
C011	Torque LAD Stop selection	0	-	0	Invalid
				1	Valid

Table 11- 6 Torque limit function (TL, TRQ1, TRQ2)

(3) When torque control valid / invalid function (TL) is set to intelligent input terminal, torque limit function is valid only during the signal turning ON. During OFF, torque limit setting is invalid, torque control value is 200% of maximum. And when torque control valid / invalid function (TL) is not set, torque limit function is always valid. (When F010=1, this function is invalid and torque limit set to 200%)

(4) Torque limit value in this function is 200% of maximum current which inverter can output. Therefore, output torque may change in accordance with motors combined. Make sure that the absolute value of torque does not appeared.

(5) When torque control signal is selected in intelligent output selection, torque limit above-mentioned turns ON while torque limit function is performed.

(6) Torque limit when 00 (4 quadrant mode) is chosen by torque limit choice (C006) becomes the bottom figure.
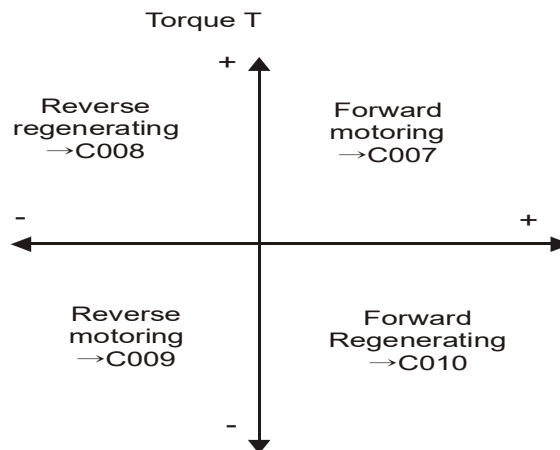
Fig. 11- 2 Torque limit (4 quadrant mode)

(7) When 01 (terminal switching) is chosen by torque limit choice (C006), torque limit 1 changed by torque limit switching 1,2 assigned to intelligent input terminal 1~4 are set up as the bottom figure.

(Example)   When torque limit switching 2 (31) was assigned to torque limit switching 1 (30), an intelligent input terminal 8 in intelligent input terminal 7.
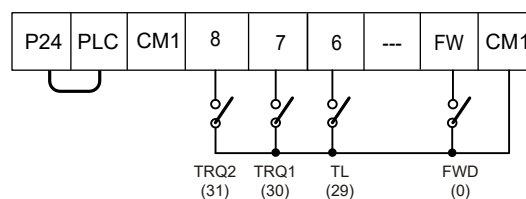
Fig. 11- 3 Torque limit setting in intelligent input terminal

(8) When using torque limit function at low speed level, use overload restriction together.

(9) For setting frequency band on torque limit, refet to Chaper 11.8

11.5 External braking control function (C012 ~ C018)

(1) This is a function that the inverter controls external braking used in systems like elevators. By braking control function selection(C012) is set to valid(01), this function is performed as the following below.

① When running command turns on, the inverter begins to operate and accelerate to releasing frequency.

② After output frequency arrives at the releasing frequency, the inverter output breaking releasing signal (BRK) after waiting for confirmation of releasing braking which is set in (C013). However, if output current of the inverter is within releasing current which is set in (C018), the braking releasing signal would not output. In this case, the inverter will incur a trip signal and output the braking error signal (BER).

③ When braking confirmation signal (BOK) is set to intelligent input terminals, if braking releasing signal is outputted, the inverter will not accelerate until the braking confirmation which is set in (C016). If braking confirmation signal is not inputted within waiting time for braking confirmation, the inverter will output braking error signal (BER) and would occur the trip. If braking confirmation signal is not set to intelligent input braking terminal, the waiting confirmation will be invalid, and after the inverter will output braking releasing signal, proceed to ④.

④ After braking confirmation signal is inputted(after braking releasing signal is outputted when BOK is not selected), the inverter waits for acceleration, and then begins to accelerates again and accelerates to the frequency.

⑤ When running command turns off, the inverter decelerates to releasing frequency and turns braking releasing signal (BRK) off.

⑥ When braking confirmation signal (BOK) is set to intelligent input terminals, after braking releasing signal turns off, the inverter will not decelerate during the waiting time for braking confirmation which is set in (C016), and will wait for braking confirmation signal to turn off.

If braking confirmation signal does not turn off within the waiting time for braking confirmation, the inverter will output braking error signal (BER) and the trip will occur.

If braking confirmation signal is not set to intelligent input braking terminal, the waiting time for braking confirmation will be invalid and after the inverter will output braking releasing signal, proceed to ⑦.

⑦ After braking confirmation signal turns off (after braking releasing signal turns off), the inverter waits for the waiting time for stop, and then begins to decelerate again and decelerates to 0 Hz.
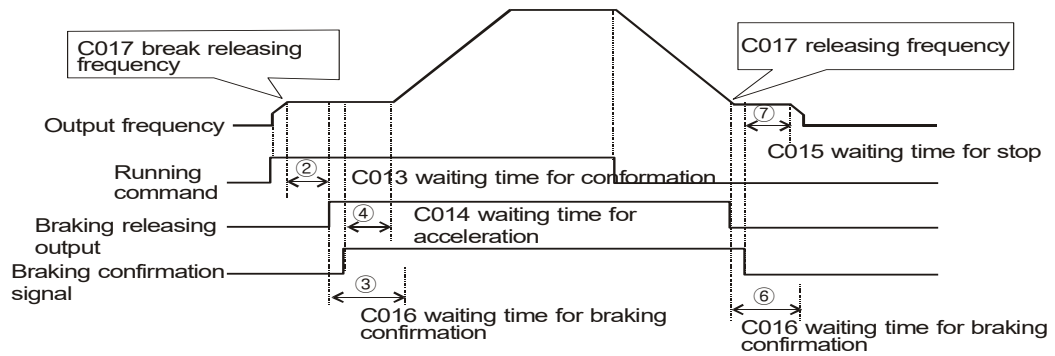
Fig. 11- 4 Timing chart that BOK is selected to intelligent input terminals.

(2) When braking control function is used, if necessary, assign the following functions to intelligent input/output terminals.

① When signal outputted from external braking during releasing braking is inputted to an inverter, one of the intelligent output terminals should be assigned braking conformation signal: BOK(33).

② One of the intelligent output terminals should be assigned to braking signal : BRK to release braking.

And when output signal at the time of braking trouble is used, signal of braking trouble : BER should be assigned.

(3) When braking control function is used, sensorless vector control or 0Hz domain sensorless vector control which generates high torque at starting should be recommended.

Code	Function name	Initial value	Unit	Setting range	Contents
C012	Braking control function selection	0	-	0	Invalid
				1	Valid
C013	Waiting time for braking releasing confirmation	0.00	Sec.	0.00~5.00	Set the time when output current arrives at releasing current after arriving at releasing frequency.
C014	Waiting time for acceleration	0.00	Sec.	0.00~5.00	Set the mechanical late time to release braking from releasing signal outputting
C015	Waiting time for stop	0.00	Sec.	0.00~5.00	Set the mechanical late time to stop braking from releasing signal off.
C016	Waiting time for stop signal confirmation	0.00	Sec.	0.00~5.00	Set longer time to input releasing stop signal which brakes outputs from releasing signal.
C017	Releasing frequency	0.00	Hz	0.00~400.0	Set frequency to output braking releasing signal. Set the value higher than the start frequency.
C018	Releasing current	1.0	times	0.0~2.0	Set output current to permit braking releasing. Be sure that the motor will slip down easily if setting current is low

Table 11- 7 Braking control function selection

(4) In the following case, the inverter trip occurs and outputs braking error signal(BER). (Braking error)

① In the case that output current is less than releasing current after waiting time for braking releasing confirmation.

② When braking confirmation signal is used, in the case that braking confirmation signal

does not turn on within waiting time for braking confirmation during accelerating. In the case that braking confirmation signal does not turn off within waiting time for braking confirmation or braking confirmation signal turns off although braking releasing signal is outputted during decelerating.

11.6   BRD (Dynamic braking) function (C019~C021)

(1) This function only operates with the 30hp (220LF/HF) and lower, as they have the built-in BRD.

(2) This function is to consume regenerative energy from the motor as heat by the use of an external resistor.

(3) Regeneration occurs when the motor is decelerated too quickly and the motor turns into a generator and voltage flows back into the inverter.

(4) To use the BRD function, set the following condition.

Code	Function name	Initial value	Unit	Setting range	Contents
C019	Selection of BRD	0	-	0	Invalid : BRD doesn't operate
				1	During run : valid (BRD operates.) During stop : invalid (BRD doesn't operate.)
				2	During run, stop, valid (BRD operates.)
C020	BRD ON level	360	V	330~380	In case of LF(200V) class inverter, setting is valid.
		720		660~760	In case of HF(400V) class inverter, setting is valid.
C021	BRD using ratio	0.0	%	0.0~100.0	The usage ratio of BRD is set by 0.1% unit When inverter exceeds the usage ratio, a trip occurs.

Table 11- 8 BRD (Dynamic braking) function (C019~C021)

Note 1) BRD ON level is the voltage setting of the DC (direct current) voltage of the inverter.

(5) Using ratio of BRD (%) $= \dfrac{(t1+t2+t3)}{100\sec} \times 100$
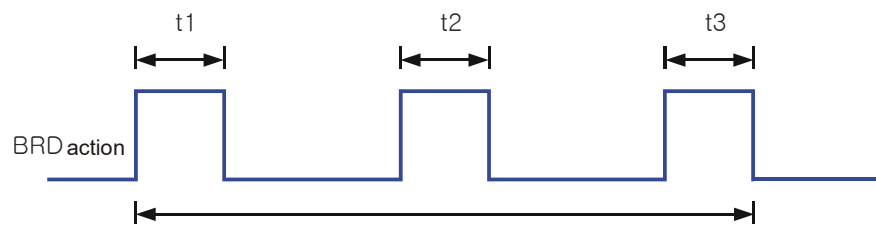
Fig. 11- 5 Using ratio of BRD

11.7   PID function (C022 ~ C034)

• This integrated process control function can be used for controls such as constant flow and control for fan and pump applications.

• When using this function set C022 to 01(PID enable). Turn off the terminal in the case that you validate this function or turn on the terminals in the case that you invalidate this function after assigned 21 (PID valid/invalid) to intelligent input terminals in the case of switching valid / invalid of this function with the outside signal.

Code	Function name	Initial value	Unit	Setting range	Contents
C022	PID selection	0	-	0	PID Invalid
				1	PID valid : Increase frequency when PID input value is smaller than target value.
				2	PID valid : Decreas frequency when PID input value is smaller than target value.
C023	PID-P gain	2.0	-	0.0~5.0	Proportional gain
C024	PID-I gain	30	Sec.	0~3600	Integration Gain
C025	PID-D gain	0.0	Sec.	0.0~100.0	Derivative gain
C026	PID-Feedback gain	1.00	Times.	0.00~99.99	Feedback gain
C027	PID-Feedback source selection (Refer Table 11-10)	0	-	0	Current (4~20mA)
				1	Voltage (0~10V)
				2	Voltage (−10~10V)
				3	Voltage (−10~10V)
				4	Current (4~20mA)
				5	Voltage (0~10V)
o029	PID Deviation setting level	3.0	%	0.0~100.0	See the page 124.
C028	PID command level	0	%	0.00~100.0	
C029	PID−Feedforward selection	0	−	0	No PID Feedforward
				1	O
				2	OI
				3	O2 irreversible
				4	C030 X F003(Max Freq.)
				5	C030 X F001(Output Freq. setting)
C030	PID−Feedforward gain	100	%		Valid when C029 = 4 or 5
C031	Reverse rotation direction	0	−	0	Invalid
				1	Valid
C032	Sleep Frequency	0.00	Hz	0.00~400.0	0.00 : Invalid Sleep & Wakeup function
C033	Sleep Frequency check time	0.0	Sec.	0.0~99.9	
C034	Wakeup Level	0.00	%	0.00~100.0	
F007	Accelerating time setting	30.0	Sec.		0.1~999.9, 1000.~3600.[sec]
F008	Decelerating time setting	30.0	Sec		0.1~999.9, 1000.~3600.[sec]

Table 11- 9 PID function table

(1) Feedback selection
    ① Select the direction of operation(FWD/REV) in C022.
    ② Select the terminal for using a feedback signal in C027.
    ③ Set the set frequency command selection with F001. (In should not be the same as the terminals selected with C027). Or when the control terminal 01 is set with F010, the setting of AT selection I049 is invalid.

Frequency source selection (F010)	PID−Feedback source selection (C027)	PID Command	PID−Feedback
Terminal(1)	0	O	OI
	1	OI	O
	2	O	O2
	3	OI	O2
	4	O2	OI
	5	O2	O

Table 11−10 Command Input terminal according to C027 setting

(2) PID command level
If C028=0, PID command is "(F001/F003)*100"
If C028 = 0.01~100.00, PID command is C028 value (F001 is not effect)

(3) Basis operation of PID control

$$Kp\left(1+\frac{1}{Ti\,s}+Td\,s\right)$$

Kp : Proportional gain   Ti : Reset time   Td : Rate time
s : Operator   ε : Deviation
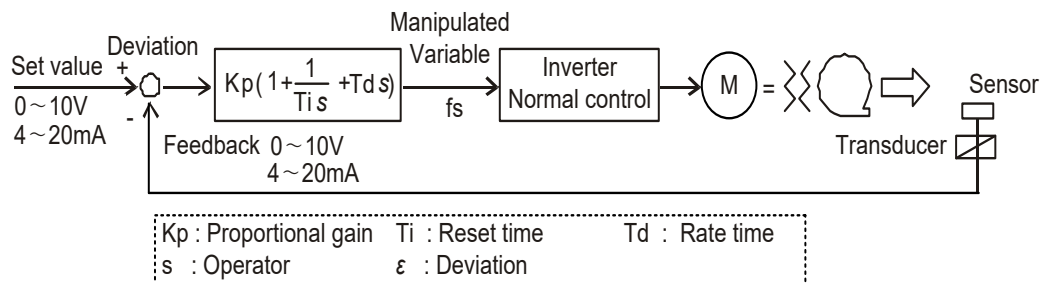
Fig. 11- 6 Basic block diagram of PID control

(4) Components of PID
    ① P action: This is the action that the manipulated variable is in proportion to the command.
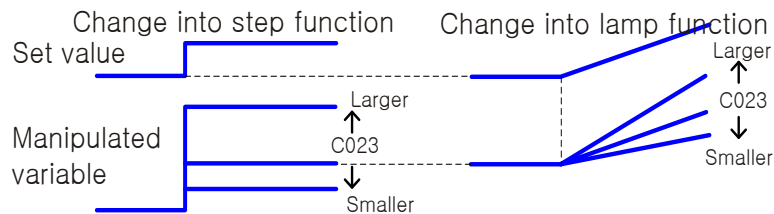
Fig. 11- 7 Components of PID (P action)

② I action: This is the action that the manipulated variable increases with time in a straight lime.
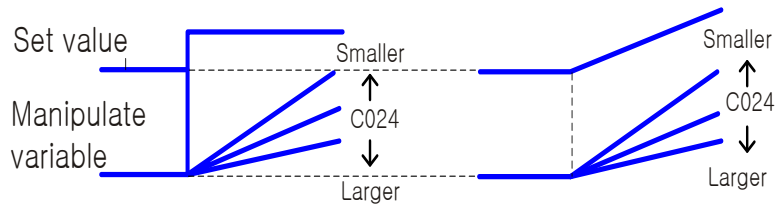
Fig. 11- 8 Components of PID (I action)

③ D action: This is the action that the manipulated variable in proportion to the changing rate of command.
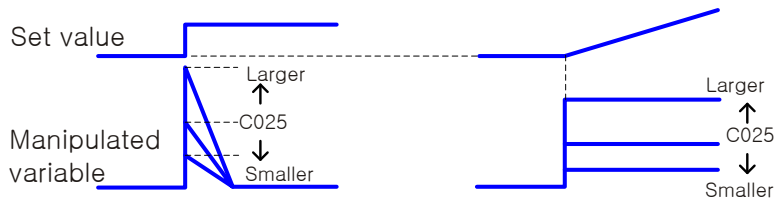
Fig. 11- 9 Components of PID (D action)

PI action combines above ① and ②, PD action does ① and ③, PID action does ①, ②, and ③.

(5) The adjustment of PID gain
Please adjust each according to the state as the following, when the response on the functional operation PID is not stable.
   ①   In spite of changing command, the change of feedback signal is slow.
            ————————→ Increase P gain.
   ②   The feedback signal changes instantly but is not stable.
            ————————→ Decrease P gain.
   ③   The command and feedback signal doesn't coincide instantly.
            ————————→ Decrease I gain.
   ④   The feedback signal oscillates and is not stable.
            ————————→ Increase I gain.
   ⑤   In spite of raising of P gain, the response is slow.
            ————————→ Increase D gain.
   ⑥   When P gain is raised, the feedback signal oscillates and is not stable.
            ————————→ Decrease D gain.

(6)   Setting acceleration & deceleration time

Acceleration & deceleration time of PID output signal is dicided by F007 & F008. For stability of system, same setting of F007 and F008 would be recommended. In case of decreasing F007&F008, it would be effect overshoot of system,

(7)   The Maximum PID Deviation Level / Output

① It is possible to establish the maximum deviation level o029 on PID control.

When the PID deviation amount reaches the set level o029, it is possible to set an intelligent output.

o029 can be set from 0 to 100.0% and corresponds with the command from 0 to maximum.

② Assign 04 (OD) to an intelligent output terminal 1~4 (o001~o004).

(8)   Feedback monitor of PID

① Feedback signal of PID can be monitored.

② The monitor value can be displayed by the product of PID scale C026.

"Monitor DISPLAY " = Feedback (%) × PID feedback gain(C026)

(9)   PID integral reset

① This is the function to clear the integral value of PID action.

② Assign 22(PIDC) to an intelligent input terminal.

③ It is cleared whenever PIDC is turned ON.

Don't turn absolutely ON PID terminal during PID action, because there is a possibility of overcurrent trip. Turn ON PIDC terminal after turning OFF PID action.

(10) PID Feedforwad selection

① This is the function to improve responsibility of speed command.

② If user want to use analog input C029=1~3 for feedfoward input, it can't select the analog input that already selected in Feedback source.

(11) If select C029=3, I038 must be set 1.

if select C029=4~5, C030 must be set together.PID output reverse

① If setting C031=1, PID output will be reverse.

but, in case of b001=1, it is not work.

(12) Sleep & Wake up function
① Inverter will be sleep mode, when output frequency stay sleep frequency(C032) value and over frequency check time(C033). Inverter will be restart when feedback value of PID is over wakeup level(C034).
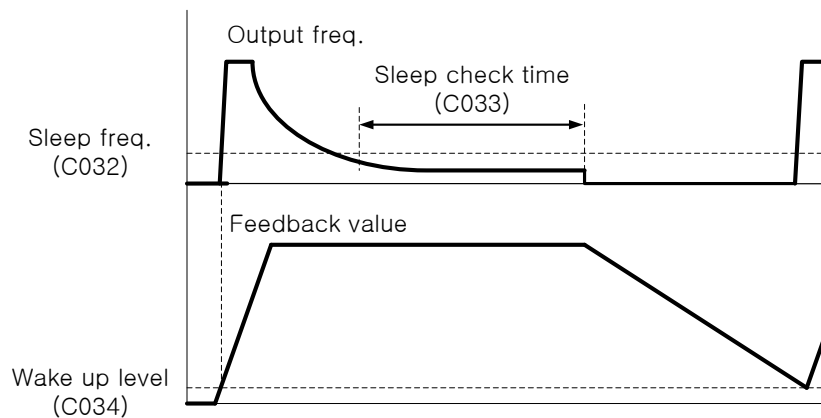
Fig. 11- 10 Sleep & Wake up function

② If C032=0, sleep&wake up function will not work.
③ Each operation according to PID selection(C022)

Sleep operation condition (when C022=1)
- Operating freq. < Sleep freq.(C032)
- PID Feedback value > Wakeup level(C034)
- Stay over sleep check time (C033)

Sleep operation condition (when C022=2)
- Operating freq. < Sleep freq.(C032)
- PID Feedback value < Wakeup level(C034)
- Stay over sleep check time (C033)

Wake up operation condtion (when C022=1)
- PID feedback value < Wake up level

Wake up operation condtion (when C022=2)
- PID feedback value > Wake up level
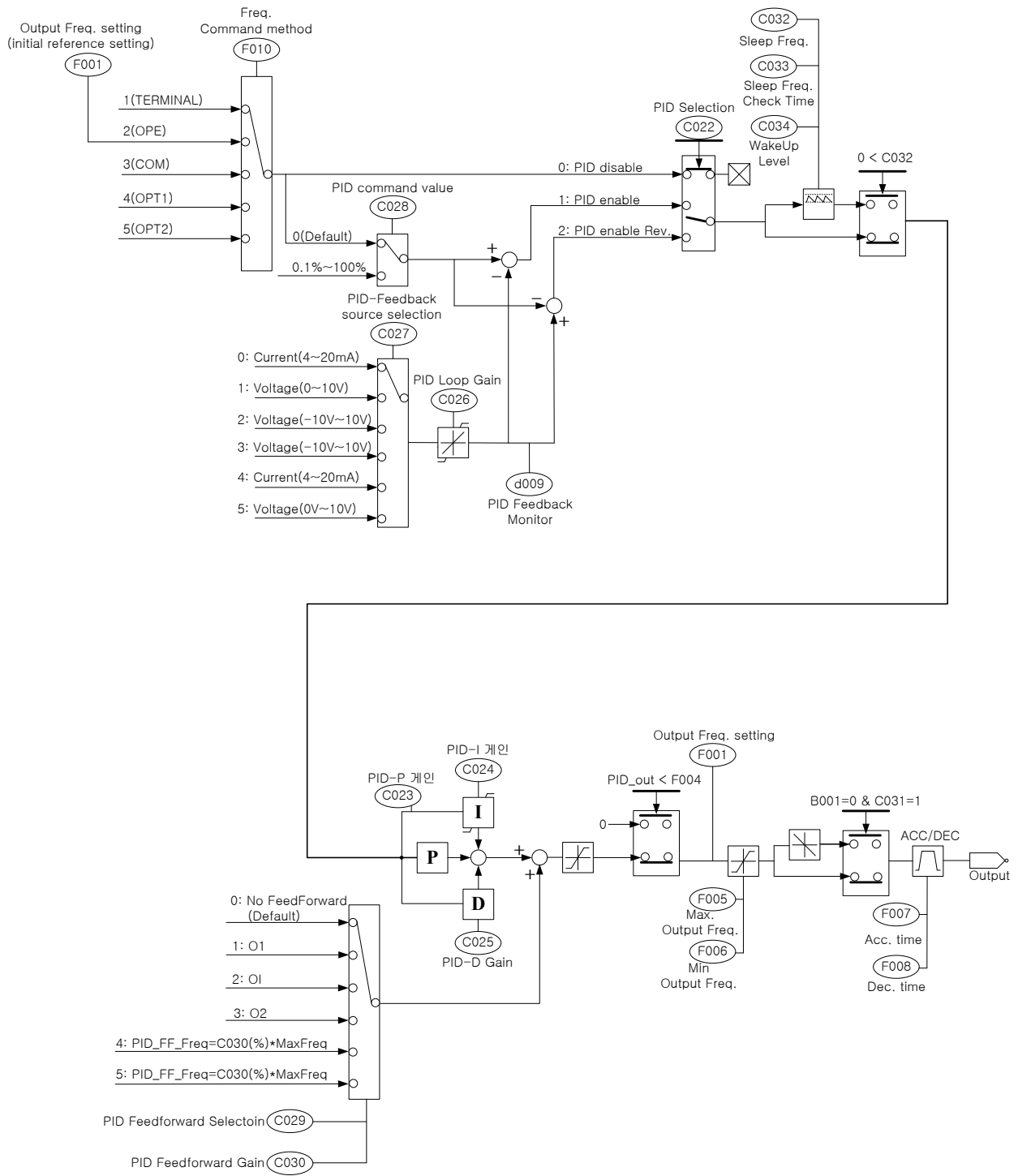
Fig. 11- 12 PID Block Diagram

11.8   Frequency band on torque limit (C035)

(1) This function is setting frequency band on torque limit when F012 is 4(indirect sesorless vector control)

(2) Output frequency by torque limit can't lower than F004(Starting frequency setting)

Code	Function Name	Initial value	Unit	Setting range	Contents
C035	Frequency band on torque limit	0.00	Hz	0.0~99.99	Change frequency band when torque limit situation

12. EXPLANATION OF H-GROUP

12.1 Motor control method and selection of motor parameters

12.1.1 Motor constant selection

(1) Change values as follows according to the kind of a using motor.

(2) When plural motors are used, add total motor capacity and select the approximate data for the motor capacity.

(3) Motor constant used in sensorless vector control and vector control with sensor can be selected from the following the three.

① General purpose motor constant

② Motor constant measured in offline autotuning

③ Motor constant measured in offline autotuning based on on-line autotuning

Code	Function Name	Initial value	Unit	Setting range	Contents
H001	Autotuning selection	0	-	0~2	0(INVALID) : Invalid
					1(VALID NOT ROT.) : Valid(the motor does not rotate)
					2(VALID IN ROT.): Valid(the motor rotates)
H002	Motor constant selection	1	-	0~2	0(MOTOR DATA) :General purpose motor
					1(AT DATA) : Autotuning data
					2(AT ONLINE DATA): On-line autotuning valid
H202	Motor constant Selection, 2nd motor	1	-	0~2	0(MOTOR DATA) :General purpose motor
					1(AT DATA) : Autotuning data
					2(AT ONLINE DATA): On-line autotuning valid
H003	Motor constant R1	R1std	Ω	0.000~9.999	Hyundai standard motor data
H203	2nd Motor constant R1	R1std	Ω	0.000~9.999	Hyundai standard motor data
H004	Motor constant R2	R2std	Ω	0.000~9.999	Hyundai standard motor data
H204	2nd Motor constant R2	R2std	Ω	0.000~9.999	Hyundai standard motor data
H005	Motor constant LI	LIstd	mH	0.00~99.99	Hyundai standard motor data
H205	2nd Motor constant LI	LIstd	mH	0.00~99.99	Hyundai standard motor data
H006	Motor constant Io	Istd	A	0.0~999.9	Hyundai standard motor data
H206	2nd Motor constant Io	Istd	A	0.0~999.9	Hyundai standard motor data
H007	Motor constant J	Jstd	kg·m^2	0.00~99.99/ 100.0~655.3	Hyundai standard motor data
H207	2nd Motor constant J	Jstd	kg· m^2	0.00~99.99/ 100.0~655.3	Hyundai standard motor data
H008	Motor constant L	Lstd	mH	0.0~999.9	Hyundai standard motor data
H208	2nd Motor constant L	Lstd	mH	0.0~999.9	Hyundai standard motor data
H009	Motor constant R1 (Autotuning data)	R1std	Ω	0.000~9.999	Autotuning motor data

Code	Function Name	Initial value	Unit	Setting range	Contents
H209	2nd Motor constant R1 (Autotuning data)	R1std	Ω	0.000~9.999	Autotuning motor data
H010	Motor constant R2 (Autotuning data)	R2std	Ω	0.000~9.999	Autotuning motor data
H210	2nd Motor constant R2 (Autotuning data)	R2std	Ω	0.000~9.999	Autotuning motor data
H011	Motor constant LI (Autotuning data)	LIstd	mH	0.00~99.99	Autotuning motor data
H211	2nd Motor constant LI (Autotuning data)	LIstd	mH	0.00~99.99	Autotuning motor data
H012	Motor constant Io (Autotuning data)	Istd	A	0.0~999.9	Autotuning motor data
H212	2nd Motor constant Io (Autotuning data)	Istd	A	0.0~999.9	Autotuning motor data
H013	Motor constant J (Autotuning data)	Jstd	kg·m^2	0.00~99.99/ 100.0~655.3	Autotuning motor data
H213	2nd Motor constant J (Autotuning data)	Jstd	kg·m^2	0.00~99.99/ 100.0~655.3	Autotuning motor data
H014	Motor constant L (Autotuning data)	Lstd	mH	0.00~99.99/ 100.0~999.9	Autotuning motor data
H214	2nd Motor constant L (Autotuning data)	Lstd	mH	0.00~99.99/ 100.0~999.9	Autotuning motor data

Table 12- 1 Autotuning and motor constant selection

Note1) The data of H003 to H015 is autotuning parameters of general purpose motor.
Please set motor constant according to the type of the motor.(F015/F215).

Note2) Initial value of AT DATA is equal to general purpose motor constant.

12.1.2   Selection of motor control method

(1) It is possible to select the motor control method in F012 (motor control method) for the precise motor control.

(2) The N700 inverter is possible to do speed control and torque control using the speed-control mode and torque-control mode. It is possible to select each function in the parameter F018.

Code	Function Name	Initial value	Unit	Setting range	Contents
F012	Motor control method	5	-	0~3, 5~7	0(VC) : Constant torque characteristic
					1(VP1) : Reduced torque characteristic(1.7)
					2(VP2) : Reduced torque characteristic(1.7)
					3(Free V/f) : V/f free setting
					5(SLV) : Sensorless vector control
					6(V2) : Sensored vector control
					7(0Hz-V2) : 0Hz-domain sensored vector control
F212	Second motor Control method	5	-	0~3,5	0(VC) : Constant torque characteristic
					1(VP1) : Reduced torque characteristic(1.7)
					2(VP2) : Reduced torque characteristic(1.7)
					3(Free V/f) : V/f free setting
					5(SLV) : sensorless vector control
F013	Motor voltage selection	220 (440)	V	200~240 (380~480)	200/215/220/230/240 – 200V class setting 380/400/415/440/460/480 – 400V class setting
F015	Motor capacity	Factory setting	kW	1.5~75	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/ 30/37/45/55/75/90/110/132
F215	Second motor capacity	Factory setting	kW	1.5~75	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/ 30/37/45/55/75/90/110/132
F016	Motor pole selection	4	pole	2~12	2/4/6/8/10/12
F216	Second motor pole selection	4	pole	2~12	2/4/6/8/10/12
F017	Motor rated current	Factory setting	A	0.0~999.9	Rated current value[RMS]
F217	Second motor rated current	Factory setting	A	0.0~999.9	Rated current value[RMS]
F018	Speed/Torque mode selection	0	-	0~1	0 : Speed control mode
					1 : Torque control mode
F019	SLV Control method selection	0	-	0~1	0 : Normal Operation
					1 : 0Hz Operation

Table 12- 2 Selection of motor control method

Note1) In 1st motor control method (F012), it is possible to select setting range 0~3 , 5~7.
   In 2nd motor control method (F212), it is possible to select setting range 0~3, 5.

Note2) The motor rated current for F017/F217 code is the factory setting value according to the inverter capacity.
   You can adjust this parameter according to applicable motor.

Note3) The data of F012 must be setted range 5~7.
   The data of F212 must be setted range 5.

12.2   Autotuning

12.2.1   Off-line autotuning

(1)   This is a function for measuring and automatically setting the motor circuit constant necessary for the sensorless vector control and sensored vector control.

(2)   When the sensorless vector control and the sensored vector control is performed by using the motor whose circuit constant is unknown, please measure the motor circuit constant by the offline autotuning function.

(3)   When 0(MOTOR DATA) in motor constant selection (H002) is set, a general-purpose motor is given a constant, which is initial value. In most case, the characteristics will be obtained without trouble, even if offline autotuning is not executed.

(When online autotuning function mentioned later is performed, please be sure to operate offline autotuning)

Code	Function Name	Initial value	Unit	Setting range	Contents
H001	Autotunig selection	0	-	0~2	0(INVALID) : Invalid 1(VALID NOT ROT.): Valid(the motor does not rotate) 2(VALID IN ROT.): Valid(the motor rotates)
H002	Motor constant selection	1	-	0~2	0(MOTOR DATA): General purpose motor 1(AT DATA) : Autotuning data 2(AT ONLINE DATA):On-line autotuning valid
H009	Motor constant R1 (Autotuning data)	R1std	Ω	0.000~9.999	Stator resistor
H010	Motor constant R2 (Autotuning data)	R2std	Ω	0.000~9.999	Rotor resistor
H011	Motor constant Ll (Autotuning data)	Llstd	mH	0.00~99.99	Leakage inductance
H012	Motor constant Io (Autotuning data)	Istd	A	0.0~999.9	No-load current
H013	Motor constant J (Autotuning data)	Jstd	kg·m^2	0.00~655.3	Inertia moment
H014	Motor constant L (Autotuning data)	Lstd	mH	0.00~999.9	Inductance
F013	Motor voltage selection	220 (440)	V	200~240 (380~480)	200/215/220/230/240 – 200V class setting 380/4000/415/440/460/480 – 400V class setting
F015	Motor capacity	Factory setting	kW	1.5~75	1.5/2.2/3.7/5.5/7.5/11/15/18.5/22/30 /37/45/55/75/90/110/132
F016	Motor pole selection	4	pole	2~12	2/4/6/8/10/12
F017	Motor rated current	Factory setting	A	0.0~999.9	Rated current value[RMS]

Table 12- 3 Autotuning(Off-line autotuning) and motor constant selection

(4) Precautions
① Set motor base frequency (F002), motor voltage selection (F013), and motor rated current(F017) to the specification of the motor measued.
② The motor capacity which is measured is to the maximum capacity of an application motor and below 1 level capacity.
③ In the state that the DC braking selection (A081) is set validly 1(VALID), the accurate motor constant will not be measured. Please set DC braking selection invalidly 0(INVALID). (Initial value is invalid.)
④ In the case of selecting 2(VALID IN ROT.) that the motor rotates in autotuning selection(H001), be cautious the following points,
  ● It causes no trouble to accelate up to 80% of the base frequency,
  ● Do not operate the motor from outside.
  ● Do not release the brake.
  ● Torque is not enough during autotuning. In application like an elevator, as it is possibility to slip down.
  ● The motor should be removed from the machine of the load and excute autotuning by itself. (In this case, as inertia motor J is motor itself, add the motor shaft converting value to inertia motor.)
  ● In the machine restricted the motor shaft revolution permit (elevator, ball screw, and so on), the mode H001=1(VALID NOT ROT.) should be selected in which operates autotuning without rotating.
⑤ Sometimes, the motor can rotate in spite of selecting 1 (VALID NOT ROT) in H001.
  If the motor rotates in spite of selecting 1 (VALID NOT ROT), set the autotuning selection to the mode H001=2(VALID IN ROT.).
⑥ When operating autotuning by using one class low motor. Validate overload restriction function, then set the overload restriction level 1.5 times as high as rated output current of motor.

(5) Setting method
① Set the autotuning selection (H001) to 1(VALID NOT ROT.) or 2(VALID IN ROT.) and push the store(STR) key.
② Turn the Run command ON.
  After turning the Run command ON, the motor automatically runs in the following order of (1) to (4).
  ● The first DC excitation (not rotate)
  ● The second AC excitation (not rotate)
  ● V/f Operation (When H001 is set to 1(VALID NOT ROT.), this is not operated.)
  ● Display the tuning data.
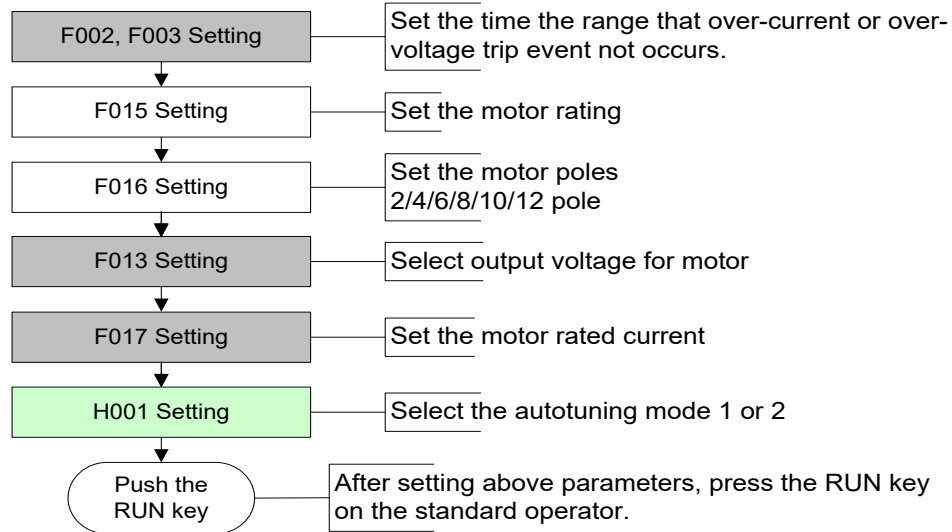
Fig. 12- 1 Autotuning setting

(6) Cautions

① When autotuning (set H001 to 01) that the motor does not rotate is selected, '3) The second AC excitation' will not be performed.

② When autotuning operation terminates, the following is displayed.

Normal termination   Abnormal termination
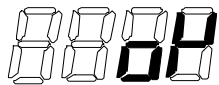
When the autotuning operation terminates abnormally, please execute the autotuning again. (When one of the keys is pressed, the display stops.)

③ When a trip occurred during the autotuning, the autotuning is forced to terminate.
(Abnormal termination is not displayed. The display of a trip has priority.)
After eliminating the cause of the trip, execute the autotuning again.

④ If the autotuning is interrupted by power off (with the stop key or turning the run command off), the constant for autotuning may be stored.
After making an initialization and reset the setting range, carry out autotuning again.
(In the case of normal running, do in the same way)

⑤ When an autotuning is interrupted by stop command (STOP key or stop of running) during autotuning, the constant for autotuning may be stored.
When re-autotuning is carried out, initiate and set again to upper setting value.

```
┌─────────────────────────┐
│    Motor connection     │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│ Auto-tuning mode selection │
│      H001=1 or 2        │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│    RUN command ON       │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐        ① DC excitation (no ratation)
│ Motor parameter setting │————    ② AC excitation (no ratation)
└─────────────────────────┘        ③ V/F operation (For H001=1, no rotation)
            │                      ④ Display the tuning result
            ▼
┌─────────────────────────┐
│   Parameter setting     │————  ┌─────────────┐
│   completed, stop       │      │ End display │
└─────────────────────────┘      └─────────────┘
```

Fig. 12- 2 Autotuning procedure

12.2.2 ON-LINE autotuning

(1) Online autotuning can revise the motor constant by increase of temperature, and stabilize running.

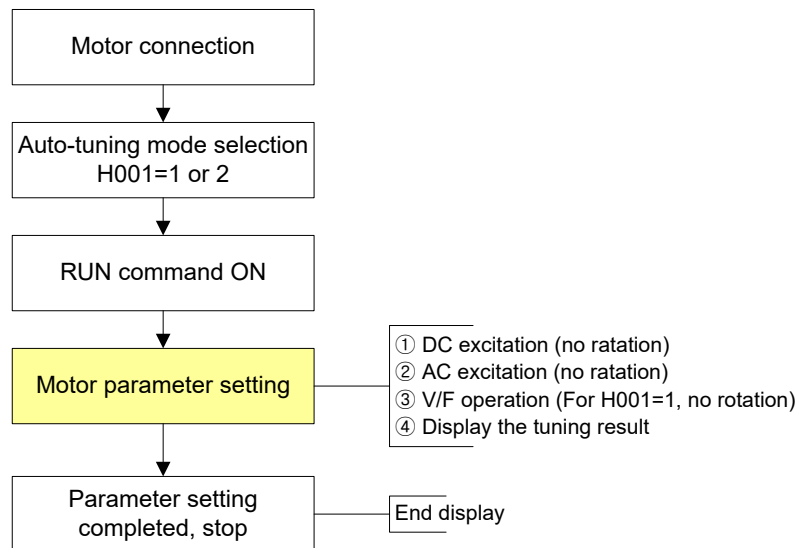(2) This function acts only the 1st motor control. Do not operate it in the 2nd motor control.

(3) Precautions

① Be sure to execute offline autotuning before executing online autotuning.

② Be sure to execute autotuning once when a general-purpose motor, as the data for online autotuning is computed during offline autotuning.

③ If DC braking is set when the motor stops, online autotuning is executed after DC braking operation terminates.

(4) Setting method

① Set the motor constant selection (H002/H202) to the data of autotuning that is valid 2(AT ONLINE DATA) online tuning.
(Give the autotuning selection (H001) as the ineffectiveness (0).)

② Input the run command.

12.3 Sensorless vector control(SLV)

(1) This function is the method that the revolution of motor and output torque are estimated by output current, voltage of the inverter and motor constant of setting. It is possible to operate high starting torque and high accuracy at low frequency(0.5Hz).

(2) In the case of using this function, please set 5(SLV) in F012.

(3) In the case of using this function, please set surely the suitable motor constant of using the motor according to the parameter of "selection of motor constant [H**]".

(4) Precautions

① If the inverter operates less than two steps in capacity level for the maximum adopted motor, the full performances may not be demonstrated.

② If a satisfactory performance can not be obtained, please adjust the motor constant for the phenomena according to the following table.

Status of running	Phenomena	Contents of adjustment	Adjusting parameter
Driving	Speed fluctuation is minus(-)	Set "Motor constant R2"bigger and bigger slowly until 1.2 times for preset constant.	H004/H204 H010/H210
	Speed fluctuation is plus(+)	Set "Motor constant R2" smaller and smaller slowly until 0.8 times for preset constant.	H004/H204 H010/H210
Regenerating	Lack of torque at low frequency	Set "Motor constant R1"bigger and bigger slowly until 1.2 times for preset constant.	H003/H203 H009/H209
		Set "Motor constant I0" bigger and bigger slowly until 1.2 times for preset constant.	H006/H206 H012/H212
At starting	The shock is occurred at starting	Set "Motor constant J" smaller for preset constant.	H007/H207 H013/H213
At deceleration	Unstable of motor rotation	Set "Motor constant J" smaller for preset constant.	H007/H207 H013/H213
During torque limit	Insufficient torque during torque limit at low speed	Set overload restriction level lower than torque limit level.	b031 C007~C010
At low frequency operation	Irregular of rotation	Set "Motor constant J" bigger for preset constant.	H007/H207 H013/H213

Table 12- 4 Sensorless vector control (SLV)

12.4   Sensored vector control(V2)/0Hz-Sensored vector control(0Hz-V2)

(1) It is possible to realize precision and high torque by this function.

(2) Please set F012 to 6(V2) or 7(0Hz-V2) for this function.

(3) If programming the inverter for sensored vector use, It will need an encoder and a Feedback Option Card for vector control function.

(4) Please refer to the feedback option card manual for this function.

13.   COMMUNICATION FUNCTION

13.1   Communication function

Communication circuit for RS485/RS23/CAN is built in N700 Inverter.

It is possible to control 1~32 Inverters (Slave) from a main control device (Master) by using RS485 serial communication(note1). Standard RS232 and CAN communication is supported. (note2)

RS485 Serial Network
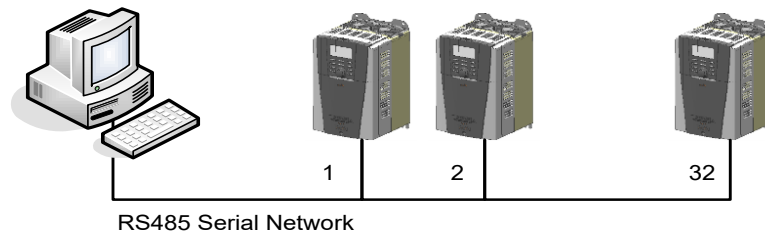
Fig. 13- 1 RS485 Serial network

[RS485 port specification and connection]

Serial communication is possible from the communication terminal J2 of the inverter to any external equipment using RS232/485 protocol.
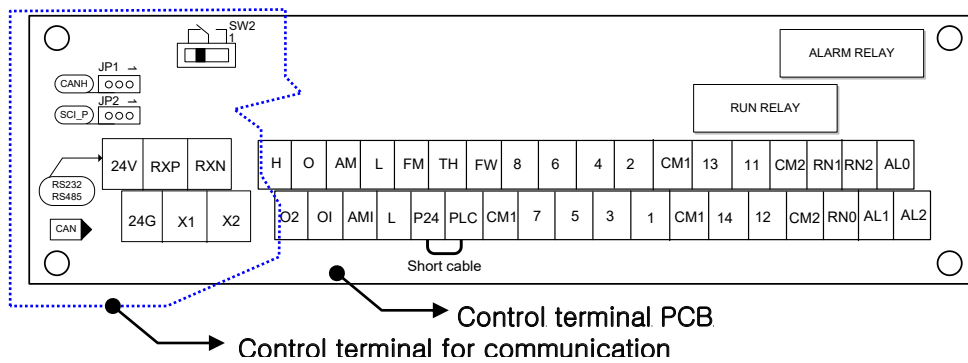
Fig. 13- 2 RS485 port specification (Control terminal PCB)

Abbreviation name	Description	Abbreviation name	Description
RXP	Transmission and Reception + side for RS485/232	JP1	Terminal resistance valid/invalid CAN communication
RXN	Transmission and Reception - side for RS485/232	JP2	Terminal resistance valid/invalid RS485/232 communication
X1	Transmission and Reception + side for CAN	SW2	Left direction setting of SW2 : RS485 (default setting)
X2	Transmission and Reception + side for CAN		Right direction setting of SW2 : RS232

Table 13- 1 RS485 port connection

Note1) Sometimes happened communication malfunctions depend on wiring method, kind of wire, and abnormal noise of each enviroments. For stability communicating operation, connect under 16 pcs at the same time.

Note2) Please inquire of our technical expert about CAN communication.

The CAN is a serial network that means 'Controller Area Network'.

(1) RS485 Communication specification

Item	Specification	Notes
Communication interface	RS485	SW2 (3-4) (Right position)
Communication methods	Half duplex communication methods	
Transmission speed (Baud Rate)	2400/4800/9600/19200/38400[BPS]	Selection with operator (b038)
Start methods	Response for the external read, write command	The inverter operates only as slave.
Transmission code	Binary code	
Data bit	7/8[bit]	Selection with Operator (b040)
Parity	No parity/even/odd	Selection with Operator (b041)
Stop bit	1/2[bit]	Selection with Operator (b042)
Connect form	1:N(N=Maximum32)	Selection with Operator (b039)
Main function	Fleming/CRC/CMD/MAXREQ/Parameter	

Table 13- 2 RS485 Communication specification

(2) RS485 Communication setting

Connect each inverter by multiple and short in case of the end inverter by using JP2 jumper. (Although RS485 communication is used to one inverter, short JP2 jumper as an equal method.) RS485 communication requires a termination resistor. The N700 has built-in terminal resistor that by shorting JP2 jumper, the termination resistor of the control terminal is valid and enables to control the reflection of a signal.

(Refer to clause 13.1 Communication function on page 139)

The following setting are required to operate RS485 communication

Function code	Set item	Initial data	Data	Description
b037	Data command	0	0(OPERATOR)	Reserved
			1(RS485)	RS485
			2(CAN)	CAN
			3(OPT)	Reserved (Option)
			4(RS232)	RS232
b038	Communicating transmission speed	2	0(2400BPS)	2,400 BPS
			1(4800BPS)	4,800 BPS
			2(9600BPS)	9,600 BPS
			3(19200BPS)	19,200 BPS
			4(38400BPS)	38,400 BPS
b039	Communication code	1	1~32	This assigns the station number of the inverter. This is used when you control more than one simultaneously.
b040	Communication bit	8	7(7BIT)	7bits
			8(8BIT)	8bits
b041	Communication parity	0	0(NO PARITY)	No parity
			1(EVEN PARITY)	Even parity
			2(ODD PARITY)	Odd parity
b042	Communication stop bit	1	1(1BIT)	1bit
			2(2BIT)	2bit

Table 13- 3 RS485 Communication specification

(Note) Even if b037 = 1 or 4, key pad operator can action STOP button and change b037 value.

(3) Communication order

The flow of the communication protocol between an external control device and an inverter is shown below in the time diagram.
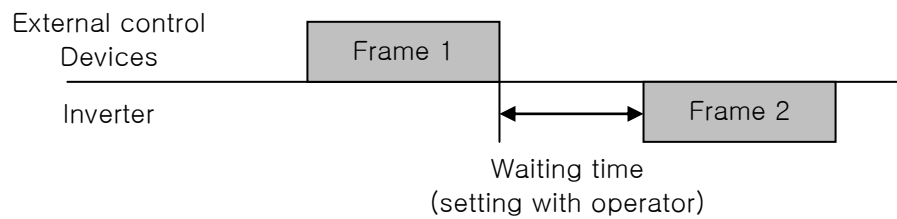
Fig. 13- 3 Communication order

Frame start :   Frame start is recognized by signal line data transmitted.

Frame completion: Frame completion is recognized by no data during correspond 4, 5- character time.

Frame 1:   Transmit from external controller to inverter.

Frame 2:   Indication reflects from inverter to external controller.

Frame 2 in inverter displays as the signal that inverter receiving Frame 1 and recognizes a suitable frame and responds, and don't output actively.

13.2   Communication protocol

ModBus protocol that applies Query-Response Cycle method is used in the communication.

The communication network is controlled by the master equipment, and it is operated by the method that the slave equipment reply from the transmission request of the master equipment. ModBUS communication frame type and form is as follows.

13.2.1   Inverter read frame

It requires 1~8 parameters of Inverter.

(1) External controller transmit frame

Communication number	Command	parameter	Parameter count	CRC Hi	CRC Lo

Clause	Description	Data size	Specifications
Communication number	Inverter communication number	1 byte	1~32
Command	Frame type	1 byte	0x03
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : index
Parameter number	Request parameter Number	2 byte	1st byte : 0x00 2nd byte : N(0x01~0x08)
CRC Hi	-	1 byte	Higher 8bit of 16 bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16 bit CRC

Table 13- 4 External controller transmit frame

(2) Inverter response frame

Communication number	Order	Byte number	Data1	....	Data N	CRC Hi	CRC Lo

Clause	Description	Data size	Specifications
Communication number	Inverter communication number	1 byte	1~32
Command	Frame type	1 byte	0x03
Request Byte	Data byte number	1 byte	Request parameter number × 2
Data 1	Parameter 1	2 byte	Parameter value
Data N	Parameter N	2 byte	Nth parameter value
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

Table 13- 5 Inverter response frame

※ Frame size =   5byte (Communication number + Command + Request Byte + CRC H + CRC L)
               + Request parameter number × 2byte (Data1 + Data2 + ….. + Data N)

13.2.2 Request frame for setting parameter

Setting 1 parameter and command (note3) of Inverter.

If communication number set by 0xFF, user can control several inverters at the same time.

(1) (RUN FWD/REV, STOP, RESET, SETTING) But, there is no response from inverters.External transmit frame

Communication number	Order	Parameter	Data	CRC Hi	CRC Lo

Clause	Description	Data size	Specifications
Communication number	Inverter communication number	1 byte	1~32
Command	Frame type	1 byte	0x06
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : index (Note1)
Data	Data	2 byte	Setting value (Note2)
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

Table 13- 6 External transmit frame

(2) Inverter response frame

Communication number	Order	Parameter	Data	CRC Hi	CRC Lo

Clause	Description	Data size	Specifications
Communication number	Inverter communication number	1 byte	1~32
Order	Frame type	1 byte	0x06
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : index (Note1)
Data	Data	2 byte	Setting value is response (note 4)
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

Table 13- 7 Inverter response frame

(3) Parameter setting
   Basic parameter
   1st byte : Each group is setting.

Group	1st byte	Group	1st byte
D	0x01	O	0x07
F	0x02	C	0x08
A	0x03	H	0x09
U	0x04	P	0x0a
B	0x05		
I	0x06		

Table 13- 8 Basic parameters (1st byte)

2nd byte : Parameter number setting
Ex) The case of A60 parameter reading or writing
1st byte : 0x03
2nd byte : 0x3C

Trip information
Trip information is 4 parameters. (output frequency, output current, DC link voltage at trip occurs)

	Trip count	Trip information	Previous first trip	Previous second trip	Previous third trip	Previous fourth trip	Previous fifth trip
1st byte	0x01	0x01	0x01	0x01	0x01	0x01	0x01
2nd byte	0x12	0x13	0x17	0x1B	0x1F	0x23	0x27

Table 13- 9 Trip information List (1st byte, 2nd byte)

Trip information items

Trip data	Trip contents	Trip data	Trip contents
1	Over current trip (Constant speed)	17	Abnormal temperature trip
2	Over current trip (acceleration)	18	-
3	Over current trip (Deceleration)	19	output phase open protection
4	Over current trip (Others)	20	Open phase protection (R phase)
5	Overload trip	21	Open-phase trip(S phase)
6	Braking resistor overload trip	22	Open-phase trip(T phase)
7	Over voltage trip	23	-
8	EEPROM trip	24	Thermistor error
9	Under voltage	25	Abnormal brake
10	-	26	Communication error
11	-	27	Over time of reset input
12	External trip	28	IGBT protection(U phase)
13	USP error	29	IGBT protection(V phase)
14	Ground fault-voltage	30	IGBT protection(W phase)
15	-	31	Option 1,2 error
16	Temporary power loss protection	32	Over speed error

Table 13- 10 Trip information items

(4) Data value setting

Data value is transmitted except decimal point.

Ex1) Output frequency

Parameter value	Communication data	Converted hexadecimal value
60.00Hz	6000	1st byte : 0x17 2nd byte : 0x70

Ex 2) acceleration/deceleration time

Parameter value	Communication data	Converted hexadecimal value
10.0sec	100	1st byte : 0x00 2nd byte : 0x64

(5) Special parameter

A special parameter is used to operating and commanding a frequency value for the basic parameter.

Run command Parameter

1st byte : 0x00

2nd byte : 0x02

Setting data

1st byte

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved							

2nd byte

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved					RST	REV	FWD

Bit0 : Forward command

Bit1 : Reverse command

Bit2 : Reset command

Frequency command Parameter

1st byte : 0x00

2nd byte : 0x04

Setting data

Output frequency $\times$ 100

Ex) The case of output frequency command is 60 Hz

Data 6000 transmit

1st byte : 0x17

2nd byte : 0x70

Note) Response frame when you send a command for setting a parameter

When the data cannot be stored due to the attempt to store data while the unit is running, the setting data will not be stored and the original data will be responded.

16bit CRC generation

The step of CRC-16 generation is as follows:

- All of 16-bit register is 1. 0xffff
- The exclusive OR of 16-bit register and 8-bit register.
- Shift right side 1bit a 16-bit register
- If the result of step 3 is 1, exclusive OR 16-bit register and 0xa001.
- Execute 8 times step 3 and step 4.
- Execute step 2~6 until data completion
- Exchange the step 6 result of higher 8bit and lower 8bit.

Ex) The case of d001 output frequency reading.

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6
Communication number	Command	Parameter		Parameter number	
0x01	0x03	0x01	0x01	0x00	0x01

The sequence of addition Byte(0x01)

16Bit Register		MSB			Flag
(Exclusive OR)	1111	1111	1111	1111	
01	0000	0001			
	1111	1111	1111	1110	
Shift1	0111	1111	1111	1111	
Shift2	0011	1111	1111	1111	1
Polynomial	1010	0000	0000	0001	
	1001	1111	1111	1110	
Shift3	0100	1111	1111	1111	
Shift4	0010	0111	1111	1111	
Polynomial	1010	0000	0000	0001	
	1000	0111	1111	1110	
Shift5	0100	0011	1111	1111	
Shift6	0010	0001	1111	1111	1
Polynomial	1010	0000	0000	0001	
	1000	0001	1111	1110	
Shift7	0100	0000	1111	1111	
Shift8	0010	0000	0111	1111	1
Polynomial	1010	0000	0000	0001	
	1000	0000	0111	1110	

Byte1~6	CRC of operation results
0x01	0x807e
0x03	0x2140
0x01	0x30e1
0x01	0x8831
0x00	0xd449
0x01	0x36d4

It exchanges higher 8bit of the final result 0x36d4. → 0xd436

Byte7 : CRC higher 8Bit = 0xd4

Byte8 : CRC lower 8Bit = 0x36

14.   PROTECTION FUNCTION

14.1   Protection function

Name	Description		Display
Over-current protection	When motor is restricted and decelerates rapidly, excessive current flows back to the inverter and it could damage the inverter. This protection turns on current protection circuit operates and the inverter output stop.	At constant speed	E01
		On acceleration speed	E02
		On deceleration speed	E03
		Other	E04
Overload protection	When the inverter detects an overload in the motor, the internal electronic thermal overload activates and the inverter output is switched off.		E05
Braking resistor overload protection	When BRD exceeds the usage ratio of the regenerative braking resistor, the over-voltage circuit activates and the inverter output is switched off.		E06
Overvoltage protection	When regenerative energy from the motor exceeds the maximum level, the over -voltage circuit activates and the inverter output is switched off.		E07
EEPROM	The inverter output is cuf off when EEPROM in ther inverter has an error due to external noise, excessive temperuature rise, or other factor		E08
Under-voltage protection	When the incoming voltage of inverter is low, the control circuit can't operate correctly. In this case, the under -voltage circuit activates and the inverter output is switched off.		E09
External trip	When a signal is given to the EXT intelligent input terminal, the inverter output is switched off. (on external trip function select)		E12
USP error	This error is displayed when the inverter power is restored while running. (Valid when the USP function is selected)		E13
Ground fault protection	When power is turned ON, this detects ground faults between the inverter output and the motor.		E14
Temporary power loss protection	When an instantaneous power failure occurs for more than 15ms, the inverter output is switched off. Once the instantaneous power failure wait time has elapsed and the power has not been restored, it is regarded as a normal power failure. However, when the operation command is still ON with restart selection, the inverter will restart. So please be careful of this.		E16
Abnormal temperature	When main circuit temperature rises abnormally high by stopping the cooling fan, the inverter output is switched off.		E17
Open-phase protection	When open output phases occur the invereter is switched off.		E19
	When an R opens - phase on the input supply occurs the inverter output is switched off.		E20
	When an S opens - phase on the input supply occurs the inverter output is switched off.		E21
	When a T opens - phase on the input supply occurs the inverter output is switched off.		E22
Thermistor error	When the inverter detects a high resistance on the thermistor input from the motor, the inverter output is switched off.		E24
Abnormal brake	When inverter cannot detect switching of the brake(ON/OFF) after releasing the brake and for signal condition. When the braking control selection is enable.		E25
Communication error	This error is displayed, when communication timeout occurs between the inverter and the operator.		E26

Name	Description	Display
Overtime of reset input	This error is displayed when input time of the reset signal exceeds the setting time 5seconds	E27
IGBT protection	When an instantaneous over -current is detected, on the output the inverter output is switched off to protect the main devices. - output phase U	E28
	When an instantaneous over -current is detected, on the output the inverter output is switched off to protect the main devices. - output phase V	E29
	When an instantaneous over -current is detected, on the output the inverter output is switched off to protect the main devices. - output phase W	E30
Option error	These indicate the error of option PCB 1,2. You can refer to the details of option PCB's instruction manual	E31
Over speed error	This is displayed when the motor rotation speed exceeds.	E32

Table 14- 1 Protection function List

Note) When a trip occurs, please proceed with reset operation after that you first find the cause of the fault.

14.2   Trip monitor display

(1) The conditions at the time of an error provide important clues to help you understand the cause. The inverter displays a "status at trip point" digit to the right of the decimal point for the same error codes.

(2) For example, E07.2 means Error E07 occurred and the inverter status was condition 2(During deceleration) when the error occurred.
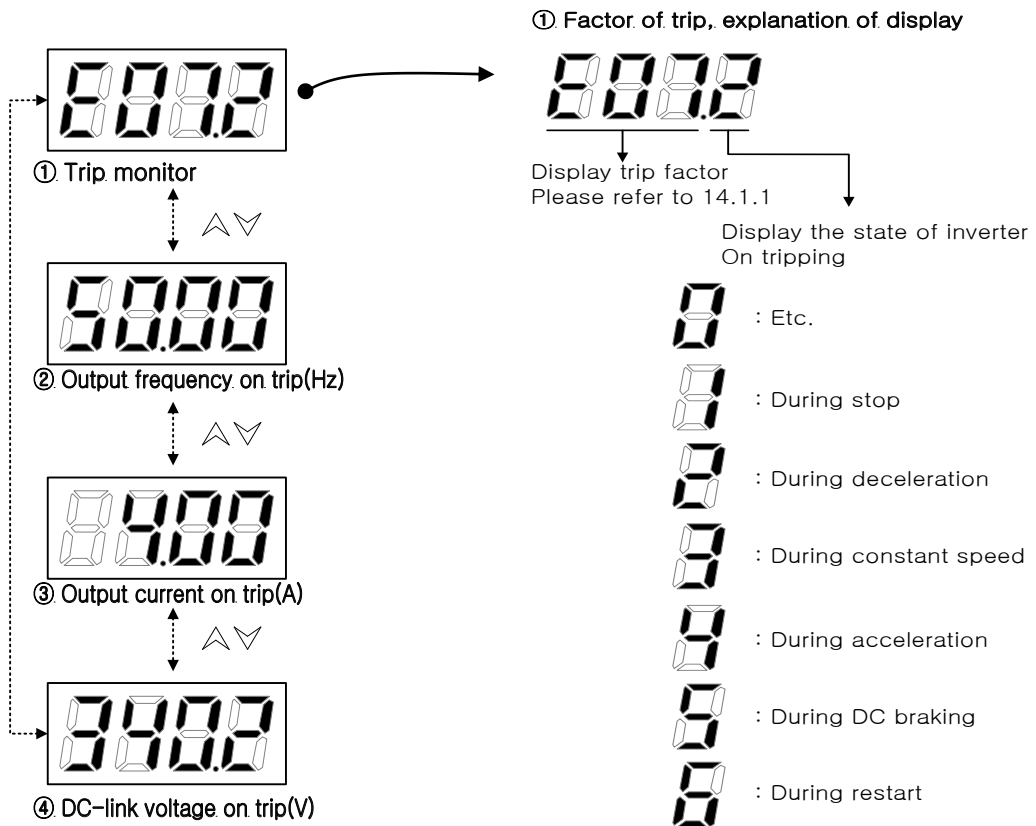
① Factor of trip, explanation of display

Display trip factor
Please refer to 14.1.1

Display the state of inverter
On tripping

0 : Etc.

1 : During stop

2 : During deceleration

3 : During constant speed

4 : During acceleration

5 : During DC braking

6 : During restart

① Trip monitor

② Output frequency on trip(Hz)

③ Output current on trip(A)

④ DC-link voltage on trip(V)

Fig. 14- 1 Trip monitor display

15. MAINTENANCE AND INSPECTION

15.1 Precautions for Maintenance/Inspection

15.1.1 Daily inspection

(1) Check out the followings daily before operation:
   ① Does the motor operate according to the settings?
   ② Is there any trouble with the surroundings of the installation?
   ③ Is there any trouble with the cooling or ventilation system?
   ④ Is there any abnormal vibration or sound?
   ⑤ Are their any signs of over-current or discoloration?
   ⑥ Is their any unusual odor present?

(2) Check the input voltage to the inverter by using a meter during running
   ① Is the supply voltage constant?
   ② Are all the phases of the supply balanced?

15.1.2 Cleaning

(1) Make sure that the inverter is not dirty when operating.

(2) If necessary, wipe clean with a soft cloth and synthetic detergent.
   (Note) Don't use solvents containing any of the following: acetone, benzene, toluene, alcohol etc. because they can cause melting of the inverter surface, peeling of paint.
   Never clean the display part of the digital operator with detergent on alcohol.

15.1.3 Regular inspection

Inspections should be regularly carried out on the parts that can't be inspected while the inverter is running.

(1) Is there any trouble with the cooling system? ---- Cleaning of air filter etc.

(2) Check that all screw terminals and fixings are tight as they may loosen due to vibration or temperature change etc.

(3) Is there any corrosion, damage to insulators?

(4) Measurement of the insulation resistance.

(5) Check of cooling fan, smoothing capacitor, relay and exchange if necessary.

⚠ **CAUTION**

- After a lapse of more than 10 minutes after turning off the input power supply, perform the maintenance and inspection. Otherwise, there is a danger of electric shock.
  After checking the charge lamp of a main frame is off, check again whether a DC voltage between terminal P, N is below 45V.

- Make sure that only qualified persons will perform maintenance, inspection and part replacement.
  (Before starting the work, remove metallic objects from your person wristwatch, bracelet, etc.)
  (Be sure to use tools protected with insulation)
  Otherwise, there is a danger of electric shock and/or injury.

15.2   Daily inspection and regular inspection

Inspection Parts	Inspection item	Inspection item	Daily	Year 1	Year 2	Inspection methods	Decision standard	Meter
Whole	Surroundings	Check temperature of surrounding, humidity, dust.	O			Refer to 2.1 Installing.	Temperature range is between -10℃ and 50℃. No dew present and humidity is below 90%	Thermometer hygrometer recorder
	Whole equipment	Is there abnormal vibration, abnormal sound?	O			By watching, hearing.	No trouble	
	Power voltage	Is main circuit voltage normal?	O			Measurement of inverter terminal R,S,T phase voltage	Within alternating voltage allowable change.	Tester,digital multi-meter
Main circuit	Whole	(1) Megger check Between circuit terminal and earth terminal (2) Are all screws terminals tight? (3) Is there any sign of over - voltage? (4) cleaning		O O O	O	(1) After you remove connector J61 from inside the inverter Take out the wiring of input/output of inverter main circuit terminal and control terminal, measure between parts shortened shortened terminal R, S, T, U, V, W, P, PD, N, RB and earth terminal with megger (2) Incremental clamping. (3) Watch	(1) To be over 5M ohm. (2) (3) No abnormality.	DC500V class megger
	Connection conductor/ electric line	(1) Is there warp in conductor? (2) Is there any damage of coating of wires?		O O		(1) (2) By watching	(1) (2) No abnormality	
	Terminals	Is there any damage?		O		By watching.	No abnormality.	
	Inverter parts converter parts	Resistance check between each terminal.			O	Take out connect of inverter, measure terminal between R, S, T and P, N between U, V, W and P, N with tester x 1 ohm range.	Refer to check method of 6.5 inverter, converter parts.	Analog form tester
	Smoothing capacitor	(1) Is there any liquid? (2) Does relief valve come out? Is there any swell? (3) Measure of allowable static-electricity.	O O		O	(1), (2) By watching. (3) Measure with capacity measure	(1), (2) No abnormality (3) Over 80% of rated capacity.	Capacity meter
	Relay	(1) Is there abnormal sound in operation? (2) Is there damage to the contacts?		O O		(1) By hearing (2) By watching	(1), (2) No abnormality	
	Resistor	(1) Is there any crack, discoloration of resistance insulator. (2) Confirm existance of breaking of wire.		O O		(1) By watching cementing resistance. Curl type resistance. Take out connection to other side, measure it with tester.	(1) No abnormality Error to be within 10% of Display resistance.	Tester Digital multimeter
Control circuit protection circuit	Operation check	(1) Confirm balance of each output phase voltage with inverter single operation. (2) Operate sequence		O O		(1) Measure inverter output terminal U, V, W phase voltage. (2) Short or open protection circuit output of inverter.	(1) Phase voltage balance 400V class is within 8V. (2) On sequence, to operate abnormality.	Digital multimeter rectification type voltmeter

Inspection Parts	Inspection item	Inspection item	Inspection cycle			Inspection methods	Decision standard	Meter
			Daily	Year				
				1	2			
		protection moving test. And no abnormality.						
Cooling system	Cooling fan	(1) Is there abnormal vibration, abnormal sound? (2) Is there loosening of connecting parts?	O	O		(1) Revolve by hands in the state of tone-on idle. (2) By watching.	(1) Revolving smooth. (2) No abnormality.	
Display	Display	(1) Is the LED lamp illuminated? (2) Cleaning.	O			(1) Lamp indicates lamp on operator. (2) Cleaning with cloth.	(1) Confirm light.	
	Meter	Is direction value Normal?	O	O		Confirm indication value of board meter.	Satisfy normal value, control value.	Voltage meter, current meter
Motor	Whole	(1) Is there abnormal signal, abnormal sound? (2) Is there any abnormal occur?	O O			(1) By hearing, feeling, watching. (2) Abnormal odor from overheat, damage etc. confirmation.	(1)(2) No abnormality.	
	Insulated resistance	(1) Megger check (terminal collection earth terminal)			O	(1) Remove connection to U,V and W and disconnect motor wiring.	(1) To be over 5M ohm.	DC 500V Megger

Table 15- 1 Daily inspection and regular inspection

(Note) Lifetime of the capacitors depends on the ambient temperature.

Please refer to chapter 15.4 [Capacitor Life Curve].

15.3   Withstand Voltage test

Never perform a withstand voltage test on the inverter.

The inverter main circuit uses semiconductors. Semiconductors can deteriorate when a withstand voltage test is performed.

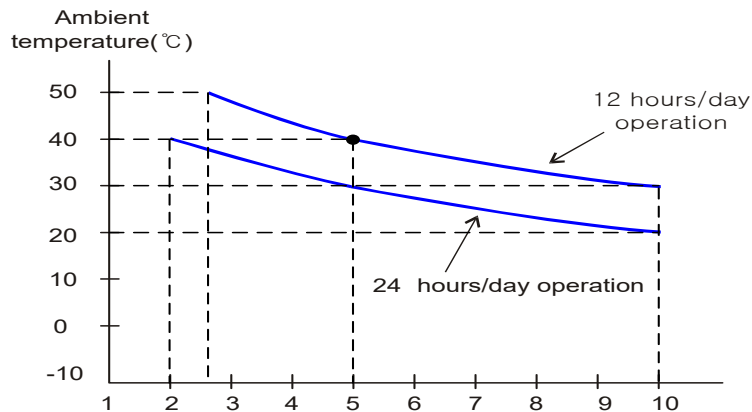## 15.4   Capacitor Life Curve

Fig. 15- 1 Capacitor Life Curve

(Note 1)   Ambient air temperature means the surrounding temperature of the inverter. In case the inverter is installed in a cabinet, ambient air temperature is the temperature of the internal air of the cabinet.

(Note 2)   DC bus capacitors are recommended to be replaced every 5 years. And if the inverter is used in a worse condition, this recommended replacing period is reduced.

15.5   Megger test

(1)   When executing a megger test on the inverter remover all wires to R, S, T, PD, N, RB, U, V and W.

(2)   Do not use a megger or buzzer on the control circuit only use a digital multi-meter. (Megger Voltage 500V DC)

(3)   Execute megger test is complete, reconnect the J61 connector has been removed.

(4)   Short terminals of R, S, T, PD, P, N, RB, U, V, and W.

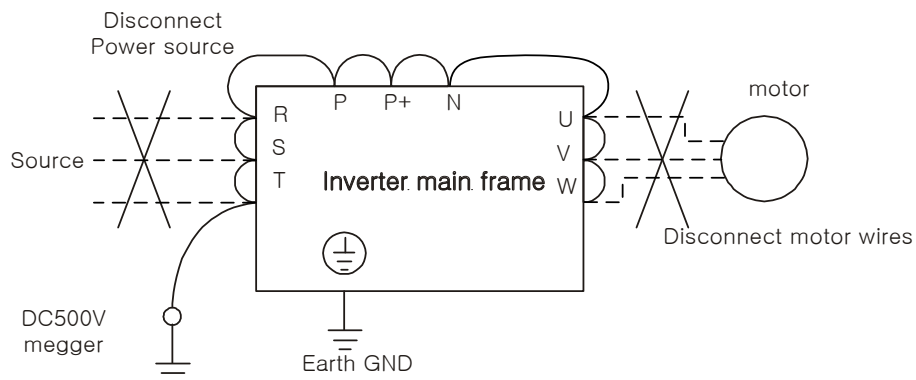(5)   After the megger test is complete, reconnect the J16 connector as before.

Fig. 15- 2 Megger test Method

15.6   The method to check Inverter, converter part

A test is possible to check for any issues with the module.

(1) Preparation
    ① [1] Remove the power lines (R, S and T connected to the inverter, the motor connection lines (U, V and W) and the regenerative control resistance(P and RB).
    ② [2] Prepare tester. (Using range of 1 ohm resistance measure range)

(2) How to check
    It is possible to check the quality of the charging state of the terminals R, S, T, U, V, W RB, P and N of the inverter and the pole of the resistor by measuring the charging state.

(Note 1)   Before you measure the voltage between P and N with DC current range, confirm that the smoothing capacitor is discharged fully, then execute checks.

(Note 2)   Almost infinite value is indicated on no conducting.
    With the effect of the smoothing capacitor, the inverter conducts instantly and an infinite value isn't indicated. Ohm-number 10 ohms is indicated on conducting.
    The values indicated will not be exactly the same for each terminal, however they will be very close together. If there is a significant difference a problem may exist.

|		Pole of tester		Measure value
		(+)Red	(−)Black	
Converter	D1	R	PD	Conduct
		PD	R	No−Conduct
	D2	S	PD	Conduct
		PD	S	No−Conduct
	D3	T	PD	Conduct
		PD	T	No−Conduct
	D4	R	N	No−Conduct
		N	R	Conduct
	D5	S	N	No−Conduct
		N	S	Conduct
	D6	T	N	No−Conduct
		N	T	Conduct
Inverer	TR1	U	P	Conduct
		P	U	No−Conduct
	TR2	V	P	Conduct
		P	V	No−Conduct
	TR3	W	P	Conduct
		P	W	No−Conduct
	TR4	U	N	No−Conduct
		N	U	Conduct
	TR5	V	N	No−Conduct
		N	V	Conduct
	TR6	W	N	No−Conduct
		N	W	Conduct
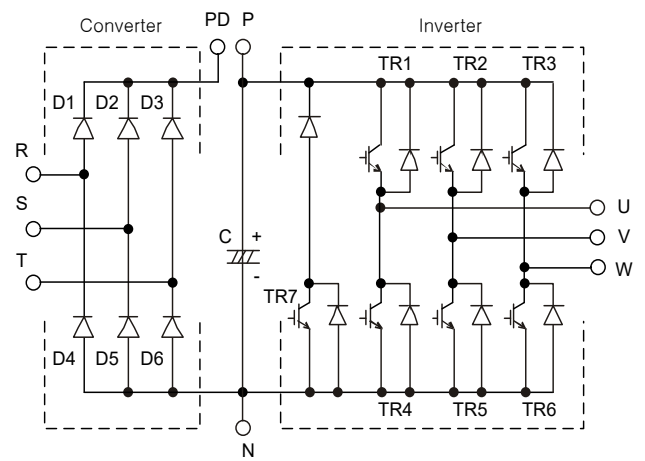
Fig. 15- 3 The method to check Inverter, converter part

16.   SPECIFICATION

16.1   Standard specification list

16.1.1   200V class

INVERTER MODEL		N700-055LF	N700-075LF	N700-110LF	N700-150LF	N700-185LF	N700-220LF	N700-300LF	N700-370LF	N700-450LF	N700-550LF
Max. Applicable Motor (4P, kW(hp))		5.5	7.5	11	15	18.5	22	30	37	45	55
Rated input alternating (kVA)	200V	8.3	11.0	15.9	22.1	26.3	32.9	41.9	50.2	63.0	76.2
	240V	9.9	13.3	19.1	26.6	31.5	39.4	50.2	60.2	75.8	91.4
Reted input alternating voltage		Three phase 200 ~ 240V (±10%) 50/60Hz									
Rated output voltage		Three phase 200 ~ 240V (This corresponds to input voltage.)									
Rated output current(A)		24	32	46	64	76	95	121	145	182	220
Stating	Regenerative control	BRD circuit built-in (The discharge resistance is optional.)						Regenerative control unit is optional.			
	Min. resistance to be connected(Ω)	17	17	17	8.7	6	6	3.5	3.5	2.4	2.4
Weight (kg)		7	7	7	15	15	15	25	37	37	51
Size (mm)		182 x 300 x 195			290 x 435 x 230			330 x 520 x 250	400 x 550 x 260		440 x 590 x 270

Table 16- 1 Standard specification list (200V class)

16.1.2   400V Class

INVERTER MODEL		N700-055HF	N700-075HF	N700-110HF	N700-150HF	N700-185HF	N700-220HF	N700-300HF	N700-370HF	N700-450HF	N700-550HF	N700-750HF	N700-900HF	N700-1100HF	N700-1320HF
Max. Applicable Motor (4P, kW(hp))		5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132
Rated input alternating (kVA)	400V	8.3	11.0	15.9	22.1	26.3	33.2	41.9	50.2	63.0	76.2	103.2	121.9	150.3	180.1
	480V	9.9	13.3	19.1	26.6	31.5	39.9	50.2	60.2	75.8	91.4	123.8	146.3	180.4	216.1
Reted input alternating voltage		3상 380 ~ 480V±10%, 50/60Hz													
Rated output voltage		3상 380 ~ 480V (This corresponds to input voltage.)													
정격출력전류(A)		12	16	23	32	38	48	58	75	90	110	149	179	217	260
Stating	Regenerative contro	BRD circuit built-in (The discharge resistance is optional.)						Regenerative control unit is optional							
	Min. resistance to be connected(Ω)	70	50	50	30	20	20	12	12	8	8	6	6	6	6
Weight (kg)		7	7	7	15	15	15	25	37	37	51	70	70	90	90
Size(mm)		182 x 300 x 195			290 x 435 x 230			330 x520 x250	400 x 550 x 260		440 x590 x270	420 x 660 x 320		500 x 700 x 320	

Table 16- 2 Standard specification list (400V class)

16.1.3   Common specification for 200V/400V class

Inverter Model			Common specification for all model
Control system			space vector modulation PWM system
Output frequency range			0.1～400Hz
Frequency accuracy			Digital command ±0.01% for Max. frequency, analog frequency ±0.2% (25±10℃)
Frequency resolving power			Digital setting : 0.01HZ, Analog setting : Max. frequency / 4,000
Voltage/frequency characteristic			V/f control (constant torque, reduced torque), free V/f control
Overload current rate			150%, 60sec
Acceleration/Deceleration			0.01～3600.0 sec (Director, curve setting)
DC Braking			On starting and decelerating by stop command, inverter operates under operation setting frequency. Or inverter operates with external input (Breaking power, time, frequency can be set.)
Input	Frequency	Operator	Setting by up/ down key
		Extend signal	Input voltage : DC0～+10V, -10～+10V (Input impedance 10KΩ), Input current : 4～20mA (Input impedance 100Ω)
	Run / Stop	Operator	Run / Stop key (Forward / Reverse function mode)
		Extend signal	Forward run / stop (1a connect, 1b selection possibility, 3wire input possibility)
		Extend port	Setting with RS485 communication
	Intelligent input terminal		FW and 8 terminal selection: REV(Reverse), CF1~CF4(Multi-speed bit 1~4), JG(jogging), DB(External dc braking), SET2(2nd control), 2CH(2nd acceleration), 3CH(3rd acceleration), FRS(free-run stop), EXT(external trip), USP(USP function), SFT(software lock), AT(analog input change), RESET(reset), STA(3 wire run), STP(3wire keep), F/R(3wire direction selection), PID(PID selection valid/invalid), PIDC(PID integrating reset), UP(remote control, up function), DOWN(remote control down function), UDC(remote control data clear), OPE(compulsion operation), TL(torque limit exist or no), TRQ1(torque limit change1), TRQ2(torque limit change2), BOK(brake confirmation), ORT(orientation), LAC(LAD cancel), PCLR(position deviation clear), STAT(90 degrees the phase difference permission), XT1, XT2, XT3 (Multi-step acceleration/deceleration time 1~3)
	Thermistor input terminal		1 terminal(PTC characteristic)

Inverter Model		Common specification for all model
Output	Intelligent output terminal	Open collect output 4 terminal, relay(c connect) 2terminal selection : RUN(Signal during run), FA1(Frequency arrival type 1 signal), FA2(Frequency arrival type 2 signal), OL(Overload advance notice signal), OD(Output deviation for PID control), ALM(Alarm signal), FA3(Arrival signal for only setting frequency), OTQ(Over torque), IP(Instantaneous stop signal), UV(Under voltage signal), TRQ(Torque limit), RNT(RUN time over), ONT(ON time over), THM(Thermal caution), BRK(Brake opening), BER(Brake error), ZS(Zero speed detect signal), DSE(Speed deviation excessive), POK(Positioning completion), FA4(Arrival signal for over setting frequency2), FA5(Arrival signal for only setting frequency2), OL2(Overload advance notice signal2), IPALM(Instantaneous power failure alarm signal), UVALM(Under voltage alarm signal)
	Intelligent monitor output terminal	Analog voltage output, analog current output, pulse line output
Display monitor		Output frequency, output current, frequency conversion value, trip history, input output terminal state, input electric power, output voltage, motor torque
Main function		V/F free setting(7points), Upper/lower frequency limiter, Frequency jump, curve adjustable speed, manual torque boost level/Braking point, Analog meter adjustment, Starting frequency, Carrier frequency adjustment, Electronic thermal, Free setting, External start/end (frequency / rate), Analog input selection, Trip retry, Reduced voltage start, Overload restriction, Restarting after an instantaneous power failure, Various kinds signal output, Initialization value setting, Automatic deceleration at the time of the power supply block, AVR function, Auto turning(Online/Offline)
Protection function		Over-current, over-voltage, under-voltage, electronic thermal level, Temperature option error, abnormal trouble, ground fault current on starting, instantaneous stop, USP error, input open-phase error, output open-phase error, control resistor over load, external trip, communication error. EEPROM error
Standard application		Lower voltage provision (Low voltage directive 72/73/EEC), EMC provision (EMC Directive 2004/108/EC), CE, UL, cUL
Usage surrounding	Frequency temperature / Preservation temperature / Humidity	-10 ~ 50℃ / -20 ~ 65℃ / 20 ~ 90% RH(installed with no dew condensation)
	Vibration	5.9m/s²(0.6G), 10 ~ 55Hz(5.5~22㎾) 　2.94m/s²(0.3G), 10 ~ 55Hz(30~132㎾)
	Using place	Under 1000m above sea level, indoors (Installed away from corrosive gasses dust)
Paint color		DIC-582(upper case), DIC-P819(lower case)
Other option	Internal option	Feedback unit, Profibus unit
	Exterior option	Operator with copy function, cable for operator, braking resistor, regenerative control unit, alternating reactor, D.C. reactor, EMC Mains filter, higher harmonic control unit, LCR filter, applied control installation
Operator		OPE-N7 (4line LED)

Table 16- 3 Common specification for 200V/400V class

16.2   Dimension

(1)   Model N700-055LF/055HF, N700-075LF/075HF, N700-110LF/110HF

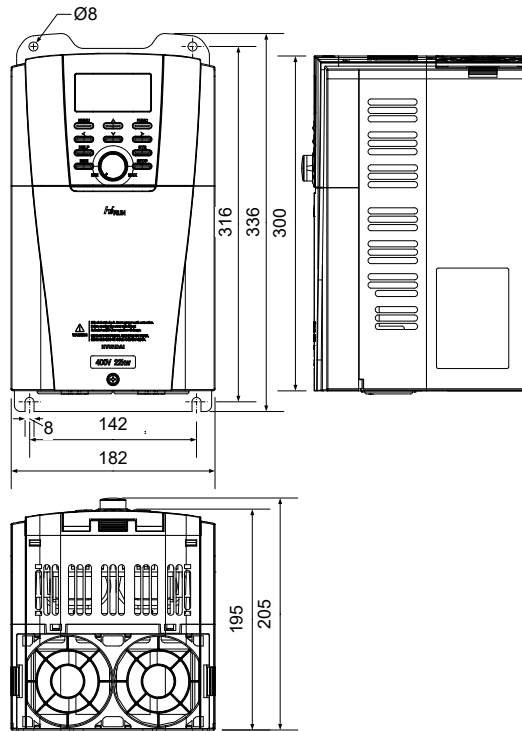**Fig. 16- 1 Dimension of model N700-055LF/055HF, N700-075LF/075HF, N700-110LF/110HF**

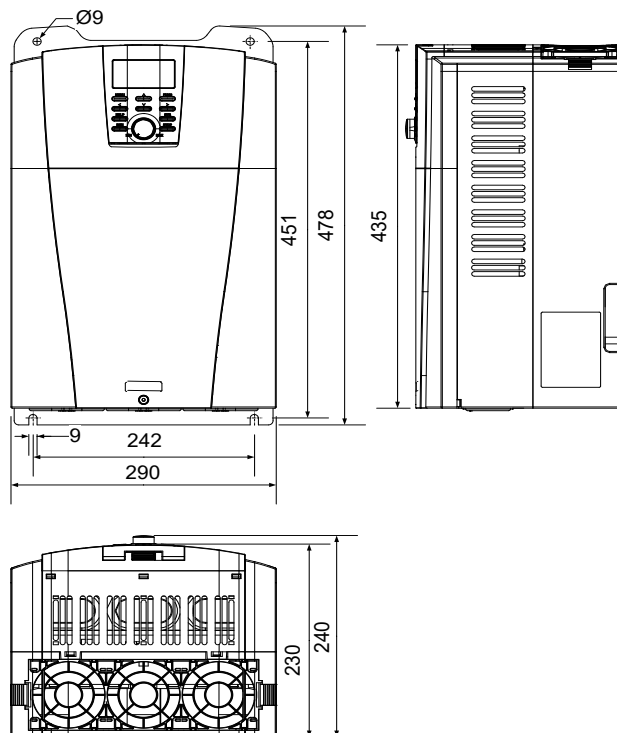(2)   Model N700-150LF/150HF, N700-185LF/185HF, N700-220LF/220HF

Fig. 16- 2 Dimension of model N700-150LF/150HF, N700-185LF/185HF, N700-220LF/220HF
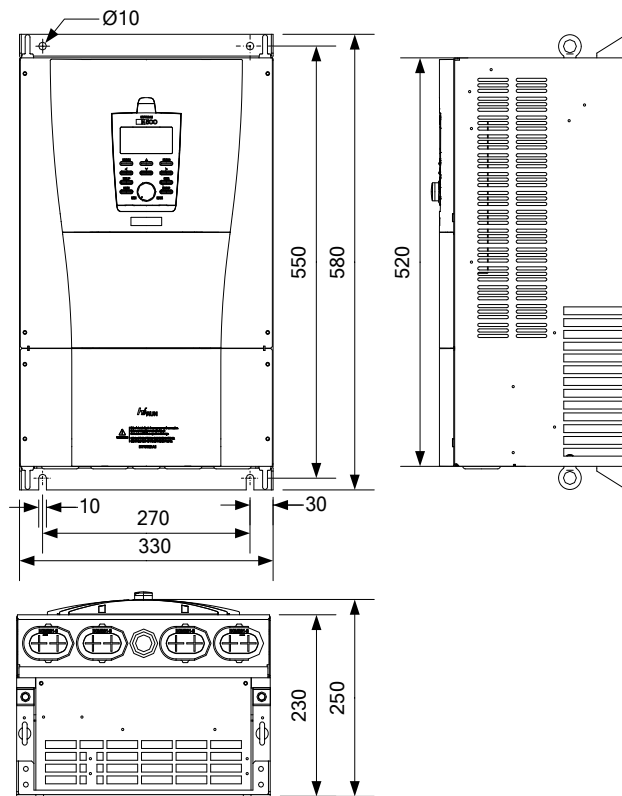
(3) Model N700-300LF/300HF

Fig. 16- 3 Dimension of model N700-300LF/300HF

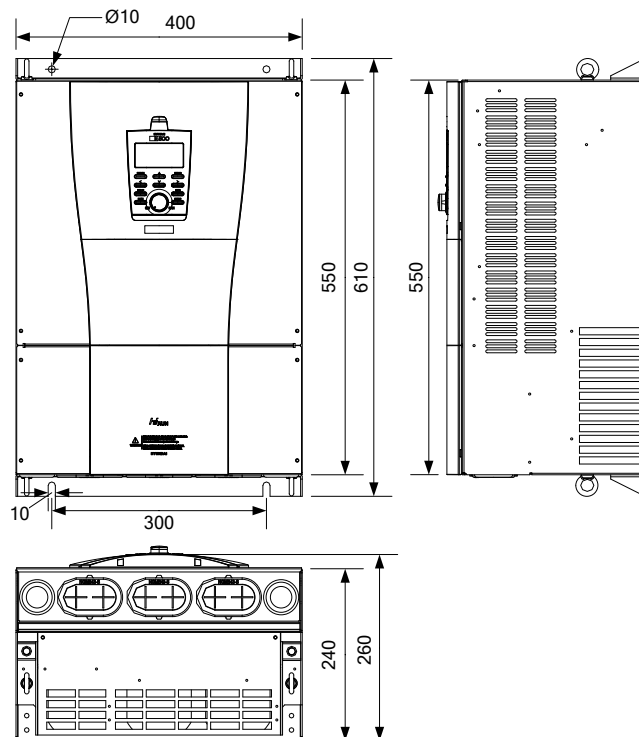(4) Model N700-370LF/370HF, N700-450LF/450HF

Fig. 16- 4 Dimension of model N700-370LF/370HF, N700-450LF/450HF
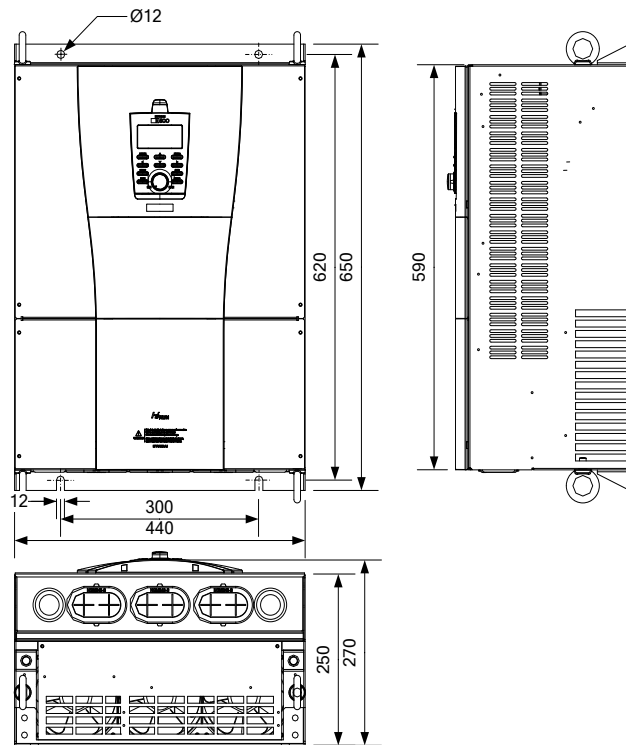
(5) Model N700-550LF/550HF

Fig. 16- 5 Dimension of model N700-550LF/550HF
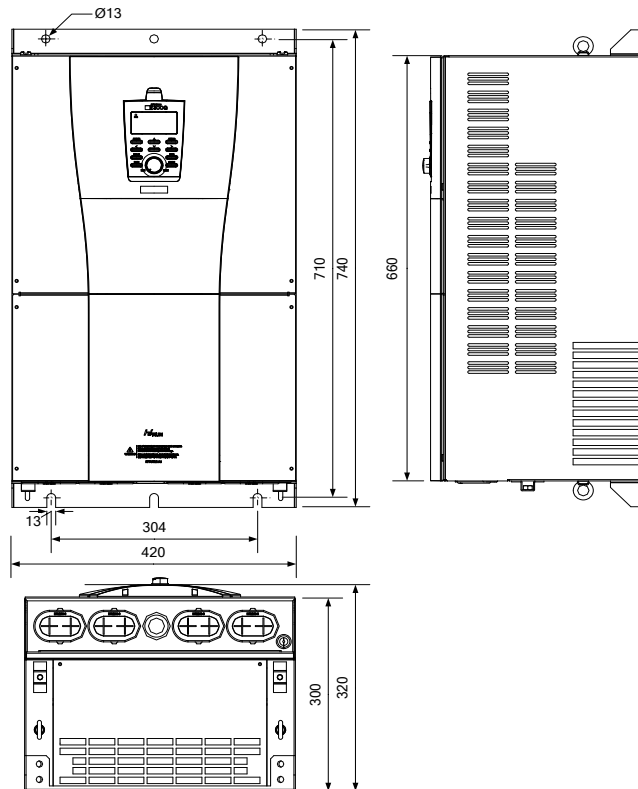
(6) Model N700-750HF, 900HF

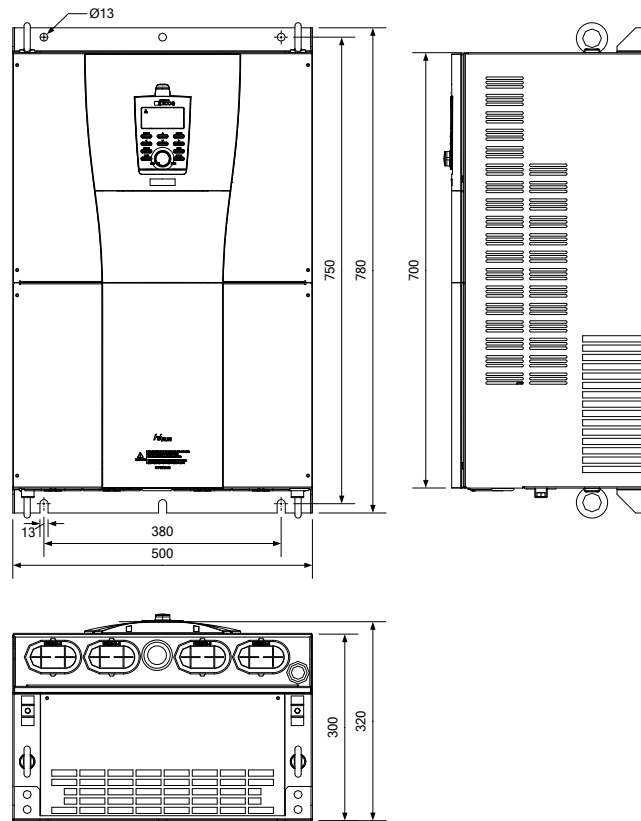**Fig. 16- 6 Dimension of model N700-750HF, 900HF**

(7) Model N700-1100HF, 1320HF

Fig. 16- 7 Dimension of model N700-1100HF, 1320HF

REVISION HISTORY FOR N700 OPERATING INSTRUCTIONS AND PARTS MANUAL

No.	Revision contents	Date of issue	Version No.
1	Initial release of manual.	JAN. 2008	Ver. M1.0E
2	Manual contents modification	Feb. 2008	Ver. M1.1E
3	Revision	Apr. 2013	Ver. M1.2E
4	2nd revision	Nov. 2013	Ver. M1.3E