www.convo.com.cn

R912004814 Rev04

Bosch Rexroth (Xi'an) Electric Drives and Controls Co., Ltd.

博世力士乐（西安）电子传动与控制有限公司

CONVO

博世力士乐旗下品牌

Frequency Converter G5
Operating Instructions

Record of Revision

Edition	Release Date	Notes
DOK-VCON02-G5*********-IT05-EN-P	2013-06	The fifth revision

Copyright

Liability

The specified data is intended for product description purposes only and shall not be deemed to be a guaranteed characteristic unless expressly stipulated in the contract. All rights are reserved with respect to the content of this documentation and the availability of the product.

Preface

Thanks for using the Convo Frequency Converters FSCG05 (G5/P5).

This operating instructions provides instructions on frequency converters of the following two series:

- FSCG05_G Type: Frequency converters for general applications
- FSCG05_P Type: Special frequency converters for fans or pumps

For any question or special demand on use of frequency converters, please feel free to contact your Convo dealers or our service.

The content of this operating instructions is subject to change without notice.

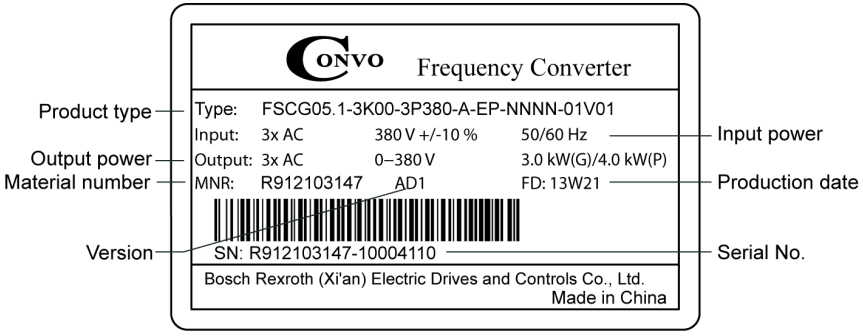
Other series of frequency converters are also available for you:

- FSCZ01 Injection integrated cabinet
- FSCZ02 Special frequency converter for injection molding machine
- FSCS01 Single-phase low-power frequency converter
- FSCM03 Single-phase, low-power Mini frequency converter

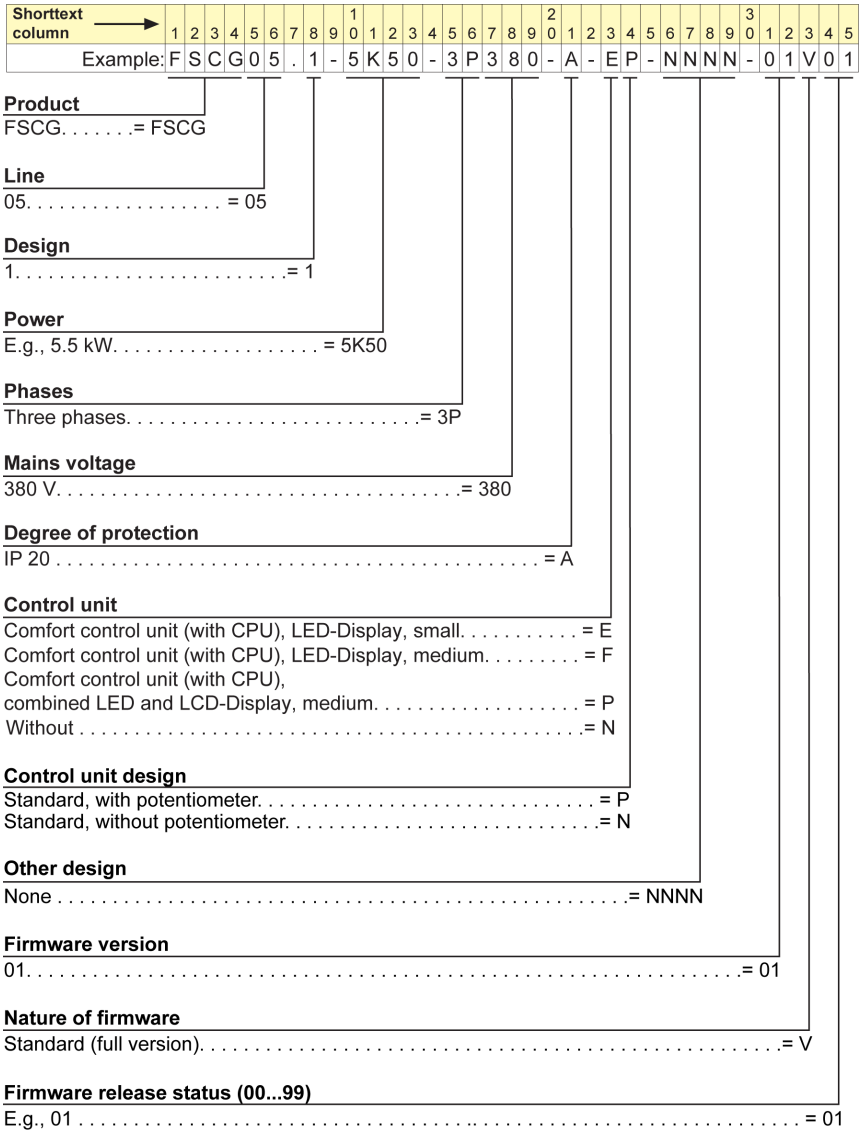
Before unpacking, please be sure to check:

1. If the product has any deformation, loose parts or damages.
2. If rated parameters listed on the nameplate are consistent with your order.

   In case any of the above problems, please contact service or Convo dealers immediately.



Frequency converter nameplate



Frequency converter model

Table of Contents

Page

Page

Page

Page

1 Safety Instructions for Electric Drives and Controls

1.1 General Information

1.1.1 Using the Safety Instructions and Passing them on to Others

Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Convo sales representative. If the device is resold, rented and/or passed on to others in any other form, then these safety instructions (official language version of the user) must be delivered with the device.

⚠ WARNING **Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!**

Read these instructions before the initial start-up of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times. Bosch Rexroth is not liable for damages resulting from failure to observe the warnings provided in this documentation.

- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this device.
- Only assign trained and qualified persons to work with electrical installations.
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.

- Only use safety-relevant applications that are clearly and explicitly approved in the Operating Instructions. If this is not the case, they are excluded.
- Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
- The machine and installation manufacturer must
  - make sure that the delivered components are suited for each individual application and check the information given in this document with regard to the use of the components.
  - make sure that this application complies with the applicable safety regulations and standards and carry out required measures, modifications and complements.
  - be responsible for compliance with the limiting values as prescribed in national standards.
- Start-up of the delivered components is only permitted after the machine or installation in which they are installed complies with the national standards, safety instructions and application standards.
- Operation is only permitted if the national EMC standards for the application are met.

Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

1.1.2 Explanation of Safety Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

Safety symbols	Degree of hazard seriousness
⚠ DANGER	Death or severe bodily harm will occur.
⚠ WARNING	Death or severe bodily harm may occur.
⚠ CAUTION	Minor or moderate injury or property damage may occur.

Tab. 1-1: Safety symbols and degree of hazard

1.2 Hazards by Improper Use

⚠ DANGER	High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!
⚠ DANGER	Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!
⚠ WARNING	High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!
⚠ WARNING	Health hazard to persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!
⚠ CAUTION	Hot surfaces on device housing! Danger of injury! Danger of burns!
⚠ CAUTION	Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting, or improper handling of pressurized lines!

1.3 Instructions with Regard to Specific Dangers

Protection Against Contact with Electrical Parts

This section only concerns devices and drive components with voltages of more than 50 V. Contact with parts conducting voltages above 50 V can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.

⚠ DANGER **High electrical voltage! Danger to life, electric shock and severe bodily injury!**

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on electrical power installations.
- Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit.
- With electrical drive and filter components, observe the following:
  - Wait for 30 minutes after switching off power to allow capacitors to discharge before beginning to work.
  - Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an over current protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing. For example: a control cabinet.

☞ Always observe the above requirements, in accordance with relevant international standards.

As regard to electrical drive and filter components higher than 50 V, observe the following:

⚠ DANGER **High housing voltage and large leakage current!**
Risk of death or bodily injury by electric shock!

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the units must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 mm^2 for this equipment grounding connection!
- Before start-up, also in trial runs, always attach the equipment grounding conductor or connect with the ground wire. Otherwise, high voltages may occur at the housing causing electric shock.

1.4 Protection Against Electric Shock by Protective Low Voltage (PELV)

⚠ WARNING **High electric voltage by incorrect connection!**
Risk of death or bodily injury by electric shock!

- To all connections and terminals with voltages between 0 and 50 Volt, only devices, electrical components, and conductors may be connected which are equipped with a PELV (Protective Extra-Low Voltage) system.
- Connect only voltages and circuits which are safely isolated from dangerous voltages. Safe isolation is achieved for example by isolating transformers, safe optocouplers or battery operation without mains connection.

1.5 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- Improper or wrong wiring of cable connections
- Incorrect operation of the equipment components

- Wrong input of parameters before operation
- Malfunction of sensors, encoders and monitoring devices
- Defective components
- Software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

⚠ DANGER **Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!**

- For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage:

- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - Use safety fences
  - Use of safety guard (cover)
  - Use of protective coverings
  - Install light curtains or light barrier
- Fences and coverings must be strong enough to resist maximum possible momentum.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before start-up. Don't operate the device if the emergency stop is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

- Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  - Maintenance and repair work
  - Cleaning of equipment
  - Long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial start-up. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

1.6 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

⚠ WARNING **Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!**

- Persons with heart pacemakers and metal implants are not permitted to enter the following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The interference immunity of present or future implanted heart pacemakers differs greatly, so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

1.7 Protection Against Contact with Hot Parts

⚠ CAUTION **Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!**

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to operating conditions, temperatures can be higher than 60 °C, 140 °F during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require up to 140 minutes! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- After switching drive controllers or chokes off, wait for 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

1.8 Protection During Handling and Mounting

In unfavorable conditions, handling and assembling certain parts and components in an improper way can cause injuries.

⚠ CAUTION **Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting, or improper handling of pressurized lines!**

- Observe the general construction and safety regulations on handling and assembly.
- Use suitable devices for assembly and transport.
- Avoid jamming and bruising by appropriate measures.
- Always use suitable tools. Use specific tools in different circumstances.
- Use lifting equipment and tools in the correct manner.

- If necessary, use suitable protective devices (for example safety goggles, safety shoes, safety gloves).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids because of the danger of skidding.

1.9 Instructions on Using the Device

- FSCG05 frequency converter is of voltage source type which outputs PWM wave voltage, including certain high harmonic. High temperature and vibration of motor may occur during operation, which is more severe than power frequency running.
- When the ordinary motor works with constant torque under low-speed for a long time, the motor insulation may be worse and lifetime reduced due to the bad effect of heat dissipation, so frequency motor or derating is recommended.
- When the output frequency of frequency converter with motor exceeds 50 Hz, there may be increased vibration and noise, please ensure mechanical devices like motor bearing is within allowed speed range.
- When the frequency converter works under low-speed for a long time, it may be damaged due to that the lubrication for mechanical devices like gearbox gets worse, so please check it in advance.
- There may be mechanical resonance points when frequency converter is within certain output frequency ranges, skip frequencies can be set to avoid this.
- When the wiring between frequency converter and motor is longer than 30 m, there will be a high dv/dt within the motor coil which will cause bad insulation for motor, so please apply an AC output choke in the output side.
- Please control RUN and STOP via external terminals or control panel. Never directly use switches like contactor in the input side of the frequency converter!
- When use the motor for the first time or after a long-time storage, please check its insulation with 500 V voltage megohm meter and ensure the insulating resistor is not less than 5 MΩ, as shown below:

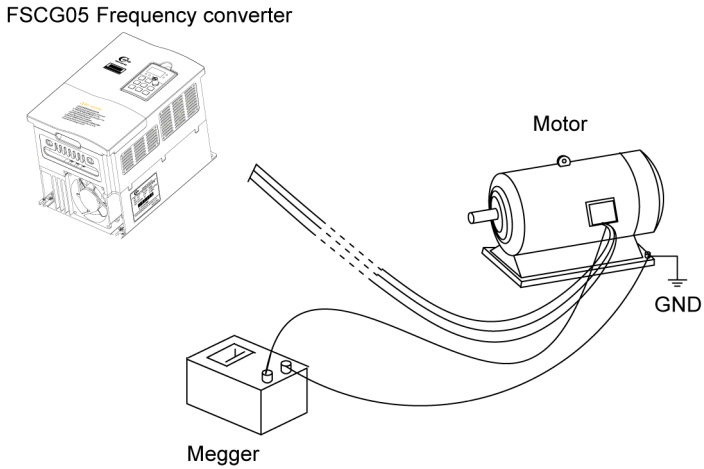


Fig. 1-1: Motor insulation check

- When interphase/grounding short circuit (such as line-touching short-circuit caused by wearing, corrosive, breaking of motor line) or imbalance in the three phases (such as damaged motor insulation, partial short-circuit of coil) occurred to the load, the frequency converter may be badly damaged, please check the motor and wiring regularly. Applying an AC output choke in the output side of the frequency converter may reduce the damage caused by load short-circuit.
- Overcurrent, overvoltage and short-circuit protection is designed only to reduce damages to the frequency converter to it's minimum, so in case faults occurred (such as overcurrent, overvoltage and short-circuit), please firstly check and resolve these faults, and then reuse the frequency converter.
- Only frequency converters with certain power are designed with short-circuit protection, please see chapter 3.13 "Protection for each Power Range" on page 49 for details.
- Only plug the keypad after power off, otherwise the keypad and frequency converter may be damaged.
- The output U, V, W voltage is of PWM wave, so DO NOT mount capacitor or voltage dependent resistor in the output side, as shown below:

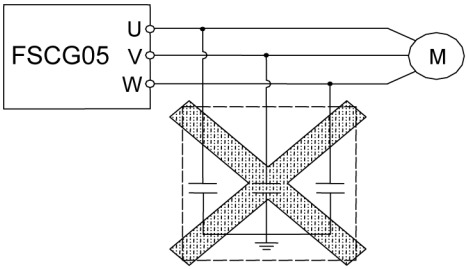


Fig. 1-2: Capacitor prohibited in the output side

- When switches such as contactor is needed to install between the frequency converter and motor, please ensure there is no output from frequency converter and then switch on/off, otherwise the frequency converter may be damaged.
- Try not to use the frequency converter beyond working voltage ranges, if needed, please use appropriate devices to increase or reduce the voltage.
- In areas with altitude above 1000 m, please derate since the heat dissipation of the frequency converter is poor due to the thin air. Derating relation between rated current output and altitude is shown as below:

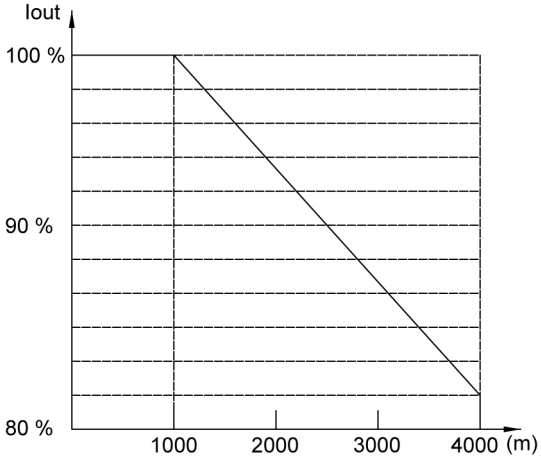


Fig. 1-3: Derating relation between rated current output and altitude

- Please derate when the input voltage is below 380 V. The calculation formula is as below:

  Derating rated power = input voltage/380 x nominal rated power

2 Important Directions for Use

2.1 Appropriate Use

Convo products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products can only be used in the appropriate way. Otherwise, situations resulting in property damage and personal injury may occur.

Convo as manufacturer is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Convo products, make sure that all the pre-requisites for appropriate use of the products are satisfied.

- Personnel that in any way or form use our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the products take the form of hardware, they must remain in their original state, in other words, no structural changes are permitted.
- It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

2.2 Inappropriate Use

Using the frequency converters outside of the operating conditions described in this manual and outside of the indicated technical data and specifications is defined as "**inappropriate use**".

Frequency converters shall not be used under following conditions:

- They are subject to operating conditions that do not meet the specified ambient conditions. These include, for example, operation under water, extreme temperature fluctuations or extremely high temperatures.
- Furthermore, the frequency converters shall not be used in applications which have not been expressly authorized by Rexroth. Please carefully follow the specifications outlined in the general Safety Instructions!

3 Mounting and Wiring

3.1 Technical Specification

Input		
Rated voltage and frequency		3-phase, 380 V, 50/60 Hz
Allowed voltage range		380 V±10 %, voltage unbalance rate<3 %; frequency±5 %
Output		
Voltage		0 to 380 V
Frequency		0 to 650 Hz
Overload capability		G type: 150 % of rated current for 60s, 180 % of rated current for 2s P type: 120 % of rated current for 60s, 150 % of rated current for 2s
Control functions		
Control mode		V/F control
Frequency resolution	Analog terminal input	Maximum output frequency x 0.1 %
	Digital setting	0.01 Hz
	Panel analog setting	Maximum frequency x 0.4 %
	External pulse	Maximum frequency x 0.1 %
Frequency accuracy	Analog setting	Maximum output frequency x (±0.2 %)
	Digital setting	±0.01 Hz
	External pulse setting	Maximum output frequency x (±0.1 %)
V/F curve (voltage frequency characteristics)		Basic frequency can be freely set between 5 Hz to 650 Hz, and 4 kinds of curves can be selected: constant torque, decrement torque 1, decrement torque 2 and multi-point V/F
Torque boost		Manual setting: 0 % to 20 % of rated output Auto boost: Automatically define torque boost as per output current
Automatic energy-saving running		Load-dependent adaptation of V/F characteristic curve
Acc/Dec time setting		0.1–6000 continuous setting, with S and linear modes available
Braking	Dynamic braking	Rated motor output torque x 75 %
	DC braking	Available for start and stop respectively, action frequency: 0–15 Hz, rated motor voltage x (0 %–15 %), time: 0–20.0s or acts continuously
Auto current limit		Auto current limit, to prevent frequent over-current during acceleration or under impact load
Stall voltage prevention		Prevent over-voltage during deceleration

Carrier frequency adjustment		1.0–15.0 kHz, continuously adjustable, to reduce motor noise to its minimum
Frequency setting signal	**Analog input**	DC voltage 0–10 V, -10–10 V, DC current 0–20 mA (upper and lower limits can be defined)
	Digital setting	Setting with operating panel
	Pulse input	0.1–50000 Hz (include upper and lower limit)
Start-up signal		Forward, reverse and start-up signal automatic holding (3-line control) available
Timer, counter		Embedded one timer and one counter for system integration
Multi-speed control /wobble frequency running		7 stages of programmable multi-speed control at most, direction and time of each can be set independently; in external terminal control, 15 stages are available with 6 running modes including wobble frequency running
Integrated PID control	**General PID**	Easy to realize simple closed-loop control system without additional PID controller
	Special for water supply (accessories needed)	At most 4-pump switch constant-pressure water supply system can be realized via accessories, including various functions like pressure upper/lower limit alarm, sleep/awake, timed water supply, etc.
Running		Upper/lower limit frequency setting, skip frequency setting, reverse run limit, slip frequency compensation, automatic voltage stabilization selection, RS485 communication, frequency increment/decrement control, fault auto-reset run, multi-converter coupled run
Output signal	**Running status (OC1/OC2/relay output)**	Frequency converter in running, frequency arrival, frequency level detection, overload alarm, stop by external fault, frequency upper limit arrival, frequency lower limit arrival, undervoltage stop, zero speed run, programmable multi-speed status, internal counter arrival, pressure upper/lower limit alarm, fault status output, auxiliary pump output, current upper/lower limit output, frequency converter in forward/reverse running
	Indication instrument	Output frequency, output current, output voltage, motor speed, PID set and feedback, external voltmeter, frequency meter
Display		
Operating panel display	**Running status**	Output frequency, output current, output voltage, motor speed, set frequency, PID setting, PID feedback, module temperature, running time accumulation, analog input/output, terminal input status, etc.
	Alarm message	6 latest fault records; 8 running parameter records at latest fault: output frequency, set frequency, output current, output voltage, DC voltage, module temperature, terminal status and total running time
Protection/alarm		
over-current, over-voltage, under-voltage, electronic thermal relay protection, over-heat, short-circuit, overload		
Environment		
Ambient temperature		-10 °C to +50 °C (without icing, derating between 40 °C to 50 °C)

Relative humidity	<90 % (without condensation)
Altitude	<1000 m
Allowed pollution degree	2 (EN 50178)
Construction	
Degree of protection	IP20
Cooling mode	Enforced air cooling
Installation	
Wall-mounting/Cabinet	

3.2 Model Description

Model (G/P)	G type (heavy load, general use)			P type (light load, fan, pump)		
	Rated apparent power (kVA)	Rated output current (A)	Adapted motor power (kW)	Rated apparent power (kVA)	Rated output current (A)	Adapted motor power (kW)
0K75	1.5	2.3	0.75	-	-	-
1K50	2.4	3.7	1.5	-	-	-
2K20	3.3	5.0	2.2	-	-	-
3K00	4.5	6.8	3.0	5.9	9.0	4.0
4K00	5.9	9.0	4.0	8.6	13	5.5
5K50	8.6	13	5.5	11	17	7.5
7K50	11	17	7.5	16.5	25	11
11K0	16.5	25	11	21.7	33	15
15K0	21.7	33	15	25.7	39	18.5
18K5	25.7	39	18.5	29.6	45	22
22K0	29.6	45	22	39.5	60	30
30K0	39.5	60	30	49.4	75	37
37K0	49.4	75	37	60	91	45
45K0	60	91	45	73.7	112	55
55K0	73.7	112	55	98.7	150	75
75K0	98.7	150	75	116	176	90
90K0	116	176	90	138	210	110
110K	138	210	110	167	253	132
132K	167	253	132	200	304	160
160K	200	304	160	230	349	185
185K	230	349	185	248	377	200
200K	248	377	200	273	415	220
220K	273	415	220	309	470	250
250K	309	470	250	336	510	280
280K	336	510	280	390	600	315
315K	390	600	315	435	660	350

3.3 Mounting Environment

- Please mount the frequency converter vertically with good ventilation.
- Please ensure the ambient temperature is between -10 ºC and 40 ºC. From 40 ºC to 50 ºC, please remove the frequency converter cover or open the front door of the cabinet to improve the efficiency of heat dissipation.
- Do not mount the frequency converter in locations with direct sunshine.
- Do not mount the frequency converter in locations with flammable, explosive or corrosive gas or liquid.
- Please ensure the environment is dust-free, without airborne fiber or metal particle.
- Please ensure the mounting surface is solid and stable, or the vibration is below 5.9 m/s^2 (0.6 g).
- Please mount the frequency converter far away from electromagnetic interference.

3.4 Mounting Dimensions

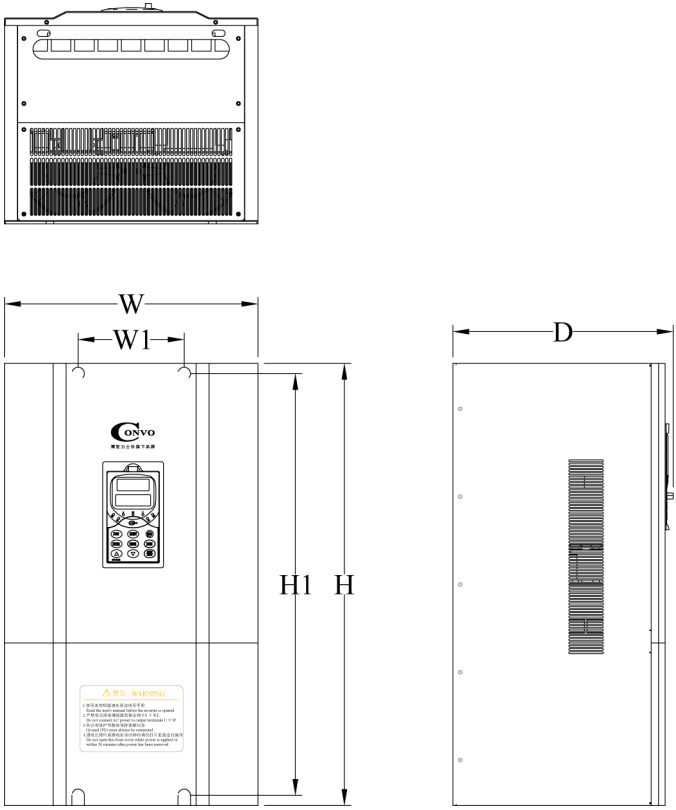


Fig. 3-1: Wall-mounted frequency converter

Model	W1 (mm)	W (mm)	H1 (mm)	H (mm)	D (mm)	Hole diameter (mm)	Net weight (kg)
0K75	108	120	158	170	140	Φ5	1.7
1K50							
2K20							
3K00	128	140	188	200	163	Φ5	2.6
4K00							
5K50							
7K50	165	180	240	255	183.5	Φ6	5.5
11K0							
15K0	150	245	373	388	245	Φ7	12.5
18K5							

Model	W1 (mm)	W (mm)	H1 (mm)	H (mm)	D (mm)	Hole diameter (mm)	Net weight (kg)
22K0	180	260	422	440	271	Φ9	18.5
30K0							
37K0	220	320	510	530	315	Φ10	30.0
45K0							
55K0	260	432	655	680	385	Φ12	65.0
75K0							
90K0	315*	489*	780*	810*	373*	Φ13*	86*
110K							
----	-	-	-	-	-	-	-

*: means the dimension may change in future, which applies to the table below too.

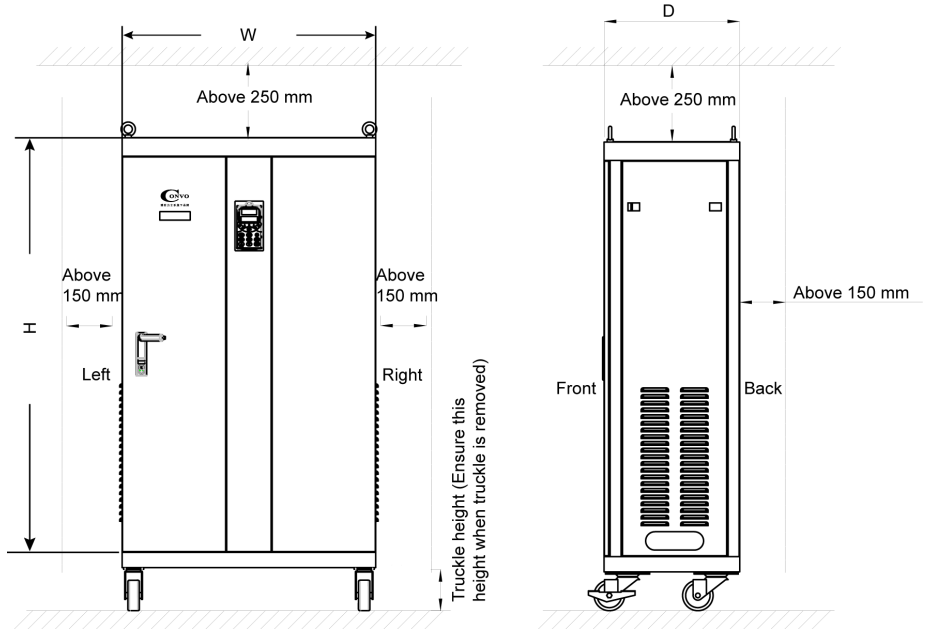


Fig. 3-2: Cabinet frequency converter

Model	W (mm)	H (mm)	D (mm)	Net weight (kg)
132K	575*	1200*	395*	-
160K				
185K	832*	1500*	445*	-
200K				
220K				
250K				
280K	850*	1750*	450*	-
315K				

3.5 Operating Panel Dimensions

3.5.1 LED Operating Panel (KP51S)

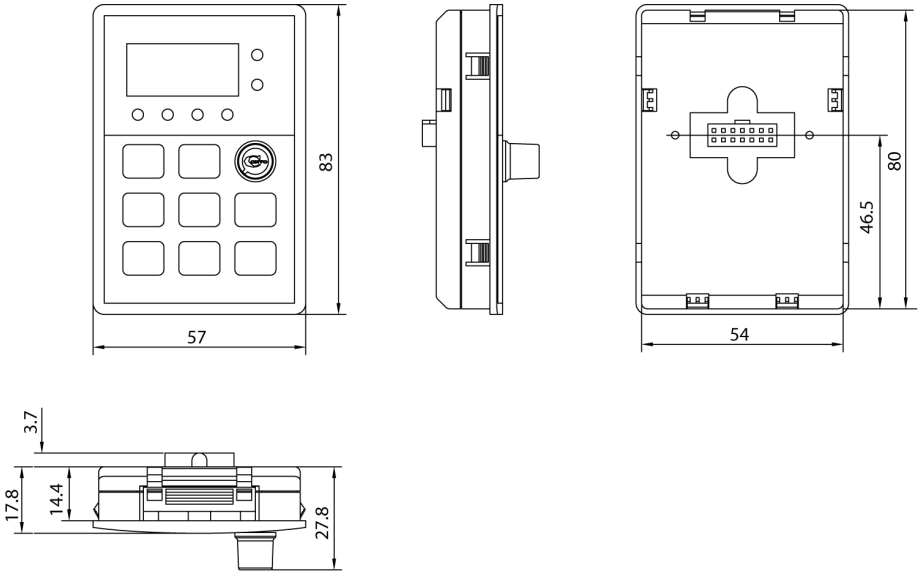


Fig. 3-3: Dimension of LED operating panel_0K75−11K0

3.5.2 LCD+LED Operating Panel (KP51B)

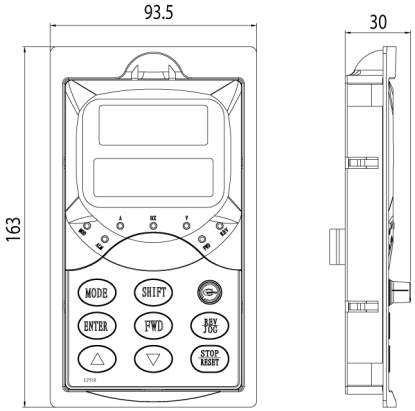


Fig. 3-4: Dimension of LCD+LED operating panel_15K0−315K

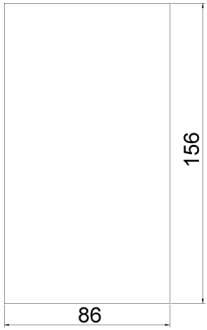


Fig. 3-5: Hole dimension of operating panel

Mounting dimension of LCD+LED operating panel: 86 mm × 156 mm

This kind of operating panel can be used to control the frequency converter, set parameters and monitor status. LED indicates the status of current parameter, LCD provides explanations on the parameter status.

3.6 Removing and Mounting the Cover

Removing

Remove the two screws at the bottom of the cover and shift it forth, then lift the cover up to about 15º, and pull it as indicated in the figure, the cover will be removed.

Mounting

Put the cover in parallel to the housing to make it exactly fix inside the two sides of the housing, then push forward to insert the "fixed hook" into the holding groove, and tighten the 2 screws at the bottom of the cover, thus the cover has been mounted successfully.

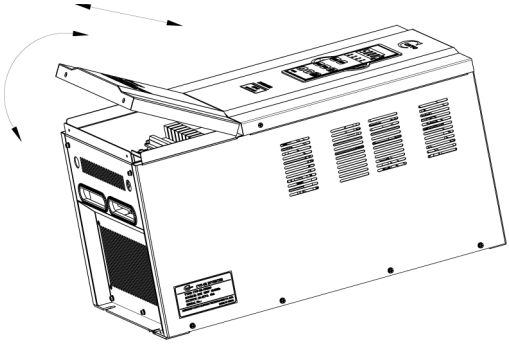


Fig. 3-6: Removing and mounting the cover

3.7 Removing and Mounting the Operating Panel (Model: KP51S, KP51B)

Removing

Press down the fixing hook on the top of the operating panel via the finger indication hole and pull outward, the panel will be removed.

Mounting

Place the operating panel aligned with the panel holder and horizontally press it down until you hear the buckle sound, thus the operating panel has been well mounted.

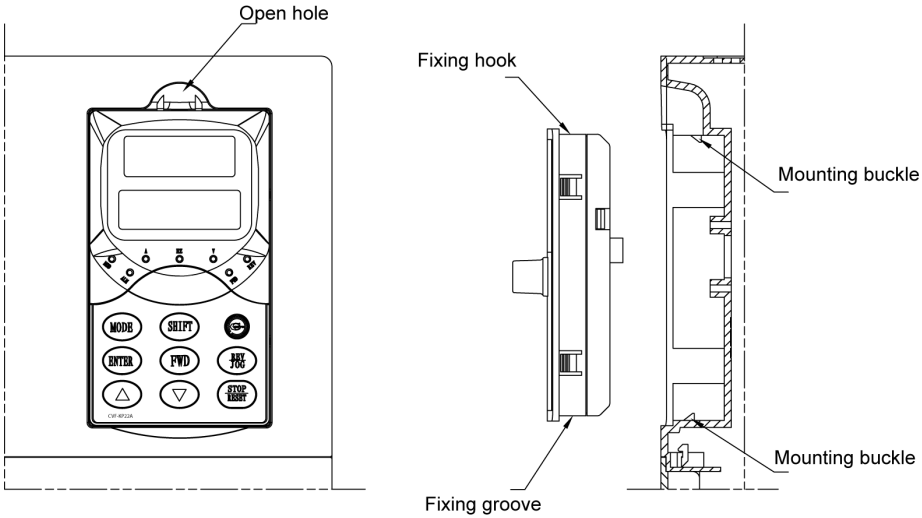


Fig. 3-7: Removing and mounting the operating panel

3.8 Mounting Direction and Space

This series of frequency converter is of wall-mounted type, please mount it vertically and leave enough space around to improve the effectiveness of ventilation and heat dissipation, as shown in the figure below:

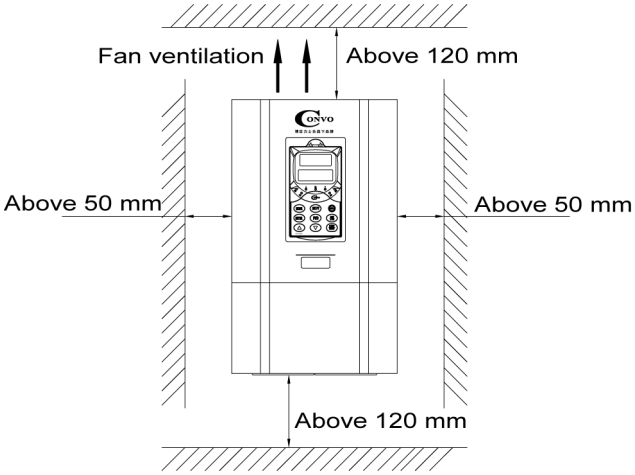


Fig. 3-8: Space around frequency converter mounting

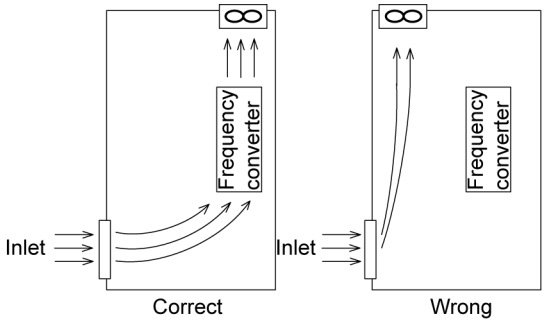


Fig. 3-9: Fan location for frequency converter mounting

Multi-wall-mounted frequency converters are installed as below:

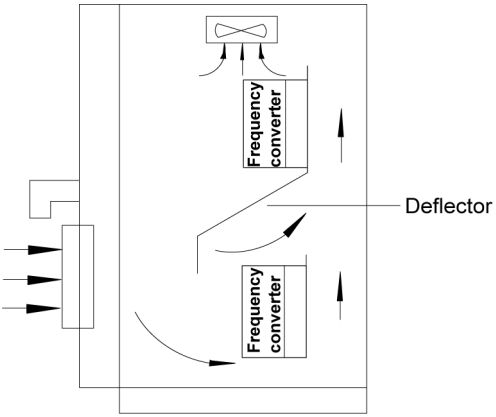


Fig. 3-10: Multi-wall-mounted frequency converters mounting 1

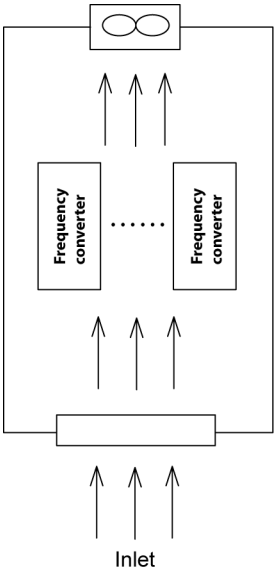


Fig. 3-11: Multi-wall-mounted frequency converters mounting 2

In vertical mounting, the air flow clapboard is required for cooling among frequency converters, as shown in fig. 3-10 "Multi-wall-mounted frequency converters mounting 1" on page 25.

For cabinet frequency converters mounting, please see fig. 3-11 "Multi-wall-mounted frequency converters mounting 2" on page 25.

3.9 Frequency Converter Wiring

3.9.1 Precautions

⚠ DANGER

- Before wiring, please ensure the voltage between P+ and P- is below DC 25 V.
- Do not connect the power supply cables to the frequency converter output terminals U, V, W.
- Ensure to install an intermediate circuit breaker between the frequency converter and power supply so that emergency measures could be taken immediately in case of frequency converter faults.
- Ensure the voltage degree for all lead wires and frequency converters must be consistent.
- All the lead wires must be well fastened with terminals; cables or copper wires should be used for the main circuit. For cables, the section area must be appropriate and they need to be securely welded before wiring.

⚠ WARNING

- Check and confirm the rated input voltage is consistent with AC supply voltage before operating the frequency converter.
- The frequency converter has been tested with high voltage, so please do not conduct the test again.
- Please connect the frequency converter to power supply via air switch or fuse switch.

☞ Please ground the frequency converter separately, instead of grounding together with load of welding machine or big-power motor, and the grounding lead wire should be as short as possible. The cable diameter shouldn't be less than the specifications in the table below. Separate terminals should be used for the frequency converter grounding (instead of using the screws at the bottom of the housing).

Motor power (kW)	Specification for grounding wire
	480 V
0.75–4.0	2 mm^2
5.5	4 mm^2
7.5–15	6 mm^2
18.5–22	10 mm^2
30–55	16 mm^2
75–90	35 mm^2

Motor power (kW)	Specification for grounding wire
	480 V
110–132	60 mm^2
160	75 mm^2
185	120 mm^2
200	120 mm^2
220–250	150 mm^2
280	185 mm^2
315	240 mm^2

3.9.2 Grounding Impedance

The grounding impedance is less than 10 Ω. When multiple frequency converters are grounded together, grounding loop is prohibited. Grounding examples are shown below:

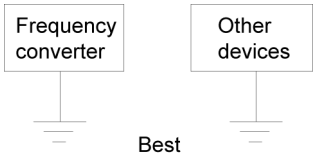


Fig. 3-12: Grounding for frequency converter and other device 1

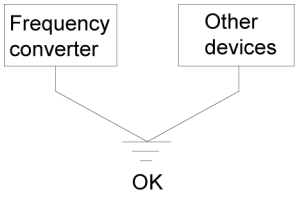


Fig. 3-13: Grounding for frequency converter and other device 2

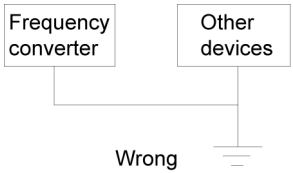


Fig. 3-14: Grounding for frequency converter and other device 3

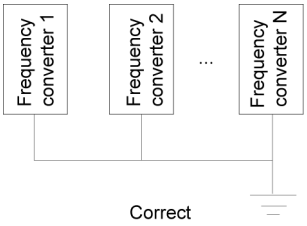


Fig. 3-15: Grounding among frequency converters 1

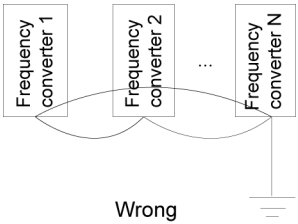


Fig. 3-16: Grounding among frequency converters 2

3.9.3 Interference

To reduce the electromagnetic interference (EMI), please connect surge absorber to the coils of electromagnetic contactors, relays, etc. Separate the control cables from main circuit power cables to avoid interference on coupling. For routing in parallel, please ensure the space of more than 20 cm; for routing in crossing, please make sure that they are arranged at an angle as near to 90 degrees as possible, as shown below:

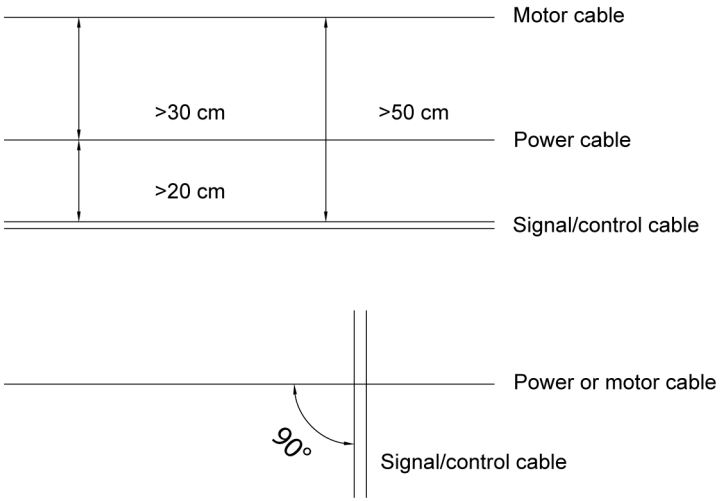


Fig. 3-17: System wiring

Generally, the control cables must be of shielded cables, and the shielding layer must be connected to the metal cabinet of the frequency converter via the clamps at two sides, as shown below:

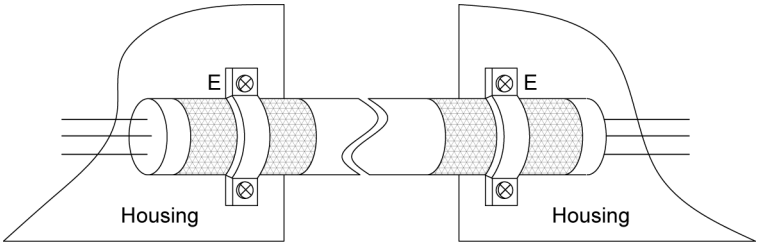


Fig. 3-18: Shielded grounding_correct

Do not ground as below:

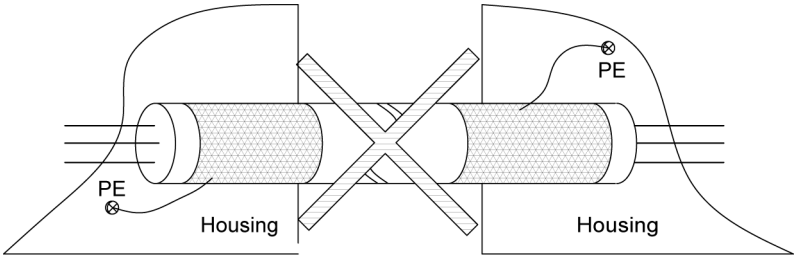


Fig. 3-19: Shielded grounding_wrong

The noise generated from the frequency converter transmits via cables to upstream devices in the same system and may cause their malfunction when the frequency converter and the external devices share the same power supply. In this case, a noise filter needs to be connected at the input side of the frequency converter. In addition, the external devices need to be isolated with an isolating transformer or an input filter.

When the devices with weak signal such as measuring instruments, radio devices, sensors, etc. as well as their signal lines are within the same cabinet as the frequency converter, and there is a close routing for them, there may be malfunctions due to the noise. To avoid malfunctions, signal lines may be placed in a metal pipe, which should be away from the frequency converter input and output cables as far as possible.

Please install a radio noise filter and a linear noise filter respectively in the input and output side of the frequency converter to suppress the noise emission from power cables.

When the signal lines and power cables are routed in parallel or in bundle, the electromagnetic inductive noise, static inductive noise and noise transmission in the cable lines may cause malfunctions of devices. These routing methods should be avoided. Signal lines easy to be affected should be routed far away from the input and output cables of the frequency converter. Please use shielded signal lines and power cables. To achieve better effect, please place the signal lines and power cables in separate metal pipes with minimum 20 cm distance.

3.9.4 Breaker Capacity and Conductor Cross Section

Motor power (kW)	Input switch	Main circuit (mm^2)		Control circuit (mm^2)
	Circuit-breaker QF (A)	Input cable	Output cable	Signal line
0.75	10	2.5	2.5	1
1.5	10	2.5	2.5	1
2.2	10	2.5	2.5	1
3.0	16	4	4	1
4.0	16	4	4	1
5.5	20	4	4	1
7.5	25	6	6	1
11	40	10	10	1
15	50	10	10	1
18.5	63	16	16	1
22	63	16	16	1
30	100	25	25	1
37	125	25	25	1
45	160	35	35	1
55	160	35	35	1
75	250	50	50	1
90	250	70	70	1
110	315	120	120	1
132	400	120	120	1
160	630	120	120	1
185	630	240	240	1
200	630	240	240	1
220	630	150*2	150*2	1
250	800	150*2	150*2	1
280	800	185*2	185*2	1
315	1000	185*2	185*2	1
350	1000	240*2	240*2	1

3.9.5 Standard Wiring Diagram

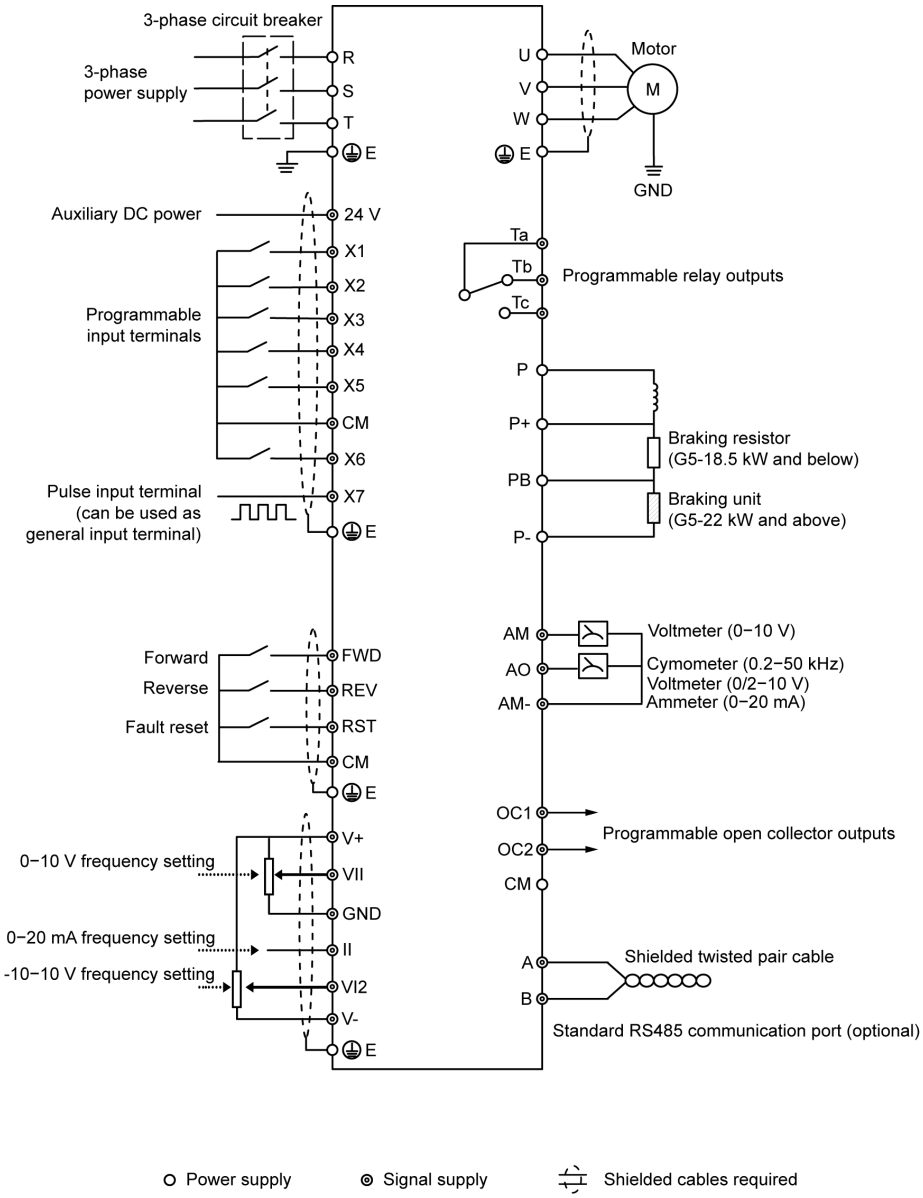


Fig. 3-20: Standard wiring diagram

3.9.6 Main Circuit Basic Wiring

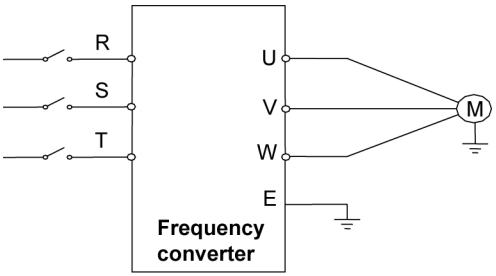


Fig. 3-21: Main circuit basic wiring

This wiring diagram can be used for basic running test.

3.9.7 System Wiring

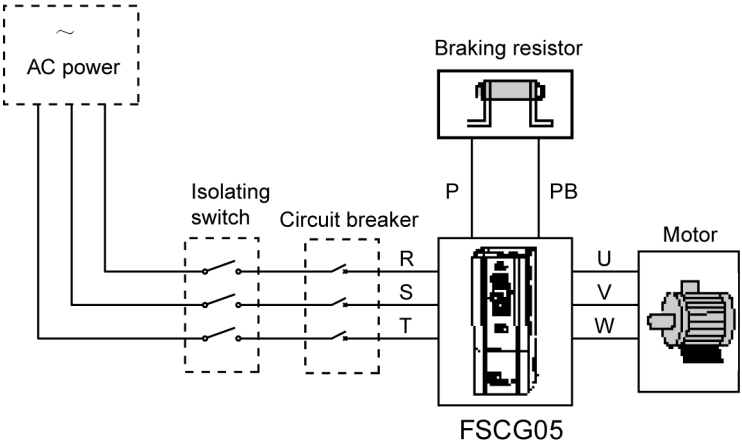


Fig. 3-22: Simple system wiring

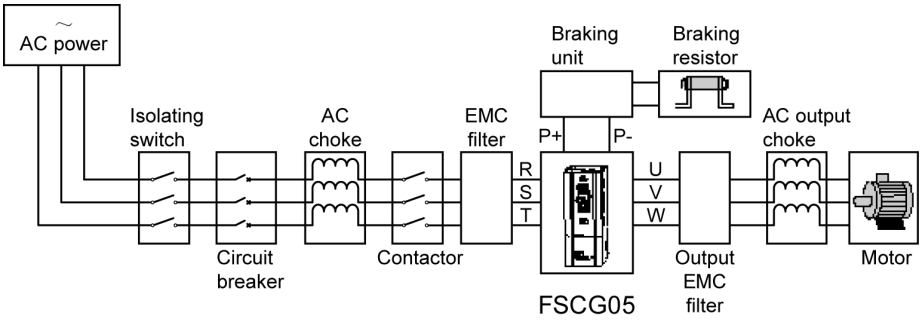


Fig. 3-23: Standard system wiring

- Please install isolating devices like the air switch between power supply and the frequency converter, which may protect the maintenance personnel from danger when faults like short-circuit or low mains voltage occur in the input side of the frequency converter.
- A circuit-breaker or a fuse must be installed in the input side of the frequency converter to prevent from influence caused by the faults of downstream devices.
- Please do not switch on/off the frequency converter with the contactor.
- An AC input choke can be additionally installed when the higher harmonics between power supply and the frequency converter cannot meet the requirement after the power supply wave is severely deformed or the DC choke has been installed for the frequency converter, or when the power factor in the input side of the frequency converter needs to be improved.
- An input EMC filter can be used to suppress the high-frequency noise interference generated from the frequency converter input cables.
- To protect the frequency converter and suppress higher harmonics, please install a DC choke in the following conditions:
  - When switch-type reactive power compensation capacitors or loads with thyristor phase control are installed in the same power supply of the frequency converter, the rectifier circuit of the frequency converter may be damaged by the supply voltage sudden change due to the transient reactive power change caused by the switching of the capacitors, or damaged by the harmonics and the grid gap caused by the phase control loads.
  - The rectifier circuit may be damaged by the current in the frequency input circuit when the input power factor needs to be increased to above 0.93, when the imbalance between the 3 phases of the power supply exceeds 3 % and when the large capacity transformer is connected to the frequency converter, A DC choke needs to be installed when the power supply capacity is higher than 550 kVA or higher than 10 times that of the frequency converter.
- An AC output choke for suppression of high-frequency oscillation is recommended when the cable from the frequency converter to motor is longer than 30 m, to prevent the damage to motor insulation and avoid frequent protection due to high current leakage .
- An output EMC filter can be optionally installed to suppress the noise interference and current leakage in the output side of the frequency converter.
- An AC output choke is recommended to prevent damages to the frequency converter caused by output short-circuit.

3.10 Wiring of Terminal Blocks

3.10.1 Wiring of Main Circuit Terminals

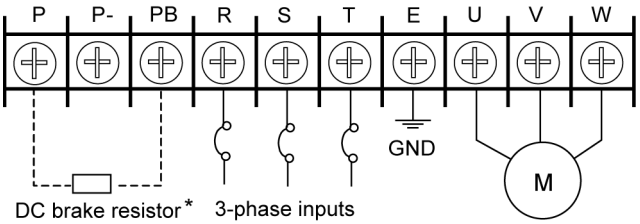


Fig. 3-24: Wiring of main circuit terminals I

Model	Terminal	Description
0K75-5K50	P	DC positive terminal
	P-	DC negative terminal
	PB	DC brake resistor can be connected between P and PB
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

*: The DC braking resistor has been integrated into G5 0.75-5.5 kW and P5 4-7.5 kW. If larger braking torque is needed, please select according to chapter 9.3 "Braking Components" on page 192 based on your actual applications carefully; if the braking resistor needed is not included in the table, please contact the manufacturer.

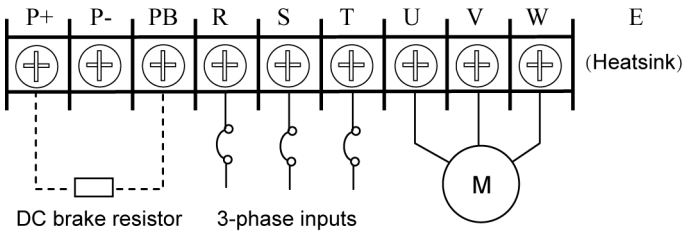


Fig. 3-25: Wiring of main circuit terminals II

Model	Terminal	Description
7K50-11K0	P+	DC positive terminal
	P-	DC negative terminal
	PB	DC brake resistor can be connected between P and PB
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

The grounding line of G5 7.5–11 kW and P5 11–15 kW is connected to the heatsink.

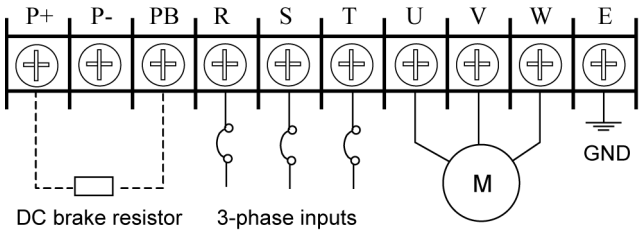


Fig. 3-26: Wiring of main circuit terminals III

Model	Terminal	Description
15K0-18K5	P+	DC positive terminal
	P-	DC negative terminal
	PB	DC brake resistor can be connected between P and PB
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

The DC braking resistor can be connected between P+ and PB when dynamic braking is needed for G5 15–18.5 kW and P5 18.5–22 kW.

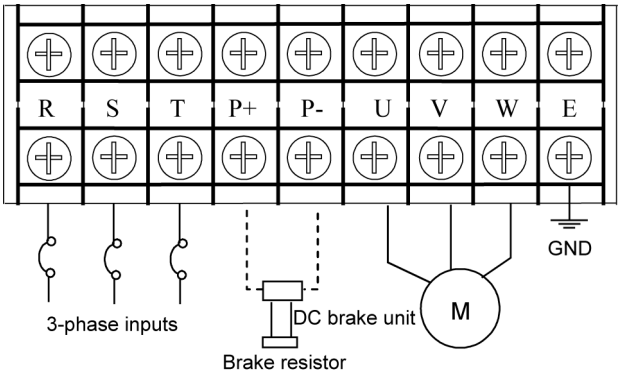


Fig. 3-27: Wiring of main circuit terminals IV

Model	Terminal	Description
22K0–45K0	P+	DC positive terminal
	P-	DC negative terminal
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

A DC brake unit with DC brake resistor can be connected between P + and PB when dynamic braking is needed for G5 22–45 kW and P5 30–55 kW.

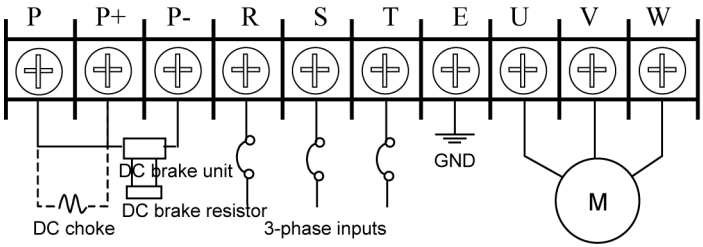


Fig. 3-28: Wiring of main circuit terminals V

Model	Terminal	Description
55K0-110K	P+	DC positive terminal
	P-	DC negative terminal
	P	DC brake resistor can be connected between P and P-
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

☞ G5 55–110 kW and P5 75–132 kW:

- The short-circuit copper bar between terminal P and P+ needs to be removed when the DC choke is installed externally.
- A DC brake unit a DC brake resistor can be connected between P + and P- when dynamic braking is needed.

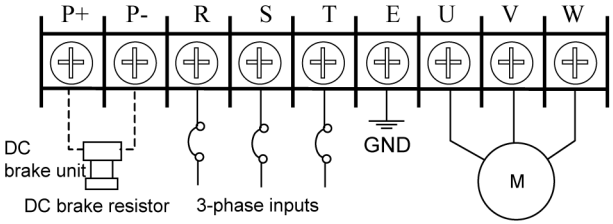


Fig. 3-29: Wiring of main circuit terminals VI

Model	Terminal	Description
132K-250K	P+	DC positive terminal
	P-	DC negative terminal
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

☞ A DC brake unit with DC brake resistor can be connected between P + and P- when dynamic braking is needed for G5 132–315 kW and P5 160–350 kW.

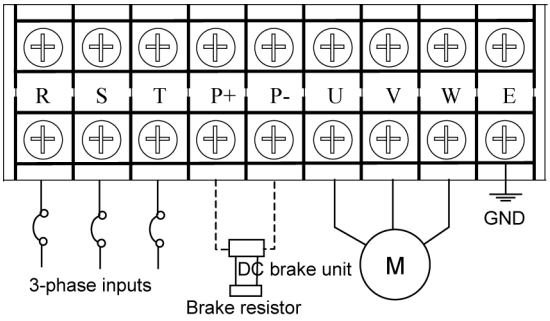


Fig. 3-30: Wiring of main circuit terminals VII

Model	Terminal	Description
280K-315K	P+	DC positive terminal
	P-	DC negative terminal
	R, S, T	Connect to 3-phase AC power
	U, V, W	Connect to 3-phase AC motor
	E	Grounding terminal

3.10.2 Terminals of Control Circuit

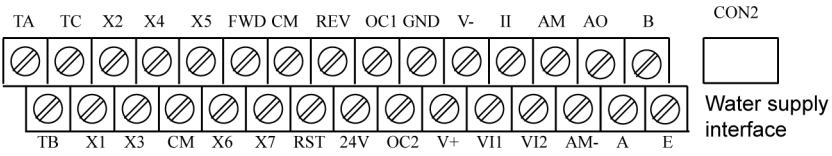


Fig. 3-31: Terminals of control circuit_0.75−11 kW

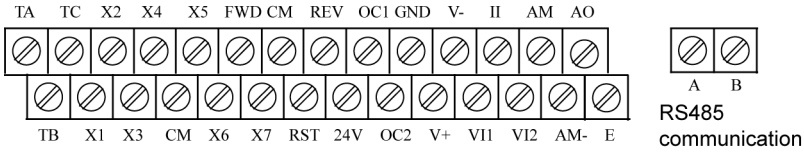


Fig. 3-32: Terminals of control circuit_15 kW and above

Descriptions on control circuit terminals

Type	Terminal	Description	Remark
Analog input	V+	Power supply of +5 V/10 mA or +10 V/10 mA	Select via JP1 on the control panel, see fig. 3-33 "JP position in the PCB_G5-11 kW and below" on page 43, fig. 3-34 "JP position in the PCB_above G5-11 kW" on page 43
	V-	Power supply of -15 V/15 mA	
	VI1	Frequency setting voltage signal input terminal 1	0−10 V
	VI2	Frequency setting voltage signal input terminal 2	-10−10 V
	II	Positive terminal (current input terminal) for frequency setting current signal	0−20 mA
	GND	Common terminal (V+, V-) for frequency setting voltage signal, negative terminal (current output terminal) for frequency setting current signal	

Type	Terminal	Description	Remark
Control terminal	X1	Multi-function input terminal 1	See parameters L-47 to L-53 for multi-function input terminals. Valid when connected with terminal CM.
	X2	Multi-function input terminal 2	
	X3	Multi-function input terminal 3	
	X4	Multi-function input terminal 4	
	X5	Multi-function input terminal 5	
	X6	Multi-function input terminal 6	
	X7	Multi-function input terminal 7, can be used as input terminal for external pulse signal	
	FWD	Forward control command terminal	Valid when connected with terminal CM
	REV	Reverse control command terminal	
	RST	Fault reset input terminal	
	CM	Control terminals common terminal	
	+24	Power supply of +24 V/50 mA (terminal CM is the grounding of this power supply)	
Analog output	AM	Programmable voltage signal output terminal, connected with voltmeter (set by parameter L-54)	
	AO	Frequency output: open collector, CM-GND	0–50 kHz
		Voltage/current output (AM-GND)	0–10 V or 0–20 mA
	AM-	Common terminal of AM, AO	Connect to analog ground internally
OC output	OC1	Programmable open collector output (terminal CM is the grounding of this power supply), set by parameters L-59 and L-60	Max. load current: 50 mA, max. withstand voltage: 24 V
	OC2		
Relay output	TA	TA-TB: N.C TA-TC: N.O	Contact transmitter capacity: 250 VAC, 1 A resistive load
	TB		
	TC		
RS485 communication	A	RS485 communication terminals	
	B		
E		Grounding terminal	

3.11 JP Description

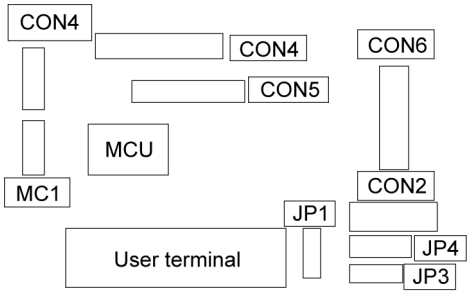


Fig. 3-33: JP position in the PCB_G5-11 kW and below

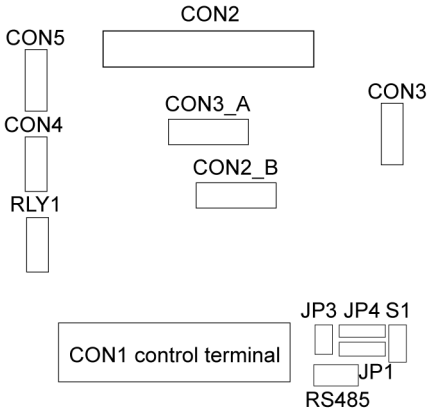


Fig. 3-34: JP position in the PCB_above G5-11 kW

- JP1 description:
  - Position 1-2: V+ provides power supply of 5 V/10 mA
  - Position 2-3: V+ provides power supply of 10 V/10 mA
- JP3, JP4 description:

  JP3 and JP4 are used to set AO outputs, see L-58 for details.
- S1 description:

  S1 is the terminator activation switch in the RS485 communication network. Please set switch S1 to ON when the communication is via the slave at the termination (end) of the network, and set it to OFF if via other slaves.

3.12 Wiring

- VI1 is the input terminal for analog inputs from 0 V to +10 V, the wiring is shown as below:

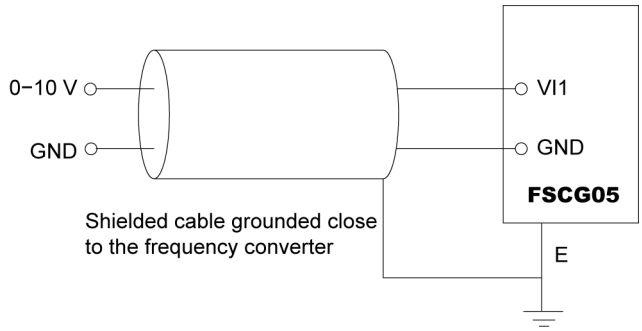


Fig. 3-35: Wiring of terminal VI1

- Wiring of terminal VI2 analog signal input is shown as below:

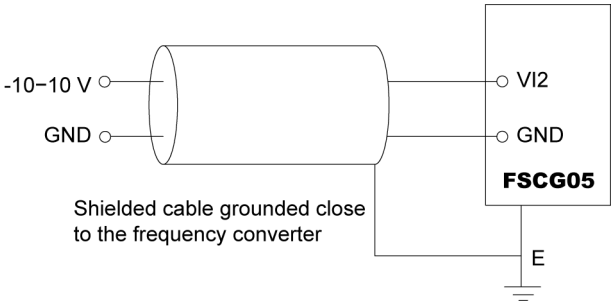


Fig. 3-36: Wiring of terminal VI2

- II is the input terminal for analog inputs from 0 mA to 20 mA, the wiring is shown as below:

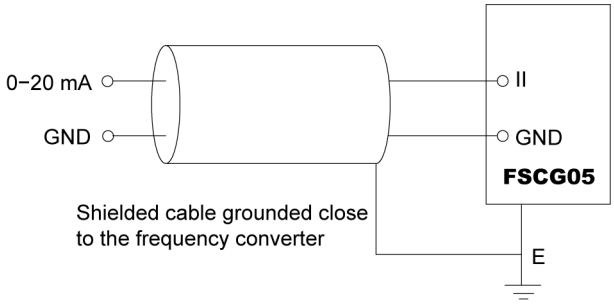


Fig. 3-37: Wiring of terminal II

- V+ is the output terminal for power supply of +5 V/10 mA or +10 V/10 mA, the wiring is shown as below:

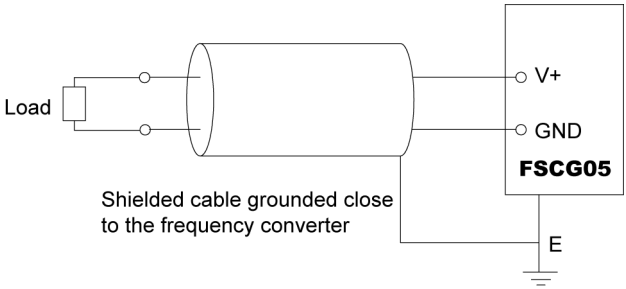


Fig. 3-38: Wiring of V+

- V- is the output terminal for the power supply of -10 V/10 mA, the wiring is shown as below:

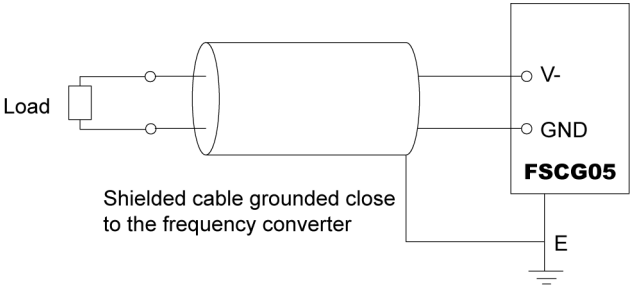


Fig. 3-39: Wiring of V-

- X1−X7, FWD, REV, RST input dry contact mode, the wiring of which is shown as below:

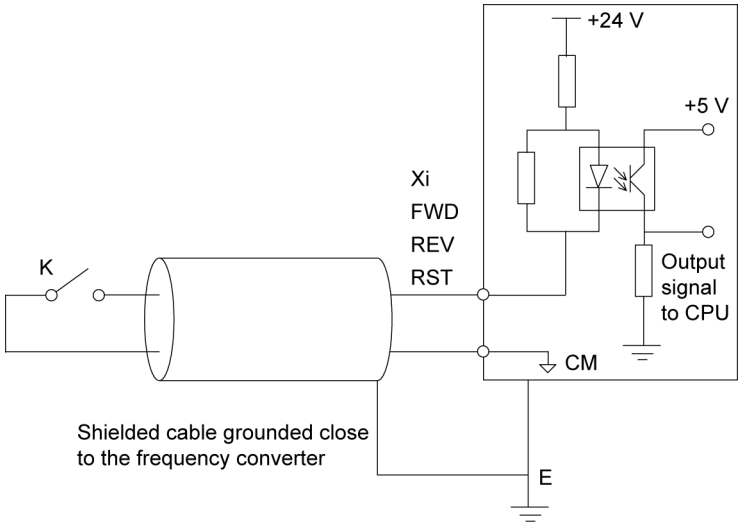


Fig. 3-40: Wiring of Xi, FWD, REV, RST input dry contact mode

- X1−X7, FWD, REV, RST input source (drain) mode, NPN common emitter, external device, the wiring of Xi, FWD, REV, RST input source is shown as below:

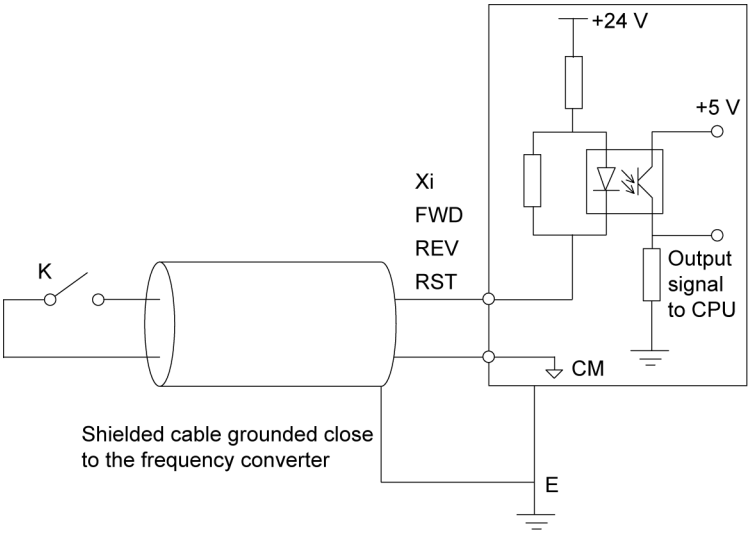


Fig. 3-41: Wiring of Xi, FWD, REV, RST input source mode

- Wiring of multi-function terminals OC1, OC2

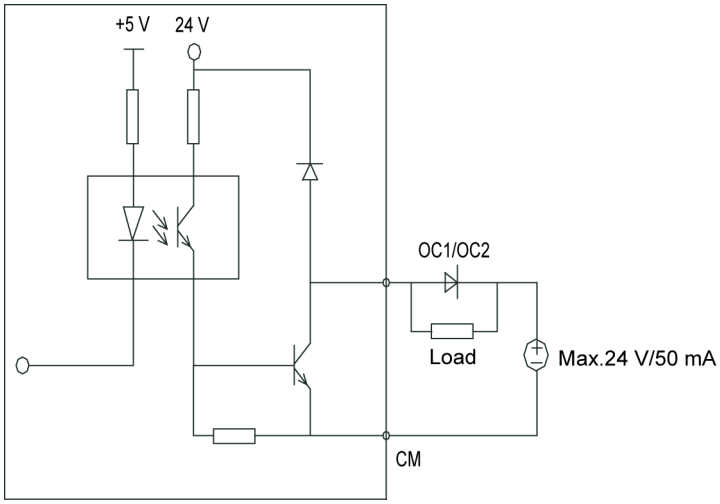


Fig. 3-42: OC1, OC2 outputs with external power supply

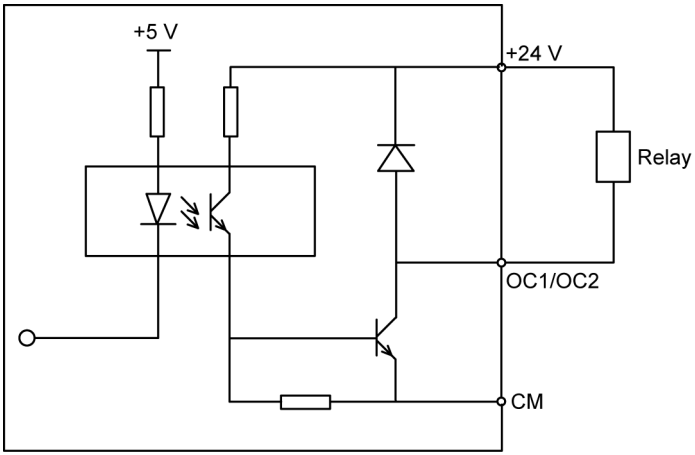


Fig. 3-43: OC1, OC2 outputs with internal power supply

The freewheeling diode should be applied in parallel when external inductive loads (such as relay, contactor, etc) need to be connected.

- Wiring of relay output terminals TA, TB, TC

  To drive the inductive loads (such as relay, contactor), the surge absorption circuit such as RC absorption circuit (please note its current-leakage should be less than the holding current of controlled contactor or relay), varistor or

freewheeling diode should be additionally applied. Please pay attention to the polarity when they are used in DC electromagnetic circuit. Absorption components should be installed as close as possible to the two ends of relays' or contactors' coils.

Wiring of relay output terminals TA, TB, TC is shown as below:

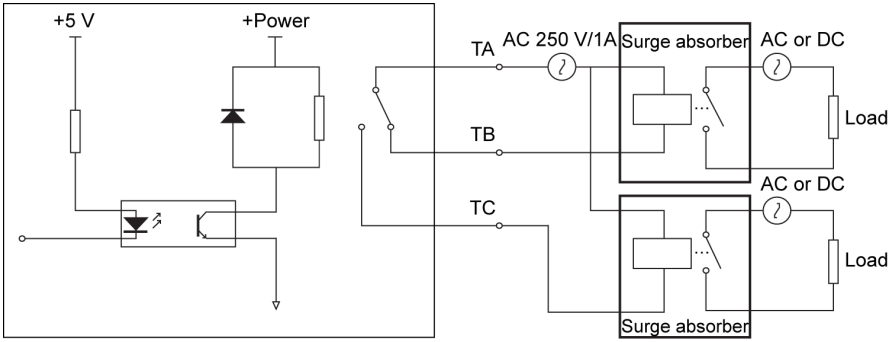
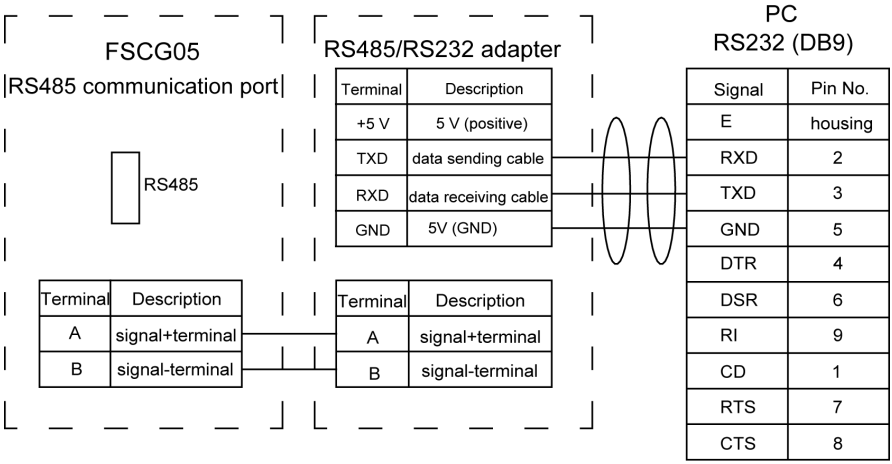


Fig. 3-44: Wiring of relay output terminals TA, TB, TC

- Wiring of RS485 communication terminals



Terminal	Description
+5 V	5 V (positive)
TXD	data sending cable
RXD	data receiving cable
GND	5V (GND)

Terminal	Description
A	signal+terminal
B	signal-terminal

Terminal	Description
A	signal+terminal
B	signal-terminal

Signal	Pin No.
E	housing
RXD	2
TXD	3
GND	5
DTR	4
DSR	6
RI	9
CD	1
RTS	7
CTS	8

Fig. 3-45: Connection of RS485 interface and PC

When multiple frequency converters are connected in the same RS485 system, the interference to communication increases, please pay more attention to the wiring arrangement.

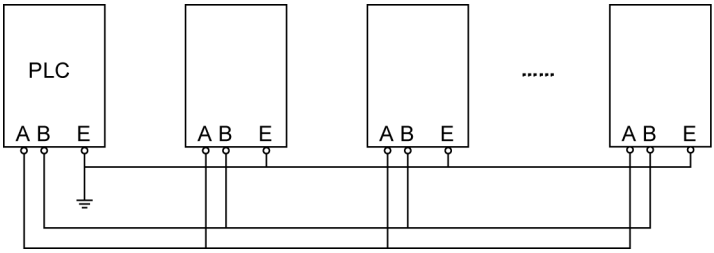


Fig. 3-46: Wiring for multiple frequency converters connected in the same RS485 system

☞ If communication still cannot be established with the above wiring, please take the following measures:

- Separate or isolate the power supply of the PLC (or external computer);
- Separate the power supply when a RS485/232 conversion module is applied;
- Use a ferrite magnetic ring for the communication lines;
- Reduce the carrier frequency of the frequency converter appropriately.

3.13 Protection for each Power Range

Type	0.75–2.2 kW	3.0–5.5 kW	7.5–18.5 kW	22–315 kW
Over-current	√	√	√	√
Over-voltage	√	√	√	√
Over-heat	√	√	√	√
Thermal relay	×	×	×	√
Interphase short circuit	√	Ø	√	√
Short circuit to earth	√	Ø	Ø	√
Input phase loss	√	√	√	√
Over-load	√	√	√	√

☞ √: with protection
×: without protection
Ø: with weak protection

4 Commissioning

4.1 Operating Panel

4.1.1 Overview

Operating panel I (KP51S LCD panel)

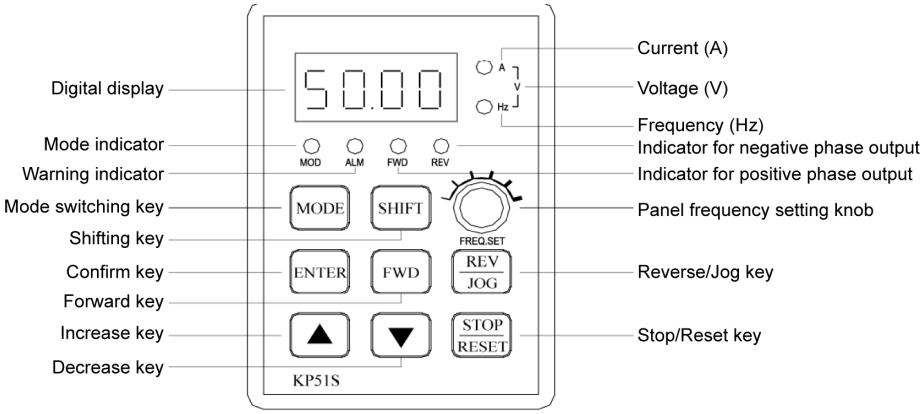


Fig. 4-1: Operating panel I_0K75−11K0

Operating panel II (KP51B LCD + LED panel)

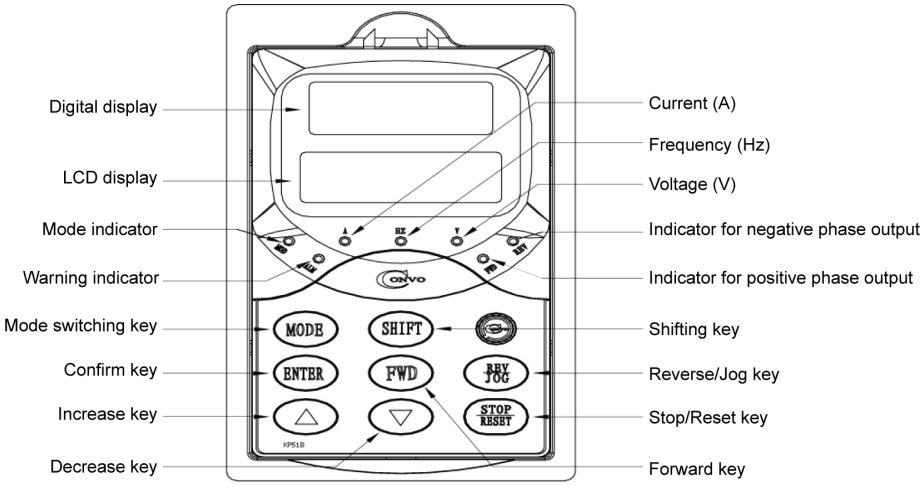


Fig. 4-2: Operating panel II_15K0−315K

Users can run the frequency converter, set parameters and monitor status via the operating panel. The LED displays the current parameter status, and the LCD displays notes and descriptions of the parameter.

Special notes on LED display

When the actual displayed value ≥10000, the decimal point at the lowest place is lit, which representing one "0". For example, "1234." means "12340" and the LED displays as below:

Fig. 4-3: LED display

4.2 Term Explanation

4.2.1 Running Parameters Selection

To simplify the operations in different applications, the frequency converter is designed with 4 groups of parameters: basic parameters, intermediate parameters, advanced parameters and extended application parameters. Users can hide certain group or groups of intermediate parameters, advanced parameters and extended application parameters based on actual applications.

Different parameters can be accessed by setting the parameter b-0:

1. Basic parameters

   When [b-0]=0, the frequency converter is only controlled by basic parameters (group b). Intermediate parameters (group L), advanced parameters (group H) and application parameters (group E) are deactivated and invisible.

   This mode is used for simple speed control with most of the advanced functions deactivated.

☞ When the running mode with intermediate, advanced or extended application parameters needs to be resumed, the previous settings of these parameters can only be restored automatically after the frequency converter is switched off and on.

---

2. Intermediate parameters

   When [b-0]=1, the frequency converter is controlled by basic parameters (group b) and intermediate parameters (group L). Advanced (group H) and extended application parameters (group E) are deactivated and invisible.

   Demands of most applications can be fulfilled with intermediate parameters.

- When the running mode with advanced or extended application parameters needs to be resumed, the previous settings of these parameters can only be restored automatically after the frequency converter is switched off and on.
- The frequency converter runs with intermediate parameters by factory defaults.

3. Advanced and extended application parameters

   When [b-0]=2, the frequency converter can be controlled by all parameters.

   Special functions such as speed tracking restart, programmable multi-speed running, integrated PID control, multiple frequency converters running, RS485 communication, etc. can only be realized with advanced parameters.

4.2.2 Working Mode of the Operating Panel

The operating panel provides 4 operating modes according to different contents to be displayed and operating commands. Except the mode of frequency digital setting, other modes can be switched via the key **MODE**.

1. Status monitoring mode

   The operating panel stays in the status monitoring mode for most cases. If there is no operating command to the panel over 1 minute, the status monitoring mode will be activated automatically. In this mode, the running parameter is displayed on the operating panel and status indicator----**MOD** is off.

   - The frequency converter provides 34 parameters (d-0 to d-33) for running status monitoring. Which parameter will be displayed in the monitoring mode depends on the settings of parameter L-68.
   - In status monitoring mode, the values of 3 status parameters can be fast read by pressing the key **SHIFT**. By factory defaults, values of output frequency, output current and output voltage will be displayed in sequence.

2. Parameter setting mode

   Parameters of the frequency converter can be read and modified in this mode.

   In details, there are 4 parameter setting modes: basic parameter setting mode, intermediate parameter setting mode, advanced parameter setting mode and extended application parameter setting mode. In each of the above modes, parameter or its value can be displayed.

3. Monitoring parameter reading mode

   In this mode, running parameters and fault records of the frequency converter can be viewed/read with d-□□ (□□: the index number of the parameter) or the respective value displayed on the panel.

4. Modification mode of the digital frequency setting

In the status monitoring mode, the digital frequency settings can be fast modified after accessing to the digital frequency modification mode by pressing ▲, ▼ or **ENTER.**

The digital frequency settings can only be modified when the frequency input channel is set as "Digital setting".

4.2.3 Notes on Parameter Description

Three kinds of expressions for parameters and their settings are used in this operating instructions, as shown below (taking the parameter b-0 as an example):

- b-0: means the parameter itself instead of its value, with "0" indicating the index number of the parameter.
- [b-0]: means the value of the parameter, i.e. the set value of parameter b-0.
- [b-0]=0: means the set value of parameter b-0 is "0".

4.3 Parameter Duplication with Operating Panel

4.3.1 Function Description

When multiple frequency converters need the same parameter settings, the fast setting can be realized with the parameter duplication function.

4.3.2 Parameter Duplication with Operating Panel KP51B

1. Set and save parameters with one of the frequency converters;
2. Set the frequency converter in stop monitoring mode;
3. Set [b-1]≠1, [b-0]=2;
4. Press keys **ENTER**, **STOP**, ▼, **ENTER** in sequence to copy parameters to the operating panel. In the duplication process, "Copying parameters" will be displayed on the LCD. The frequency converter will resume stop monitoring status when the duplication process is finished.
5. Remove the operating panel with set and saved parameters, and install it to the frequency converter which needs parameter setting.
6. Press keys **ENTER**, **STOP**, ▼, ▼ in sequence to copy parameters to the frequency converter. In the downloading process from the panel, "Downloading parameters" will be displayed on the LCD; the operating panel can be removed after the downloading is finished.
7. Repeat step 5 and 6 to finish parameter setting of all the frequency converters.

4.3.3 Parameter Duplication with Operating Panel KP51S

The duplication process is similar to that of KP51B, except that the duplication needs to be done in two parts due to the smaller memory for operating panel KP51S, as shown below:

- A: Duplication of parameters in group B and L
  1. Frequency converter→panel: press keys **ENTER**, **STOP**, ▼, **ENTER** in sequence;
  2. Panel→frequency converter: press keys **ENTER**, **STOP**, ▼, ▼ in sequence;
  3. "BL" is displayed on the panel during the duplication.
- B: Duplication of parameters in group H and E
  1. Frequency converter→panel: press keys **ENTER**, **STOP**, ▼, **STOP** in sequence;
  2. Panel→frequency converter: press keys **ENTER**, **STOP**, ▼, ▼ in sequence;
  3. "HE" is displayed on the panel during the duplication.
- C: Duplication of parameters in all groups (B, L, H, E)

  Follow the steps A and B above to duplicate parameters in group B, L and H, E respectively.

4.3.4 Special Notes on Duplication

- The panel KP51B / KP51S can only be used for frequency converter FSCG05.
- If power-off occurs to the panel during the duplication, please re-execute the whole duplication process after power-on; if an error such as CERR occurs, it may be caused by model mismatch between the panel and the frequency converter.
- Certain parameters are mutually restricted, please firstly restore the frequency converter to be duplicated to factory defaults to avoid failure of parameter duplication.
- When the frequency converters are of different power ratings, the power rating relevant parameters such as L-9 of the target frequency converter will keep its original value after being downloaded from the panel when the copied set value is higher than the maximum value or lower than the minimum value of the target frequency converter, while the duplication of other parameters will not be affected.
- Duplication function is only available for KP51S V2.11, KP51B V2.01 and later versions (press keys **ENTER**, **STOP**, ▼, ▲ in sequence to check the panel version).

4.4 Description on Operating Panel

Item			Function description
Display	Digital display		Display the value of monitored parameter in the monitoring mode; display the function code and parameter value in the setting mode.
	Status indicator	A, Hz, V	The unit corresponding to current displayed parameter.
		MOD	The indicator is ON under non-monitoring status, it will be OFF and the frequency converter returns to monitoring status when there is no keypad input over 1 minute.
		ALM	Alarm indicator, indicating the frequency converter is in over-current or over-voltage suppression.
		FWD	Forward indicator, indicating the frequency converter outputs positive phase, and the motor will run in forward direction when being connected.
		REV	Reverse indicator, indicating the frequency converter outputs negative phase, and the motor will run in reverse direction when being connected. If **FWD** and **REV** indicators are ON at the same time, it indicates the frequency converter is in DC braking status.
Keypad	**FWD**		**Forward**: When "Running command channels" [b-3]=0: "Panel control", pressing this key will activate the forward run command, and the output frequency of the frequency converter will reach the set frequency as per the defined acceleration/deceleration curve.
	REV/JOG		**Reverse, Jog**: [L-21]=0 activates reverse run; [L-21]=1 activates jogging.
	STOP/RESET		**Stop, Fault reset**: When the frequency converter is running normally, and "Running command channels" [b-3]=0, 2, 4 (panel **STOP** valid), pressing this key will stop the frequency converter in specified way; when the frequency converter is in fault, by pressing this key, the frequency converter will be reset and return to the normal stop status.
	MODE		**Mode switch**: Switch the working modes of the operating panel.
	ENTER		**Confirm**: Used to confirm the parameter status or settings (parameter settings are stored in the internal memory). When the frequency converter is in monitoring status, pressing this key will enter into command frequency modification interface (**MOD** indicator is ON at the same time), where you can use ▲▼ keys to modify the command frequency.
	▲ ▼		**Data modification**: Used to read the function code or modify the parameter settings. Pressing ▲▼ at the same time will speed up the parameter modification: firstly pressing ▲, then ▼ will speed up parameter modification upward, releasing ▼ will retain current speed; firstly pressing ▼, then ▲ will speed up parameter modification downward, releasing ▲ will retain current speed. In status monitoring mode, if the frequency command channel is set as panel digital setting, pressing this key will directly modify the frequency command value, and the **MOD** indicator will be ON at the same time.
	SHIFT		**Shift**: When modifying the parameter settings via ▲▼, pressing this key can select the bit to be modified, which will blink at the same time.

4.5 Keypad Operation

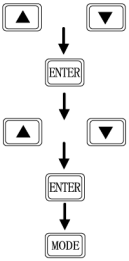
Mode switching

Operation	Description	Display
Switch working mode of the operating panel	Current mode: status monitoring mode	Current running parameter, such as 50.00
Initial status ↓ MODE ↓ MODE ↓ MODE ↓ MODE ↓ MODE	Enter monitoring parameter reading mode	Monitoring code, such as d-0
	Enter basic parameter setting mode	Code: b-0
	Enter intermediate parameter setting mode	Code: L-0
	Enter advanced parameter setting mode	Code: H-0
	Enter extended application parameter setting mode	Code: E-0
	Enter status monitoring mode	

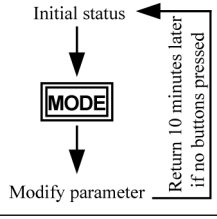
Monitoring parameter reading

Operation	Description	Display
View set frequency	Current mode: monitoring parameter reading mode	Such as d-0
▲ ↓ ▲ ▼ ↓ ENTER ↓ MODE	Monitoring code +1	d-1
	Modify the function code to expected parameter d-4	d-4
	Confirm the expected monitoring settings	Parameter value of d-4: set frequency
	Switch working mode of the operating panel as necessary	

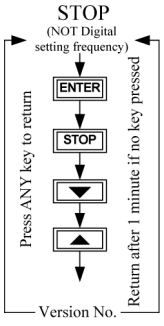
Parameter setting

Operation	Description	Display
Modify Acc. time 1 from 5.0s to 10.0s	Current mode: parameter setting mode (take basic parameters as example)	b-0
	Modify the function code to expected: b-8	Such as b-8 (Acc. time 1)
	Confirm the parameter to be modified	Parameter value of b-8: 5.0
	Modify the parameter value to expected: 10.0	10.0
	Confirm the parameter value and save it to internal memory	b-8
	Switch working mode of the operating panel as necessary	

Parameter modification at under-voltage

Operation	Description	Display
Modify the parameter at under-voltage	Current mode: status monitoring mode	Running parameter (defined by L-68)
	In under-voltage status	P.OFF
	Enter status monitoring mode, modify parameters via keypad normally	Running parameter (defined by L-68)
	Return to under-voltage status after modification if no keypad input for 10s	

Keypad software version reading

Operation	Description	Display
Keypad software version reading	Current mode: status monitoring mode	Running parameter (defined by L-68)
	Stop mode, display monitored parameters	Stop parameter (defined by L-71)
	After pressing **ENTER**, **STOP**, ▼, ▲ in sequence	
	Display keypad software version	KP51S: V2.11
		KP51B: V2.01

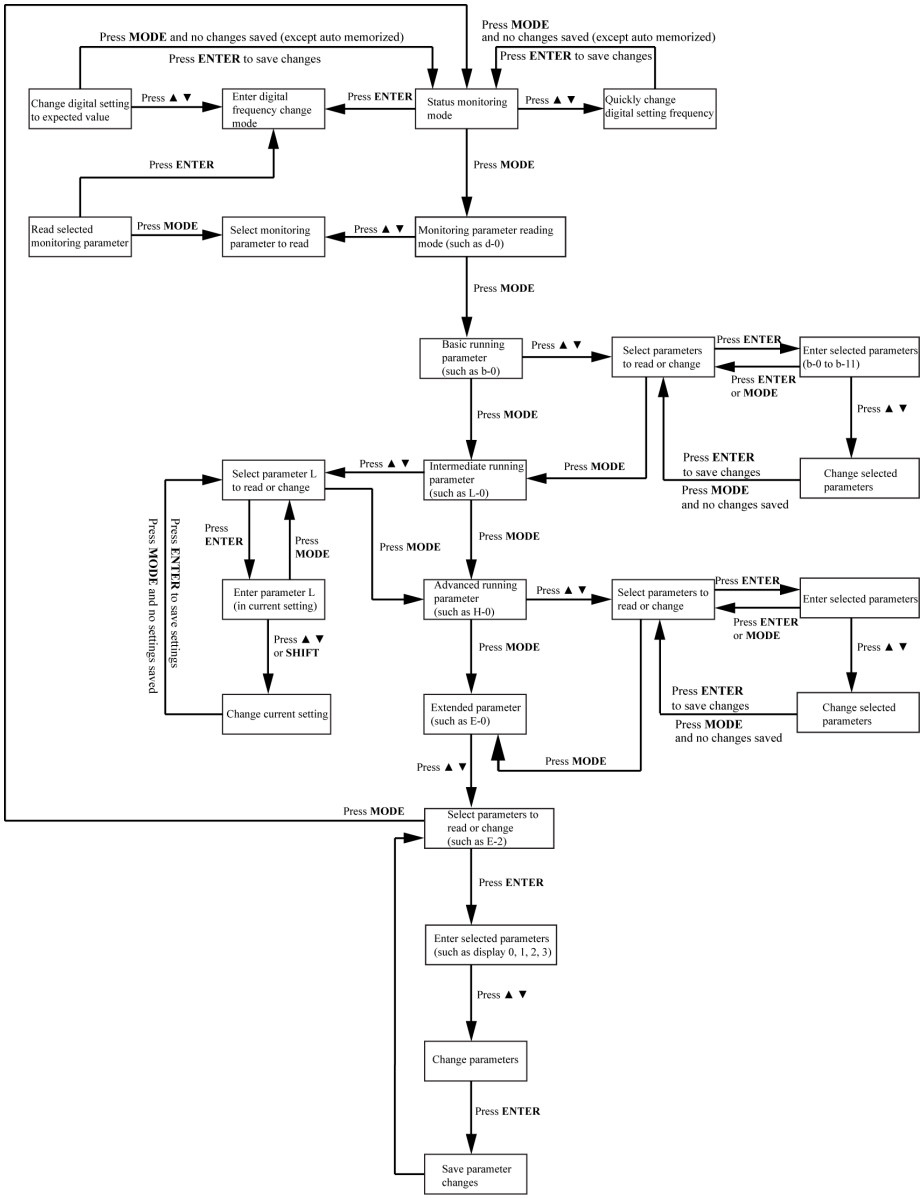


Fig. 4-4: Keypad operation

4.6 Running the Frequency Converter

4.6.1 Initial Setting of the Frequency Converter

The initial setting of the frequency converter is the factory setting (see chapter 5 "Parameter List" on page 63). Here we focus on the initial setting of parameters below:

- Running parameter selection (b-0)

  The initial setting is intermediate parameter mode ([b-0]=1), so parameter groups H and E are invisible. To work with parameter groups H and E, please set the advanced parameter mode ([b-0]=2).

- Frequency input channel selection (b-1)

  The initial setting is via panel potentiometer ([b-1]=0).

  When there is no panel potentiometer on the operating panel or other channels are needed to set frequency (such as via external voltage), please modify parameter b-1 to set the appropriate frequency setting channel (see b-1 descriptions).

- Running command input channel (b-3)

  The initial setting is via panel ([b-3]=0), so please run, stop the frequency converter via **FWD**, **STOP**/**RESET**, **REV**/**JOG** on the operating panel.

  To control the frequency converter via external control terminals, please modify the setting of b-3 (see b-3 descriptions).

4.6.2 Basic Running of the Frequency Converter

⚠ DANGER

Never connect the input cables to the output terminals U, V, W of the frequency converter!

Set the frequency via panel potentiometer

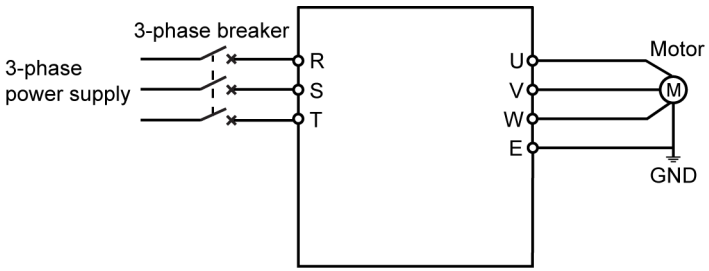


Fig. 4-5: Wiring for basic running

☞ Two common startup methods (solution 1 and 2) are illustrated below, please select one on demand.

⚠ WARNING

Please STOP the frequency converter and disconnect the power supply immediately once it is abnormal in any step below. Retry after problems have been found out and solved.

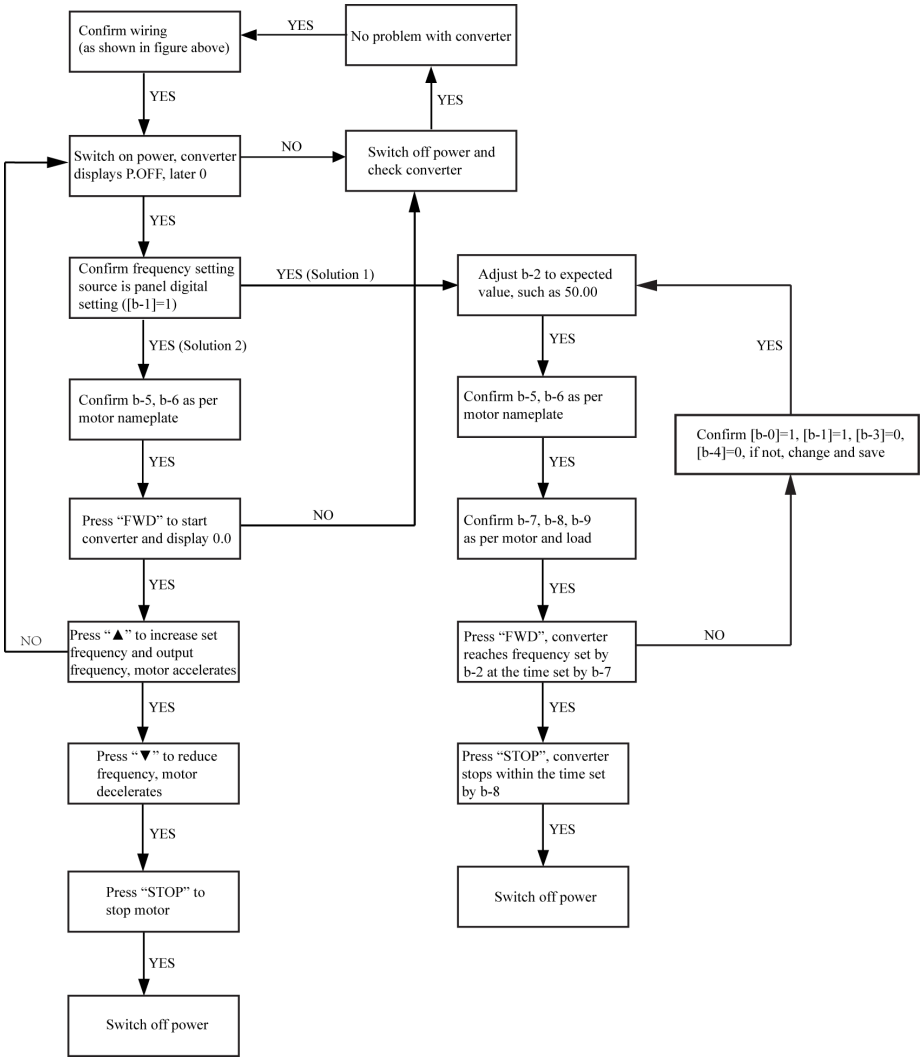


Fig. 4-6: Commissioning of the frequency converter

5 Parameter List

5.1 Description of Attribute Symbols in Parameter Tables

Attribute	Description
×	This parameter cannot be modified when the frequency converter is in run mode.
*	This parameter is relevant to the frequency converter model.

5.2 Basic Parameters (Group b)

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
b-0	Running parameter selection	**G type** 0: Basic parameters 1: Intermediate parameters 2: Advanced/extended application parameters 3: Reserved **P type** 4: Basic parameters 5: Intermediate parameters 6: Advanced/extended application parameters	1	1	×	00H
b-1	Frequency input channel selection	0/16: Panel potentiometer 1/17: Panel digital setting, save via **ENTER** 2/18: External voltage signal 1 3/19: External voltage signal 2 4/20: External current signal 5/21: ▲/▼ terminal increment/decrement control 6/22: External pulse signal 7/23: RS485 interface 8/24: Combined setting 9/25: External terminal selection 10: Start with frequency set by E-29 Note: • When [b-1]=0–10, the frequency is **NOT** automatically saved • When [b-1]=16–25, the frequency is automatically saved	1	0		01H
b-2	Frequency digital setting	0.00–upper frequency	0.01	0.0		02H
	PID digital setting	0.0 %–100.0 %	0.1			
	Pressure digital setting	[E-17]–[E-18] MPa	0.001			

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
b-3	Running command channels	0: Panel control (**FWD** invalid) 1: External terminal (keypad **STOP** invalid) 2: External terminal (keypad **STOP** valid) 3: RS485 interface (keypad **STOP** invalid) 4: RS485 interface (keypad **STOP** valid) 5: Panel control (**FWD** valid)	1	0		03H
b-4	Direction control	0: Same as the set direction 1: Opposite to the set direction 2: Reverse run preventing	1	0		04H
b-5	Upper frequency	Lower frequency–650.00 Hz	0.01	50.00		05H
b-6	Rated motor frequency	5.00–650.00 Hz	0.01	50.00	×	06H
b-7	Rated motor voltage	200–500 V	1	380	×	07H
b-8	Acc. time 1	0.1–6000s	0.1	*		08H
b-9	Dec. time 1	0.1–6000s	0.1	*		09H
b-10	Acc./Dec. mode	0: Linear; 1: S curve	1	0		0AH
b-11	Parameter initialization	0: No action; 1: Initialization; 2: Clear fault record	1	0	×	0BH

5.3 Intermediate Parameters (Group L)

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-0	V/F curve selection	0: Constant torque curve 1: Decrement torque curve 1 2: Decrement torque curve 2 3: User-defined V/F curve 4: Constant torque correction 5: Decrement torque correction 1 6: Decrement torque correction 2	1	0	×	0CH
L-1	Torque boost	0 %–20 %	1	*		0DH
L-2	Torque boost mode	0: Manual torque boost 1: Auto torque boost	1	0	×	0EH
L-3	V/F frequency 1	0.00 Hz–[L-5]	0.01	12.50		0FH
L-4	V/F voltage 1	0 %–120 %	1	25		10H
L-5	V/F frequency 2	[L-3]–[L-7]	0.01	25.00		11H
L-6	V/F voltage 2	0 %–120 %	1	50		12H
L-7	V/F frequency 3	[L-5]–upper frequency	0.01	37.50		13H
L-8	V/F voltage 3	0 %–120 %	1	75		14H
L-9	Carrier frequency	1.0–15.0 kHz	0.1	*		15H
L-10	Lower frequency	0.00–upper frequency	0.01	0.50		16H
L-11	Lower frequency running mode	0: Stop 1: Run with lower frequency	1	0	×	17H
L-12	Starting mode	0: Start with starting frequency 1: Firstly brake, then start 2: Start with speed tracking	1	0		18H
L-13	Starting frequency	0.00–10.00 Hz	0.01	0.50		19H
L-14	Starting frequency holding time	0.0–20.0s	0.1	0.0	×	1AH
L-15	DC braking voltage at start-up	0 %–15 %	1	0	×	1BH
L-16	DC braking time at startup	0.1–20.0s	0.1	0.0	×	1CH
	Zero frequency braking valid	0.0s (zero frequency braking)				
L-17	Stopping mode	0: Decelerate to stop 1: Freewheel to stop	1	0		1DH

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-18	Stopping DC braking initial frequency	0.00–15.00 Hz	0.01	3.00		1EH
L-19	Stopping DC braking time	0.0–20.0s	0.1	0.0	×	1FH
L-20	Stopping DC braking voltage	0 %–15 %	1	5	×	20H
L-21	**REV/JOG** selection	0: Reverse; 1: Jogging	1	0		21H
L-22	Jog frequency	0.00–upper frequency	0.01	10.00		22H
L-23	Jog Acc. time	0.1–6000s	0.1	10.0		23H
L-24	Jog Dec. time	0.1–6000s	0.1	10.0		24H
L-25	Frequency input channel combination	100–766	100	101	×	25H
L-26	Gain coefficient for panel potentiometer input	0.01–5.00	0.01	1.00		26H
L-27	VI1 input lower voltage	0.00 V–[L-28]	0.01	0.00		27H
L-28	VI1 input upper voltage	[L-27]–10.00 V	0.01	10.00		28H
L-29	VI1 input adjusting coefficient	0.01–5.00	0.01	1.00		29H
L-30	VI2 input lower voltage	-10.0 V–[L-31]	0.1	0.0		2AH
L-31	VI2 input upper voltage	[L-30]–10.0 V	0.1	10.0		2BH
L-32	VI2 input adjusting coefficient	0.01–5.00	0.01	1.00		2CH
L-33	VI2 input zero offset	-1.00–1.00 V	0.01	0.00		2DH
L-34	VI2 input bipolar control	0: Invalid; 1: Valid	1	0		2EH
L-35	VI2 input bipolar control zero hysteresis width	0.00–1.00 V	0.01	0.20		2FH
L-36	II input lower current	0.00 mA–[L-37]	0.01	4.00		30H
L-37	II input upper current	[L-36]–20.00 mA	0.01	20.00		31H
L-38	II input adjusting coefficient	0.01–5.00	0.01	1.00		32H
L-39	Suppression analog input setting swing	0–30	1	3		33H
L-40	Analog input filtering time	0.01–5.00s	0.01	0.20	×	34H
L-41	Pulse input lower frequency	0.000 kHz–[L-42]	0.001	0.000		35H
L-42	Pulse input upper frequency	[L-41]–50.00 kHz	0.001	10.00		36H
L-43	Pulse input adjusting coefficient	0.01–5.00	0.01	1.00		37H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-44	Set frequency for lower input	0.00–upper frequency	0.01	0.00		38H
L-45	Set frequency for upper input	0.00–upper frequency	0.01	50.00		39H
L-46	External running command modes	0: 2-line control 1 (after power-on, disconnect the control terminal, then connect) 1: 2-line control 2 (after power-on, disconnect the control terminal, then connect) 2: 3-line control 3: Reserved 4: 2-line control 1 (after power-on, if the control terminal is connected, the frequency converter starts automatically) 5: 2-line control 2 (after power-on, if the control terminal is connected, the frequency converter starts automatically)	1	0	×	3AH

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-47	Input terminal 1 function (X1: 0–28)	0: Control terminal in idle 1: Multi-control terminal 1 2: Multi-control terminal 2 3: Multi-control terminal 3 4: Multi-control terminal 4 5: Forward jog control 6: Reverse jog control 7: Freewheel-to-stop control 8: External device fault input 9: Acc./Dec. time terminal 1 10: Acc./Dec. time terminal 2 11: Frequency increment control (▲) 12: Frequency decrement control (▼) 13: Frequency setting channel terminal 1 14: Frequency setting channel terminal 2 15: Frequency setting channel terminal 3 16: Simple PLC pause 17: 3-line control 18: DC braking control 19: Internal timer triggering terminal 20: Internal timer resetting terminal 21: Internal counter zeroing terminal 22: Closed-loop control invalid 23: Coupled-control terminal 24: PID input 2 enabled 25: Zero frequency braking control 26–28: Reserved 29: Internal counter clock terminal 30: External pulse input	1	0	×	3BH
L-48	Input terminal 2 function (X2: 0–28)		1	0	×	3CH
L-49	Input terminal 3 function (X3: 0–28)		1	0	×	3DH
L-50	Input terminal 4 function (X4: 0–28)		1	0	×	3EH
L-51	Input terminal 5 function (X5: 0–28)		1	6	×	3FH
L-52	Input terminal 6 function (X6: 0–28)		1	7	×	40H
L-53	Input terminal 7 function (X7: 0–28)		1	30	×	41H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-54	Analog output (AM) setting	0: Output frequency	1	0		42H
L-55	Frequency output (AO) setting	1: Output current 2: Output voltage 3: Motor speed 4: PID setting 5: PID feedback 6: Panel potentiometer 7: Panel digital setting 8: External voltage signal 1 9: External voltage signal 2 10: External current signal 11: External pulse signal	1	0		43H
L-56	AM output gain	0.50–2.00	0.01	1.00		44H
L-57	AO output gain	0.10–5.00	0.01	1.00		45H
L-58	AO output channels	0: FM output (0–50 kHz) 1: 0–10 V 2: 2–10 V 3: 0–20 mA 4: 4–20 mA 5: FM output (0–[b-5] x [L-57]) 6: FM output ([L-62]–[b-5] x [L-57])	1	3		46H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-59	OC1 output setting	0: Frequency converter in running	1	0		47H
L-60	OC2 output setting	1: Frequency arrival	1	1		48H
L-61	Relay output functions	2: Frequency level detection signal (FDT) 3: Overload warning 4: Stop by external fault 5: Output frequency reaches upper limit 6: Output frequency reaches lower limit 7: Stop by undervoltage 8: Frequency converter runs at zero speed 9: PLC running 10: PLC run for one cycle 11: PLC run for one phase 12: PLC running finished 13: Internal timer time reached 14: Internal counter final value reached 15: Internal counter defined value reached 16: Pressure upper limit warning 17: Pressure lower limit warning 18: Fault status and in current limiting for overheat or overload 19: Auxiliary pump output 20: Output current upper limit reached 21: Output current lower limit reached 22: Frequency converter in forward running 23: Frequency converter in reverse running 24–26: Reserved	1	18		49H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
L-62	Frequency arriving at detection width	00.00–20.00 Hz	0.01	5.00		4AH
	Frequency offset					
L-63	FDT (frequency level) setting	0.00–upper frequency	0.01	10.00		4BH
L-64	FDT output delay time	0.0–20.0s	0.1	2.0		4CH
	Current upper limit	0.0 %–200.0 %				
L-65	Overload warning level	50 %–200 %	1	110		4DH
L-66	Overload warning delay time	0.0–20.0s	0.1	2.0		4EH
	Current lower limit	0.0 %–200.0 %				
L-67	Units digit: number of monitoring parameters	1–3	1	23		4FH
	Tens digit: number of motor pole	2–8				
L-68	Run monitoring 1	0–19	1	0		50H
L-69	Run monitoring 2	0–19	1	1		51H
L-70	Run monitoring 3	0–19	1	2		52H
L-71	Stop monitoring	0–19	1	0		53H
L-72	Linear speed coefficient setting	0.01–100.0	0.01	1.00		54H
L-73	Parameter writing protection	0: All parameters writable 1: All parameters except b-2 and L-73 unwritable 2: All parameters unwritable	1	0		55H

5.4 Advanced Parameters (Group H)

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
H-0	Slip frequency compensation	0 %–150 %	1	0	×	56H
H-1	Overload, overheat protection actions	0: Frequency converter output blocked 1: Run with current limit (warning) 2: Run with decreased frequency (warning)	1	0		57H
H-2	Motor overload protection coefficient	50 %–110 %	1	110	×	58H
H-3	Auto energy-saving	0: No action; 1: Action	1	0	×	59H
H-4	Restart after power failure	0: No action (fault alarm for power failure) 1: Action (fault alarm for power failure) 2: No action (no fault alarm for power failure) 3: Action (no fault alarm for power failure)	1	0	×	5AH
H-5	Waiting time for restart after power failure	0.0–10.0s	0.1	0.5	×	5BH
H-6	Auto fault reset attempts	0, 1, 2	1	0	×	5CH
H-7	Interval between auto fault reset	2–20s	1	5	×	5DH
H-8	Auto voltage stabilization	0: No action 1: Action 2: No action only at deceleration	1	0		5EH
H-9	Current limit level	110 %–200 %	1	150		5FH
H-10	Forward/reverse dead zone time	0.0–5.0s	0.1	0.1	×	60H
H-11	Internal timer setting	0.1–6000s	0.1	0.0	×	61H
H-12	Internal counter final value setting	1–60000	1	1	×	62H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
H-13	Internal counter defined value setting	1–60000	1	1	×	63H
H-14	Multi-speed frequency 1	0.00–upper frequency	0.01	35.00		64H
H-15	Multi-speed frequency 2	0.00–upper frequency	0.01	15.00		65H
H-16	Multi-speed frequency 3	0.00–upper frequency	0.01	3.00		66H
H-17	Multi-speed frequency 4	0.00–upper frequency	0.01	20.00		67H
H-18	Multi-speed frequency 5	0.00–upper frequency	0.01	25.00		68H
H-19	Multi-speed frequency 6	0.00–upper frequency	0.01	30.00		69H
H-20	Multi-speed frequency 7	0.00–upper frequency	0.01	35.00		6AH
H-21	Multi-speed frequency 8	0.00–upper frequency	0.01	40.00		6BH
H-22	Multi-speed frequency 9	0.00–upper frequency	0.01	45.00		6CH
H-23	Multi-speed frequency 10	0.00–upper frequency	0.01	50.00		6DH
H-24	Multi-speed frequency 11	0.00–upper frequency	0.01	40.00		6EH
H-25	Multi-speed frequency 12	0.00–upper frequency	0.01	30.00		6FH
H-26	Multi-speed frequency 13	0.00–upper frequency	0.01	20.00		70H
H-27	Multi-speed frequency 14	0.00–upper frequency	0.01	10.00		71H
H-28	Multi-speed frequency 15	0.00–upper frequency	0.01	5.00		72H
H-29	Programmable multi-speed running	**LED tens digit:** **simple PLC running time unit** 1: Minute; 0: Second **LED units digit: PLC action mode** 0: Disable PLC, enable multi-speed 1: Single cycle 2: Continuous cycle 3: Final value holding 4: Run in swing frequency 5: Single cycle stop mode 6: Continuous cycle stop mode 7: Final value holding stop mode 8: Reserved	1	0	×	73H
H-30	Phase 1 running time	0.0–6000	0.1	10.0	×	74H
H-31	Phase 1 running direction	0: Forward; 1: Reverse	1	0		75H
H-32	Phase 1 Acc./Dec. time	0.1–6000s	0.1	10.0		76H
H-33	Phase 2 running time	0.0–6000	0.1	10.0	×	77H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
H-34	Phase 2 running direction	0: Forward; 1: Reverse	1	0		78H
H-35	Phase 2 Acc./Dec. time	0.1–6000s	0.1	10.0		79H
H-36	Phase 3 running time	0.0–6000	0.1	10.0	×	7AH
H-37	Phase 3 running direction	0: Forward; 1: Reverse	1	0		7BH
H-38	Phase 3 Acc./Dec. time	0.1–6000s	0.1	10.0		7CH
H-39	Phase 4 running time	0.0–6000	0.1	10.0	×	7DH
H-40	Phase 4 running direction	0: Forward; 1: Reverse	1	0		7EH
H-41	Phase 4 Acc./Dec. time	0.1–6000s	0.1	10.0		7FH
H-42	Phase 5 running time	0.0–6000	0.1	10.0	×	80H
H-43	Phase 5 running direction	0: Forward; 1: Reverse	1	0		81H
H-44	Phase 5 Acc./Dec. time	0.1–6000s	0.1	10.0		82H
H-45	Phase 6 running time	0.0–6000	0.1	10.0	×	83H
H-46	Phase 6 running direction	0: Forward; 1: Reverse	1	0		84H
H-47	Phase 6 Acc./Dec. time	0.1–6000s	0.1	10.0		85H
H-48	Phase 7 running time	0.0–6000	0.1	10.0	×	86H
H-49	Phase 7 running direction	0: Forward; 1: Reverse	1	0		87H
H-50	Phase 7 Acc./Dec. time	0.1–6000s	0.1	10.0		88H
H-51	Skip frequency 1	0.00–upper frequency	0.01	0.00		89H
H-52	Skip frequency 1 width	0.00–5.00 Hz	0.01	0.00		8AH
H-53	Skip frequency 2	0.00–upper frequency	0.01	0.00		8BH
H-54	Skip frequency 2 width	0.00–5.00 Hz	0.01	0.00		8CH
H-55	Skip frequency 3	0.00–upper frequency	0.01	0.00		8DH
H-56	Skip frequency 3 width	0.00–5.00 Hz	0.01	0.00		8EH
H-57	Acceleration time 2	0.1–6000s	0.1	*		8FH
H-58	Deceleration time 2	0.1–6000s	0.1	*		90H
H-59	Acceleration time 3	0.1–6000s	0.1	*		91H
H-60	Deceleration time 3	0.1–6000s	0.1	*		92H
H-61	Acceleration time 4	0.1–6000s	0.1	*		93H
H-62	Deceleration time 4	0.1–6000s	0.1	*		94H
H-63	Dynamic brake initial voltage	620–720	1	700	×	95H
H-64	Braking ratio	0–100	1	25		96H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
H-65	Protocol selection	0: User-defined protocol slave station 1: User-defined protocol master station 2: ModBus protocol	1	0	×	97H
H-66	Local address	0–30 (ModBus: 0–247)/*	1	0	×	98H
H-67	Data format	0: No parity (8, N, 2) 1: Even parity (8, E, 1) 2: Odd parity (8, O, 1) ModBus options: 0: RTU no parity (8, N, 2) 1: RTU even parity (8, E, 1) 2: RTU odd parity (8, O, 1) 3: ASCII no parity (7, N, 2) 4: ASCII even parity (7, E, 1) 5: ASCII odd parity (7, O, 1) 6: ASCII no parity (8, N, 2) 7: ASCII even parity (8, E, 1) 8: ASCII odd parity (8, O, 1)	1	0	×	99H
H-68	Baud rate	0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps	1	3	×	9AH
H-69	Multiple frequency converters control setting ratio	0.10–10.00	0.01	1.00		9BH
H-70	RS485 communication disruption action	0: Stop 1: Keep current status	1	1		9CH

5.5 Extended Application Parameters (Group E)

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
E-0	Internal PID control	0: No PID control 1: General PID control 2: Single pump constant pressure water supply PID 3: Two-pump constant pressure water supply PID (accessory needed) 4: Three-pump constant pressure water supply PID (accessory needed) 5: Four-pump constant pressure water supply PID (accessory needed)	1	0	×	9DH
E-1	PID setting channels	0: Panel potentiometer 1: Panel digital setting 2: External voltage signal 1 (0–10 V) 3: External voltage signal 2 (-10–10 V) 4: External current signal 5: External pulse signal 6: RS485 interface setting	1	0	×	9EH
E-2	PID feedback channels	0: Voltage input 1 (0–10 V) 1: Current input 2: Pulse input 3: Voltage input 2 (-10–10 V)	1	0	×	9FH
E-3	Feedback signal characteristic	0: Positive characteristic 1: Negative characteristic	1	0	×	A0H
E-4	Feedback channel gain	0.01–10.00	0.01	1.00		A1H
E-5	PID setting Feedback display coefficient	0.01–100.0	0.01	1.00		A2H
E-6	PID controller modes	0: Proportion 1: Integral 2: Proportional integral 3: PID (proportional integral derivative)	1	2	×	A3H
E-7	Proportional gain	0.00–5.00	0.01	0.50		A4H
E-8	Integral time constant	0.1–100.0s	0.1	10.0		A5H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
E-9	Derivative gain	0.0–5.0	0.1	0.1	×	A6H
E-10	Sampling period	0.01–1.00s	0.01	0.10		A7H
E-11	Allowable deviation limit	0 %–20 %	1	0		A8H
E-12	PID feedback disruption detection threshold	0.0 %–20.0 %	0.1	0.0		A9H
E-13	PID feedback disruption action	0: Stop 1: Run with digital set frequency 2: Run with upper frequency 3: Run with half of upper frequency	1	0		AAH
E-14	Scale of remote pressure gauge	0.001–20.000 MPa	0.001	1.000		ABH
E-15	Lower pressure for warning	0.001–[E-16]	0.001	0.001		ACH
E-16	Upper pressure for warning	[E-15]–[E-14]	0.001	1.000		ADH
E-17	Lower pressure limit	0.001–[E-18]	0.001	0.001		AEH
E-18	Upper pressure limit	[E-17]–[E-14]	0.001	1.000		AFH
E-19	Lower frequency holding time (pump-decreasing judgement)	0.1–1000s	0.1	300.0		B0H
E-20	Upper frequency holding time (pump-increasing judgement)	0.1–1000s	0.1	300.0		B1H
E-21	Electromagnetic switch delay time	0.1–10.0s	0.1	0.5	×	B2H
E-22	Pump switching frequency (for pump-decreasing and switching)	0.00–upper frequency	0.01	25.00		B3H
E-23	Timed switching interval	0.5–100.0 hours	0.1	5.0		B4H
E-24	Timed water supply interval	0.5–24.0 hours	0.1	24.0		B5H
E-25	Sleep/auxiliary pump frequency	0.00–upper frequency	0.01	25.00		B6H
E-26	Sleep delay	0.1–3600s	0.1	60.0		B7H

Function code	Name	Setting range	Minimum unit	Factory default	Attribute	Code address
E-27	Wake up/disable auxiliary pump	0.1–100.0	0.1	75.0		B8H
E-28	Wake-up delay	0.1–60.0s	0.1	0.5		B9H
E-29	PID input 2 setting	[E-17]–[E-18]	0.001	1.000		BAH

5.6 Monitoring Parameters List

Function code	Name	Minimum unit	Code address
d-0	Output frequency in monitoring	0.01 Hz	DBH
d-1	Output current in monitoring	0.1 A	DCH
d-2	Output voltage in monitoring	1 V	DDH
d-3	Motor speed in monitoring	1 rpm	DEH
d-4	Set frequency in monitoring	0.01 Hz	DFH
d-5	DC bus voltage	1 V	E0H
d-6	PID set value	0.1 %/ MPa*	E1H
d-7	PID feedback value	0.1 %/ MPa*	E2H
d-8	Running linear speed	0.01*	E3H
d-9	Set linear speed	0.01*	E4H
d-10	Input AC voltage	1 V	E5H
d-11	Module temperature	0.1 ℃	E6H
d-12	Cumulated running time	1 H	E7H
d-13	Input terminal status		E8H
d-14	Analog input VI1	0.01 V	E9H
d-15	Analog input VI2	0.01 V	EAH
d-16	Analog input II	0.01 mA	EBH
d-17	External pulse input	0.01 kHz	ECH
d-18	Analog output AM	0.01 V	EDH
d-19	Frequency output AO	0.01 Hz*	EEH
d-20	The first fault record		EFH
d-21	The second fault record		F0H
d-22	The third fault record		F1H
d-23	The fourth fault record		F2H
d-24	The fifth fault record		F3H
d-25	The sixth fault record		F4H
d-26	Output frequency at the latest fault	0.01 Hz	F5H
d-27	Set frequency at the latest fault	0.01 Hz	F6H
d-28	Output current at the latest fault	0.1 A	F7H
d-29	Output voltage at the latest fault	1 V	F8H
d-30	DC voltage at the latest fault	1 V	F9H
d-31	Module temperature at the latest fault	0.1 ℃	FAH
d-32	Input terminal status at the latest fault		FBH
d-33	Cumulated running time at the latest fault	1 H	FCH

Function code	Name	Minimum unit	Code address
d-34	Major software version		FDH
d-35	Minor software version		FEH

Code address means the address specified when accessing these monitoring parameters via RS485 interface.

Relation between displayed signals of d-13, d-32 and external input terminals is shown as below:

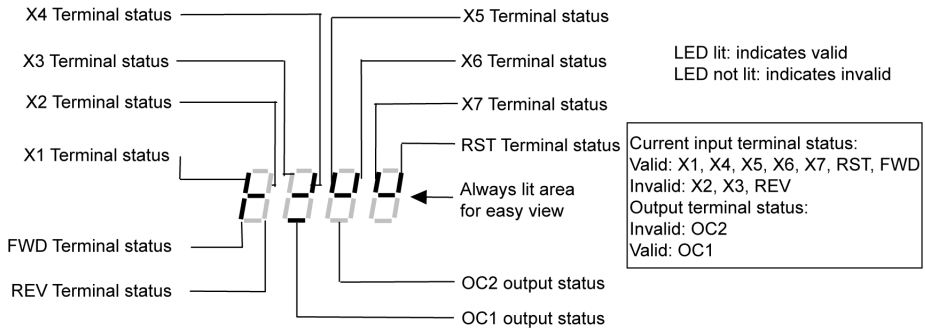


Fig. 5-1: Relation between displayed signals of d-13, d-32 and external input terminals

5.7 Fault and Solution

Fault code	Description	Reason	Solution
Er.01	Overcurrent in acceleration	Too short acceleration time	Increase acceleration time
		Too much torque boost or improper V/F curve	Decrease torque boost, adjust V/F curve
Er.02	Overcurrent in deceleration	Too short deceleration time	Increase deceleration time
Er.03	Overcurrent in running	Sudden load change	Reduce load change
Er.04	Overvoltage in acceleration	Too high input voltage	Check power voltage
		Frequent power on/off	Control on/off with control terminals
Er.05	Overvoltage in deceleration	Too short deceleration time	Increase deceleration time
		Abnormal input voltage	Check power voltage
			Install or reselect braking resistor
Er.06	Overvoltage in running	Abnormal power voltage	Check power voltage
		Energy feedback load existing	Install or reselect braking resistor
Er.07	Overvoltage in stop	Abnormal power voltage	Check power voltage
Er.08	Undervoltage in running	Abnormal power voltage	Check power voltage
		Large load fluctuation existing	Separate the power supply
Er.09	Frequency converter overload	Too heavy load	Reduce load or use frequency converter with higher capacity
		Too short acceleration time	Increase acceleration time
		Too much torque boost or improper V/F curve	Decrease torque boost, adjust V/F curve
		Low mains voltage	Check mains voltage
Er.10	Motor overload	Too heavy load	Reduce load
		Too short acceleration time	Increase acceleration time
		Low protection coefficient	Increase motor overload protection coefficient (H-2)
		Too much torque boost or improper V/F curve	Decrease torque boost, adjust V/F curve
Er.11	Frequency converter overheat	Air duct blocked	Clear air duct or improve ventilation
		High ambient temperature	Improve ventilation, reduce carrier frequency
		Fan damaged	Replace fan

Fault code	Description	Reason	Solution
Er.12	Self-detection fault	Output short-circuit	Remove possible causes
		Frequency converter damaged	Seek technical support
Er.13	Interference	Interfered during self-detection	Power on again, or press **RESET**
		Misact due to electromagnetic interference around	Add absorber around frequency converter
Er.14	Reserved		
Er.15	IPM fault	Output short-circuit or grounding	Check wiring
		Too heavy load	Seek technical support
Er.16	External device fault	Signal input existing for external device fault input terminal	Check signal source and relevant device
Er.17	Current detection error	Damaged current detection element or circuit	Seek technical support
		Problem with auxiliary power	
Er.18	RS485 communication fault	Error happened for data sending and receiving under serial communication	Check wiring
			Seek technical support
Er.19	PID feedback fault	Feedback signal line disconnected	Check feedback channel
		Sensor error for feedback signal detection	Check sensor
		Feedback signal mismatches with set signal	Check if feedback signal complied with set signal
Er.20	Connection fault with water supply accessories	Select multi-pump constant pressure water supply PID but with no special accessories selected	Use general PID or single pump constant pressure water supply
			Select special accessories
		Problem for connection with accessories	Check if wiring is solid between control panel and accessories

5.8 Fault Record Reading

The latest 6 fault codes and output parameters for the last fault are recorded, which are helpful for troubleshooting.

Fault information and status monitoring parameters are stored together, please refer to operating panel descriptions.

Monitoring item	Content
d-20	The first fault record
d-21	The second fault record
d-22	The third fault record
d-23	The fourth fault record
d-24	The fifth fault record
d-25	The sixth fault record
d-26	Output frequency at the latest fault
d-27	Set frequency at the latest fault
d-28	Output current at the latest fault
d-29	Output voltage at the latest fault
d-30	DC voltage at the latest fault
d-31	Module temperature at the latest fault
d-32	Input terminal status at the latest fault
d-33	Cumulated running time at the latest fault

6 Parameter Settings

6.1 Basic Parameters (Group b)

b-0	Running parameter selection
Setting range	0~6
Factory default	1

This parameter is used to set application type (G type/P type) of the frequency converter, as well as the current controlled parameters, which can be defined by users on demand for simplified operation (see chapter 4.2 "Term Explanation" on page 51 for details).

- G type
  - [b-0]=0: Basic parameters
  - [b-0]=1: Intermediate parameters
  - [b-0]=2: Advanced and extended application parameters
- P type
  - [b-0]=4: Basic parameters
  - [b-0]=5: Intermediate parameters
  - [b-0]=6: Advanced and extended application parameters
- [b-0]=0/4: Basic parameters

  The operation of frequency converter is only controlled by basic parameters (b-0 to b-11), other groups are deactivated and invisible.
- [b-0]=1/5: Intermediate parameters

  The operation of frequency converter is controlled by basic parameters (b-0 to b-11) and intermediate parameters (L-0 to L-73), other groups are deactivated and invisible.
- [b-0]=2/6: Advanced and extended application parameters

  The operation of frequency converter is controlled by basic parameters (b-0 to b-11), intermediate parameters (L-0 to L-73), advanced parameters (H-0 to H-70) and extended application parameters (E-0 to E-29).
- [b-0]=3: Reserved

- When changing from basic setting to advanced setting, the original advanced parameters will only be restored automatically after power off.
- 0.75~2.2 kW cannot be set as P type machine, please select the frequency converter with the same power as motor.

b-1	Frequency input channel selection
Setting range	0~25
Factory default	0

This parameter is used to set the frequency input channel and frequency saving function.

- [b-1]=0/16: Panel potentiometer

  Set running frequency via potentiometer on the operating panel.

- [b-1]=1/17: Panel digital setting

  Set running frequency via keys on the operating panel, and press **ENTER** to save the set frequency. Selecting 17 will automatically save the set frequency.

- [b-1]=2/18: External voltage signal 1

  Set running frequency via external analog voltage input terminal VI1 (0~10 V).

- [b-1]=3/19: External voltage signal 2

  Set running frequency via external analog voltage input terminal VI2 (-10 to 10 V).

- [b-1]=4/20: External current signal

  Set running frequency via external analog current input port II (0~20 mA).

- [b-1]=5/21: ▲/▼ terminal increment/decrement control

  Set running frequency via external control terminal ▲/▼ (select ▲/▼ via L-47 to L-53). The running frequency increases when UP-CM is closed and decreases when DW-CM is closed. It keeps unchanging when ▲/▼ and CM are closed or open at the same time. Frequency increases or decreases according to the set Acc./Dec. time. When this parameter is set as 21, the set frequency will be saved automatically.

- [b-1]=6/22: External pulse signal

  Set running frequency via external pulse signal. Pulse input terminal can be selected via L-53 (X7).

- [b-1]=7/23: RS485 interface

  Receive the frequency command from PC via RS485 interface, which is used when frequency is set by external PC or when the frequency converter is set as slave in multiple frequency converters control.

- [b-1]=8/24: Combined setting

  Set running frequency via linear combination of setting channels which are defined by L-25.

- [b-1]=9/25: External terminal selection

  Select frequency setting channel via external terminals (select terminals via L-47 to L-53). Relation between terminal status and frequency setting channel is shown as below:

Frequency setting terminal			Frequency setting channel
3	2	1	
0	0	0	Panel potentiometer
0	0	1	Panel digital setting
0	1	0	External voltage signal VI1
0	1	1	External voltage signal VI2
1	0	0	External current signal II
1	0	1	▲/▼ terminal
1	1	0	External pulse
1	1	1	RS485 interface

- "0": means the corresponding terminal is open with CM.
- "1": means the corresponding terminal is closed with CM.

- [b-1]=10: Start with frequency set by E-29

  The frequency converter runs with the frequency set by E-29 at each startup, and the default setting for E-29 means the frequency is set to 10 Hz.

- When [b-1]=0–10, the frequency is **NOT** automatically saved
- When [b-1]=16–25, the frequency is automatically saved

b-2	Frequency digital setting/PID digital setting/Pressure digital setting
Setting range	0.00–upper frequency/0.0 %–100.0 %/[E-17]–[E-18] MPa
Factory default	0.0

This parameter has multiple functions. It is only used for frequency digital setting when internal PID is disabled. In this case, the output frequency is set by this parameter if the frequency input channel is set as panel digital setting ([b-1]=1).

It is used for PID digital setting when the internal PID function is enabled as general PID control ([E-0]=1). In this case, the PID setting percentage of the frequency converter is set by this parameter if the PID setting channel is set as panel digital setting ([E-1]=1).

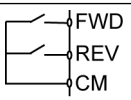
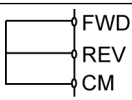
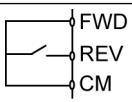
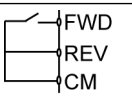
It is used for pressure value setting when the internal PID function is enabled as constant water supply specific control ([E-0]>1).

When the operating panel is under status monitoring mode, pressing ▲ or ▼ can modify this parameter directly, see chapter 4.5 "Keypad Operation" on page 56 for details.

b-3	Running command channels
Setting range	0~5
Factory default	0

This parameter is used to set the run or stop command channel for the frequency converter.

- [b-3]=0/5: Panel control. Users can run or stop the frequency converter via **FWD**, **REV**/**JOG**, **STOP**/**RESET** on the operating panel. When [b-3]=5, the running direction is decided by status of external terminal FWD-CM: the frequency converter runs forwardly when FWD-CM is open and reversely when it is closed. The panel jogging direction is also decided by the status of FWD-CM.
- [b-3]=1: External terminal (keypad **STOP** invalid). Users can run or stop the frequency converter via status (closed/open) of control terminals FWD, REV and CM. The default setting is shown as below:

Command	Stop		Forward	Reverse
Terminal status				

 In this mode, the key **STOP**/**RESET** on the panel is invalid.

- [b-3]=2: External terminal (keypad **STOP** valid). The functions are basically the same as [b-3]=1: External terminal (keypad **STOP** invalid). In this mode, users can stop the frequency converter via **STOP** on the operating panel. To resume running, users must firstly input Stop command via external terminals, and then input Run command.
- [b-3]=3: RS485 interface (keypad **STOP** invalid). Running command is received from RS485 interface, and generally sent out via external PC or the master frequency converter in the multiple frequency converters control mode. In this mode, the key **STOP**/**RESET** is invalid.
- [b-3]=4: RS485 interface (keypad **STOP** valid). The functions are basically the same as [b-3]=3: RS485 interface (keypad **STOP** invalid). In this mode, users can stop the frequency converter via **STOP**/**RESET** on the operating panel. To restart the frequency converter, users must firstly input Stop command via RS485 interface, and then input Run command.

b-4	Direction control
Setting range	0~2
Factory default	2

This parameter is used to change the output phase sequence, accordingly changing the running direction of the motor.

- [b-4]=0: Same as the set direction
- [b-4]=1: Opposite to the set direction

In this mode, the actual output phase sequence is opposite to the set one, for example: in mode of external control, activate the FWD-CM, the motor will run reversely instead of forwardly, and the key **FWD** also works as reverse.

- [b-4]=2: Reverse run preventing

  The frequency converter will only run forwardly, ignoring all other direction commands.

This parameter works together with direction control via external terminals.

b-5	Upper frequency
Setting range	Upper frequency–650.0 Hz
Factory default	50.00 Hz

The upper limit output frequency of the frequency converter is represented as f_U in the following descriptions.

b-6	Rated motor frequency
Setting range	5.00–650.00 Hz
Factory default	50.00 Hz
b-7	**Rated motor voltage**
Setting range	200–500 V
Factory default	380 V

Please set the motor parameters as specified on the motor nameplate.

b-8	Acc. time 1
Setting range	0.1–6000s
Factory default	*
b-9	**Dec. time 1**
Setting range	0.1–6000s
Factory default	*

Acc. time 1 means the time needed for output frequency increasing from 0.0 Hz to the base frequency.

Dec. time 1 means the time needed for output frequency decreasing from the base frequency to 0.0 Hz.

The default base frequency is 50.00 Hz.

b-10	Acc./Dec. mode
Setting range	0–1
Factory default	0

- [b-10]=0: Linear

  Linear Acc./Dec. is applicable to most loads.

- [b-10]=1: S curve

  S curve is mainly applicable to loads, for which the noise and vibration, as well as the shocking in run/stop need to be reduced during acceleration/ deceleration, as shown below:

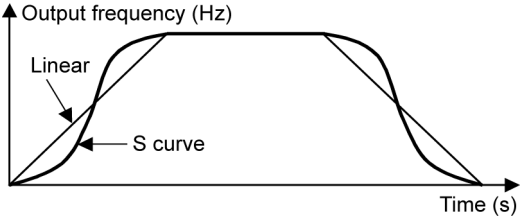


Fig. 6-1: Acceleration/deceleration curve

b-11	Parameter initialization
Setting range	0~2
Factory default	0

This parameter is used to restore parameters to factory defaults.

- [b-11]=0: No action
- [b-11]=1: Initialization
- [b-11]=2: Clear fault record

- Parameters b-0, b-1 and b-3 will not be initialized.
- For firmware of V1503.1015 or later versions, L-46 will be initialized.

6.2 Intermediate Parameters (Group L)

L-0	V/F curve selection
Setting range	0~6
Factory default	0

- [L-0]=0: Constant torque curve

  The output voltage is in direct ratio with the output frequency, which is applicable to most loads.

- [L-0]=1: Decrement torque curve 1

  The output voltage is in square curve with the output frequency, which is applicable to loads like fan, pump, etc.

- [L-0]=2: Decrement torque curve 2

  The output voltage is in square curve with the output frequency, which is applicable to constant power loads like fan, pump, etc. Please switch to run in decrement torque curve 1 mode if it is unstable with light load.

- [L-0]=3: User-defined V/F curve

  Users can set V/F curve by setting parameters L-3 to L-8.

- [L-0]=4: Constant torque correction

  Users can partially correct the constant torque curve via parameters L-3 to L-8.

- [L-0]=5: Decrement torque correction 1

  Users can partially correct the decrement torque curve 1 via parameters L-3 to L-8.

- [L-0]=6: Decrement torque correction 2

  Users can partially correct the decrement torque curve 2 via parameters L-3 to L-8.

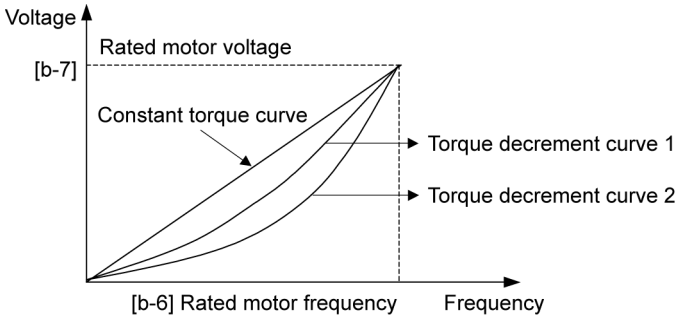


Fig. 6-2: V/F curve

L-1	Torque boost
Setting range	0 %–20 %
Factory default	*

This parameter is used to improve the low-frequency torque characteristics of the frequency converter. When the frequency converter runs in low frequency mode, the output voltage can be compensated with the boost.

Boost voltage=[L-1]/200 x rated motor voltage

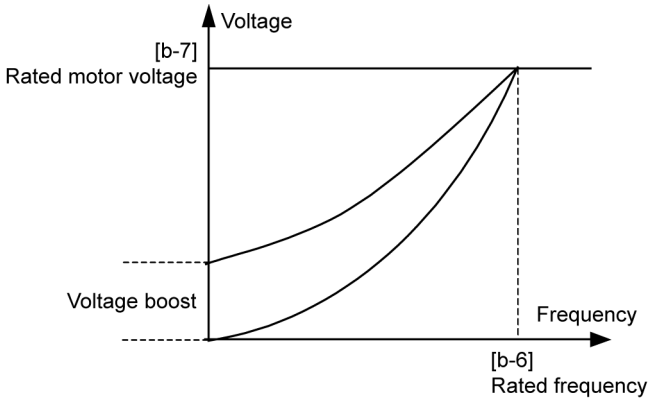


Fig. 6-3: Torque boost for decrement torque curve

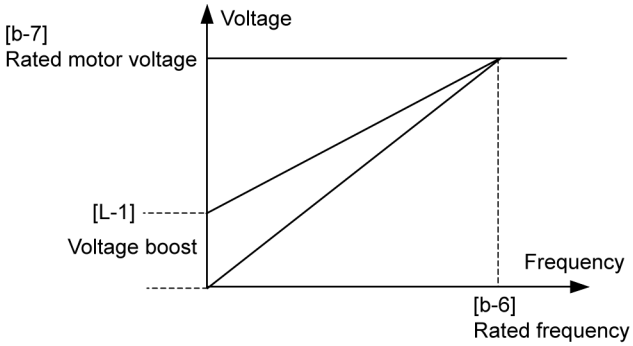


Fig. 6-4: Torque boost for constant torque curve

Too much torque boost may cause overcurrent protection or starting failure.

L-2	Torque boost mode
Setting range	0–1
Factory default	0

- 0: Manual torque boost

  The torque boost voltage is completely decided by L-1. In this mode, the voltage boost performance is stable, while the motor is easy to get magnetic saturation with light load.

- 1: Auto torque boost

  The torque boost voltage is dependent on the current of motor stator.

$$\text{Voltage boost} = \frac{[L\text{-}1]}{200} \times \text{rated motor voltage} \times \frac{\text{output current (frequency converter)}}{2 \times \text{rated current (frequency converter)}}$$

Fig. 6-5: Torque boost formula

Function code	Name	Setting range	Factory default
L-3	V/F frequency 1	0.00 Hz–[L-5]	12.50
L-4	V/F voltage 1	0 %–120 %	25
L-5	V/F frequency 2	[L-3]–[L-7]	25.00
L-6	V/F voltage 2	0 %–120 %	50
L-7	V/F frequency 3	[L-7]–upper frequency	37.50
L-8	V/F voltage 3	0 %–120 %	75

When [L-2]=0/1, the parameters above are used for user-defined V/F curve, as shown below:

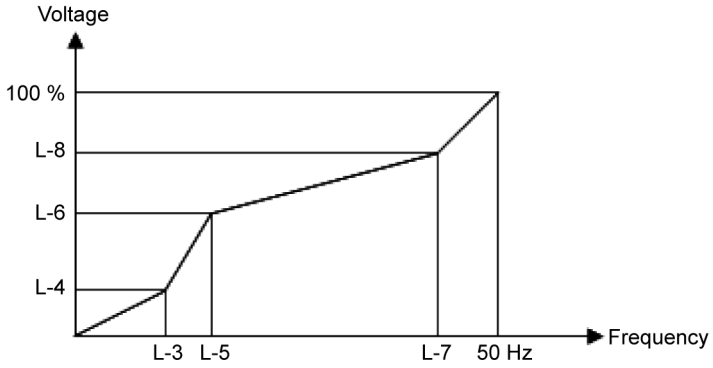


Fig. 6-6: User-defined V/F curve setting

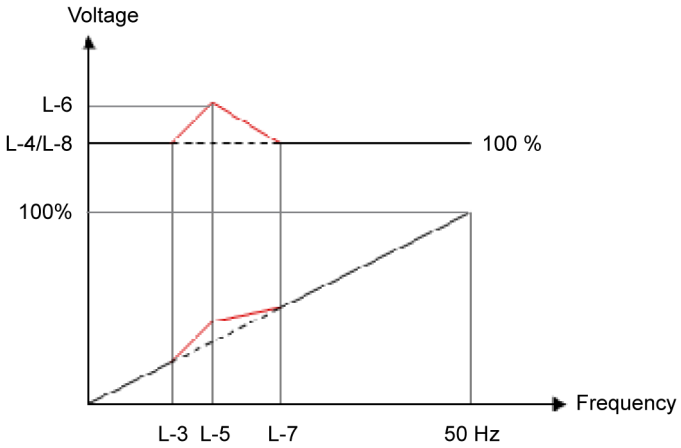


Fig. 6-7: V/F curve correction

L-9	Carrier frequency
Setting range	1.0–15.0 kHz
Factory default	*

This parameter mainly affects noise and heating effect when the frequency converter is running:

- When the carrier frequency is higher, the motor noise reduces, and the temperature rise increases;
- When the carrier frequency is lower, the motor noise raises, and the temperature rise decreases.

Also:

- When the motor power is higher, users can select the lower carrier frequency to refuce the interference of the frequency converter to other devices;
- When the carrier frequency exceeds the maximum carrier frequency, please derate the frequency converter;
- When the ambient temperature is high and the motor load is heavy, the carrier frequency should be properly reduced to improve the heat characteristic of the frequency converter. Please consider that the limit of the highest carrier frequency differs for different power models.

The limit of the highest carrier frequency differs for different power models.

L-10	Lower frequency
Setting range	0.00–upper frequency
Factory default	0.50

L-11	Lower frequency running mode
Setting range	0~1
Factory default	0

The lower frequency is represented as f_L in the following descriptions.

When the set frequency is below the lower frequency, the frequency converter will reduce the output frequency; after the output frequency reaches the lower frequency, the frequency converter decides the steady outputs according to the lower frequency running modes: if [L-11]=0 (stop mode), the frequency converter will keep reducing the output frequency until it stops; if [L-11]=1 (run mode), the frequency converter will run with lower frequency.

The lower frequency in stop mode works as below:

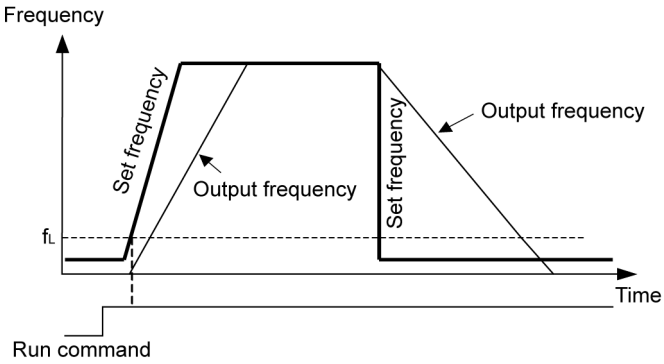


Fig. 6-8: Working with lower frequency in stop mode ([L-11]=0)

L-12	Starting mode
Setting range	0~2
Factory default	0

- [L-12]=0: Start with starting frequency. After receiving the command, the frequency converter runs with the starting frequency [L-13], then accelerates/decelerates to set frequency after being held for time of "Starting frequency holding time" [L-14].
- [L-12]=1: Firstly brake, then start. The frequency converter firstly imposes certain DC braking energy (i.e. electromagnetic brake, defined in L-15, L-16) to the load motor, then start, which is applicable to low-inertial load with forward or reverse run in stop mode.
- [L-12]=2: Start with speed tracking. The frequency converter firstly detects the motor speed, and then accelerates/decelerates to the set frequency with the detected speed.

L-13	Starting frequency
Setting range	0.00–10.00 Hz
Factory default	0.50 Hz
L-14	**Starting frequency holding time**
Setting range	0.0–20.0s
Factory default	0.0s

The starting frequency is used together with torque boost for best adjustment of starting torque performance, while overcurrent may occur if the set value is too high.

The starting frequency holding time means the time running with the starting frequency. If the set frequency is lower than the starting frequency, the frequency converter firstly runs with the starting frequency, then decelerates to the set frequency after being held for starting frequency holding time [L-14]. Start with the starting frequency is shown as below:

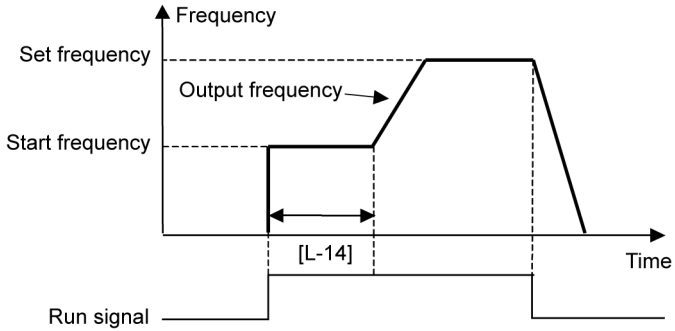


Fig. 6-9: Start with the starting frequency

L-15	DC braking voltage at startup
Setting range	0 %–15 %
Factory default	0.50 %
L-16	**DC braking time at startup/zero frequency braking valid**
Setting range	0.0–20.0s/0.1–20.0s; 0.0s
Factory default	0.0s

When the frequency converter is firstly braked, then started, the DC braking at startup function is enabled. This parameter is used to set the corresponding DC braking voltage and holding time. The frequency converter outputs DC voltage when it is under DC braking. Start with DC braking is shown as below:

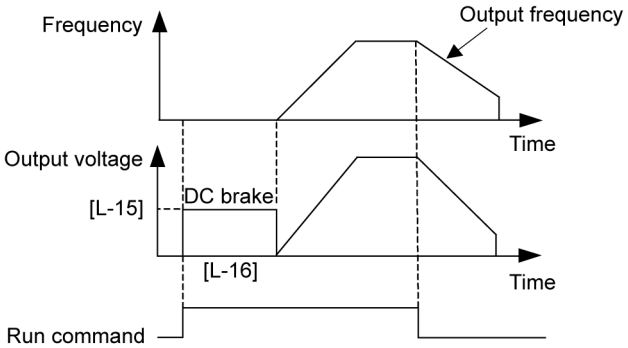


Fig. 6-10: Start with DC braking

When [L-16]=0, the zero frequency braking is enabled, and the braking voltage is set by L-15.

L-17	Stopping mode
Setting range	0–1
Factory default	0

- [L-17]=0: Decelerate to stop

  In stop mode, the frequency converter decelerates to stop according to the set deceleration time.

- [L-17]=1: Freewheel to stop

  In stop mode, the output is blocked and the motor is freewheeling to stop.

In freewheel-to-stop mode, if the frequency converter runs with zero frequency before the motor stops completely, overcurrent or overvoltage protection may occur, so please set [L-12]=2 to start the frequency converter with speed tracking.

L-18	Stopping DC braking initial frequency
Setting range	0.00–15.00 Hz
Factory default	3.00 Hz
L-19	**Stopping DC braking time**
Setting range	0.0–20.0s
Factory default	0.0s
L-20	**Stopping DC braking voltage**
Setting range	0 %–15 %
Factory default	5 %

Parameters L-18 to L-20 are used to define the stopping DC braking function for the frequency converter. If the output frequency is lower than the DC braking in-

itial frequency when the frequency converter is in stopping, the DC braking will be enabled.

The stopping DC braking time L-19 means the time held for DC braking. When [L-19]=0, the stopping DC braking function is disabled. When it is enabled, the frequency converter outputs DC voltage, as calculated below:

Braking voltage=[L-20]/100 x rated motor voltage

The DC braking function can provide zero speed torque, which is usually used to improve the stopping precision, but cant' be used for deceleration-to-stop under normal running. The stopping DC braking is shown as below:

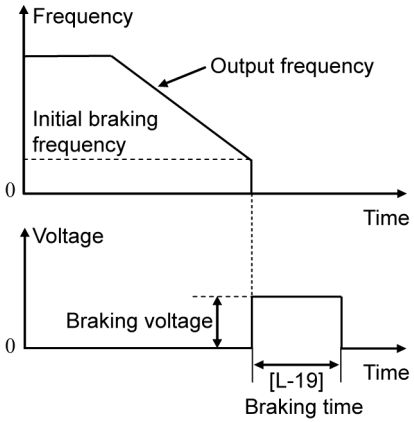


Fig. 6-11: Stopping DC braking

☞ If the DC braking voltage is too high, overcurrent may occur when the frequency converter stops.

L-21	REV/JOG selection
Setting range	0–1
Factory default	0

- [L-21]=0: Reverse

  REV/JOG on the operating panel is used to input the reverse command. The frequency converter will output frequency in reverse phase if pressing this key in panel control mode ([b-3]=0).

- [L-21]=1: Jogging

  REV/JOG on the operating panel is used to input the jog command. The frequency converter will run with the set jog frequency [L-22] by pressing this key.

L-22	Jog frequency
Setting range	0.00–upper frequency

Factory default	10.00
L-23	**Jog Acc. time**
Setting range	0.1–6000s
Factory default	10.0s
L-24	**Jog Dec. time**
Setting range	0.1–6000s
Factory default	10.0s

The jog frequency has the highest priority. As long as the jog command is input, no matter what kind of status the frequency converter runs in, it will immediately switch to jog frequency running according to the set jog acceleration/deceleration time, as shown below:

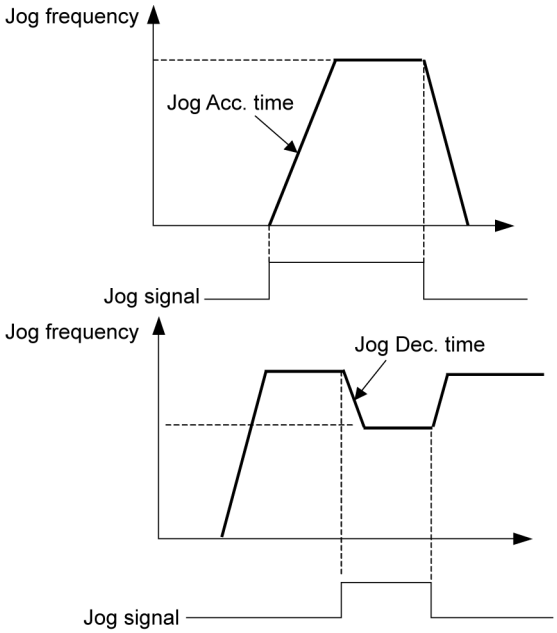


Fig. 6-12: Jog running

L-25	**Frequency input channel combination**
Setting range	100–766
Factory default	101

The set frequency of the frequency converter is defined by the linear combination of multi-frequency input channels.

This parameter is only valid when the frequency input channel is set as "combined setting" ([b-1]=8).

Users can set the hundreds digit to define the combination of two channels, and set the tens digit and units digit to define the data source for the first channel and the second channel respectively. Thus the combined frequency input value is defined by setting the value for units digit, tens digit and hundreds digit.

Detailed as below:

- LED hundreds digit represents one of the 7 combination modes (1−7):
  - 1: 1st channel + 2nd channel
  - 2: 1st channel - 2nd channel
  - 3: 1st channel x 2nd channel
  - 4: Higher value of the two channels
  - 5: Lower value of the two channels
  - 6: Non-zero value of the two channels, 1st channel if non-zero with both channels
  - 7: 1st channel x (2nd channel - 0.5 x 2nd channel + 1)
- LED tens digit represents input mode for the 1st channel, including analog channel and digital channel, altogether 7 modes (0−6):
  - Analog channel:
    - 0: Panel potentiometer
    - 1: External voltage signal 1
    - 2: External voltage signal 2
    - 3: External current signal
    - 4: External pulse signal
  - Digital channel:
    - 5: Panel digital setting
    - 6: RS485 interface
- LED units digit represents input mode for the 2nd channel, including analog channel and digital channel, altogether 7 modes (0−6):
  - Analog channel:
    - 0: Panel potentiometer
    - 1: External voltage signal 1
    - 2: External voltage signal 2
    - 3: External current signal
    - 4: External pulse signal
  - Digital channel:
    - 5: Panel digital setting
    - 6: RS485 interface

When analog channel (0−4) is selected, the analog value scaled at 0 represents 0 Hz, the analog value with full scale represents 50 Hz. For example: for external voltage signal 1, inputting 0 V means 0 Hz, inputting 10 V means 50 Hz, which bears strict linear relation also.

Example 1:

When [L-25]=123, the combined input frequency is:

External voltage signal 2 (1st channel) + external current signal (2nd channel). When frequency input channel combination [L-25] (LED hundreds digit)=3 (1st channel x 2nd channel), the 1st channel represents base frequency, and the 2nd channel represents proportion factor. Set frequency=1st channel frequency*Kx(2nd channel proportion factor).

When analog value input is selected as the 2nd channel (0−4), the proportion factor is calculated as below:

Kx=Inx*Ax

Among which:

- Kx: the 2nd channel proportion factor
- Inx: analog input value (in this case, when the analog value is input, the input with full scale is represented as 100.00 %. For example: 1 (external voltage signal 1) is selected as input, inputting 10 V is shown as 100.00 %).
- Ax: parameters for gain adjustment corresponding to channels 0−4 are:
  - 0: Panel potentiometer (L-26)
  - 1: External voltage signal 1 (L-29)
  - 2: External voltage signal 2 (L-32)
  - 3: External current signal (L-38)
  - 4: External pulse signal (L-43)

Example 2:

When [L-25]=310, the combined input frequency will be: (1st channel x 2nd channel). Here the 1st channel (base frequency) represents external voltage signal 1, the 2nd channel (proportion factor) Kx=Inx*324.00 % when it selects 0 and the corresponding gain [L-26]=3.24, which means Kx can be adjusted from 0 % to 324.00 %. So the combined input frequency will be: external voltage signal 1*Kx, that is, (VI1 set frequency) x (0 %−324.00 %).

When digital value input is selected as the 2nd channel (5−6), the relation between digital value and gain is shown as below:

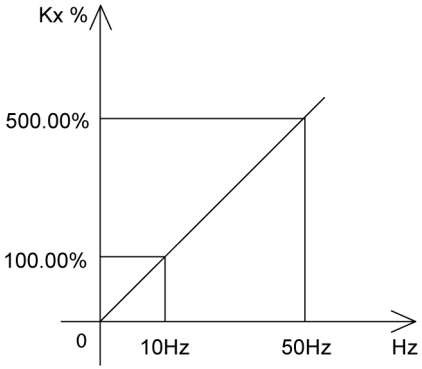


Fig. 6-13: Relation between digital value and gain

Example 3:

When [L-25]=315, the combined input frequency will be: (1st channel x 2nd channel). Here the 1st channel (base frequency) represents external voltage signal 1, the 2nd channel (proportion factor) = 230.00 % when it selects 5 (panel digital setting) and the panel digital setting=23.00. So the combined input frequency will be: external voltage signal 1 x 230.00 % (Hz).

L-26	Gain coefficient for panel potentiometer input
Setting range	0.01~5.00
Factory default	1.00

This parameter is used to adjust the panel potentiometer gain in mode of frequency input combination, for details please see L-25.

L-27	VI1 input lower voltage
Setting range	0.00 V~[L-28]
Factory default	0.00 V
L-28	**VI1 input upper voltage**
Setting range	[L-27]~10.00 V
Factory default	10.00 V
L-29	**VI1 input adjusting coefficient**
Setting range	0.01~5.00
Factory default	1.00

These parameters are used to define the range of analog input voltage channel VI1, which needs to be set according to the actual input signal.

The input adjusting coefficient is used to correct the input voltage, and the weight coefficient can be modified in combined setting mode.

L-30	VI2 input lower voltage
Setting range	-10.0 V~[L-31]
Factory default	0.0 V
L-31	**VI2 input upper voltage**
Setting range	[L-30]~10.0 V
Factory default	10.0 V
L-32	**VI2 input adjusting coefficient**
Setting range	0.01~5.00
Factory default	1.00

These parameters are used to define the range of analog input voltage channel VI2, which needs to be set according to the actual input signal.

The input adjusting coefficient is used to correct the input voltage, and the weight coefficient can be modified in combined setting mode.

L-33	VI2 input zero offset
Setting range	-1.00~1.00 V
Factory default	0.00 V
L-34	**VI2 input bipolar control**
Setting range	0: Invalid; 1: Valid
Factory default	0
L-35	**VI2 input bipolar control zero hysteresis width**
Setting range	0.00~1.00 V
Factory default	0.20 V

These parameters are used to set the bipolar control of the voltage input channel VI2.

The bipolar control means the output phase sequence (or motor direction) of the frequency converter is decided by the polarity of input voltage VI2, where all other direction commands are ignored. When voltage VI2>0, positive phase sequence is output and the motor runs forwardly; when voltage VI2<0, negative phase sequence is output and the motor runs reversely (if [b-4]=1, the setting of this parameter is ignored).

Bipolar control function is only enabled when VI2 ([b-1]=3) is selected as the frequency input channel, where the frequency value is decided by the absolute value of input voltage VI2.

In the mode of unipolar control ([L-34]=0) and bipolar control ([L-34]=1), the relation between VI2 and set frequency is respectively shown as below:

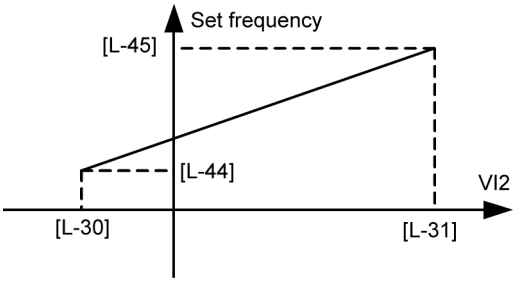


Fig. 6-14: Relation between VI2 and set frequency in unipolar control

In unipolar control, the VI2 input lower voltage [L-30] can be higher or lower than 0, while the linear relation between VI2 and the set frequency unchanged. When [L-30]<0, the output phase sequence is decided by the external terminal or the panel.

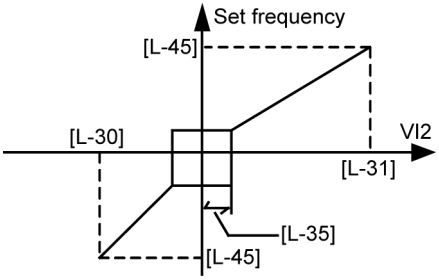


Fig. 6-15: Relation between VI2 and set frequency in bipolar control

In bipolar control, L-34 is invalid (default as 0). When VI2>0, the input voltage VI2 between 0−[L-31] is in linear relation with the set frequency between 0.0 Hz −[L-45], and the positive phase sequence is output. When VI2<0, the input voltage VI2 between 0−[L-30] is in linear relation with frequency between 0.0 Hz−[L-45], and the negative phase sequence is output.

L-35 is used to define the hysteresis width of phase sequence control when voltage passes zero.

When the same polarity is set for the upper and lower limit of the VI2 input channel (i.e. L-30 and L-31 are higher or lower than 0 at the same time), even it is in bipolar control mode, it is still invalid.

L-32 is used to adjust the zero position of the input voltage VI2, which is meaningless in unipolar control mode.

L-36	**II input lower current**
Setting range	0.00 mA−[L-37]
Factory default	4.00 mA
L-37	**II input upper current**

Setting range	[L-36]–20.00 mA
Factory default	20.00 mA
L-38	**II input adjusting coefficient**
Setting range	0.01–5.00
Factory default	1.00

These parameters are used to define the range of analog input current channel II, which needs to be set according to the actual input signal.

The input adjusting coefficient is used to correct the input current, and the weight coefficient can be modified in combined setting mode.

L-39	**Suppression analog input setting swing**
Setting range	0–30
Factory default	3

Analog input setting swing can be suppressed by increasing the value of L-39 when there is a severe interference, which is valid to all analog input channels.

L-40	**Analog input filtering time**
Setting range	0.01–5.00s
Factory default	0.20s

This parameter means the time constant for the frequency converter to internally filter the sampling value when the frequency is set by external analog channel or panel potentiometer. The unstable set frequency caused by long wiring or severe interference can be alleviated by increasing the analog input filtering time L-40.

L-41	**Pulse input lower frequency**
Setting range	0.000 kHz–[L-42]
Factory default	0.000 kHz
L-42	**Pulse input upper frequency**
Setting range	[L-41]–50.00 kHz
Factory default	10.00 kHz
L-43	**Pulse input adjusting coefficient**
Setting range	0.01–5.00
Factory default	1.00

These parameters are used to define the frequency range of pulse input channel, which needs to be set according to the actual input signal.

The input adjusting coefficient is used to correct the pulse input frequency, and the weight coefficient can be modified in combined setting mode.

L-44	**Set frequency for lower input**
Setting range	0.00 Hz–upper frequency
Factory default	0.00 Hz

L-45	Set frequency for upper input
Setting range	0.00 Hz–upper frequency
Factory default	50.00 Hz

These parameters are used to define the relation between external input value and set frequency.

The external input value includes: input voltage VI1, input voltage VI2, input current II and external pulse, with upper and lower limit defined in L-27 to L-42. The set frequency corresponding to the minimum analog input (f_{min}) means the set frequency corresponding to the lower limit of these input values; the set frequency corresponding to the maximum analog input (f_{max}) means the set frequency corresponding to the upper limit of these input values.

The relation between input value and set frequency is shown as below:

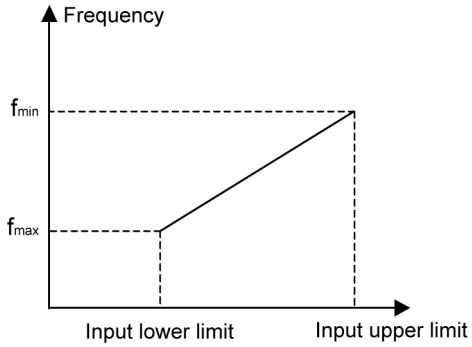


Fig. 6-16: Relation between input value and set frequency_1

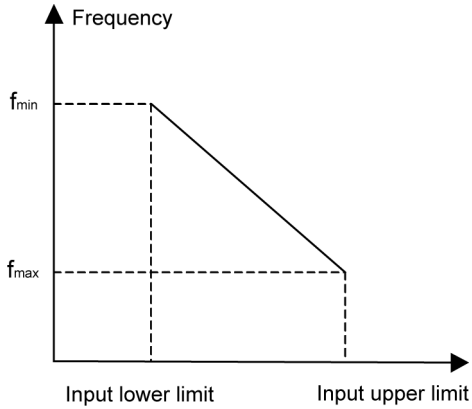


Fig. 6-17: Relation between input value and set frequency_2

L-46	External running command modes
Setting range	0–5
Factory default	0

This parameter is used to set the control modes of external running commands:

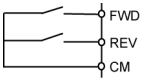
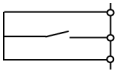
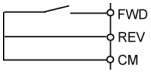
When [L-46]=0 or 1, if FWD/REV is connected after power-on, the frequency converter will not start. Please disconnect and then connect the control terminal, the frequency converter will start.

When [L-46]=4 or 5, if FWD/REV is connected after power-on, the frequency converter starts automatically (same to the function of [L-46]=0 or 1 in version 1503.1016 or earlier).

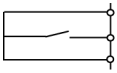
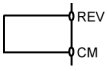
- This parameter is only enabled when external control ([b-3]=1, 2) is selected.
- For V1503.1015 and later versions, b-11 "Parameter initialization" is valid for this parameter.

- [L-46]=0/4: 2-line control 1

  The frequency converter is set in this mode by default.

Command	Stop		Forward	Reverse
Terminal status				

- [L-46]=1/5: 2-line control 2

Command	Stop	Run	Forward	Reverse
Terminal status				

- [L-46]=2: 3-line control

  A 3-line control terminal must be selected for the 3-line control mode (see L-47 to L-53 descriptions). Wiring for the 3-line control mode is shown as below:

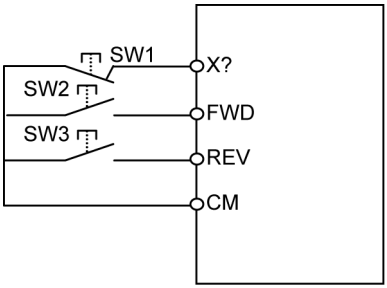


Fig. 6-18: Wiring for the 3-line control mode

"X?" means the 3-line control terminals, which are selected by L-47 to L-53 via input terminal X1−X7. When X1 is selected, the wiring is shown as below:

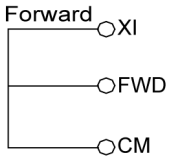


Fig. 6-19: 3-line control_forward

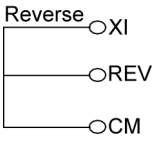


Fig. 6-20: 3-line control_reverse

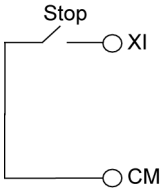


Fig. 6-21: 3-line control_stop

The function of each switch is as below:

- SW1: Stop triggering switch
- SW2: Forward triggering switch
- SW3: Reverse triggering switch

L-47	Input terminal 1 function
Setting range	0–28
Factory default	0
L-48	**Input terminal 2 function**
Setting range	0–28
Factory default	0
L-49	**Input terminal 3 function**
Setting range	0–28
Factory default	0
L-50	**Input terminal 4 function**
Setting range	0–28
Factory default	0
L-51	**Input terminal 5 function**
Setting range	0–28
Factory default	6
L-52	**Input terminal 6 function**
Setting range	0–29
Factory default	7
L-53	**Input terminal 7 function**
Setting range	0–30
Factory default	30

These parameters are used to select functions for programmable input terminals X1–X7:

- 0: Control terminal in idle
- 1: Multi-control terminal 1
- 2: Multi-control terminal 2
- 3: Multi-control terminal 3
- 4: Multi-control terminal 4
- 5: Forward jog control
- 6: Reverse jog control
- 7: Freewheel-to-stop control
- 8: External device fault input
- 9: Acc./Dec. time terminal 1
- 10: Acc./Dec. time terminal 2
- 11: Frequency increment control (▲)
- 12: Frequency decrement control (▼)

- 13: Frequency setting channel terminal 1
- 14: Frequency setting channel terminal 2
- 15: Frequency setting channel terminal 3
- 16: Simple PLC pause
- 17: 3-line control
- 18: DC braking control
- 19: Internal timer triggering terminal
- 20: Internal timer resetting terminal
- 21: Internal counter zeroing terminal
- 22: Closed-loop control invalid
- 23: Coupled-control terminal
- 24: PID input 2 enabled
- 25: Zero frequency braking control
- 26–28: Reserved
- 29: Internal counter clock terminal
- 30: External pulse input

When the frequency converter is freewheeling to stop via external terminal, after the external freewheel-to-stop signal is cancelled, the frequency converter will resume operation in speed tracking restart mode.

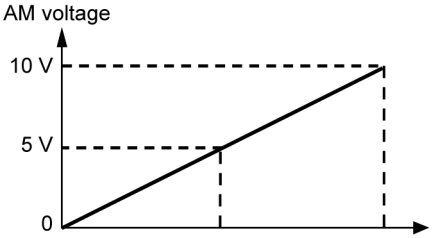
L-54	Analog output (AM) setting
Setting range	0–11
Factory default	0
L-55	**Frequency output (AO) setting**
Setting range	0–11
Factory default	0

0: Output frequency
1: Output current
2: Output voltage
3: Motor speed
4: PID setting
5: PID feedback
6: Panel potentiometer
7: Panel digital setting
8: External voltage signal 1

9: External voltage signal 2

10: External current signal

11: External pulse signal



Setting value		
0:		Upper limit frequency
1:	Rated current	
2:		Rated motor voltage
3:	Rated motor speed	
4:		PID full-scale setting
5:		PID full-scale feedback
6:		Full-scale value for panel potentiometer
7:		Full-scale value for panel digital setting
8:		Full-scale value for external voltage signal 1
9:		Full-scale value for external voltage signal 2
10:		Full-scale value for external current signal
11:		Full-scale value for external pulse signal

Fig. 6-22: Output content for analog output terminal AM

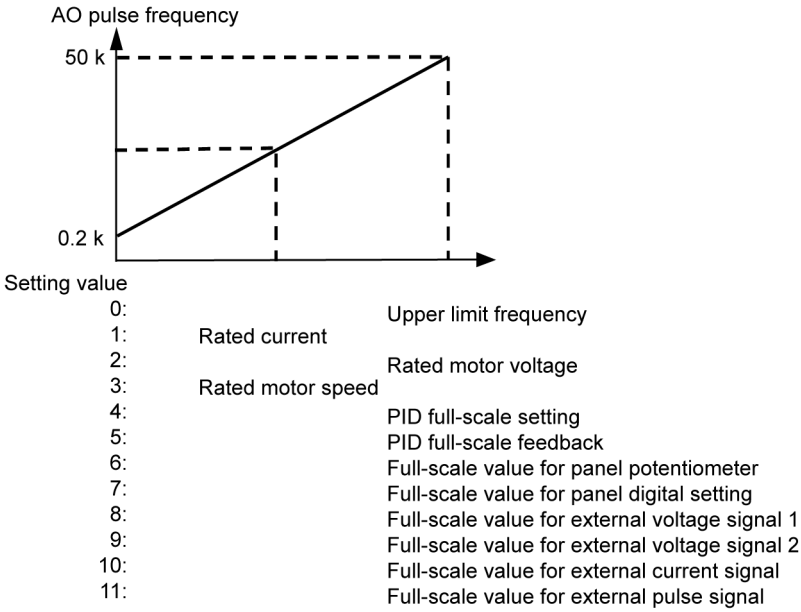


Fig. 6-23: Output content for frequency output terminal AO

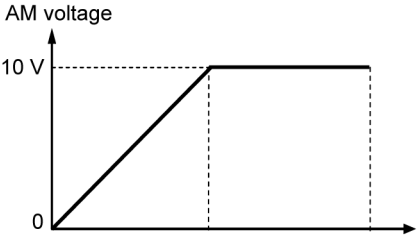
L-56	AM output gain
Setting range	0.50–2.00
Factory default	1.00
L-57	**AO output gain**
Setting range	0.10–5.00
Factory default	1.00

Parameters L-56, L-57 are used to adjust the value of AM output voltage and AO output terminal respectively, that is, the slop shown in fig. 6-24 "[L-56]=2.00" on page 113, fig. 6-25 "[L-57]=5.00" on page 114.

L-58	AO output channels
Setting range	0–6
Factory default	3

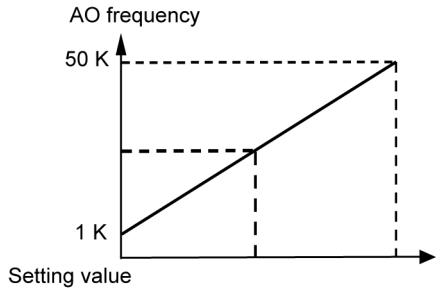
- [L-58]=0: FM output (0–50 kHz)
- [L-58]=1: 0–10 V
- [L-58]=2: 2–10 V
- [L-58]=3: 0–20 mA
- [L-58]=4: 4–20 mA
- [L-58]=5: FM output (0–[b-5] x [L-57])

- [L-58]=6: FM output ([L-62]−[b-5] x [L-57])



Setting value	
0:	Upper limit frequency
1:	Rated current
2:	Rated motor voltage
3:	Rated motor speed
4:	PID full-scale setting
5:	PID full-scale feedback
6:	Full-scale value for panel potentiometer
7:	Full-scale value for panel digital setting
8:	Full-scale value for external voltage signal 1
9:	Full-scale value for external voltage signal 2
10:	Full-scale value for external current signal
11:	Full-scale value for external pulse signal

Fig. 6-24: [L-56]=2.00



0:	Upper limit frequency
1:	Rated current
2:	Rated motor voltage
3:	Rated motor speed
4:	PID full-scale setting
5:	PID full-scale feedback
6:	Full-scale value for panel potentiometer
7:	Full-scale value for panel digital setting
8:	Full-scale value for external voltage signal 1
9:	Full-scale value for external voltage signal 2
10:	Full-scale value for external current signal
11:	Full-scale value for external pulse signal

Fig. 6-25: [L-57]=5.00

- When [L-58]=0, 5 or 6 (pulse output), JP3 wiring is shown as below:

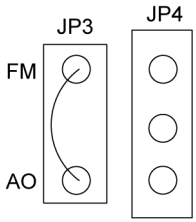


Fig. 6-26: [L-58]=0, 5 or 6

Short circuit the AO and FM of JP3 to output frequency FM.

- When [L-58]=1 or 2, JP4 wiring is shown as below:

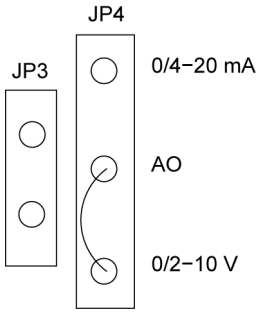


Fig. 6-27: [L-58]=1 or 2

Remove the jumper cap from AO and FM of JP3, then short circuit AO of JP4 with 0/2−10 V, as shown in the figure above.

– When [L-58]=1, the external terminal AO outputs 0−10 V;
– When [L-58]=2, the external terminal AO outputs 2−10 V.

- When [L-58]=3 or 4, JP4 wiring is shown as below:

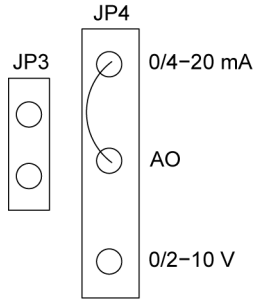


Fig. 6-28: [L-58]=3 or 4

Remove the jumper cap from AO and FM of JP3, then short circuit AO of JP4 with 0/4−20 mA, as shown in the figure above.

– When [L-58]=3, the external terminal AO outputs 0−20 mA;
– When [L-58]=4, the external terminal AO outputs 4−20 mA.

- When [L-58]=5 or 6, low frequency pulse signal is output.

  If [L-58]=6, users can set the initial frequency offset L-62 (shared with frequency arriving at detection width).

- The setting of L-58 also decides the output display of d-19 (AO output display):

  – When [L-58]=0, 5 or 6, d-19 displays AO output frequency, corresponding to current running frequency (corresponding relation is decided by users);

– When [L-58]=1 or 2, d-19 displays AO output voltage, corresponding to current running frequency (corresponding relation is decided by users);
– When [L-58]=3, d-19 displays AO output current, corresponding to current running frequency (corresponding relation is decided by users).

L-59	OC1 output setting
Setting range	0–23 (24–26 are reserved)
Factory default	0
L-60	**OC2 output setting**
Setting range	0–23 (24–26 are reserved)
Factory default	1
L-61	**Relay output functions**
Setting range	0–23 (24–26 are reserved)
Factory default	18

These parameters are used to define the content of the open collector output terminal OC1, OC2 and relay output.

The internal wiring for OC output terminal is shown as below, or please see fig. 3-42 "OC1, OC2 outputs with external power supply" on page 47 and fig. 3-43 "OC1, OC2 outputs with internal power supply" on page 47.

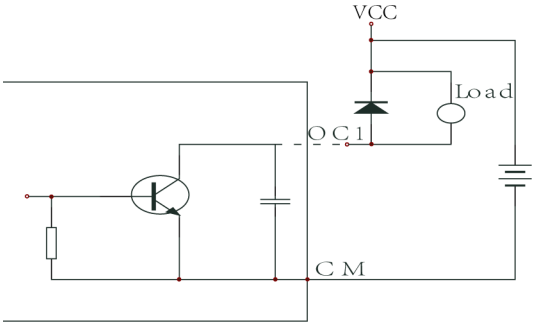


Fig. 6-29: Internal wiring for OC output terminal

In relay output, TA-TB is always closed, and TA-TC is always open.

When an inductive component such as relay coil is connected externally, the freewheeling diode "D" must be connected in parallel.

- 0: Frequency converter in running

  The frequency converter outputs valid signal (low level) when it is running and outputs invalid signal (high resistance) when it stops.
- 1: Frequency arrival

When the output frequency is reaching the set frequency to certain extent (range decided by L-62 and fixed as 5.00 Hz when [b-0]=0), the frequency converter outputs valid signal (low level), as shown below:

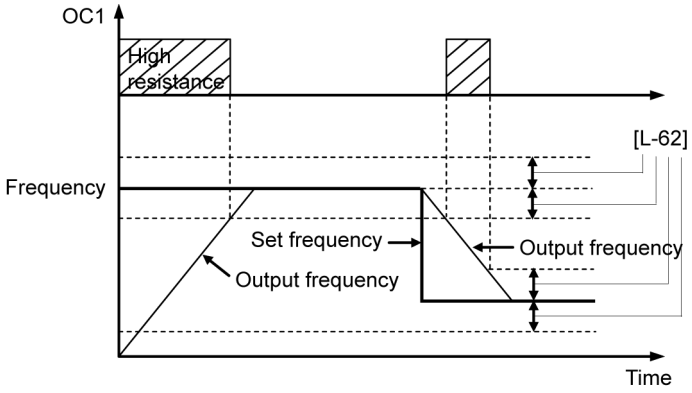


Fig. 6-30: Frequency arrival signal

DC 24 V/50 mA is recommended if external power is needed.

- 2: Frequency level detection signal (FDT)

  When the output frequency exceeds FDT frequency level, the frequency converter outputs valid signal (low level) after passing the set delay time; when the output frequency is below FDT frequency level, the frequency converter outputs invalid signal (high resistance) after passing the same set delay time. Frequency level detection (FDT) is shown as below:

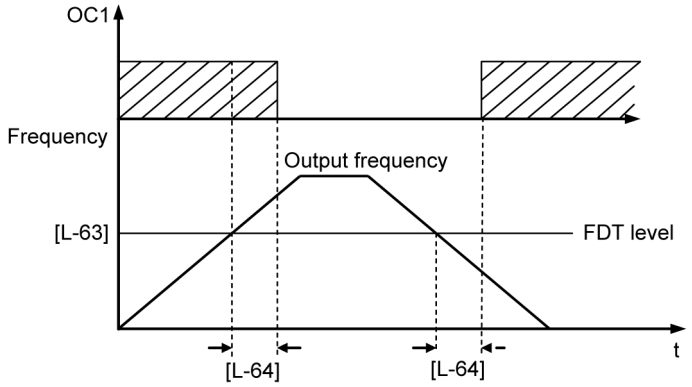


Fig. 6-31: Frequency level detection (FDT)

☞ – FDT level is set by L-59 and fixed as 10.0 Hz when [b-0]=0.
– Delay time is set by L-60 and fixed as 2s when [b-0]=0.

- 3: Overload warning

  When the output current exceeds overload warning level, the frequency converter outputs valid signal (low level) after passing the set warning delay time; when the output current is below overload warning level, the frequency converter outputs invalid signal (high resistance) after passing the same set delay time. Overload warning is shown as below:

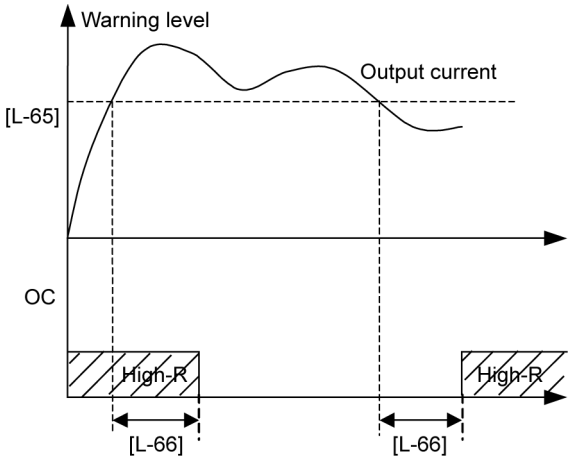


Fig. 6-32: Overload warning

☞ – Overload warning level is set by L-65 and fixed as 110 % when [b-0]=0.
– Warning delay time is set by L-66 and fixed as 2s when [b-0]=0.

- 4: Stop by external fault

  When the frequency converter stops by valid external fault signal, this terminal outputs valid signal (low level), otherwise outputs invalid signal (high resistance).

- 5: Output frequency reaches upper limit

  When the output frequency reaches upper frequency, this terminal outputs valid signal (low level), otherwise outputs invalid signal (high resistance).

- 6: Output frequency reaches lower limit

  When the output frequency reaches lower frequency, this terminal outputs valid signal (low level), otherwise outputs invalid signal (high resistance).

- 7: Stop by undervoltage

When the DC voltage of the frequency converter is lower than specified, the frequency converter will stop running and this terminal will output valid signal (low level) at the same time.

- 8: Frequency converter runs at zero speed

  When the output frequency is 0, but voltage is still output (such as DC braking, dead zone during forward and reverse running), this terminal outputs valid signal (low level).

- 9: PLC running

  When the frequency converter is under programmable multi-speed running, this terminal outputs valid signal (low level).

- 10: PLC run for one cycle

  When PLC is run for one cycle, this terminal outputs a valid pulse signal (low level) with width of 0.5ms.

- 11: PLC run for one phase

  When the frequency converter is under programmable multi-speed running, after completing running of each phase, this terminal outputs a valid pulse signal (low level) with width of 0.5ms. See fig. 6-37 "Internal counter" on page 129.

- 12: PLC running finished

  When programmable multi-speed running cycle is finished, this terminal outputs a valid pulse signal (low level) with width of 0.5ms.

- 13: Internal timer time reached

  When the set time of the frequency converter internal timer is reached, this terminal outputs a valid pulse signal (low level) with width of 0.5ms.

- 14: Internal counter final value reached

  See H-12 descriptions.

- 15: Internal counter defined value reached

  See H-13 descriptions.

- 16: Pressure upper limit warning

  When the feedback pressure exceeds the pressure upper limit warning value [E-16], and the output frequency already reaches lower running frequency (in multi-pump system, other pumps stopped), this terminal outputs valid signal (low level), which can be used to indicate the blocking of water pipe.

- 17: Pressure lower limit warning

  When the feedback pressure is below the pressure lower limit warning value [E-15], and the output frequency already reaches upper running frequency (in multi-pump system, other pumps in running with line frequency), the corresponding terminal outputs valid signal (low level), which can be used to indicate the leakage of water pipe.

- 18: Fault status and in current limiting for overheat or overload

Output signal when fault happens, and when run in overheat, overload with current limit.

- 19: Auxiliary pump output

  Auxiliary pump output, the status of which is relevant to sleep status. In case of small amount of water needed, the auxiliary pump can prevent the frequency converter from frequent startup, to achieve better effect of energy saving.

- 20: Output current upper limit reached

  This setting is activated when the output current reaches the upper limit, upon which the terminal outputs low level. Upper current can be set by L-64 (shared with FDT output delay time).

- 21: Output current lower limit reached

  This setting is activated when the output current reaches the lower limit, upon which the terminal outputs low level. Lower current can be set by L-66 (shared with overload warning delay time).

- 22: Frequency converter in forward running

  This setting is activated when the frequency converter runs forwardly, and the terminal outputs low level.

- 23: Frequency converter in reverse running

  This setting is activated when the frequency converter runs reversely, and the terminal outputs low level.

L-62	Frequency arriving at detection width/ Frequency offset
Setting range	0.00–20.00 Hz
Factory default	5.00 Hz

This parameter is used as both frequency arriving at detection width (see L-59, L-60, L-61) and frequency offset (see L-58). Frequency arriving at detection width means the out frequency of the frequency converter is within the plus/ minus detection width of the set frequency.

L-63	FDT (frequency level) setting
Setting range	0.00–upper frequency
Factory default	10.00
L-64	**FDT output delay time/Current upper limit**
Setting range	0.0–20.0s/0.0 %–200.0 %
Factory default	2.0

These parameters are used to set the frequency detection level. When the output frequency exceeds the FDT set value, the frequency converter outputs valid signal after passing the delay time set by L-64. Parameter L-64 is used as both FDT output delay time and current upper limit (relative to percentage of rated current). When the output current exceeds the current upper limit [L-64], valid signal is output (OC1, OC2 or relay terminal, see fig. 6-31 " Frequency level detection (FDT)" on page 117 and L-59, L-60, L-61).

L-65	Overload warning level
Setting range	50 %–200 %
Factory default	110 %
L-66	**Overload warning delay time/ Current lower limit**
Setting range	0.0–20.0s/0.0 %–200.0 %
Factory default	2.0

When the output current continuously exceeds the overload warning level, the frequency converter outputs valid signal after passing the delay time set by L-66. Parameter L-66 is used as both overload warning delay time and current lower limit (relative to percent of rated current). When the output current is below the current lower limit [L-66], valid signal is output (OC1, OC2 or relay terminal, see fig. 6-32 "Overload warning" on page 118 and L-59, L-60, L-61).

L-67	Units digit: number of monitoring parameters	Tens digit: number of motor pole
Setting range	1–3	2–8
Factory default	23	

The units digit is used to set number of monitoring parameters, with maximum of 3. When [L-67]=1, the monitoring parameters are set by L-68, L-69 and L-70, which will be displayed in sequence with certain interval.

The tens digit is used to set the number of motor poles, and 0–2 means 2-pole motor.

L-68	Run monitoring 1
Setting range	0–19
Factory default	0
L-69	**Run monitoring 2**
Setting range	0–19
Factory default	1
L-70	**Run monitoring 3**
Setting range	0–19
Factory default	2

These parameters are used to define the content displayed for status monitoring 1/2/3 when the operating panel is under status monitoring mode and the frequency converter is running. For displayed content, please see the status monitoring parameter list as below:

Function code	Name	Unit	Code address
d-0	Output frequency in monitoring	Hz	DBH
d-1	Output current in monitoring	A	DCH
d-2	Output voltage in monitoring	V	DDH

Function code	Name	Unit	Code address
d-3	Motor speed in monitoring	rpm	DEH
d-4	Set frequency in monitoring	Hz	DFH
d-5	DC bus voltage	V	E0H
d-6	PID set value	%/MPa	E1H
d-7	PID feedback value	%/MPa	E2H
d-8	Running linear speed		E3H
d-9	Set linear speed		E4H
d-10	Input AC voltage	V	E5H
d-11	Module temperature	℃	E6H
d-12	Cumulated running time	H	E7H
d-13	Input terminal status		E8H
d-14	Analog input VI1	V	E9H
d-15	Analog input VI2	V	EAH
d-16	Analog input II	mA	EBH
d-17	External pulse input	kHz	ECH
d-18	Analog output AM	V	EDH
d-19	Frequency output AO	Hz	EEH

L-68, L-69 and L-70 are used to select the status monitoring parameters, with which users can set 3 most expected monitoring parameters on demand when the frequency converter is running, and switch among these 3 parameters with key **SHIFT**.

L-71	Stop monitoring
Setting range	0–19
Factory default	0

This parameter is used to select the monitoring parameters when the frequency converter is in stop.

L-72	Line speed coefficient setting
Setting range	0.01–100.0
Factory default	1.00

This parameter is used to define the display value of running linear speed and set linear speed, and display other physical values positively proportional to output frequency.

Running linear speed [d-8]=[L-72] x output frequency [d-0]

Set linear speed [d-9]=[L-72] x set frequency [d-4]

When the actually displayed value ≥10000, the rightmost decimal point is lit to indicate that one more digit is hidden to the right, for example: "1234." means "12340".

L-73	Parameter writing protection
Setting range	0~2
Factory default	0

This parameter is used to prevent the mis-modification of the data.

- [L-73]=0: All parameters writable
- [L-73]=1: All parameters except b-2 and L-73 unwritable
- [L-73]=2: All parameters unwritable

When [L-73]=0, all parameters are writable, but when the frequency converter is in running, some parameters are unwritable and "– –" will be displayed if attempting to modify them. So please firstly stop the frequency converter, then modify these parameters.

6.3 Advanced Parameters (Group H)

H-0	Slip frequency compensation
Setting range	0 %–150 %
Factory default	0 %

This parameter is used to adjust the output frequency in accordance with load changes, to dynamically compensate the slip frequency of the asynchronous motor, thus finally control the rotation speed within set value. Using this function together with the automatic torque boost function, a better low-speed torque characteristic can be achieved.

When [H-0]=100 % and the frequency converter outputs rated current: actual output frequency = set frequency + 2.50 Hz, but the displayed out frequency keeps the same. The default setting is 0, so there is no slip frequency compensation.

Slip frequency compensation is shown as below:

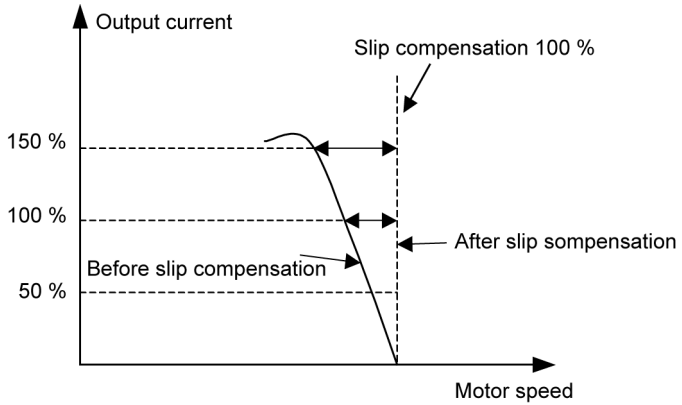


Fig. 6-33: Slip frequency compensation

H-1	Overload, overheat protection actions
Setting range	0–2
Factory default	0

This parameter is used to define the protection mode when overload, overheat occurs.

- [H-1]=0: Frequency converter output blocked

  The frequency converter output is blocked when overload, overheat occurs, and the motor freewheels to stop.

- [H-1]=1: Run with current-limit (warning)

  The frequency converter runs with current-limit when overload, overheat occurs, and it may reduce the output frequency to decrease the load current, and output warning signal at the same time.

– "Run with current-limit" for this parameter means the protection mode when the frequency converter is overload or overheat, the current-limit level cannot be defined.
– When the module temperature exceeds certain value, the frequency converter will stop even it is in current-limit protection mode.

H-2	Motor overload protection coefficient
Setting range	50 %–110 %
Factory default	110 %

This parameter is used to the set the thermal relay coefficient for the frequency converter to protect the motor, which helps to protect the motor timely and properly when the rated motor current mismatches with the rated frequency converter current.

Thermal relay protection is shown as below:

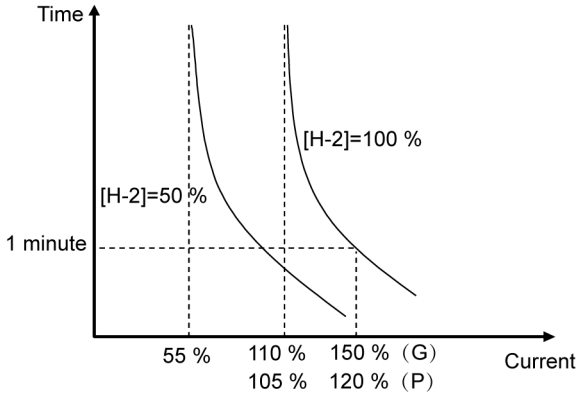


Fig. 6-34: Thermal relay protection

The factory default setting for the overload capacity of the frequency converter is:

- G type:150 % x rated current, 1 minute
- P type: 120 % x rated current, 1 minute

Calculation:

[H-2]=rated motor current/rated frequency converter output current x 100

When multiple motors are running in parallel driven by one frequency converter, the thermal relay protection will be invalid. So please install the thermal protection relay at the input side of each motor.

H-3	Auto energy-saving
Setting range	0~1
Factory default	0

When this parameter is enabled, the frequency converter can adjust the motor excitation according to the load status, to keep the motor working with high efficiency. This function is mainly used in occasions where the load changes frequently.

H-4	Restart after power failure
Setting range	0~3
Factory default	0
H-5	Waiting time for restart after power failure
Setting range	0.0~10.0s
Factory default	0.5s

- [H-4]=0: No action (fault alarm for power failure)
- [H-4]=1: Action (fault alarm for power failure)
- [H-4]=2: No action (no fault alarm for power failure)
- [H-4]=3: Action (no fault alarm for power failure)

When [H-4]=1 or 3, the restart after transient stop function is activated. If the frequency converter is in running before power off, users can set [H-4]=1 or 3 to decide whether the fault Er.08 will be alarmed. Being powered on again, the frequency converter will automatically restart with speed tracking after being held for the set waiting time [H-5]. During the restart waiting time, the frequency converter will not start even the run command is input. If the stop command is input, the frequency converter will be released from the status of restart with speed tracking.

⚠ WARNING

By setting this parameter, the frequency converter can automatically restart after powering on again, please be careful!

H-6	Auto fault reset attempts
Setting range	0~2
Factory default	0
H-7	Interval between auto fault reset
Setting range	2~20s
Factory default	5s

When [H-6]=0, the frequency converter can't be reset automatically; when [H-6]=1 or 2, the frequency converter can be reset automatically once or twice.

When fault occurs and output is stopped due to load changes during frequency converter running, parameter H-6 auto fault reset attempts can be set to continue the operation. During auto reset, the frequency converter restarts with speed tracking. If the frequency converter fails to resume running within set attempts, fault protection will be activated and the output is stopped. When [H-6]=0, the auto fault reset function is deactivated.

The auto fault reset function is not applicable to fault protection caused by overload or overheat.

Before using the auto fault reset function, please ensure there is no actual damage to the frequency converter.

H-8	Auto voltage stabilization
Setting range	0–2
Factory default	0

- [H-8]=0: No action
- [H-8]=1: Action
- [H-8]=2: No action only at deceleration

This parameter is used to prevent the output voltage from changing with input voltage change of the frequency converter. It is mainly applied when the power supply voltage changes greatly but a stable motor stator voltage and current are expected.

When the frequency converter decelerates to stop, if AVR is disabled, the deceleration time will be shorter but the running current will be higher; if AVR is enabled, the motor will decelerate stably but with a longer time, the running current will be lower.

H-9	Current limit level
Setting range	110 %–200 %
Factory default	150 %

This parameter is used to set the maximum current when the frequency converter accelerates, that is, the stallover level. During acceleration, if the output current exceeds the set current, the frequency converter will adjust the acceleration time automatically to keep the current within the set value.

This parameter is represented as percent of rated current, as shown below:

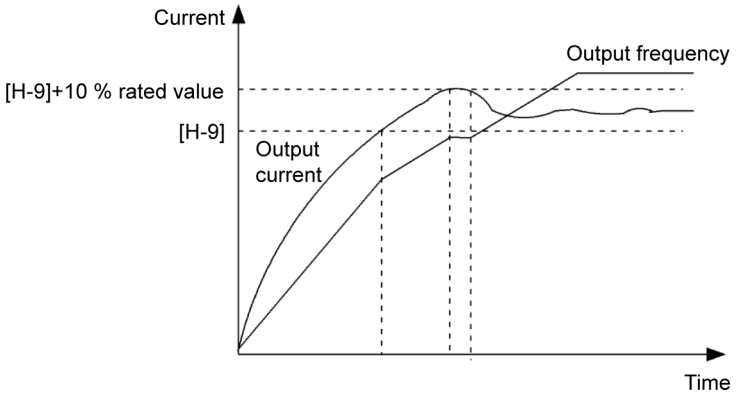


Fig. 6-35: Current limit during acceleration

During start-up, if the output frequency fluctuates within a comparatively stable range and cannot reach the expected set frequency, it means the current limit function is activated. In this case, reduce the load or modify related parameters settings.

H-10	Forward/reverse dead zone time
Setting range	0.0–5.0s
Factory default	0.1s

This parameter is used to set the holding time at zero frequency output when the running direction of the frequency converter is changed, as shown below:

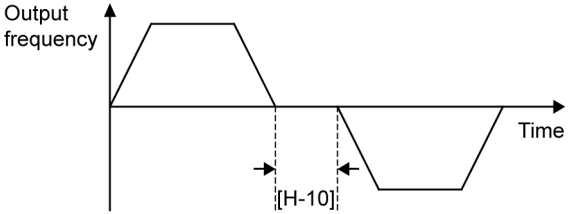


Fig. 6-36: Forward/reverse dead zone time

The forward/reverse dead zone time is mainly applicable to devices with large inertia and mechanical dead zone during direction change.

H-11	Internal timer setting
Setting range	0.1–6000s
Factory default	0.1s

This parameter is used to set the timing of internal timer, which is enabled by the external triggering terminal (set by parameters L-47 to L-53). A valid pulse

signal with 0.5ms will be output via the corresponding OC terminal after the timing is reached, starting from the receipt of external triggering signal.

H-12	Internal counter final value setting
Setting range	1–60000
Factory default	1
H-13	**Internal counter defined value setting**
Setting range	1–60000
Factory default	1

These parameters are used to set the counting of internal counter, with the clock terminal selected by L-52, L-53.

When the counting for external clock reaches the value set by H-12, a valid signal with width equal to the external clock cycle will be output via the corresponding OC terminal.

When the counting for external clock reaches the value set by H-13, a valid signal will be output via the corresponding OC terminal; when the counting exceeds the value set by H-12 and causes zeroing to the counter, the valid signal will be cancelled.

The clock cycle for the counter should be larger than 5ms, and the pulse width larger than 2ms. The internal counter is shown as below:

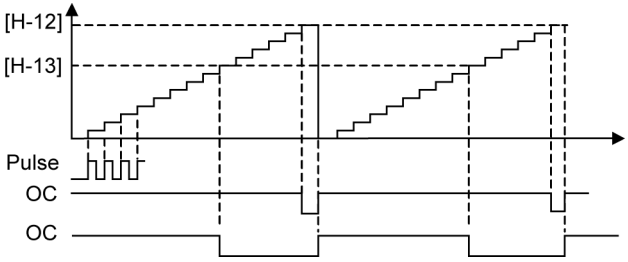


Fig. 6-37: Internal counter

Function code	Name	Setting range	Factory default
H-14	Multi-speed frequency 1	0.00–upper frequency	35.00
H-15	Multi-speed frequency 2	0.00–upper frequency	15.00
H-16	Multi-speed frequency 3	0.00–upper frequency	3.00
H-17	Multi-speed frequency 4	0.00–upper frequency	20.00
H-18	Multi-speed frequency 5	0.00–upper frequency	25.00
H-19	Multi-speed frequency 6	0.00–upper frequency	30.00
H-20	Multi-speed frequency 7	0.00–upper frequency	35.00
H-21	Multi-speed frequency 8	0.00–upper frequency	40.00
H-22	Multi-speed frequency 9	0.00–upper frequency	45.00

Function code	Name	Setting range	Factory default
H-23	Multi-speed frequency 10	0.00–upper frequency	50.00
H-24	Multi-speed frequency 11	0.00–upper frequency	40.00
H-25	Multi-speed frequency 12	0.00–upper frequency	30.00
H-26	Multi-speed frequency 13	0.00–upper frequency	20.00
H-27	Multi-speed frequency 14	0.00–upper frequency	10.00
H-28	Multi-speed frequency 15	0.00–upper frequency	5.00

These parameters are used to set the output frequency when the frequency converter runs under terminal controlled multi-speed running or programmable multi-speed running.

The multi-speed frequency has a priority lower than jog frequency, but higher than other frequencies.

The table below shows the corresponding multi-speed frequency after combination of multi-speed terminals, among which "1" means high level, and "0" means low level. The corresponding multi-speed frequency is set by H-14 to H-28.

Control terminal				Corresponding multi-speed
1	2	3	4	
1	0	0	0	1
0	1	0	0	2
1	1	0	0	3
0	0	1	0	4
1	0	1	0	5
0	1	1	0	6
1	1	1	0	7
0	0	0	1	8
1	0	0	1	9
0	1	0	1	10
1	1	0	1	11
0	0	1	1	12
1	0	1	1	13
0	1	1	1	14
1	1	1	1	15

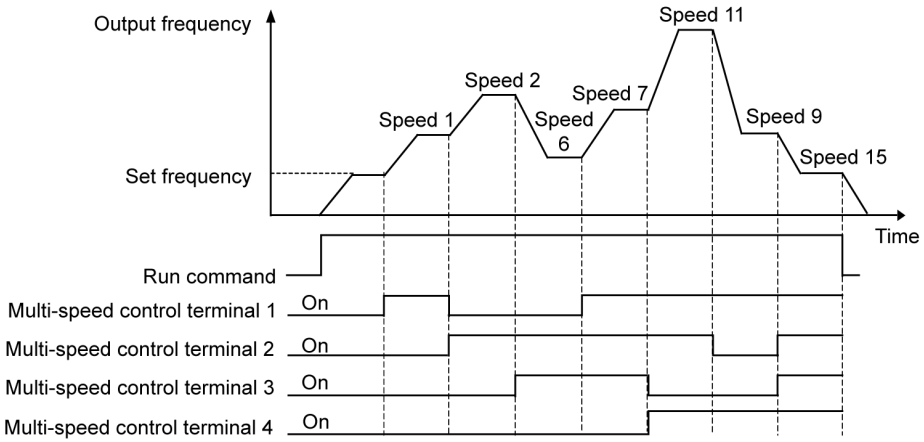


Fig. 6-38: Multi-speed running

The multi-speed terminals are selected by L-47 to L-53, and the factory default setting is X1, X2, X3.

The acceleration/deceleration time for each phase of the external terminals can also be set individually, as shown below:

Multi-speed	Acceleration/deceleration time
Multi-speed 1	Phase 1 acceleration/deceleration time H-32
Multi-speed 2	Phase 2 acceleration/deceleration time H-35
Multi-speed 3	Phase 3 acceleration/deceleration time H-38
Multi-speed 4	Phase 4 acceleration/deceleration time H-41
Multi-speed 5	Phase 5 acceleration/deceleration time H-44
Multi-speed 6	Phase 6 acceleration/deceleration time H-47
Multi-speed 7	Phase 7 acceleration/deceleration time H-50
Multi-speed 8	Acceleration/deceleration time 1 b-8, b-9
Multi-speed 9	Acceleration/deceleration time 2 H-57, H-58
Multi-speed 10	Acceleration/deceleration time 3 H-59, H-60
Multi-speed 11	Acceleration/deceleration time 4 H-61, H-62
Multi-speed 12	Acceleration/deceleration time 1 b-8, b-9
Multi-speed 13	Acceleration/deceleration time 1 b-8, b-9
Multi-speed 14	Acceleration/deceleration time 1 b-8, b-9
Multi-speed 15	Acceleration/deceleration time 1 b-8, b-9

The running mode, direction and time for programming multi-speed running are set by H-29 to H-50.

H-29	Programmable multi-speed running
Setting range	0–18
Factory default	0
H-30	Phase 1 running time
Setting range	0.0–6000
Factory default	10.0
H-31	Phase 1 running direction
Setting range	0: Forward; 1: Reverse
Factory default	0
H-32	Phase 1 Acc./Dec. time
Setting range	0.1–6000s
Factory default	10.0s
H-33	Phase 2 running time
Setting range	0.0–6000
Factory default	10.0
H-34	Phase 2 running direction
Setting range	0: Forward; 1: Reverse
Factory default	0
H-35	Phase 2 Acc./Dec. time
Setting range	0.1–6000s
Factory default	10.0s
H-36	Phase 3 running time
Setting range	0.0–6000
Factory default	10.0
H-37	Phase 3 running direction
Setting range	0: Forward; 1: Reverse
Factory default	0
H-38	Phase 3 Acc./Dec. time
Setting range	0.1–6000s
Factory default	10.0s
H-39	Phase 4 running time
Setting range	0.0–6000
Factory default	10.0
H-40	Phase 4 running direction
Setting range	0: Forward; 1: Reverse
Factory default	0
H-41	Phase 4 Acc./Dec. time

Setting range	0.1–6000s
Factory default	10.0s
H-42	**Phase 5 running time**
Setting range	0.0–6000
Factory default	10.0
H-43	**Phase 5 running direction**
Setting range	0: Forward; 1: Reverse
Factory default	0
H-44	**Phase 5 Acc./Dec. time**
Setting range	0.1–6000s
Factory default	10.0s
H-45	**Phase 6 running time**
Setting range	0.0–6000
Factory default	10.0
H-46	**Phase 6 running direction**
Setting range	0: Forward; 1: Reverse
Factory default	0
H-47	**Phase 6 Acc./Dec. time**
Setting range	0.1–6000s
Factory default	10.0s
H-48	**Phase 7 running time**
Setting range	0.0–6000
Factory default	10.0
H-49	**Phase 7 running direction**
Setting range	0: Forward; 1: Reverse
Factory default	0
H-50	**Phase 7 Acc./Dec. time**
Setting range	0.1–6000s
Factory default	10.0s

These parameters are used to set the programmable multi-speed running (simple PLC running). Its priority is higher than the external terminal controlled multi-speed.

Parameters H-29 to H-50 define the running time, direction and acceleration/deceleration time for each speed of the programmable multi-speed running.

The programmable multi-speed running mode is set by H-29:

- LED tens digit: simple PLC running time unit
  - 1: Minute
  - 0: Second

- LED units digit: PLC action mode
  - 0: Disable PLC, enable multi-speed
  - 1: Single cycle

    Upon receipt of the running command, the frequency converter starts running from the multi-speed 1 (set by H-14), after reaching the running time set by H-30, it starts running with next speed until finishes running with all the 7 speeds (running time for each speed can be set separately), and the frequency converter outputs 0 frequency at the end. If the running time for certain speed is 0, the frequency converter will skip this phase.
  - 2: Continuous cycle

    After the frequency converter has finished running with all the 7 speeds, it returns to run with speed 1 and cycles endlessly.
  - 3: Final value holding

    After the frequency converter has finished running for one cycle, it doesn't stop, but keeps running with the speed of the last non-zero running time, as shown below:

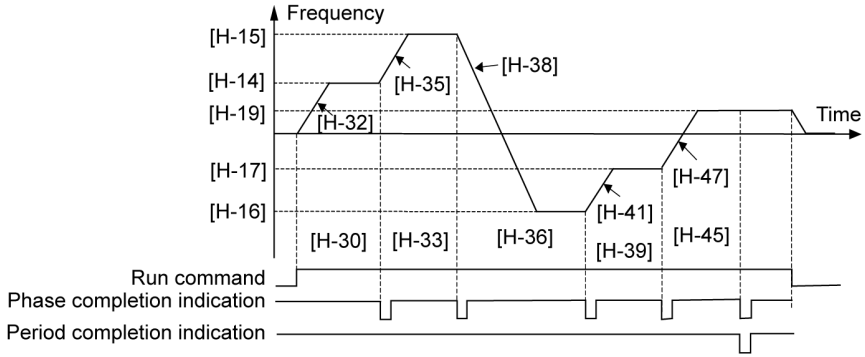


Fig. 6-39: Final value holding

  - 4: Run in swing frequency

    The set frequency changes periodically according to the defined acceleration/deceleration time. This function is mainly applied to industries like textile, where the rotating speed changes depending on the different front and back bobbin diameters, as shown below:

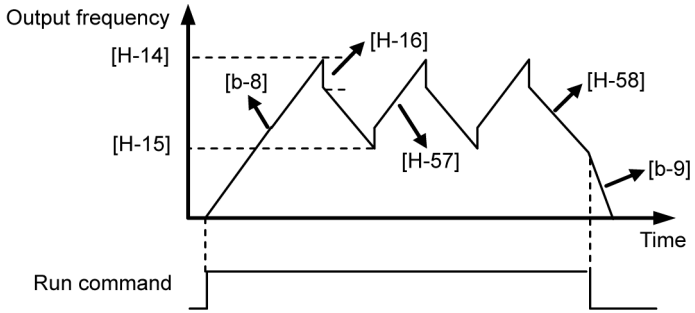


Fig. 6-40: Swing frequency

– 5: Single cycle stop mode

After running with each speed phase, the frequency converter firstly decelerates to zero frequency, and then accelerates to next speed phase and continues running. Other actions are same to mode 1: Single cycle. As shown below:

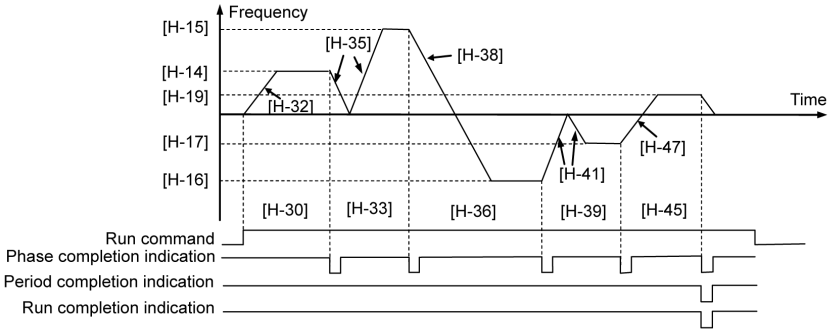


Fig. 6-41: Single cycle stop mode

– 6: Continuous cycle stop mode

After running with each speed phase, the frequency converter firstly decelerates to zero frequency, and then accelerates to next speed phase and continues running. Other actions are same to mode 2: Continuous cycle.

– 7: Final value holding stop mode

After running with each speed phase, the frequency converter firstly decelerates to zero frequency, and then accelerates to next speed phase and continues running. Other actions are same to mode 3: Final value holding.

H-51	Skip frequency 1
Setting range	0.00–upper frequency
Factory default	0.00

H-52	Skip frequency 1 width
Setting range	0.00–5.00 Hz
Factory default	0.00 Hz
H-53	**Skip frequency 2**
Setting range	0.00–upper frequency
Factory default	0.00
H-54	**Skip frequency 2 width**
Setting range	0.00–5.00 Hz
Factory default	0.00 Hz
H-55	**Skip frequency 3**
Setting range	0.00–upper frequency
Factory default	0.00
H-56	**Skip frequency 3 width**
Setting range	0.00–5.00 Hz
Factory default	0.00 Hz

Skip frequency is used to avoid the mechanical resonance point of the frequency converter load. Altogether 3 skip frequency points are available, which are invalid if the skip frequency range is set to 0.

The skip frequency means the system will not keep running in this frequency range, while during acceleration/deceleration, these frequencies will not be skipped.

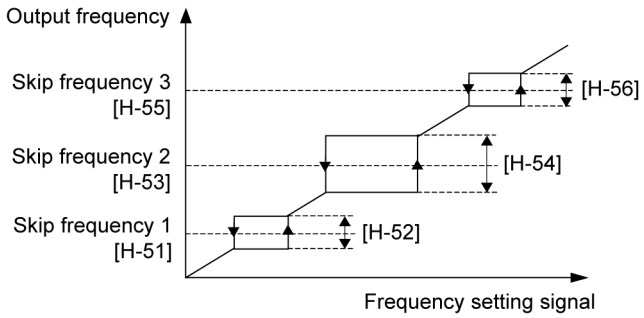


Fig. 6-42: Skip frequency

H-57	Acceleration time 2
Setting range	0.1–6000s
Factory default	*
H-58	**Deceleration time 2**

Setting range	0.1–6000s
Factory default	*
H-59	**Acceleration time 3**
Setting range	0.1–6000s
Factory default	*
H-60	**Deceleration time 3**
Setting range	0.1–6000s
Factory default	*
H-61	**Acceleration time 4**
Setting range	0.1–6000s
Factory default	*
H-62	**Deceleration time 4**
Setting range	0.1–6000s
Factory default	*

These parameters are used to set the acceleration/deceleration time 2, 3 and 4. While the actual acceleration/deceleration time will be selected by external terminals.

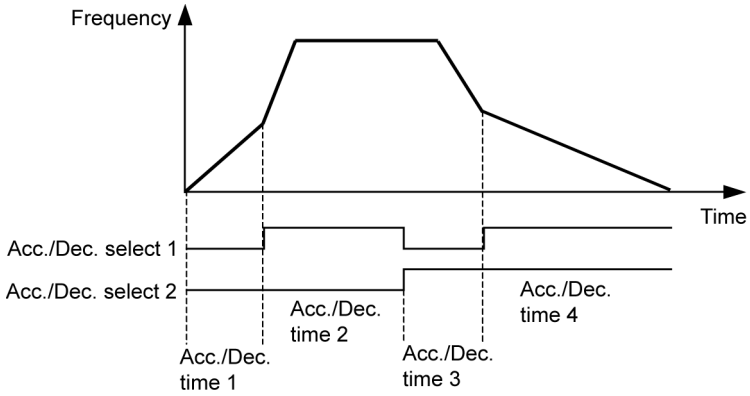


Fig. 6-43: Acceleration/deceleration time selection

The acceleration/deceleration time of the multi-speed running and jog running are not controlled by external terminals, in stead, they will be set by specific parameters respectively.

H-63	**Dynamic brake initial voltage**
Setting range	620–720 V
Factory default	700 V

This parameter is used to define the values of the brake unit. When the internal DC voltage is higher than the dynamic brake initial voltage, the internal brake

unit will be activated. If brake resistor is connected at this time, the pump voltage at the internal bus side will be released via this braking resistor to decrease the DC voltage. When the DC voltage decreases to certain value, the internal brake unit will be deactivated.

H-64	Braking ratio
Setting range	0–100
Factory default	25

This parameter is designed for frequency converters of 0.75–18.5 kW with internal brake unit. Users can set the value according to actual situations: set a lower ratio when there is no strict requirement on braking or stopping; otherwise, set a higher ratio.

- This parameter is only valid to frequency converters of 18.5 kW and below.
- For applications with frequent braking, please use brake unit and brake resistor, and set [H-64]=0.

H-65	Protocol selection
Setting range	0–2
Factory default	0

- [H-65]=0: User-defined protocol slave station
- [H-65]=1: User-defined protocol master station
- [H-65]=2: ModBus protocol

This parameter is used to select protocol for the frequency converter. When [H-65]=2, ModBus protocol is selected for communication; when [H-65]=0 or 1, user-defined protocol is selected for communication.

When the frequency converter works as master, it sends out the running status (command and set frequency) continuously as per defined protocol via RS485 interface. If the frequency converter is connected with other slave frequency converters via RS485 interface, and the slave running command and frequency setting channels are set as RS485, all the slave running command, frequency setting and jog running will be controlled by the master frequency converter and keep consistent with it.

H-66	Local address
Setting range	0–30 (ModBus: 0–247)
Factory default	0

This parameter is used to set the local address during communication. The frequency converter will only receive data from external PC matching with the local address. For details please see chapter 7 "RS485 Communication Protocol" on page 149.

The local address ranges from 0 to 30 for user-defined protocol, and from 0 to 247 for ModBus protocol.

H-67	Data format
Setting range	0–2 (ModBus: 0–8)
Factory default	0

This parameter is used to define the data format during RS485 communication, and the same data format must be set for communication.

When the user-defined protocol is selected, the data format can be set between 0–2, as shown below:

- [H-67]=0: No parity (8, N, 2)
- [H-67]=1: Even parity (8, E, 1)
- [H-67]=2: Odd parity (8, O, 1)

When the ModBus protocol is selected, the data format can be set between 0–8, as shown below:

- [H-67]=0: RTU no parity (8, N, 2)
- [H-67]=1: RTU even parity (8, E, 1)
- [H-67]=2: RTU odd parity (8, O, 1)
- [H-67]=3: ASCII no parity (7, N, 2)
- [H-67]=4: ASCII even parity (7, E, 1)
- [H-67]=5: ASCII odd parity (7, O, 1)
- [H-67]=6: ASCII no parity (8, N, 2)
- [H-67]=7: ASCII even parity (8, E, 1)
- [H-67]=8: ASCII odd parity (8, O, 1)

H-68	Baud rate
Setting range	0–5
Factory default	3

This parameter is used to define the baud rate during RS485 communication, and the same baud rate must be set for communication.

- [H-68]=0: 1200 bps
- [H-68]=1: 2400 bps
- [H-68]=2: 4800 bps
- [H-68]=3: 9600 bps
- [H-68]=4: 19200 bps
- [H-68]=5: 38400 bps

H-69	Multiple frequency converters control setting ratio
Setting range	0.10–10.00
Factory default	1.00

This parameter is used to set the weight coefficient for the frequency converter to receive frequency command via RS485 interface. The actual running frequency=[H-69] x "received set frequency command".

During multiple frequency converters control running, this parameter can be used to set the frequency ratio for multiple frequency converters.

H-70	RS485 communication disruption action
Setting range	0~1
Factory default	1

- [H-70]=0: Stop

  When [b-3] "Running command channels"=4: RS485 interface, if RS485 communication is disrupted (no command from master for more than 1s), the frequency converter will stop automatically. When b-1 "Frequency input channels" or "PID setting channel" is set as RS485 interface, if RS485 communication is disrupted, the parameter H-70 will be automatically set to 0.

- [H-70]=1: Keep current status

  If RS485 communication is disrupted, the frequency converter will keep the current running status and set value until next frame command is received.

6.4 Extended Application Parameters (Group E)

E-0	Internal PID control
Setting range	0~5
Factory default	0

- [E-0]=0: No PID control
- [E-0]=1: General PID control
- [E-0]=2: Single pump constant pressure water supply PID
- [E-0]=3: Two-pump constant pressure water supply PID (accessory needed)
- [E-0]=4: Three-pump constant pressure water supply PID (accessory needed)
- [E-0]=5: Four-pump constant pressure water supply PID (accessory needed)

- When [E-0]=3, 4, 5, multi-pump constant pressure water supply accessories need to be purchased and parameters E-19 to E-24 will be valid.
- In mode of multi-pump constant pressure water supply, RS485 communication is disabled.

E-1	PID setting channels
Setting range	0~6
Factory default	0

This parameter is used to select the input channel for PID command.

- [E-1]=0: Panel potentiometer
  Set via potentiometer on the operating panel.
- [E-1]=1: Panel digital setting
  Set via keys on the operating panel.
- [E-1]=2: External voltage signal 1 (0~10 V)
  Set via external analog voltage VI1 (0 to +10 V).
- [E-1]=3: External voltage signal 2 (-10~10 V)
  Set via external analog voltage VI2 (-10 to +10 V).
- [E-1]=4: External current signal
  Set via external analog current signal II (0~20 mA).
- [E-1]=5: External pulse signal
  Set via external pulse signal, with the pulse input terminal selected from L-53.
- [E-1]=6: RS485 interface setting
  Set via RS485 interface.

When digital panel or RS485 interface is set as PID channel, in ordinary PID control mode, the set value 100.0 corresponds to the maximum set value (corre-

sponding to the maximum feedback value). In mode of constant pressure water supply PID, the set value directly indicates the pressure value, such as when [b-2]=0.500, it means the set pressure is 0.5 MPa.

E-2	PID feedback channels
Setting range	0–3
Factory default	0

This parameter is only valid when PID control is selected.

- [E-2]=0: Voltage input 1

  External voltage input VI1 is set as feedback input terminal (0–10 V).
- [E-2]=1: Current input

  External current input II is set as feedback input terminal (0–20 mA).
- [E-2]=2: Pulse input

  External pulse is set as feedback input terminal.
- [E-2]=3: Voltage input 2

  External voltage input VI2 is set as feedback input terminal (-10–10 V).

Please define the upper and lower limit of the channel according to the actual scale of feedback signal (see L-27 to L-43 descriptions).

E-3	Feedback signal characteristic
Setting range	0–1
Factory default	0

This parameter is used to define the relation between feedback signal and set signal.

- [E-3]=0: Positive characteristic

  Indicates the maximum feedback signal corresponds to the maximum set value.
- [E-3]=1: Negative characteristic

  Indicates the minimum feedback signal corresponds to the maximum set value.

E-4	Feedback channel gain
Setting range	0.01–10.00
Factory default	1.00

This parameter can be used to adjust the feedback channel gain when the signal levels for feedback channel and set channel are inconsistent.

E-5	PID setting, feedback display coefficient
Setting range	0.01–10.00
Factory default	1.00

In mode of ordinary PID control, the full scale for d-6 "PID setting value" and d-7 "PID feedback value" is 100.0, which may be inconsistent with the actual engineering value, so this parameter can be used to modify the proportion.

In mode of constant pressure water supply PID, according to E-14 "Remote pressure gauge", d-6 "PID setting value" and d-7 "PID feedback value" directly indicate the set pressure or feedback pressure. When the displayed value is inconsistent with the actual value, please use this parameter to correct.

E-6	PID controller modes
Setting range	0~3
Factory default	2

This parameter is used to select the mode of internal PID controller.

- [E-6]=0: Proportion
- [E-6]=1: Integral
- [E-6]=2: Proportional integral
- [E-6]=3: PID (proportional integral derivative)

E-7	Proportional gain
Setting range	0.00~5.00
Factory default	0.50
E-8	Integral time constant
Setting range	0.1~100.0s
Factory default	10.0s
E-9	Derivative gain
Setting range	0.0~5.0
Factory default	0.1

Please adjust parameters of the PID controller according to actual situations.

E-10	Sampling period
Setting range	0.01~1.00s
Factory default	0.10s

This parameter is used to set the sampling period for the feedback value.

The mode of PID controller is shown as below:

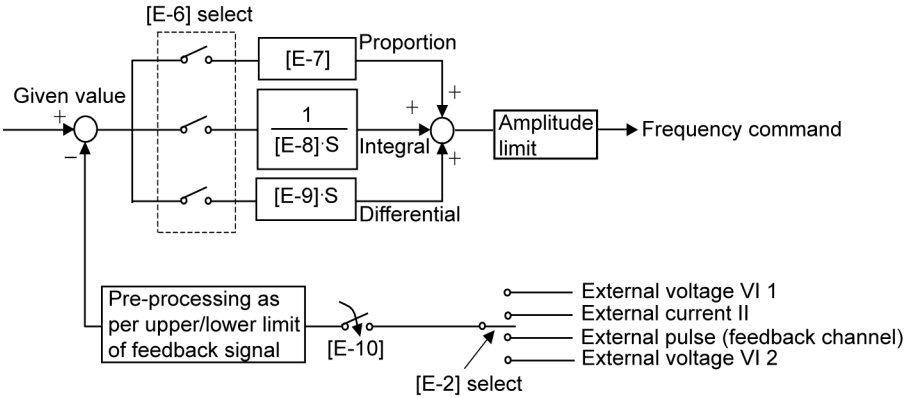


Fig. 6-44: PID controller modes

E-11	Allowable deviation limit
Setting range	0 %–20 %
Factory default	0 %

This parameter is used to define the allowable deviation limit. When the difference between feedback value and set value is lower than [E-11] "Allowable deviation limit", the PID controller will stop working.

The allowable deviation limit is mainly used to systems which do not need an critical control precision, but need to avoid frequent adjustment.

The allowable deviation limit for PID controller is shown as below:

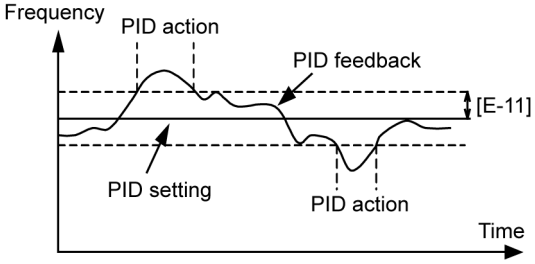


Fig. 6-45: Allowable deviation limit for PID controller

E-12	PID feedback disruption detection threshold
Setting range	0.0 %–20.0 %
Factory default	0.0 %
E-13	**PID feedback disruption action**
Setting range	0–3
Factory default	0

- [E-13]=0: Stop
- [E-13]=1: Run with digital set frequency
- [E-13]=2: Run with upper frequency
- [E-13]=3: Run with half of upper frequency

When the PID feedback value is below [E-12] "PID feedback disruption detection threshold", the feedback is judged to be disrupted. The following action will be decided by E-13 "PID feedback disruption action".

The PID feedback disruption detection threshold is represented as percent of feedback full scale.

When the PID feedback disruption is detected, and the frequency converter keeps running with settings above, Er.19 and running status will be displayed alternatively at the same time.

E-14	Scale of remote pressure gauge
Setting range	0.001–20.000 MPa
Factory default	1.000 MPa

This parameter should be set as same as the actual scale of pressure gauge.

E-15	Lower pressure for warning
Setting range	0.001–[E-16]
Factory default	0.001
E-16	**Upper pressure for warning**
Setting range	[E-15]–[E-14]
Factory default	1.000

When the pipe pressure is below the lower pressure, and the running frequency reaches the upper limit or all pumps are running with power frequency, the pipe is supposed to be undervoltage, and the frequency converter may output alarm (when parameters L-59/L-60/L-61=17). This feature can help to judge if pipe leakage occurs.

When the pipe pressure exceeds the upper pressure, and the running frequency reaches the lower limit, the pipe is supposed to be overvoltage, and the frequency converter may output alarm (when parameters L-59/L-60/L-61=16). This feature can help to judge if pipe blocking occurs.

E-17	Lower pressure limit
Setting range	0.001–[E-18]
Factory default	0.001
E-18	**Upper pressure limit**
Setting range	[E-17]–[E-14]
Factory default	1.000

These parameters are used to set the lower and upper limits of the pressure respectively.

E-19	Lower frequency holding time (pump-decreasing judgement)
Setting range	0.1–1000s
Factory default	300.0s
E-20	**Upper frequency holding time (pump-increasing judgement)**
Setting range	0.1–1000s
Factory default	300.0s

These parameters are used to define the holding time for judgement of the pump switching. When the running frequency reaches the lower limit, reduce number of pumps. When the running frequency reaches the upper limit, add number of pumps.

E-21	Electromagnetic switch delay time
Setting range	0.1–10.0s
Factory default	0.5s

This parameter is used to define the switching delay time of the electromagnetic switch when switching from power frequency to variable frequency or from variable frequency to power frequency, to prevent the short circuit between output terminal and power supply due to delayed action of electromagnetic switch.

E-22	Pump switching frequency (for pump-decreasing and switching)
Setting range	0.00–upper frequency
Factory default	25.00

During pump decreasing, the variable frequency pump normally runs with the lowest speed. Switching off the power frequency pump may lead to transient pressure drop until the variable frequency pump accelerates. To avoid this situation, please firstly accelerate the frequency converter to pump-switching frequency before switching off the power frequency pump (please adjust the pump-switching frequency to its best to avoid transient pressure drop during pump switching. Too low pump switching frequency may lead to closing of check valve at the water outgoing side, so please be sure the pump switching frequency is properly set to keep the check valve open).

During pump switching, same problem may occur when switching off the power frequency pump, to which E-22 is also applicable.

This parameter is disabled when the set value is below the lower frequency.

E-23	Timed switching interval
Setting range	0.5–100.0 hours
Factory default	5.0 hours

This parameter is used to redefine the index number of pumps after the defined time. With this setting, each pump has equal operating opportunity and time, which can avoid certain pump(s) getting rusty due to long time in idle.

E-24	Timed water supply interval
Setting range	0.5–24.0 hours
Factory default	24.0 hours

In constant pressure water supply system, this parameter is used to set the running time of the frequency converter. The timing starts from the startup of the frequency converter, after the defined water supply time is reached, the frequency converter stops automatically until next command is entered.

When [E-24]=24.0, the timed water supply is disabled.

E-25	Sleep/auxiliary pump frequency
Setting range	0.00–upper frequency
Factory default	25.00
E-26	**Sleep delay**
Setting range	0.1–3600s
Factory default	60.0s

In case of running with only variable frequency pump, if the output frequency doesn't exceed [E-25] "Sleep/auxiliary pump frequency", after time of E-26 "Sleep delay", the frequency converter will go into sleep mode and freewheel to stop.

E-27	Wake up/disable auxiliary pump
Setting range	0.1–100.0
Factory default	75.0
E-28	**Wake-up delay**
Setting range	0.1–60.0s
Factory default	0.5s

E-27 represents the percentage corresponding to PID setting. In sleep mode, if the PID feedback doesn't exceed "PID setting x [E-27]", after passing time of E-28 "Wake-up delay", the variable frequency pump is started.

E-29	PID input 2 setting
Setting range	[E-17]–[E-18]
Factory default	1.000

- [E-0]=1: The set value corresponds to the percentage directly, e.g. 50.0 means 50.0 %.
- [E-0]=2/3/4/5: The set value corresponds to the set pressure, e.g. 0.500 means 0.500 MPa.
- [b-1]=10: Start with frequency set by E-29. The frequency converter runs with the frequency set by E-29 at each startup, and the default setting for E-29 means the frequency is set to 10 Hz.

The set pressure should be limited between [E-17] and [E-18] in the application of constant pressure water supply.

7 RS485 Communication Protocol

7.1 User-defined Protocol

7.1.1 Brief Introduction

FSCG05 frequency converters provide standard RS485 communication port. With the help of PC/PLC, centralized control can be realized (set the running parameters and read the running status of the frequency converter) to fulfill the requirements of specific applications.

7.1.2 Protocol Content

This protocol defines the transmission message and format during serial communication, including the master (polling or broadcasting) request format and the master coding format such as function code, transmission data and error check of the request. The slave response bears the same structure including action confirming, data returning, error checking, etc. If error occurs when receiving message, or failing to execute the request from the master, the slave will respond to the master with an error message.

7.1.3 Application Mode

- The frequency converter is connected to PC/PLC network configured with RS485 bus "single master/multiple slaves".
- The frequency converter is connected to PC/PLC monitoring background configured with RS485/RS232 (switching interface) "point-to-point" mode.

7.1.4 Bus Structure and Protocol Description

Bus structure

- Interface

  RS485 (RS232 optional, additional level-switching accessories prepared by users)

- Transmission

  In mode of asynchronous serial and half duplex. At a particular time, only the master or the slave can send data, and correspondingly the other can only receive data. During asynchronous serial communication, the data is transmitted in message frame by frame.

- Topology

  Single master system, with at most 32 stations, among which 1 is master, the other 31 are slaves. The slave address ranges from 0 to 30, and 31 (1FH) is for broadcasting. The slave address must be unique. The point-to-point mode is actually one special application of "single master/multiple slaves" topology, that is, only one slave is configured.

Protocol description

Serial slave/master communication protocol, among which only one device (master) can establish protocol ("request/command"), other devices (slave) can only respond to the master request/command by providing data, or respond according to the master request/command. Here the "master" means personal computer (PC), programmable logic controller (PLC), etc., and the "slave" means the frequency converter.

There are two types of dialogs between the master station and the slave stations:

- The master station sends a request to a slave station and waits for its response.
- The master station sends a request to all slave stations and does not wait for their response (broadcasting).

Parameters relevant to RS485 communication: b-1, b-3, H-49, H-65 to H-70, please pay attention to the settings of these parameters.

Data format

3 kinds of data formats are available:

- 1 start bit, 8 data bits, 1 stop bit, no parity;
- 1 start bit, 8 data bits, 1 stop bit, odd parity;
- 1 start bit, 8 data bits, 1 stop bit, even parity;

Default setting for the slave: 1 start bit, 8 data bits, 1 stop bit, no parity.

Baud rate

6 kinds of baud rates are available: 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps.

Default setting for the slave: 9600 bps.

Communication mode

- Point-to-point communication of the master polling and the slave responding.
- Set serial communication parameters such as local address, baud rate and data format via keypad of the frequency converter.

The same baud rate and data format must be set for the master and the frequency converter.

Communication rule

- 3 times handshaking call processes are designed for the master, which means the master can resend the current message for 3 times after the communication failed.

- Start-up interval for at least 4 bytes need to be kept between data frames. Only messages with specified startup interval can be identified. Bytes within one frame of the slave are sent continuously with no interval. The time needed for sending one frame is dependant on the baud rate.

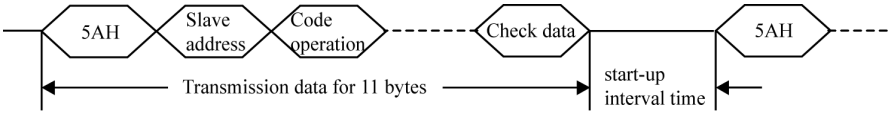
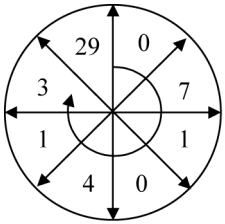


Fig. 7-1: Frame sending

- The longest time for the master handshaking waiting and the slave responding are not allowed to exceed transmission time of 8 bytes, otherwise, it is judged as communication failure.
- The master polling to the slave (frequency converter) can be established on a user-defined polling table, with sequence defined according to the actual situations. If some slaves need to be polled more frequently than others, users can list their addresses in the polling table for more times. If there is only one slave in the polling table, the point-to-point connection can be realized.



Master polling:

0	7	1	0	4	1	3	29

Fig. 7-2: Master polling

- Each slave in the polling table must be polled by the master periodically with the period less than 1000ms. If there is no response from the slave, the master needs to call for 3 times, which not only helps detect the slave communication failure in time, but also realizes the "plug and play" operation.
- If the frequency converter receives no message after particular time (1000ms), it will suppose there is a communication disruption, and run in safety mode (set by H-70).

Message structure

Each message comprises 11 bytes in 3 parts: frame header, user data and frame end, as shown below:

Sending sequence	Start byte	Slave address	Code operation	Code address	Parameter value	Operation word	Set value	Check data
Sending bytes	single byte	single byte	single byte	single byte	double bytes	double bytes	double bytes	single byte
Definition	frame header		parameter data			process data		frame end
			user data					

Among which:

- Frame header: including start byte, slave address.
- Frame end: including check data (i.e. check sum).
- User data: including parameter data and process data. Parameter data further includes code operation command/response, code address, code setting/ actual value. Process data further includes the master control command/slave response, master running set frequency/actual slave running frequency.

Master command frame

Data sent out from the master is called master command frame, as shown below:

Sending sequence	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set value	Check data
Data	5AH	0-30						
Sending bytes	1	1	1	1	2	2	2	1
Definition	frame header		parameter data			process data		frame end
			user data					

Slave response frame

Data sent out from the slave (frequency converter) is called slave response frame, as shown below:

Sending sequence	Start byte	Slave address	Slave response	Code address	Parameter value/error code	Status word	Actual frequency	Check data
Data	5AH	0-30						
Sending bytes	1	1	1	1	2	2	2	1
Definition	frame header		parameter data			process data		frame end
			user data					

Message code

Frame header

- Start byte

  As specified in this protocol, the start byte of each message is 5AH, while the start byte itself is not enough to start the message identification since it could be other data except start byte of the message. Therefore a start interval of at least 4-byte transmission time is defined ahead of the start byte, which is part of the message.

  The message start intervals for different baud rates are shown as below:

Baud rate (bps)	Start interval (ms)	Baud rate (bps)	Start interval (ms)
1200	36.8	2400	18.4
4800	9.2	9600	4.6
19200	2.3	38400	1.15

- Slave address

  The local address of the frequency converter expressed in hexadecimal which occupies 1 byte and ranges from 0 to 30.

User data

- Parameter data

  Example 1:

  Master command frame: master command code

  Slave response frame: slave response code

  Data format: hexadecimal, single byte

Parameter data	Code value	Description
Master command code	0	No task: no parameters data reading or writing.
	1	Read parameter data: read the parameter data specified by slave code address.
	2	Modify parameter data: modify the parameter data specified by the slave code address, which will not be saved after power off.
	3	Modify parameter data and store to EEPROM: modify the parameter data specified by the salve code address and store it to EEPROM.
Slave response code	0	No task response: slave responses to the master "no task" command message.
	1	Task finished: slave finishes the task specified by the master command.
	2	Task not finished and error code returned: slave fails to finish the task specified by the master command, and the reason is returned in error code.
	1F	Communication error: check sum error, or the slave didn't receive the specified bytes.

Example 2:

Code address

Data definition: address corresponding to the slave parameter

Data format: hexadecimal, single byte

For details of the slave code address, please see chapter 5 "Parameter List" on page 63.

Example 3:

Master command frame: parameter value

Slave response frame: parameter value or error code

Data format: hexadecimal, double bytes, higher byte behind.

For the master, the parameter value means the data provided to specified code address according to the master command. When the command code=0 or 1 (i.e. no task or read parameter data), the parameter value can be freely defined within the parameter range.

For the slave, the parameter value means the data returned corresponding to the specific master command when the task is executed successfully. When the execution fails, the error code will be returned, as shown below:

- 0: Parameter modification prohibited (unwritable)

  Parameters can be allowed or prohibited to be modified by setting parameter L-73. If users try to modify parameters which are not allowed for modification, this error message will be returned.

- 1: Parameter modification in running prohibited (unwritable)

  Some parameters are prohibited to be modified when the frequency converter is in running. If users try to modify these parameters, this error message will be returned.

- 2: Parameters hidden (unreadable, unwritable)

  The intermediate, advanced and internal parameters of the frequency converter can be hidden. Only after entering into these parameters, is reading or writing possible. Otherwise, this error message will be returned.

- 3: Parameters reserved (unreadable, unwritable)

  Some parameters of the frequency converter are reserved without definition. If users try to modify these parameters, this error message will be returned.

- 4: Parameter value out of limit, writing failed

  If the expected parameter value is out of limit of set value, this error message will be returned.

- 5: Modification of process parameters (status monitoring parameters)

  The status monitoring parameters d-0 to d-35 can't be modified externally, otherwise, this error message will be returned.

- 6: Illegal function code

  Code address specified in the message is invalid (not the code address specified in the status monitoring parameter table and function parameter table). In this case, the error message will be returned.

Parameter value=set parameter value/minimum unit. When [H-5] "Waiting time for restart after power failure"=5.6s, the minimum unit is 0.1, parameter value=5.6/0.1=56, i.e. hexadecimal 38H. For minimum unit of parameters, please see chapter 5 "Parameter List" on page 63.

- Process data

  Example 1:

  Master command frame: operation word

  Slave response frame: status word

  Data definition: the operation word means the data when the master is controlling the slave, status word means the data when the slave returns to current running status. See the table below for details.

  Data format: hexadecimal, double bytes, higher byte behind.

Bit	Definition	Description
0	Reserved	
1	Forward	0: Invalid 1: Send forward command to the slave (frequency converter)
2	Reverse	0: Invalid 1: Send reverse command to the slave (frequency converter)
3	Fault reset	0: Invalid 1: Fault reset
4	Master control valid	0: The control word and set value for the current data frame are invalid, and the frequency converter keeps the previous control word and set value 1: The control word and set value for the current data frame replace the previous data, this setting is necessary to complete the current control task
5	Reserved	
6	Reserved	
7	Reserved	
8	Freewheel-to-stop	0: Invalid 1: Send freewheel-to-stop command to the slave (frequency converter)
9	Reserved	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	

Bit	Definition	Description
14	Forward jog	0: Invalid 1: Send forward jog command to the slave (frequency converter)
15	Reverse jog	0: Invalid 1: Send reverse jog command to the slave (frequency converter)

Tab. 7-1: Operation word (PC→frequency converter)

Control priority: forward jog, reverse jog, forward, reverse, free-wheel-to-stop.

Bit	Definition	Description
0	DC voltage status	0: DC voltage abnormal; 1: DC voltage normal
1	Motor direction	0: Forward; 1: Reverse
2	Output phase sequence	0: Positive; 1: Negative
3	System fault	0: Frequency converter works normally 1: Frequency converter is in fault
4	Working status	0: Frequency converter stops 1: Frequency converter is in running
5	Fault reset waiting	0: Frequency converter is not waiting for fault reset 1: Frequency converter is waiting for fault reset
6	Reserved	
7	DC braking	0: Frequency converter is not in DC braking 1: Frequency converter is in DC braking
8	Freewheel-to-stop	0: Frequency converter is not freewheeling to stop 1: Frequency converter is freewheeling to stop
9	Restart after speed tracking	0: Frequency converter is not restarting after speed tracking 1: Frequency converter is restarting after speed tracking
10	In acceleration	0: Frequency converter is not in acceleration 1: Frequency converter is in acceleration
11	In deceleration	0: Frequency converter is not in deceleration 1: Frequency converter is in deceleration
12	Current-limit action	0: Current-limit is disabled 1: Current-limit is enabled
13	Voltage-limit action	0: Voltage-limit is disabled 1: Voltage-limit is enabled

14	Jog	0: Frequency converter is not in jogging 1: Frequency converter is in jogging
15	Wait for restart after transient stop	0: Frequency converter is not waiting for restart after transient stop 1: Frequency converter is waiting for restart after transient stop

Tab. 7-2: Status word: (frequency converter→PC)

Example 2:

Master command frame: set frequency value

Slave response frame: actual frequency value

Data definition:

- Set frequency value: set the running frequency according to the master command code.
- Actual frequency value: the actual running frequency is returned according to the master command code. If error occurs to the frequency converter, the corresponding fault code will be returned.

Data format: hexadecimal, double bytes, higher byte behind.

Fault codes are shown as below:

Fault code	Description	Fault code	Description
0	No fault	1	Overcurrent in acceleration
2	Overcurrent in deceleration	3	Overcurrent in stable running
4	Overvoltage in acceleration	5	Overvoltage in deceleration
6	Overvoltage in stable running	7	Overvoltage at stop
8	Undervoltage in running	9	Frequency converter overload
10	Motor overload	11	Frequency converter overheat
12	Second-class protection fault	13	Interference fault
14	Reserved	15	IPM fault
16	External device fault	17	Current detection circuit fault
18	Communication fault		

Tab. 7-3: Status word: (frequency converter→PC)

Frame end (check sum)

Data definition: the calculated result of data frame check sum.

Data format: hexadecimal, single byte.

Calculation: all continuous bytes from "start byte" to "user data" are added together, result of which is divided by 256 (100H), the remainder is the check sum. If the check sum is wrong, the communication will fail.

Example:

One frame data is: 5A 0A 03 02 88 13 00 00 00 00 04

Calculation of check sum: (5A+0A+03+02+88+13+00+00+00+00) / 100=104 / 100, the remainder is 4.

7.1.5 Use Cases

Case 1: Set the digital frequency b-2 of the frequency converter 6 to 27.00 Hz.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	06	03	02	8C 0A	00 00	00 00	FB
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	06	01	02	8C 0A	01 00	00 00	FA

Remark: the slave task is executed successfully.

Case 2: Set the rated motor frequency b-6 of the frequency converter 0 to 60.00 Hz.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	00	03	06	70 17	12 00	00 00	FC
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	00	01	06	70 17	01 00	00 00	E9

Remark: the slave task is executed successfully.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	00	03	06	70 17	12 00	00 00	FC
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	00	02	06	01 00	11 00	00 00	74

Remark: the slave is in running, so this parameter can't be modified.

Case 3: Set the frequency converter 1 to run forwardly with 10.30 Hz.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	01	00	00	00 00	12 00	06 04	77

Slave responding frame	Start byte	Slave address	Slave response	Code address	Parameter value error code	Status word	Actual frequency	Check sum
	5A	01	00	00	00 00	11 00	06 04	76

Remark: the slave task is executed successfully.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	01	00	00	00 00	12 00	06 04	77
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	01	00	00	00 00	09 00	01 00	65

Remark: overcurrent occurred to the slave during acceleration.

Case 4: Set the lower input voltage VI1 L-27 of the frequency converter 0 to 1.0 V, and run the frequency converter forwardly with 30 Hz.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	00	03	27	64 00	12 00	B8 0B	63
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	00	01	27	64 00	01 00	00 00	8D

Remark: the slave task is executed successfully, the slave DC voltage is normal, and the actual frequency is 0 Hz.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	00	03	27	64 00	12 00	B8 0B	63
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	00	1F	92	00 00	01 00	00 00	0C

Remark: error occurred to the slave communication, so the master command can't be executed. The current slave DC voltage is normal and the actual frequency is 0 Hz.

Case 5: Set the PID feedback disruption detection threshold E-12 of the frequency converter 0 to 9.5 %, and control the frequency converter freewheel to stop.

Master sending frame	Start byte	Slave address	Master command	Code address	Parameter value	Operation word	Set frequency	Check sum
	5A	00	03	A9	5F 00	10 01	00 00	76
Slave responding frame	**Start byte**	**Slave address**	**Slave response**	**Code address**	**Parameter value error code**	**Status word**	**Actual frequency**	**Check sum**
	5A	00	01	A9	5F 00	01 00	00 00	64

Remark: the slave task is executed successfully and the actual frequency is 0 Hz.

7.2 ModBus Communication Protocol

7.2.1 Brief Introduction

FSCG05 frequency converters provide RS485 communication port to realize the communication between the master and the slave stations via international standard ModBus protocol. With PC/PLC or an external computer, centralized control can be realized (setting of frequency control command and running frequency, modification of parameters, monitoring of frequency converter running status and failure messages) to fulfill requirements of specific applications.

7.2.2 Protocol Content

This ModBus protocol defines the frame content and format of asynchronous transmission in serial communication. The formats include master (polling or broadcasting) frame and slave responding frame. The master frame content includes slave address (or broadcasting address), executed command, data, error check and so on. The slave response bears the same structure including action confirming, data returning, error checking, etc. If error occurs when the slave is receiving frame, or the slave fails to execute the request from master, it will respond to the master with an error frame.

7.2.3 Application Mode

The frequency converter is connected to "single master/multiple slaves" network configured with RS485 bus.

7.2.4 Bus Structure

- Interface

  RS485 interface
- Transmission

In mode of asynchronous serial and half duplex. At a particular time, only the master or the slave can send data, and accordingly the other can only receive data. During asynchronous serial communication, the data is transmitted in message frame by frame.

- Topology

  Single master/multiple slaves system. The slave address ranges from 1 to 247, and 0 is for broadcasting. The slave address must be unique which is the basis for ModBus serial communication.

7.2.5 Protocol Description

Asynchronous serial slave/master ModBus communication protocol, among which only one device (master) can establish protocol ("request/command"), other devices (slaves) can only respond to the master request/command by providing data, or respond according to the master request/command. Here the "master" means personal computer (PC), programmable logic controller (PLC), etc., and the "slave" means the frequency converter or other control devices with the same communication protocol.

There are two types of dialogs between the master station and the slave stations:

- The master station sends a request to a slave station and waits for its response.
- The master station sends a request to all slave stations and does not wait for their response (broadcasting).

7.2.6 Frame Structure

The ModBus protocol comprises of two kinds of data format: RTU (Remote Terminal Units) and ASCII (American Standard Code for Information International Interchange).

- In RTU mode, the format of each byte is as below:

  Coding system: 8-bit binary, hexadecimal 0−9, A−F, each 8-bit frame contains two hexadecimal characters.

- In ASCII mode, the format of one byte is as below:

  Coding system: hexadecimal, ASCII character means “0”...“9”. “A”...“F”, each hexadecimal represents each ASCII message, for example:

Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’	‘8’	‘9’
ASCII CODE	0x30	0x31	0x32	0x33	0x34	0x35	0x36	0x37	0x38	0x39
Character	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’				
ASCII CODE	0x41	0x42	0x43	0x44	0x45	0x46				

One byte includes start bit, 7/8 data bits, parity check bit and stop bit.

Please see details as below:

11-bit character frame										
Start	bit1	bit2	bit3	bit4	bit5	bit6	bit7	bit8	No parity bit Even parity bit Odd parity bit	Stop
10-bit character frame										
Start	bit1	bit2	bit3	bit4	bit5	bit6	bit7		No parity bit Even parity bit Odd parity bit	Stop

In RTU mode, each new frame starts with at least 3.5 bytes transmission interval which can be easily controlled in baud rate based network. The following transmission data in sequence are: slave address, function code, data and CRC check, each transmission byte is of hexadecimal 0...9, A...F. The network device keeps monitoring on communication bus, even when it is in idle interval. When the first field (address message) is received, each network device will confirm on this byte. Along with finish of last byte transmission, there will be another 3.5 bytes transmission interval, indicating the end of this frame. Then, a new frame transmission starts.

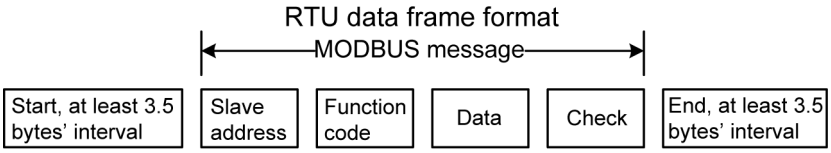


Fig. 7-3: RTU data frame format

The entire frame must be transmitted as a continuous stream of bytes. If an interval of 3.5 characters or longer occurs before a complete frame is sent out, the receiving device will clear the incomplete message and recognize the following byte as the address of a new frame. Similarly, if the interval between a new frame and the previous one is less than 3.5 characters, the receiving device will consider it as a part of the previous frame. Due to confusion of the frames, the CRC check will fail and lead to a communication fault.

Standard RTU frame format

Frame header START	T1-T2-T3-T4 (transmission time for 3.5 bytes)
Slave ADDR	Communication address: 0−247 (decimal) (0 represents broadcast address)
Function CMD	03H: read slave address; 06H: write slave address
DATA (N–1) ... **DATA (0)**	2*N bytes data, this is the main part for communication, and the core for data exchange (N<6)

CRC CHK low bit	Check value: CRC check (16BIT)
CRC CHK high bit	
Frame END	T1-T2-T3-T4 (transmission time for 3.5 bytes)

In ASCII mode, the frame header is ":" (“0x3A”), and the default frame end is “CRLF” (“0x0D”“0x0A”). Except the frame header and frame end, all other data bytes are sent out in ASCII code, with the high 4-bit the first, and the low 4-bit the later. The data has a length of 7/8 bits in ASCII mode. For ‘A’–‘F’, the ASCII code in its upper case is used. LRC check is applied to check messages from slave address to data. The check sum equals to the complement of sum of all checked bytes (abandon the carry bit).

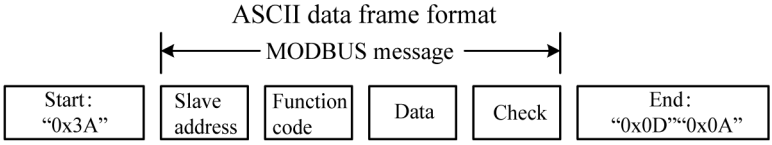


Fig. 7-4: ASCII data frame format

Standard ASCII frame format

Frame header START	‘:’ (0x3A)
Slave address (Hi)	Communication address: 8-bit address, comprises of 2 ASCII codes
Slave address (Lo)	
Function code (Hi)	Function code: 8-bit address, comprises of 2 ASCII codes
Function code (Lo)	
Data (N–1) ... Data (0)	Data content: nx8-bit, comprises of 2n * ASCII code n<6, 10 *ASCII code in maximum
LRC CHK (Hi)	LRC check code: 8-bit, comprises of 2 ASCII codes
LRC CHK (Lo)	
Frame end (Hi)	End: END Hi=CR (0x0D), END Lo=LF (0x0A)
Frame end (Lo)	

7.2.7 Description on Command Code and Communication Data

Command code: 03H (0000 0011), read N words (read 5 continuous words in maximum)

Example: To read 2 continuous words starting from start address 0004 of the slave frequency converter addressed at 01H. The frame structure is described in the tables below:

Start	T1-T2-T3-T4 (Transmission time for 3.5 bytes)
ADDR	01H
CMD	03H
Higher byte of start address	00H
Lower byte of start address	04H
Higher byte of data	00H
Lower byte of data	02H
CRC CHK lower byte	85H
CRC CHK higher byte	CAH
End	T1-T2-T3-T4 (Transmission time for 3.5 bytes)

Tab. 7-4: RTU master request

Start	T1-T2-T3-T4 (Transmission time for 3.5 bytes)
ADDR	01H
CMD	03H
Bytes of data	04H
Higher byte of data in register 0004H	00H
Lower byte of data in register 0004H	00H
Higher byte of data in register 0005H	13H
Lower byte of data in register 0005H	88H
CRC CHK lower byte	F7H
CRC CHK higher byte	65H
End	T1-T2-T3-T4 (Transmission time for 3.5 bytes)

Tab. 7-5: RTU slave response

Start	':'
ADDR	'0'
	'1'
CMD	'0'
	'3'
Higher byte of start address	'0'
	'0'

Start	':'
Lower byte of start address	'0'
	'4'
Higher byte of data	'0'
	'0'
Lower byte of data	'0'
	'2'
LRC CHK Hi	'F'
LRC CHK Lo	'6'
END Lo	CR
END Hi	LF

Tab. 7-6: ASCII master request

Start	':'
ADDR	'0'
	'1'
CMD	'0'
	'3'
Bytes of data	'0'
	'4'
Higher byte of data in register 0004H	'0'
	'0'
Lower byte of data in register 0004H	'0'
	'0'
Higher byte of data in register 0005H	'1'
	'3'
Lower byte of data in register 0005H	'8'
	'8'
LRC CHK Hi	'5'
LRC CHK Lo	'D'
END Lo	CR
END Hi	LF

Tab. 7-7: ASCII slave response

Command code: 06H (0000 0110), write a word

Example: Write 5000 (1388H) to communication register address 0002H of the slave frequency converter addressed at 02H. The frame structure is described in the tables below:

Start	T1-T2-T3-T4 (Transmission time for 3.5 bytes)
ADDR	02H
CMD	06H
Higher byte of write register address	00H
Lower byte of write register address	02H
Higher byte of write data	13H
Lower byte of write data	88H
CRC CHK lower byte	25H
CRC CHK higher byte	6FH
End	T1-T2-T3-T4 (Transmission time for 3.5 bytes)

Tab. 7-8: RTU master request

Start	T1-T2-T3-T4 (Transmission time for 3.5 bytes)
ADDR	02H
CMD	06H
Higher byte of write register address	00H
Lower byte of write register address	02H
Higher byte of write data	13H
Lower byte of write data	88H
CRC CHK lower byte	25H
CRC CHK higher byte	6FH
End	T1-T2-T3-T4 (Transmission time for 3.5 bytes)

Tab. 7-9: RTU slave response

Start	':'
ADDR	'0'
	'2'

Start	':'
CMD	'0'
	'6'
Higher byte of write register address	'0'
	'0'
Lower byte of write register address	'0'
	'2'
Higher byte of write data	'1'
	'3'
Lower byte of write data	'8'
	'8'
LRC CHK Hi	'5'
LRC CHK Lo	'B'
END Lo	CR
END Hi	LF

Tab. 7-10: ASCII master request

Start	':'
ADDR	'0'
	'2'
CMD	'0'
	'6'
Higher byte of write register address	'0'
	'0'
Lower byte of write register address	'0'
	'2'
Higher byte of write data	'1'
	'3'
Lower byte of write data	'8'
	'8'
LRC CHK Hi	'5'
LRC CHK Lo	'B'
END Lo	CR
END Hi	LF

Tab. 7-11: ASCII slave response

Error check for communication frame

The error check for communication frame mainly comprises of two parts: byte check (odd/even check) and the whole frame data check (CRC check or LRC check).

- Byte check

  Users can select odd check, even check or no check, which may affect the check bit setting of each byte.

  Even check: add an even check bit before data transmission, to indicate the number of "1" is odd or even, which is set as "0" when it is even and set as "1" when it is odd, to keep the data parity unchanged.

  Odd check: add an odd check bit before data transmission, to indicate the number of "1" is odd or even, which is set as "0" when it is odd and set as "1" when it is even, to keep the data parity unchanged.

  Example: to transmit "11001110" which contains five "1". In case of even check, the even check bit is "1", and in case of odd check, the odd check bit is "0". When data is transmitted, the parity check bit is put in the place of frame check bit after calculation. The receiving device will conduct parity check also. If the parity for received data is inconsistent with the preset one, it will be taken as communication failure.

- CRC check---CRC (Cyclical Redundancy Check)

  In RTU frame format, the frame includes frame error check field based on CRC calculation. CRC field checks the complete frame, which comprises of two bytes, including 16-bit binary value. It is added into the frame after being calculated by the transmitting device. The receiving device will recalculate the received CRC and compares the result with the received CRC. If the two CRC values are not equal, it will be taken as transmission error.

  CRC firstly stores 0xFFFF, then processes more than 6 continuous bytes of the frame with values in the current register. Only the 8-bit data in each character is valid to CRC, the start bit, stop bit and parity check are all invalid.

  During the CRC process, each 8-bit character will be separately XOR to the register, and the result moves to the LSB (Lowest significant bit), with the HSB (Highest significant bit) filled with 0. If LSB is 1, the register will be individually XOR to the preset value; if LSB is 0, there will be no XOR. The whole process will be repeated 8 times. Upon finish of the last bit (the eighth bit), the next 8-bit byte will be separately XOR to the current value of the register. The final value of the register will be the CRC value after all bytes in the frame have been executed.

  This kind of CRC calculation is based on the international standard CRC check rule. Please refer to relevant standard CRC calculation method for a satisfactory CRC calculation program.

  Here is a simple function for CRC calculation reference (Programmed with C Language):

```
unsigned int crc_cal_value(unsigned char *data_value,unsigned char
data_length)
{
    int i;
     unsigned int crc_value=0xffff;
     while(data_length--)
     {
          crc_value^=*data_value++;
                for(i=0;i<8;i++)
                {
           if(crc_value&0x0001)   crc_value=(crc_value>>1)^0xa001;
                 else   crc_value=crc_value>>1;
                }
    }
    return(crc_value);
}
```

Fig. 7-5: CRC calculation function

In ladder logic, CKSM calculates CRC by look-up table according to the frame content, which is simple and quick, but requires more ROM space. Please be careful when there is a high requirement on program space.

- ASCII check (LRC Check)

  The value summed from address to data content.

```
Static unsigned char
LRC(auchMsg,usDataLen)
unsigned char *auchMsg;
unsigned short usDataLen;
{
      unsigned char uchLRC=0;
       while(usDataLen--)
        uchLRC+=*auchMsg++;
        return((unsigned char)(
}
```

Fig. 7-6: LRC calculation function

Definition on communication data address

This part is about the definition on the communication data address, which is used to control the running of the frequency converter, collect the status of the frequency converter and set parameters for the frequency converter.

- Rules for function code address indication

  Use the address of the function code as the corresponding register address, for example, the numbering of L-9 is 15H, then it is expressed in hexadecimal as 0015H.

  Range: higher byte–00-00; lower byte–00-FC.

Frequent EEPROM storage will shorten the lifetime of the EEPROM. In communication mode, it is unnecessary to store certain function codes. Users only need to change the value of RAM by changing the highest bit of the corresponding function code address from "0" to "1", for example: function code b-2 will not be stored to EEPROM, users only need to change the RAM value by setting the address as 8002. This address is used only for writing RAM, and will be invalid when used for reading.

- Description on address of other functions

Function	Address	Data description		Attribute
Communication control command	1000H	bit	Meaning (1: Valid; 0: Invalid)	W
		0	Reserved	
		1	Forward	
		2	Reverse	
		3	Fault reset	
		4–7	Reserved	
		8	Freewheel-to-stop	
		9–13	Reserved	
		14	Forward jog	
		15	Reverse jog	

Function	Address	Data description		Attribute
Frequency converter status	1001H	bit	Set value meaning	R
		0	0: DC voltage abnormal 1: DC voltage normal	
		1	0: Motor forward 1: Motor reverse	
		2	0: Positive phase sequence 1: Negative phase sequence	
		3	0: Frequency converter normal 1: Frequency converter in fault	
		4	0: Frequency converter in stop 1: Frequency converter in running	
		5	0: Frequency converter not in waiting for restart after fault 1: Frequency converter waiting for restart after fault	
		6	Reserved	
		7	0: Frequency converter not in DC braking 1: Frequency converter in DC braking	
		8	0: Frequency converter not in freewheeling to stop 1: Frequency converter freewheeling to stop	
		9	0: Frequency converter not in restart after speed tracking 1: Frequency converter in restart after speed tracking	
		10	0: Frequency converter not in acceleration 1: Frequency converter in acceleration	
		11	0: Frequency converter not in deceleration 1: Frequency converter in deceleration	
		12	0: Frequency converter current-limit disabled 1: Frequency converter current-limit enabled	
		13	0: Frequency converter voltage-limit disabled 1: Frequency converter voltage-limit enabled	
		14	0: Frequency converter not in jog running 1: Frequency converter in jog running	
		15	0: Frequency converter not in waiting for restart after transient stop 1: Frequency converter waiting for restart after transient stop	

Function	Address	Data description		Attribute
Communication frequency address	2000H	Set the running frequency for the frequency converter		W
Fault monitoring	2101H	Value	Fault description	R
		0	No fault	
		1	Overcurrent in acceleration	
		2	Overcurrent in deceleration	
		3	Overcurrent in stable running	
		4	Overvoltage in acceleration	
		5	Overvoltage in deceleration	
		6	Overvoltage in stable running	
		7	Overvoltage at stop	
		8	Undervoltage in running	
		9	Frequency converter overload	
		10	Motor overload	
		11	Frequency converter overheat	
		12	Grounding fault	
		13	Interference fault	
		14	Reserved	
		15	IPM fault	
		16	External device fault	
		17	Current detection circuit fault	
		18	Communication fault	

Response for ModBus communication error

When the frequency converter is in communication, if error occurs, the frequency converter will respond to this error with the function code and set the first bit to 1.

Example: a master sends messages to a slave requesting to read a group of function code address of the frequency converter, the following function code will be created:

0 0 0 0 0 0 1 1 (hexadecimal 03H)

For normal response, the slave returns the same function code.

For abnormal response, the slave returns 1 0 0 0 0 0 1 1 (hexadecimal 83H)

Except the case that the function code is modified due to abnormal errors, the slave will returns a byte abnormal code which defines the abnormal causes.

After the master receives the abnormal response, typically it will resend the message, or change the command regarding to specific errors.

- Slave response for RTU fault

Start	T1-T2-T3-T4 (Transmission time for 3.5 bytes)
ADDR	01-247H
CMD	Send command or 80H
Error code	Error code value
CRC CHK lower byte	
CRC CHK higher byte	
End	T1-T2-T3-T4 (Transmission time for 3.5 bytes)

Tab. 7-12: Slave response for RTU fault

- Slave response for ASCII fault

Start	':'
ADDR	'0'
	'2'
CMD	'8'
	'6'
Error code	'0'
	'A'
LRC CHK Hi	'6'
LRC CHK Lo	'E'
END Lo	CR
END Hi	LF

Tab. 7-13: Slave response for ASCII fault

- Error code description

Error code	Description
0	Parameter modification locked (unwritable)
1	Parameter can't be modified in running (unwritable)
2	Parameter is hidden (unreadable, unwritable)
3	Parameter reserved (unreadable, unwritable)
4	Parameter value out of limit
5	Attempt to write the process parameter
6	Illegal function code
A	CRC or LRC check error
B	Data exceed reading length

C	Illegal command
D	Frame receiving error

Tab. 7-14: Error code description

8 Use Cases

8.1 Control Run/Stop with Control Panel, Set Frequency via Panel Potentiometer

8.1.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-1]=0: Set frequency via the panel potentiometer.
- [b-3]=0: Control run/stop with control panel.

8.1.2 Basic Wiring

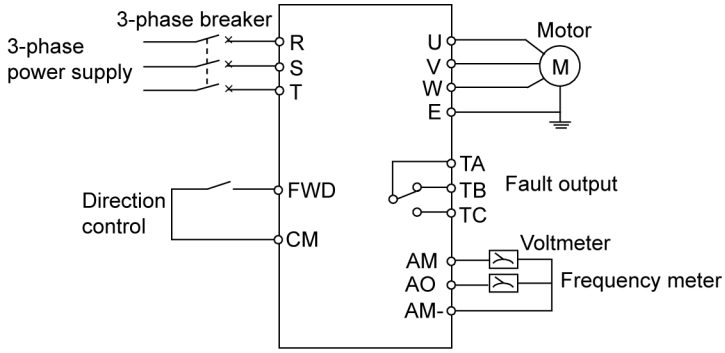


Fig. 8-1: Basic wiring_control run/stop with control panel

8.1.3 Operating Description

Press **FWD** to start the frequency converter, turning the potentiometer knob clockwise will increase the set frequency and turning it anti-clockwise will decrease the set frequency.

Press **STOP**/**RESET** to stop the frequency converter.

The motor direction can be changed via the external control terminal FWD: when FWD-CM is open, the direction keeps unchanged; when FWD-CM is closed, the direction is changed.

8.2 Three-line Control Mode

8.2.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=1: Select intermediate running parameter.
- [b-1]=0: Set the frequency input via the panel potentiometer.
- [b-3]=1: Select the external control.
- [L-46]=2: Select the external running command as 3-line control.
- [L-47]=17: Select the input terminal 1 as 3-line control.
- [L-54]=2: Select AM output as voltage output.
- [L-55]=0: Select AO output as frequency output.

Please set other parameters according to specific situations.

8.2.2 Basic Wiring

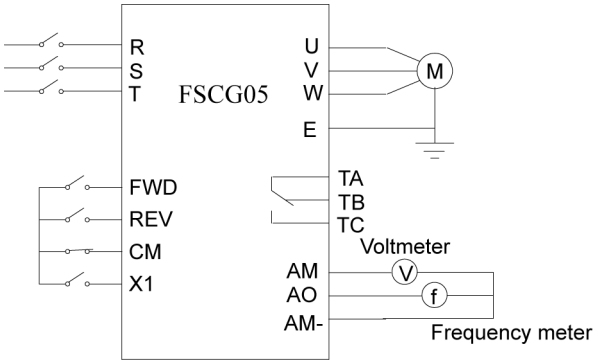


Fig. 8-2: Basic wiring_3-line control

8.2.3 Operating Description

When FWD, X1, CM are closed, the motor runs forwardly (forward command); When REV, X1, CM are closed, the motor runs reversely (reverse command); when FWD, X1, CM are open at the same time, or one of them is open, or REV is closed at this time, the frequency converter will stop; when REV, X1, CM are open at the same time, or one of them is open, or FWD is closed at this time, the frequency converter will stop.

8.3 External Control, Set Frequency via External Voltage

8.3.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-1]=2: The external voltage 1 (VI1) can receive frequency setting signal within 0−10 V.
- [b-3]=1: Select external control.
- [L-46]=2: Keep the default setting unchanged.

8.3.2 Basic Wiring

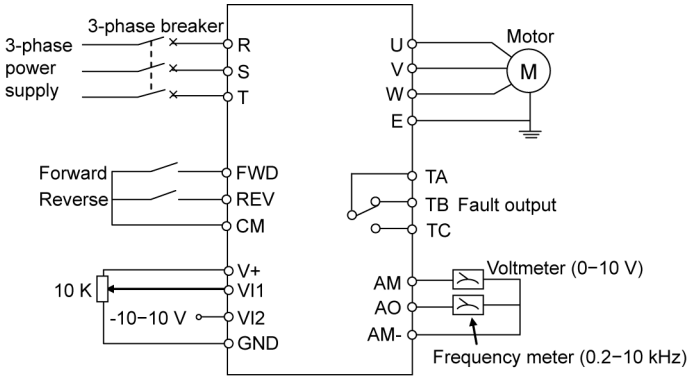


Fig. 8-3: Basic wiring_external control

8.3.3 Operating Description

When FWD-CM is closed, the motor runs forwardly (forward command); when REV-CM is closed, the motor runs reversely (reverse command). When FWD-CM and REV-CM are closed or open at the same time, the frequency converter will stop. The set frequency will be decided by external voltage signal 1 (VI1).

- According to the setting of b-1, users can select either VI1 or VI2 as frequency setting signal.
- The control mode of FWD and REV can be set via L-46.
- Please pay attention to influences of parameters L-27 to L-35 to the analog inputs.

8.4 Multi-speed Running, External Control

8.4.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-3]=1: Select the external control.
- H-14 to H-28: Set value for multi-speed frequency (altogether 15 stages).
- L-47 to L-53: Keep the default setting unchanged.

8.4.2 Basic Wiring

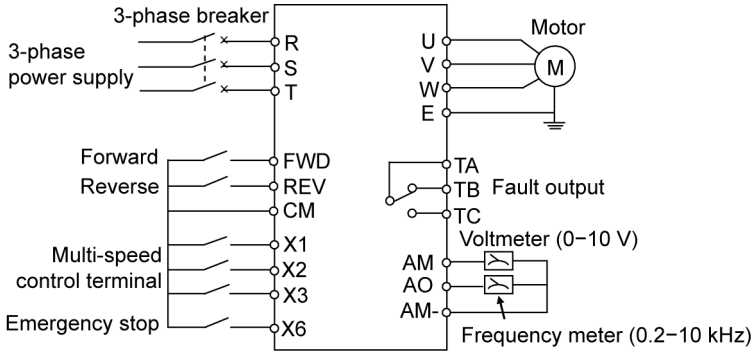


Fig. 8-4: Basic wiring_multi-speed running

8.4.3 Operating Description

When FWD-CM is closed, the motor runs forwardly (forward command); when REV-CM is closed, the motor runs reversely (reverse command). When FWD-CM and REV-CM are closed or open at the same time, the frequency converter will stop.

When all of X1, X2, X3 are open with the CM terminal, the multi-speed running will be invalid, and the frequency converter will run with the set frequency (select the frequency setting channel via b-1).

When any one or more of X1, X2, X3 is/are closed with the CM terminal (altogether 7 kinds of combination), the frequency converter will run with the multi-speed frequency selected by X1, X2, X3 (set the multi-speed frequency via H-14 to H-28).

Users can select the multi-speed control terminals via L-47 to L-53. When 4 multi-speed control terminals are selected, multi-speed control of 15 stages can be realized.

8.5 Programmable Multi-speed Control

8.5.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=2: Select the advanced running parameter.
- H-14 to H-28: Set value for multi-speed frequency (altogether 7 stages)
- [H-29]=1−7: Select any value from 1 to 7.
- H-30 to H-50: Set the running time, running direction of the simple PLC multi-speed, as well as the acceleration/deceleration time of each speed.

8.5.2 Basic Wiring

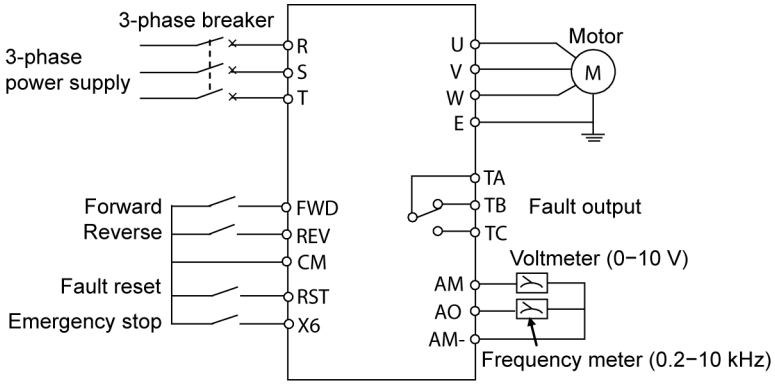


Fig. 8-5: Basic wiring_programmable multi-speed control

8.5.3 Operating Description

After the start command is input, the frequency converter will run with multi-speed frequency 1, switch to the multi-speed frequency 2 after the set running time (set by H-30), and then switch to multi-speed frequency 3, 4, 5, 6 until finishes running with multi-speed frequency 7. Then the frequency converter will work as set by H-29 (see parameter setting of H-29 to H-50).

The programmable multi-speed running can be stopped by the stopping command or by the pausing via simple PLC pause control terminal.

8.6 Multiple Frequency Converters Control (Group Control)

8.6.1 Multiple Frequency Converters Control via External Voltage

Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=2: Select the advanced/extended application running parameter.
- [b-1]=8: Select the combined setting as the frequency input channel.
- [b-3]=1: Select the external terminal as the running command channel, and the keypad stop is invalid.
- [L-46]=0: Select the 2-line control mode 1.
- [L-25]=310: Select the combined setting as 1st channel * 2nd channel, among which the 1st channel means the external voltage signal 1, and the 2nd channel means the panel potentiometer adjustment.
- [L-26]=1.00: Set the panel potentiometer input gain coefficient to 1.00 (if any deviation, please adjust it).
- [L-29]=1.00: Set the external voltage signal VI1 input gain to 1.00 (if any deviation, please adjust it).

Please set other parameters as necessary.

Basic Wiring

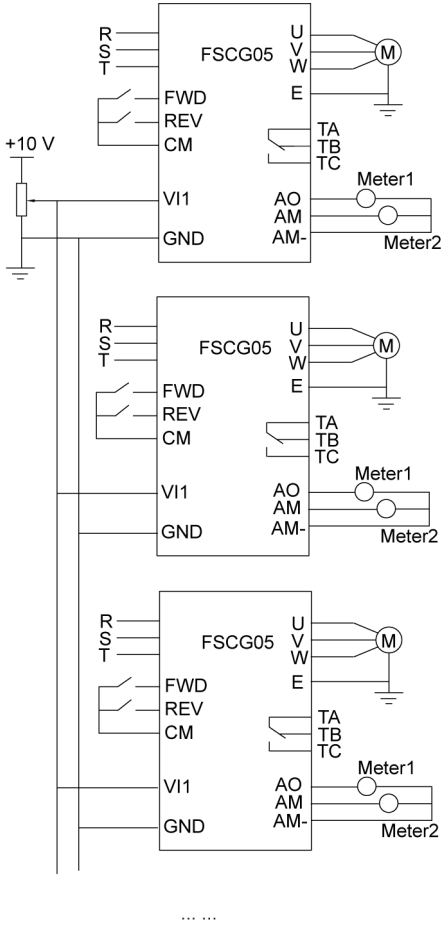


Fig. 8-6: Basic wiring_ multiple frequency converters control via external voltage

Operating Description

As shown in the figure above, the constant power supply (10 V) and a big-power adjustable resistor are needed. By setting the voltage of the adjustable resistor, the input voltage at VI1 terminal of all frequency converters will change accordingly. When multiple frequency converters are running, if the input voltage at VI1 terminal is adjusted, the frequencies will increase or decrease in the same proportion. In this case, the input setting function for each frequency converter is: input setting frequency=external voltage signal 1 (VI1) * panel potentiometer in-

put signal, which means: when the external voltage signal (VI1) is same, if the panel potentiometer input signal changes, the input set frequency of this frequency converter will change accordingly.

8.6.2 Multiple Frequency Converters Control via RS485

Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=2: Select the advanced running parameter.
- [b-1]=7: Set the frequency setting channel of the slave as RS485 mode.
- [b-3]=3: Set the running command channel of the slave as RS485 mode.
- [H-67]: Data format, the data format should be set consistently.
- [H-68]: Baud rate, the baud rate should be set consistently.
- [H-65]: Master setting, the controlling frequency converter (master) is set as 1, other frequency converters (slaves) are set as 0.
- [H-69]: Set running frequency proportion of master and slave, which is only valid to the slave.

Basic Wiring

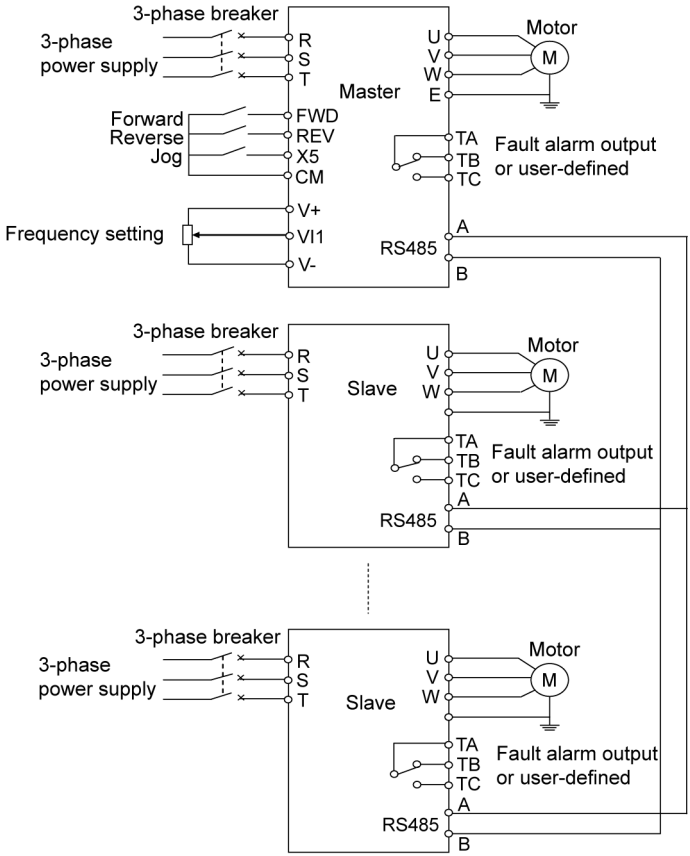


Fig. 8-7: Basic wiring_multiple frequency converter control via RS485

Operating Description

Users only need to start, stop, jog control and set frequency for the controlling frequency converters (master), all other frequency converters (slave) will keep strictly consistent with the master.

☞ In case of jog running, each frequency converter will run with its own set jog frequency respectively. To synchronize multiple frequency converters, set the same jog frequency to these frequency converters.

8.7 Closed-loop Control System

8.7.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=2: Select the advanced running parameter.
- [E-0]=1: Select the internal PID control.
- [E-1]=0: Select the panel potentiometer as the PID setting channel.
- [E-2]=3: Select the voltage input 2 (VI2) as the feedback channel, with the feedback signal ranging from 0 V to 10 V.
- [E-6]=2: Select PI controller.
- [E-7]=0.5: Set the proportional gain as necessary.
- [E-8]=10.0: Set the integral time constant as necessary.
- [E-10]=0.10: Sampling period, no change in most cases.

8.7.2 Basic Wiring

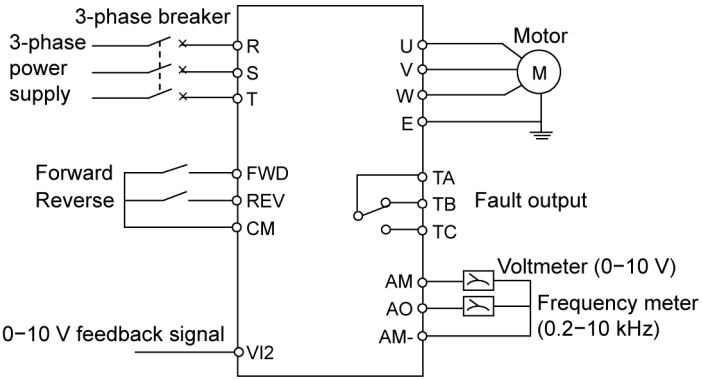


Fig. 8-8: Basic wiring_closed-loop control system

8.8 Control Multiple Frequency Converters via PC

8.8.1 Parameter Setting

Set b-6, b-7 according to the rated data on the motor nameplate.

Following settings are also required:

- [b-0]=2: Select the advanced running parameter.
- [b-1]=8: Select the frequency input channel as combined setting.
- [b-3]=3: Set the running command channel for the slave as RS485 mode.
- [H-67]: Data format, set it to be same for for all the frequency converters.
- [H-68]: Baud rate, set it to be same for for all the frequency converters.
- [H-65]=0: Set the frequency converter to 0 (slave).
- [H-69]: Set on demand.
- [L-25]=161: Select the combination mode as 1st channel + 2nd channel.

8.8.2 Basic Wiring

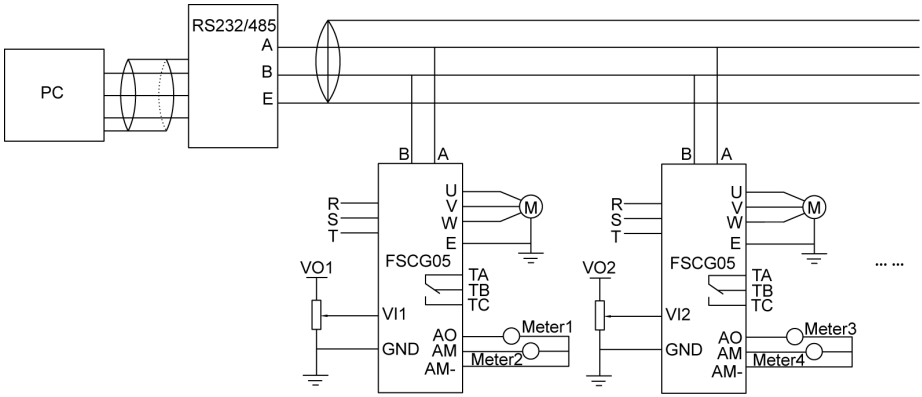


Fig. 8-9: Basic wiring_control multiple frequency converters via PC

8.8.3 Operating Description

In this use case, users can freely control the working condition of each frequency converter via the PC and respond timely. Channel VI1 is used for manual adjusting, with applied external voltage as +10 V. Users can also fine tune the frequency input setting of this frequency converter by adjusting the potentiometer knob. This system can work together with other systems to form a closed-loop control system.

9 Optional Accessories

9.1 Remote Control Cable and Remote Control Adapter

The operating panel can be connected with control cables (maximum 10 m) to the frequency converter. If a remote control adapter is used, the operating panel cable can be of 1000 m.

Specification for remote control cable

1.5 m, 2 m, 3 m, 5 m, 8 m, 10 m.

1.5 m, 2 m and 3 m are standard cables for the frequency converter. If remote control cables longer than 5 m are needed, please note specially before placing the order.

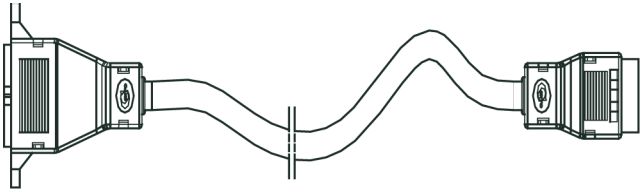


Fig. 9-1: Remote control cable

Remote control adapter type

- FSAE-1-S: applicable to the operating panel KP51S
- FSAE-2-LCD: applicable to the operating panel KP51B

9.2 Water Supply Accessory

9.2.1 Application

This set of water supply accessories is specially used for the multi-pump water supply system. To achieve an efficient control on the multi-pump water supply system, please use it together with the FSCG05 frequency converters.

9.2.2 Dimension

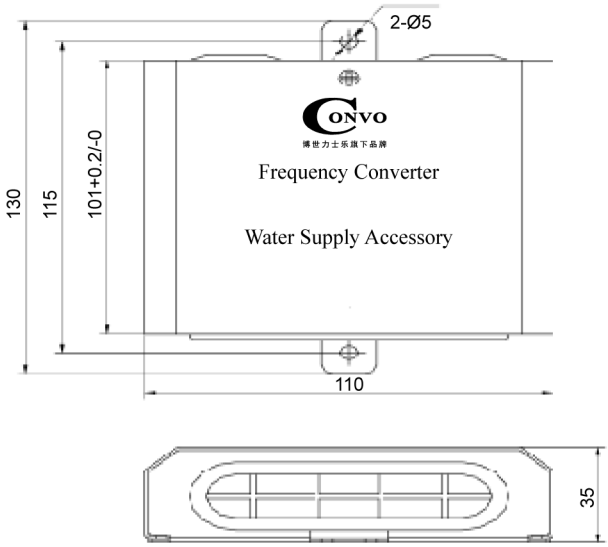


Fig. 9-2: Dimension of the water supply accessory

9.2.3 Connection of the Water Supply Accessory and Frequency Converter

This water supply accessory is designed to be connected externally. Users can connect the accessory with the frequency converter via the 7PIN flat wire, connect it with the contactor via the control terminal.

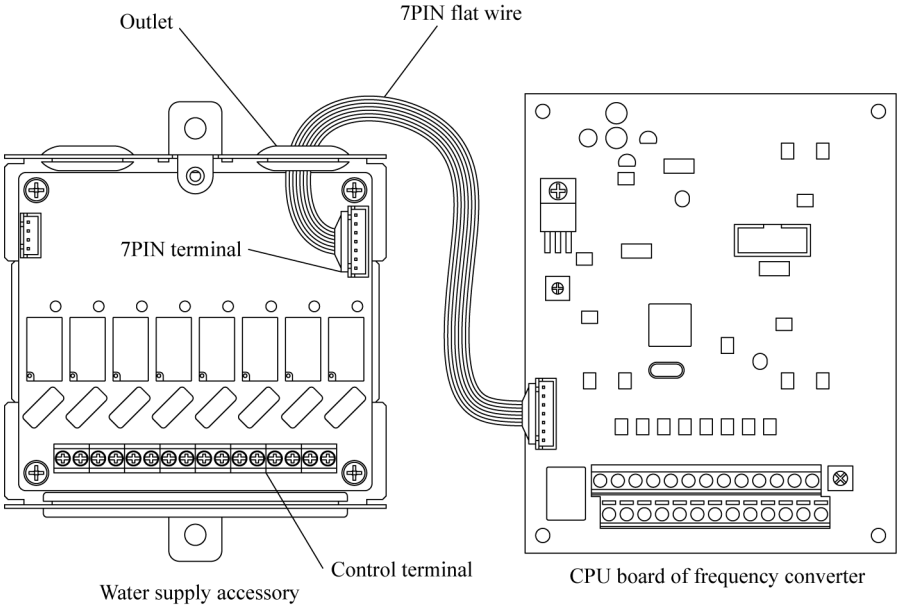


Fig. 9-3: Connection of the water supply accessory and frequency converter

9.2.4 System Wiring (4-pump)

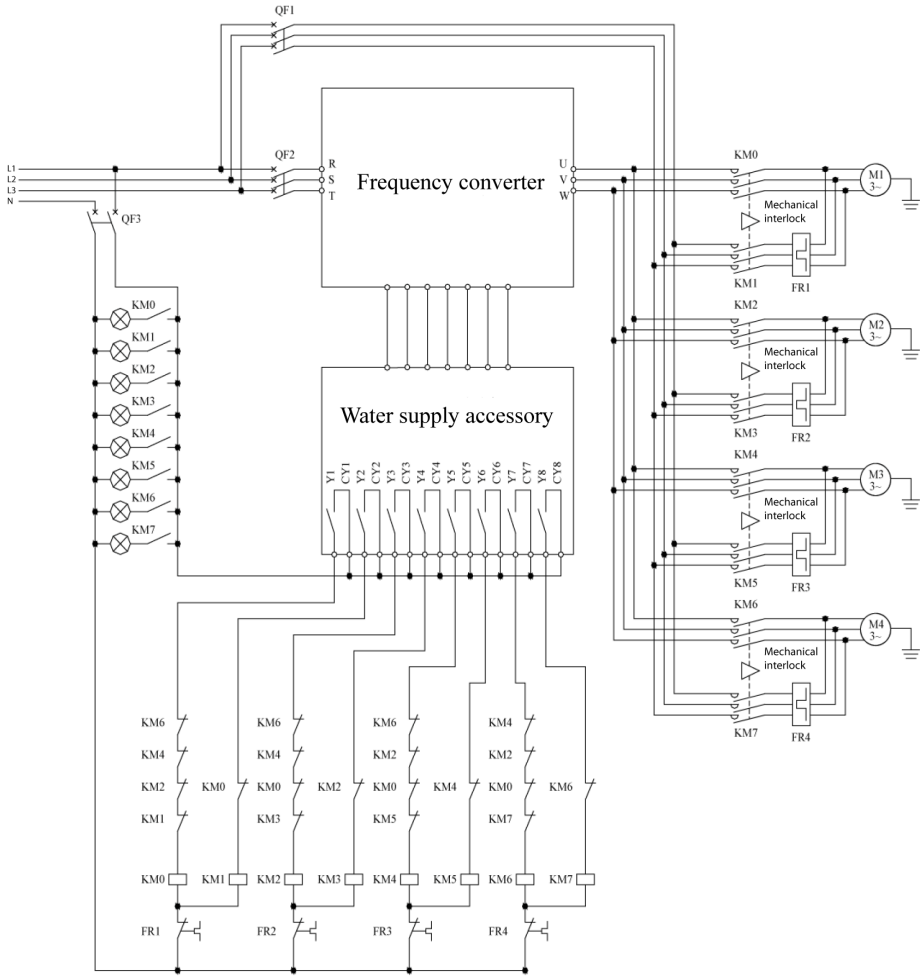


Fig. 9-4: Wring of constant pressure water supply system

Among which:

(Y1, CY1), (Y2, CY2), (Y3, CY3), (Y4, CY4), (Y5, CY5) (Y6, CY6) (Y7, CY7), (Y8, CY8) respectively represents the two terminals corresponding to the control terminals "1st variable frequency", "1st power frequency, "2nd variable frequency", "2nd power frequency, "3rd variable frequency", "3rd power frequency, "4th variable frequency", "4th power frequency on the water supply board.

- At the motor side, an AC contactor with mechanical interlock should be applied between the frequency converter output and power frequency by-pass,

and apply logical interlock at the electric control circuit to prevent damages to the frequency converter and relevant devices due to the short-circuit between the frequency converter output and power frequency power supply.

- The phase sequence of power frequency power supply L1, L2 and L3 connected to motor should keep consistent with the frequency converter output U, V and W. Please only run after confirming the consistency with the phase sequence meter, to prevent motor reverse during the variable frequency/power frequency switching.
- An overcurrent protection device should be connected in the power-frequency by-pass circuit of the motor.
- An overvoltage suppressor or surge absorber should be applied to the AC contactor between the frequency converter output and power frequency bypass, otherwise, the AC contactor may cause impact to the water supply accessory and shorten its lifetime.

9.2.5 Water Supply Control

Variable frequency/power frequency running and switching

The variable frequency running means the motor (pump) is controlled by the frequency converter output frequency; the power frequency running means the motor (pump) is directly powered by the power frequency supply. The variable frequency/power frequency switching is the process of changing the motor (pump) from the frequency converter driven to the power frequency supply driven.

Working mode

The frequency converter drives the pump to run in certain sequence with variable frequency and it can automatically decide the number of running pumps (within the set range) according to the pressure closed-loop control requirements. At a specific time, only one pump can be driven by the frequency converter. When the pump driven by the frequency converter runs to the upper frequency and more pumps are needed, the frequency converter will switch the current pump to run with power frequency, and drive another pump to run with variable frequency at the same time.

9.2.6 Parameter Setting

For details of water supply parameters E-14 to E-29, please refer to model-specific documentation.

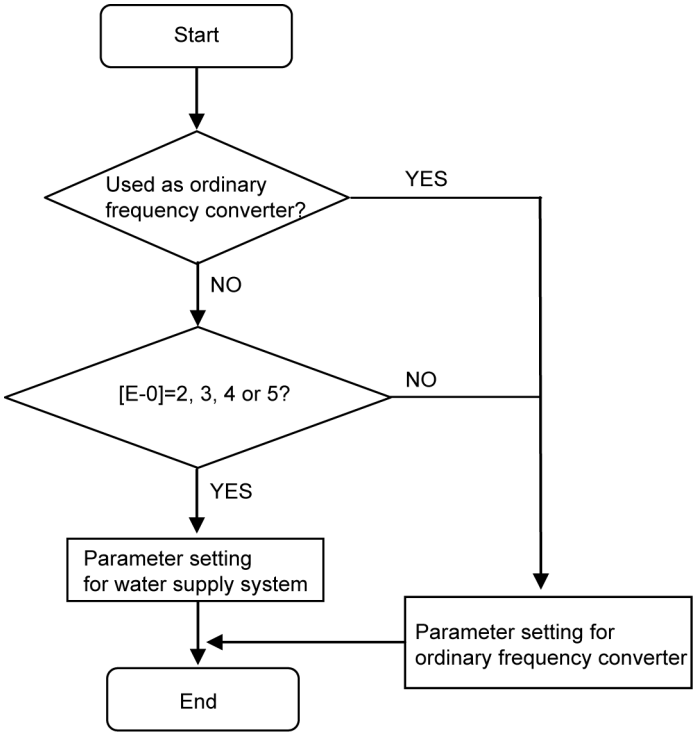


Fig. 9-5: Parameter setting flow chart

9.3 Braking Components

Please purchase appropriate external braking resistor according to the model of the frequency converter. Model description:

- CVDB–4R□□□□ (380 V series)
- CVDB–2R□□□□ (220 V series)

Here, □□□□ means the power rate of the braking resistor.

The specification of the general braking resistors are as below:

Motor (kW)	Braking power (kW)	Braking resistance (Ω)	Braking torque (%)	Resistor model
0.75	0.3	400	100	CVDB-4R0003
1.5	0.3	400	100	CVDB-4R0003
2.2	0.5	250	100	CVDB-4R0005
3.0	0.8	150	100	CVDB-4R0008
4.0	0.8	150	100	CVDB-4R0008
5.5	1.2	100	100	CVDB-4R0012
7.5	1.6	75	100	CVDB-4R0016
11	2.0	60	100	CVDB-4R0020
15	3.0	40	100	CVDB-4R0030
18.5	3.0	30	100	CVDB-4R0030
22	3.0	30	100	CVDB-4R0030
30	5.0	20	100	CVDB-4R0050
37	5.0	20	100	CVDB-4R0050
45	10.0	8	100	CVDB-4R0100
55	10.0	8	100	CVDB-4R0100
75	15	8	100	CVDB-4R0150
90	15	8	100	CVDB-4R0150
110	20	6	100	CVDB-4R0200
132	20	6	100	CVDB-4R0200
160	25	5	100	CVDB-4R0250
185	30	4	100	CVDB-4R0300
200	30	4	100	CVDB-4R0300
220	30	4	100	CVDB-4R0300
250	40	3	100	CVDB-4R0400
280	40	3	100	CVDB-4R0400
315	40	3	100	CVDB-4R0400
350	50	2.5	100	CVDB-4R0500

10 Maintenance

10.1 Daily Inspection

Potential problems may occur to frequency converters during the running due to ambient temperature, humidity, dust, vibration and aging of internal parts. To run the frequency converter steadily for a longer time, a periodical inspection every 3 to 6 months must be conducted.

The inspection must be conducted by qualified professional personnel, and the power supply should be switched off firstly if necessary.

Inspection list

Interval		Item	Content	Criteria
Daily	Periodic			
√		Operating environment	Temperature, humidity	Open the frequency converter cover when temperature>40 ℃; Humidity<90 %, no frost
			Dust, gas	No peculiar smell, no flammable or explosive gas
	√	Cooling system	Mounting environment	Well-ventilated, the air duct cleared
			Fan of the frequency converter	The fan runs normally, no noise
√		Frequency converter	Vibrating, temperature increasing	Vibrate steadily, air outlet temperature is normal
			Noise	No noise, no peculiar smell
			Conductor, terminal	No loose screw
√		Motor	Vibrating, temperature increasing	Runs steadily, temperature is normal
			Noise	No abnormal and unbalanced noise
√		Input/output parameter	Input voltage	Within the specified range
			Output current	Below the rated value

Recommended instrument

- Input voltage: moving-coil voltmeter
- Input/output current: clip-on ammeter
- Output voltage: rectifier voltmeter

- The frequency converter has been tested for electric insulation before delivery, so please do not conduct further high-voltage test.
- If the insulation test is really necessary, please remember to short circuit all the input/output terminals (R, S, T, U, V, W, P, P-, PB). Never conduct insulation test on the individual terminal! Please use the megger of 500 V.
- Do not measure the control circuit with the megger!
- When conducting the insulation test on the motor, please remember to remove the wiring between the motor and the frequency converter.

10.2 Periodic Inspection

Please conduct a periodic inspection on the frequency converter every 3 or 6 months as necessary.

- Only those trained and qualified to work with or on electrical equipment are allowed to operate, maintain and repair the frequency converter.
- Please be sure to switch off the power supply before opening the frequency converter.
- Please measure and confirm the voltage between P+ and P- with a DC high voltage meter.
- Be careful not to leave metal components like screw and washer inside the machine, otherwise, the device damage or fire may happen.

Inspection content

- Is the screw of the control circuit terminal loose? If yes, please tighten it with screwdriver.
- Is the screw of the main circuit terminal loose? If yes, please tighten it. Is it overheat at the connection point of copper bar?
- Is there any damage on the main circuit cable, control circuit cable? Especially is there any cutting mark on the surface contacted with metal parts?
- Is the main circuit cable well insulated?
- Is the dust in the air duct, on the fan and on the circuit board cleared? Especially is it regularly cleaned in environment with heavy dust?

10.3 Inspection and Replacement of Wearing Parts

Some components inside the frequency converter may wear or deteriorate during operation. To keep a steady running of the frequency converter. Please conduct preventive maintenance and replace the components when necessary. The wearing parts of the frequency converter mainly include: cooling fan, filter electrolytic capacitors, the lifetime of which are closely related to the operating environment and maintenance status.

Filter capacitor

The performance of aluminum electrolytic capacitor will be affected by the pulsating current of the main circuit to certain extent depending on the ambient temperature and operating condition. Generally, the lifetime of electrolytic capacitor is about 20, 000 hours, please replace it according to the actual running time.

Please replace the electrolytic capacitor immediately when: electrolyte of the electrolytic capacitor is leaked, safety valve falls out or the capacitor itself expands.

Cooling fan

All cooling fans inside the frequency converter have a lifetime of around 30,000 to 40,000 hours. When the fan leaf cracks, or abnormal noise exists during start-up, please check the fan carefully. If the fan is really in fault, please replace it.

10.4 Storage and Warranty

10.4.1 Storage

If the frequency converter will not be used immediately after purchase or is planned to be stored for a long time, please follow the instructions below:

- Do not store the frequency converter in places with high temperature, humidity, vibration or metal dust, and please ensure it is well-ventilated.
- If the frequency converter will not be used for a long time, please energize it every 2 years for at least 5 hours by gradually increasing its voltage with an autotransformer, to resume the performance of its filter capacitor, and check functions of the frequency converter.

If the frequency converter is not used for a long time, the performance of the internal filter capacitor will degrade.

10.4.2 Warranty

The warranty period of this product is 18 months (starting from the date of purchasing or delivery). Within the warranty period, free repair or product replacement will be provided if the fault or damage of the product happens under normal application conditions.

Warranty only covers the frequency converter itself.

Warranty DOES NOT COVER failures due to defects as below (service will be charged):

- Defects due to improper use of the device or failure to follow this operating instructions.
- Defects due to repair or alteration without authorization.
- Defects due to improper storage.
- Defects due to misapplication.
- Defects due to fire, erosion, earthquake, storm, flood, thunder, abnormal voltage, or other force majeure.

Even if the warranty period is over, paid service will be provided to the product for its whole lifetime.

11 Service and Support

Our service helpdesk at Xi'an China, will assist you with all kinds of enquiries.

	Service Hotline China	Service Hotline Worldwide
Phone	400 887 6910	Outwith China please contact our sales/service office in your area first. For hotline numbers refer to the sales office addresses on the Internet.
Fax	+86 (0)29 8655 5323	
e-mail	service.fc@boschrexroth.com.cn	
Internet	http://www.convo.com.cn You will also find additional notes regarding service, maintenance (e.g. delivery addresses) and training.	

Preparing Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone, fax numbers and e-mail address so we can contact you in case of questions.

12 Disposal and Environmental Protection

12.1 Disposal

Packaging materials

The packaging materials consist of cardboard and polystyrene. These materials can be easily recycled. For ecological reasons you should not return the empty packages to us.

12.2 Environmental Protection

No Release of Hazardous Substances

Our products do not contain any hazardous substances that they can release in case of appropriate use. Normally there are not any negative effects on the environment to be expected.

Materials contained in the electronic devices:

- steel
- aluminum
- copper
- synthetic materials
- electronic components and modules

Recycling

Due to their high content of metals most of the product components can be recycled. In order to recycle the metal in the best possible way it is necessary to disassemble the products into individual modules. The metals contained in the electric and electronic modules can also be recycled by means of specific separation processes. The synthetic materials remained after these processes can be thermally recycled.

13 Contrast between G2/G3-G5 Function Code

13.1 Basic Parameters (Group b)

Name	G2/G3 code	G5 code
Running parameter selection*	b-0	b-0
Frequency input channel selection*	b-1	b-1
Frequency digital setting	b-2	b-2
Running command channel	b-3	b-3
Direction control	b-4	b-4
Rated motor voltage	**b-5**	**b-7**
Rated motor frequency*	b-6	b-6
Acc. time 1	**b-7**	**b-8**
Dec. time 1	**b-8**	**b-9**
Acc./Dec. mode	**b-9**	**b-10**
Analog output (AM) setting	**b-10**	**L-54**
Frequency output (AO) setting	**b-11**	**L-55**
AM output gain	**b-12**	**L-56**
AO output gain*	**b-13**	**L-57**
AO output channels*	**b-14**	**L-58**
OC1 output setting*	**b-15**	**L-59**
OC2 output setting*	**b-16**	**L-60**
REV/JOG selection	**b-17**	**L-21**

13.2 Intermediate Parameters (Group L)

Name	G2/G3 code	G5 code
V/F curve selection	L-0	L-0
Torque boost	L-1	L-1
Torque boost mode	L-2	L-2
Upper frequency*	**L-3**	**b-5**
Lower frequency	**L-4**	**L-10**
Lower frequency running mode	**L-5**	**L-11**
Starting mode*	**L-6**	**L-12**
Starting frequency	**L-7**	**L-13**
Starting frequency holding time	**L-8**	**L-14**
DC braking voltage at startup	**L-9**	**L-15**
DC braking time at startup*	**L-10**	**L-16**

Name	G2/G3 code	G5 code
Stopping mode	L-11	L-17
Stopping DC braking initial frequency	L-12	L-18
Stopping DC braking time	L-13	L-19
Stopping DC braking voltage	L-14	L-20
Jog frequency	L-15	L-22
Jog Acc. time	L-16	L-23
Jog Dec. time	L-17	L-24
Multi-speed frequency 1	L-18	H-14
Multi-speed frequency 2	L-19	H-15
Multi-speed frequency 3	L-20	H-16
Multi-speed frequency 4	L-21	H-17
Multi-speed frequency 5	L-22	H-18
Multi-speed frequency 6	L-23	H-19
Multi-speed frequency 7	L-24	H-20
Multi-speed frequency 8	L-25	H-21
Multi-speed frequency 9	L-26	H-22
Multi-speed frequency 10	L-27	H-23
Multi-speed frequency 11	L-28	H-24
Multi-speed frequency 12	L-29	H-25
Multi-speed frequency 13	L-30	H-26
Multi-speed frequency 14	L-31	H-27
Multi-speed frequency 15	L-32	H-28
External running command modes	L-33	L-46
VI1 input lower voltage	L-34	L-27
VI1 input upper voltage	L-35	L-28
VI1 input adjusting coefficient	L-36	L-29
VI2 input lower voltage	L-37	L-30
VI2 input upper voltage	L-38	L-31
VI2 input adjusting coefficient	L-39	L-32
VI2 input zero offset	L-40	L-33
VI2 input bipolar control	L-41	L-34
VI2 input bipolar control zero hysteresis width	L-42	L-35
II input lower current	L-43	L-36
II input upper current	L-44	L-37
II input adjusting coefficient	L-45	L-38
Pulse input lower frequency	L-46	L-41

Name	G2/G3 code	G5 code
Pulse input upper frequency	L-47	L-42
Pulse input adjusting coefficient	L-48	L-43
Set frequency for lower input	L-49	L-44
Set frequency for upper input	L-50	L-45
Run monitoring 2	L-51	L-69
Run monitoring 3	L-52	L-70
Number of run monitoring	L-53	L-67
Stop monitoring	L-54	L-71
Analog input filtering time	L-55	L-40
Frequency input channel combination	L-56	L-25
Carrier frequency	L-57	L-9
Frequency arriving at detection width*	L-58	L-62
FDT (frequency level) setting	L-59	L-63
FDT output delay time*	L-60	L-64
Overload warning level	L-61	L-65
Overload warning delay time*	L-62	L-66
Input terminal 1 function*	L-63	L-47
Input terminal 2 function*	L-64	L-48
Input terminal 3 function*	L-65	L-49
Input terminal 4 function*	L-66	L-50
Input terminal 5 function*	L-67	L-51
Input terminal 6 function*	L-68	L-52
Input terminal 7 function*	L-69	L-53
Linear speed coefficient setting	L-70	L-72
Run monitoring 1	L-71	L-68
Parameter writing protection	L-72	L-73
Parameter initialization	L-73	b-11

13.3 Advanced Parameters (Group H)

Name	G2/G3 code	G5 code
Slip frequency compensation	H-0	H-0
Overload, overheat protection actions	H-1	H-1
Motor overload protection coefficient	H-2	H-2
Auto energy-saving	H-3	H-3
Restart after power failure*	H-4	H-4

Name	G2/G3 code	G5 code
Waiting time for restart after stop	H-5	H-5
Auto fault reset attempts	H-6	H-6
Interval between auto fault reset	H-7	H-7
Auto voltage stabilization	H-8	H-8
Current limit level	H-9	H-9
Forward/reverse dead zone time	H-10	H-10
Internal timer setting	H-11	H-11
Internal counter final value setting	H-12	H-12
Internal counter defined value setting	H-13	H-13
Programmable multi- speed running	**H-14**	**H-29**
Phase 1 running time	**H-15**	**H-30**
Phase 1 running direction	**H-16**	**H-31**
Phase 1 Acc./Dec. time	**H-17**	**H-32**
Phase 2 running time	**H-18**	**H-33**
Phase 2 running direction	**H-19**	**H-34**
Phase 2 Acc./Dec. time	**H-20**	**H-35**
Phase 3 running time	**H-21**	**H-36**
Phase 3 running direction	**H-22**	**H-37**
Phase 3 Acc./Dec. time	**H-23**	**H-38**
Phase 4 running time	**H-24**	**H-39**
Phase 4 running direction	**H-25**	**H-40**
Phase 4 Acc./Dec. time	**H-26**	**H-41**
Phase 5 running time	**H-27**	**H-42**
Phase 5 running direction	**H-28**	**H-43**
Phase 5 Acc./Dec. time	**H-29**	**H-44**
Phase 6 running time	**H-30**	**H-45**
Phase 6 running direction	**H-31**	**H-46**
Phase 6 Acc./Dec. time	**H-32**	**H-47**
Phase 7 running time	**H-33**	**H-48**
Phase 7 running direction	**H-34**	**H-49**
Phase 7 Acc./Dec. time	**H-35**	**H-50**
Skip frequency 1	**H-36**	**H-51**
Skip frequency 1 width	**H-37**	**H-52**
Skip frequency 2	**H-38**	**H-53**
Skip frequency 2 width	**H-39**	**H-54**
Skip frequency 3	**H-40**	**H-55**

Name	G2/G3 code	G5 code
Skip frequency 3 width	H-41	H-56
Acceleration time 2	H-42	H-57
Deceleration time 2	H-43	H-58
Acceleration time 3	H-44	H-59
Deceleration time 3	H-45	H-60
Acceleration time 4	H-46	H-61
Deceleration time 4	H-47	H-62
Internal PID control	H-48	E-0
PID setting channels	H-49	E-1
PID feedback channels	H-50	E-2
Feedback signal characteristic	H-51	E-3
Feedback channel gain	H-52	E-4
PID setting, feedback display coefficient	H-53	E-5
PID controller modes	H-54	E-6
Proportional gain	H-55	E-7
Integral time constant	H-56	E-8
Derative gain	H-57	E-9
Sampling period	H-58	E-10
Allowable deviation limit	H-59	E-11
PID feedback disruption detection threshold	H-60	E-12
PID feedback disruption action	H-61	E-13
Scale of remote pressure gauge	H-62	E-14
Lower pressure for warning	H-63	E-15
Upper pressure for warning	H-64	E-16
Lower pressure limit	H-65	E-17
Upper pressure limit	H-66	E-18
Lower frequency holding time (pump-reducing judgement)	H-67	E-19
Upper frequency holding time (pump-increasing judgement)	H-68	E-20
Pump switching frequency (for pump-reducing and switching)	H-69	E-22
Electromagnetic switch delay time	H-70	E-21
Relay output functions*	H-71	L-61
Timed switching interval	H-72	E-23
Timed water supply interval	H-73	E-24
Hardware correction coefficient for AM output	H-74	
Hardware correction coefficient for AO output	H-75	
Suppression analog input setting swing	H-76	L-39

Name	G2/G3 code	G5 code
Braking ratio	**H-77**	**H-64**
Local address	**H-78**	**H-66**
Data format	**H-79**	**H-67**
Baud rate	**H-80**	**H-68**
Protocol selection	**H-81**	**H-65**
Multiple frequency converters control setting ratio	**H-82**	**H-69**
RS485 communication disruption action	**H-83**	**H-70**
Gain coefficient for panel potentiometer input	**H-84**	**L-26**
Sleep/auxiliary pump frequency	**H-85**	**E-25**
Sleep delay	**H-86**	**E-26**
Wake up/disable auxiliary pump	**H-87**	**E-27**
Wake-up delay	**H-88**	**E-28**
PID input 2 setting	**H-89**	**E-29**

13.4 G5 Added Parameters

Name	G2/G3 code	G5 code
V/F frequency 1		L-3
V/F voltage 1		L-4
V/F frequency 2		L-5
V/F voltage 2		L-6
V/F frequency 3		L-7
V/F voltage 3		L-8
Dynamic brake initial voltage		H-63

- Parameters with sequence change are displayed in **Bold** in the contrast table.
- *: means the parameter definition is changed in G5.

Notes

R912004814 Rev04

Bosch Rexroth (Xi'an) Electric Drives and Controls Co., Ltd.
Address: No. 3999 Shang Ji Road, Cao Tan Ecology Industry Park,
Economic and Technological Development Zone, Xi'an, Shaanxi Province, PRC

Zip-Code: 710021
Phone: +86 29 8655 5100
Fax: +86 29 8655 5106
After-sales service hotline: 400 887 6910
After-sales service email: service.fc@boschrexroth.com.cn
Email: sales@convo.com.cn
Website: www.convo.com.cn

PRINT 13/06