Rexroth Frequency Converter Fv

R912002625 Edition 05

Instruction Manual



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DOK-RCON02-FV********-IB05-EN-P	02. 2014	Added new functions

Reference

For documentations available in other type or language, please consult your local sales partner or check www.boschrexroth.com/fv.

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Magyar Üzembe helyezés előtt olvassa el, értelmezze, és vegye figyelembe a csomagban található dokumentumban foglaltakat és a biztonsági útmutatásokat.

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귀하의 모국어로 된 안내서가 배송되지 않았다면 Bosch Rexroth 대리점에 알려주시기 바랍니다.

		Page
1	Introduction	7
1.1	Introduction to the Documentation	
1.2	Definition	8
1.3	Type Coding	9
1.3.1	Type Coding of Fv	9
1.3.2	Type Coding of Fv Function Modules	10
1.3.3	Type Coding of Fv Accessories	11
1.4	Delivery and Storage	14
1.4.1	Brief Introduction	14
1.4.2	Scope of Supply	14
1.4.3	Transport of the Components	15
1.4.4	Storage of the Components	15
1.5	Fv Description	16
1.5.1	Certification	16
1.5.2	Properties of the Basic Device Fv	18
1.5.3	Interfaces	18
1.5.4	Cooling Types	18
2	Safety Instructions for Electric Drives and Controls	10
2.1	Definitions of Terms	
2.1	Explanation of Signal Words and the Safety Alert Symbol	
2.3	General Information	
2.3.1	Using the Safety Instructions and Passing Them on to Others	
2.3.1	Requirements for Safe Use	
2.3.3	Hazards by Improper Use	
2.3.3	Instructions with Regard to Specific Dangers	
2.4.1	Protection against Contact with Electrical Parts and Housings	
2.4.2	Protective Extra-Low Voltage as Protection Against Electric Shock	
2.4.3	Protection against Dangerous Movements	
2.4.4	Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting	
2.4.5	Protection Against Contact with Hot Parts	
2.4.6	Protection During Handling and Mounting	
2		
3	Important Directions for Use	
3.1	Appropriate Use	27
3.2	Inappropriate Use	27
4	Fv Mounting	29
4.1	Mounting	
4.2	Fv Dimensions and Figure	
4.2.1	Fv Dimensions	
422	Fv Figure	32

		Page
5	Installation	35
5.1	Fv Disassembly and Assembly	
5.1.1	Removal and Mounting of Operating Panel	35
5.1.2	Removal and Mounting of Adapter	36
5.2	Drive System Wiring	37
5.2.1	Block Diagram	
5.2.2	Main Circuit Wiring	38
5.2.3	Control Circuit Wiring	
5.2.4	Cable and Fuse Dimensions	
5.3	Wiring Terminals Description	49
5.3.1	Main Circuit Terminals	49
5.3.2	Control Circuit Terminals	
5.3.3	Jumper Wiring	53
5.3.4	NPN/PNP Jumper SW1	
5.3.5	Encoder Signal Selection	55
6	Commissioning	57
6.1	Operating Panel	57
6.1.1	Overview	57
6.1.2	3-Level Menu Structure	58
6.1.3	Operation Mode Description	59
6.1.4	Example of Operating Panel Operation	59
6.2	Commission Process	59
6.2.1	Check and Preparation before Commissioning	59
6.2.2	Notes on Commissioning	60
6.2.3	Fv Basic Parameter Fast Setting	60
6.2.4	Example: Commissioning of Frequency Converter with Potentiometer	61
6.3	Restore Parameters to Factory Defaults	61
6.4	Solutions for Simple Error during Commissioning	62
6.5	Notes on Frequent Start and Stop	62
7	Parameter Settings	63
7.1	Main Functions	
7.1.1	Control Command	63
7.1.2	Frequency Setting	64
7.1.3	Start Control	
7.1.4	Stop Control	66
7.1.5	Linear/S-curve Acceleration/Deceleration	
7.1.6	Logic Control	
7.1.7	PID Control	
7.1.8	Frequency Setting via Analog and Pulse Inputs	
7.1.9	Multiple Function Digital Inputs	
7.1.10	·	
7.1.11		
7 2	Description of Attribute Symbols in Parameter Tables	

		Page
7.3	Parameters Functions	75
7.3.1	Category b: Basic Parameters	75
7.3.2	Category S: Standard Parameters	78
7.3.3	Category E - Extended Parameters	81
7.3.4	Category H: Advanced Parameters	90
7.4	Notes on Function Groups	91
7.4.1	Category b: Basic Parameters	91
7.4.2	Category S: Standard Parameters	104
7.4.3	Category E: Extended Parameters	118
7.4.4	Category H: Advanced Parameters	149
8	Error Types and Solutions	151
9	Technical Data	155
9.1	Electrical Data	155
9.2	General Technical Data	156
9.3	Derating of Electrical Data	157
9.3.1	Derating and Ambient Temperature	
9.3.2	Derating and Mains Voltage	
9.3.3	Derating of the Output Current Depending on the Pulse Frequency	159
9.4	Electromagnetic Compatibility (EMC)	
9.4.1	EMC Requirements	160
9.4.2	Ensuring the EMC Requirements	165
9.4.3	EMC Measures for Design and Installation	166
10	Accessories	175
10.1	EMC Filter	175
10.1.1	The Function of EMC Filter	175
10.1.2	External EMC Filter Type	175
10.1.3	Technical Data	176
10.2	Brake Components	181
10.2.1	Brake Chopper	181
10.2.2	Brake Resistor	186
10.3	Communication Interface	193
10.3.1	PROFIBUS Adapter	193
10.3.2	ModBus Adapter	193
10.4	Accessories for Control Cabinet Mounting	193
10.4.1	Remote Operation	193
10.4.2	Operating Panel Cable for Control Cabinet Mounting	195
10.5	Engineering Software	195
11	Additional Information	197
11.1	Simple Applications of Process Control	
11.1.1	Automatic Constant Pressure Water Control System	
11.1.2	Closed-loop Speed Control System	

		Page
11.2	Discharging of Capacitors	198
11.2.1	Discharging of DC Bus Capacitors	198
11.2.2	Discharging Device	198
12	Communication Protocols	201
12.1	Introduction	201
12.2	ModBus Protocol	201
12.2.1	Protocol Descriptions	201
12.2.2	Interface	202
12.2.3	Protocol Functions	203
12.2.4	Communication Mapping Register Address Distribution	209
12.2.5	ModBus Communication Example	213
12.2.6	Special Notes	214
12.2.7	Communication Networking	215
12.3	PROFIBUS Protocol	216
12.3.1	Protocol Description	216
12.3.2	PROFIBUS-Adapter	216
12.3.3	Electrical Installations	217
12.3.4	Periodical Data Communication	219
12.3.5	Communication Parameter Configuration	230
12.3.6	Errors and Analysis	231
13	Service and Support	233
14	Environmental Protection and Disposal	235
 14.1	Environmental Protection	
14.2	Disposal	
	·	
	Index	237

1 Introduction

1.1 Introduction to the Documentation

A WARNING

Personal injury and property damage caused by incorrect project planning for applications, machines and installations!

Do not attempt to install or put these products into operation until you have completely read, understood and observed the documents supplied with the product.

If no documents in your language were supplied, please consult your Bosch Rexroth sales partner.

Chapters and Contents

Chapter	Title	Description			
1	Introduction	Overview			
2	Safety instructions for Electric Drives and Controls	Safety cautions			
3	Important Directions for Use				
4	Fv Mounting	Product information			
5	Installation	(project specific)			
6	Commissioning				
7	Parameter Settings				
8	Error Types and Solutions				
9	Technical Data	Actual applications (for operators and repairers)			
10	Accessories	(tor operators and repairers)			
11	Additional Information				
12	Communication Protocols				
13	Service and Support	Service information			
14	Environmental Protection and Disposal	Environmental information			
_	Index	Index information			

Tab.1-1: Chapters and contents

Feedback

Your experience is important for us to improve products and this manual. We will be pleased to receive your feedback on any mistake or request for variation.

Please send your feedback via email to:

service.svc@boschrexroth.de

1.2 Definition

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Rexroth Frequency Converter Fv drive system is composed of individual parts (components) for application in different circumstances.

- Fv: Rexroth Frequency Converter Fv
- FVCC: Fv operating panel
- FSWA: Engineering software
- FVAA: ModBus / PROFIBUS adapter
- FVAM: Remote operation adapter
- FRKB: Interface adapter cable
- FRKS: Operating panel cable
- FELR: Brake resistor
- FELB: Brake chopper
- FENF: EMC filter

1.3 Type Coding

1.3.1 Type Coding of Fv

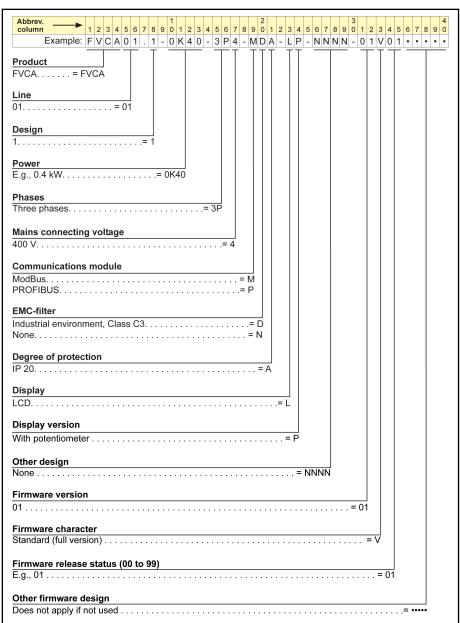


Fig.1-1: Type coding of Fv

Type Coding of Fv Function Modules 1.3.2

Operating panel type coding

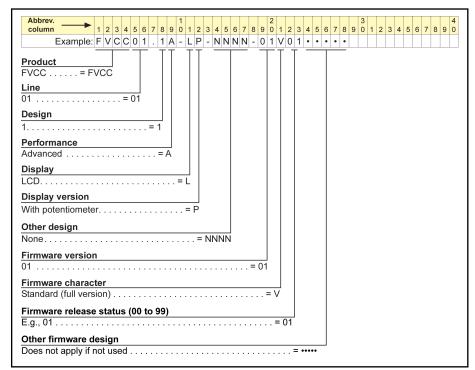


Fig. 1-2: Operating panel type coding

Engineering software type coding

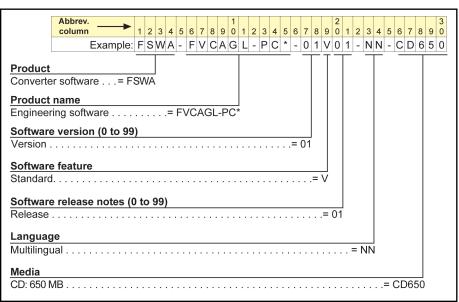


Fig.1-3: Engineering software type coding

1.3.3 Type Coding of Fv Accessories

Interface adapter type coding

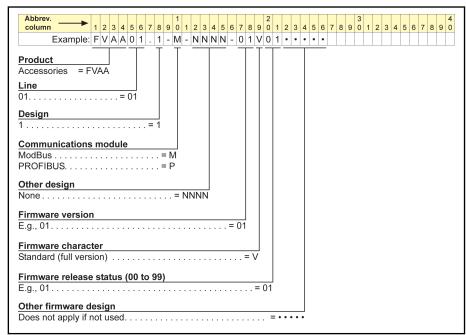


Fig.1-4: Interface adapter type coding

Remote operation adapter

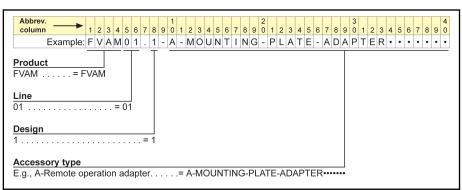


Fig.1-5: Remote operation adapter

Interface adapter cable type coding

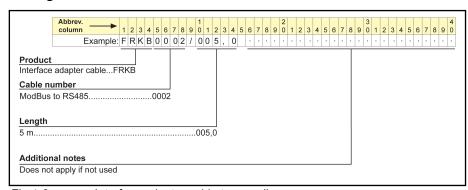


Fig. 1-6: Interface adapter cable type coding

Operating panel cable type coding

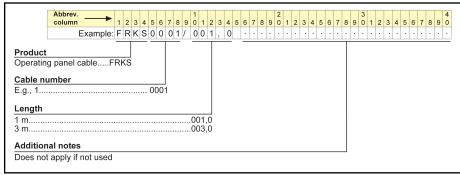


Fig.1-7: Operating panel cable type coding

Brake resistor type coding

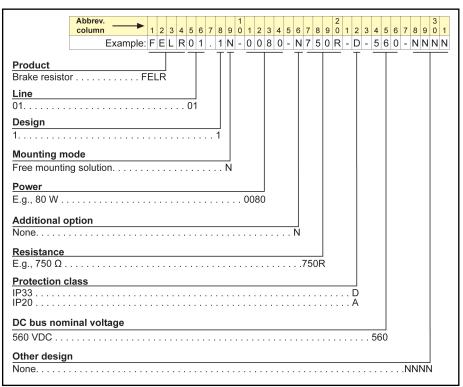


Fig. 1-8: Brake resistor type coding

External brake chopper type coding

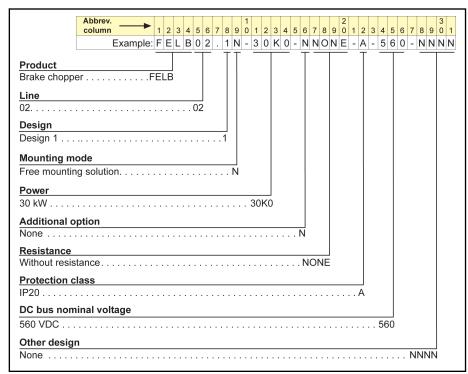


Fig.1-9: External brake chopper type coding

EMC filter type coding

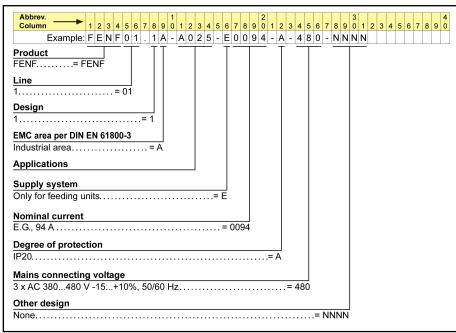


Fig. 1-10: EMC filter type coding

1.4 Delivery and Storage

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1.4.1 Brief Introduction

Check the unit for transport damages, e.g. deformation or loose parts, **immediately** after receipt/unpacking. In case of damage, contact the forwarder at once and arrange for a thorough review of the situation.

B

This is also applicable if the packaging is undamaged.

1.4.2 Scope of Supply

Standard supply

- Fv, protection class of IP 20 (Control cabinet mounting)
- Internal brake chopper (0K40 to 15K0)
- Operating panel
- Safety Instructions
- Instruction Manual (UL)
- Instruction Manual (Quick Start)
- EMC filter (EN 61800-3 Environment 2)

Optional accessories

- Instruction manual
- Remote operation adapter
- PROFIBUS adapter
- RS232/485 adapter
- Engineering software
- Motor filter (dV/dt filter)
- Mains choke
- Brake resistor
- External brake chopper (18K5 to 90K0)

1.4.3 Transport of the Components

Ambient and operating conditions-Transport

Description	Symbol	Unit	Value
Temperature range	T_{a_tran}	°C	-2570
Relative humidity	-	%	595
Absolute humidity	-	g/m³	160
Climate category (IEC 721)	-	-	2K3
Moisture condensation	-	_	not allowed
Icing	-	-	not allowed

Tab.1-2: Transport conditions

1.4.4 Storage of the Components

Pamage to the components caused by long storage periods!

Some components contain electrolytic capacitors which may deteriorate during storage.

When storing these components for a long period of time, operate them once a year for at least 1 hour with power on:

- Fv with mains voltage U_{LN}
- FELB with DC bus voltage U_{DC}

Ambient and operating conditions-Storage

Description	Symbol	Unit	Value	
Temperature range	T _{a_store}	°C	-2555	
Relative humidity	-	%	595	
Absolute humidity	-	g/m³	129	
Climate category (IEC 721)	-	-	1K3	
Moisture condensation	-	-	not allowed	
Icing	_	_	not allowed	

Tab.1-3: Storage conditions

Fv Description 1.5

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1.5.1 Certification

CE certification

Declaration of Conformity

For Fv, there are declarations of conformity which confirm that the devices comply with the applicable EN standards and EC Directives. If required, you can ask our sales representative for the declarations of conformity.

Description	Standard
CC conformity regarding Law Voltage Directive	EN 61800-5-1
CE conformity regarding Low-Voltage Directive	(IEC 61800-5-1: 2007)
CE conformity regarding EMC product standard	EN 61800-3
CE comornity regarding EMC product standard	(IEC 61800-3: 2004)

Tab.1-4: Conformity and standards

CE Label



CE label Fig. 1-11:

High-Voltage Test

According to standard EN 61800-5-1, all Fv components are tested with high voltage.

UL Certification

The frequency converters are listed by UL "Underwriters Laboratories Inc.[®]". You can find the evidence of certification on the Internet under http://www.ul.com under "Certifications" by entering the file number or the "Company Name: Rexroth".

UL listing



Fig. 1-12: UL listing

UL standard UL 508C

Company name BOSCH REXROTH (XIAN) ELECTRIC DRIVES AND CONTROLS CO., LTD.

Category name Power Conversion Equipment

File number E328841

UL ratings For using the components in the scope of UL, take the UL ratings of the indi-

vidual component into account.

Make sure that the indicated short circuit rating SCCR is not exceeded (5000 Arms), e.g. by appropriate fuses in the mains supply of the supply unit.

Wiring material UL In the scope of UL, use only copper conductors rated 60 °C and above.

For frequency converters 45K0 to 90K0, use only copper conductors rated

75 °C and above.

1.5.2 Properties of the Basic Device Fv

Allowed ambient temperature: -10 to 40 °C;

Protection class: IP20 (Control cabinet mounting)

• Power range: 0.4 to 90 kW

Power supply voltage: 3 AC 380 to 480 V (-15 % / +10 %)

• High start-up torque and precise motor speed control

Overload capability:

150 % of rated current for 60s

180 % of rated current for 10s

Output frequency: 0 to 400 Hz

Pulse width modulation (PWM):

Model	Default value of	Effective adjustable range
Model	PWM frequency [kHz]	of PWM frequency [kHz]
0K40 to 7K50	8.0	1.0 to 15.0
11K0 to 22K0	6.0	1.0 to 12.0
30K0 to 37K0	3.0	1.0 to 8.0
45K0 to 90K0	2.0	1.0 to 4.0

- Internal brake chopper (0K40 to 15K0) (brake resistor connected externally)
- Control mode:
 - V/F Control (V/F)
 - Sensorless Vector Control (SVC)
 - Field Oriented Vector Control (FOC)

1.5.3 Interfaces

- 10 digital inputs
- 1 encoder input for speed feedback
- 4 analog inputs
- 2 open collector outputs
- 1 pulse output
- 2 relay outputs AC 250 V, 3 A / DC 30 V, 3 A
- 2 analog outputs
- 1 optional ModBus / PROFIBUS communication port

1.5.4 Cooling Types

- Air cooling
- Forced, temperature-controlled air cooling

Safety Instructions for Electric Drives and Controls

2 Safety Instructions for Electric Drives and Controls

Definitions of Terms 2.1

Documentation

A documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, mounting, installing, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: Operating Instructions, Instruction Manual, Commissioning Manual, Application Description, Assembly Instructions, Project Planning Manual, Safety Notes, Product Insert, etc.

Component A component is a combination of elements with a specified function, which

are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers,

mains choke, mains filter, motors, cables, etc.

Control System A control system comprises several interconnected control components

placed on the market as a single functional unit.

Device A device is a finished product with a defined function, intended for users and

placed on the market as an individual piece of merchandise.

Electrical Equipment Electrical equipment encompasses all devices used to generate, convert,

> transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit

board assemblies, plug-in units, control cabinets, etc.

Electric Drive System An electric drive system comprises all components from mains supply to mo-

> tor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and ca-

bles.

Machine

Installation An installation consists of several devices or systems interconnected for a

defined purpose and on a defined site which, however, are not intended to be

A machine is the entirety of interconnected parts or units at least one of

placed on the market as a single functional unit.

which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also

covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Manufacturer The manufacturer is an individual or legal entity bearing responsibility for the

> design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess

the required authority to take responsibility for the product.

Product Examples of a product: Device, component, part, system, software, firmware,

among other things.

Qualified Persons In terms of this application documentation, qualified persons are those per-

sons who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work requires. To comply with these qualifications, it is necessary, among other

things.

Safety Instructions for Electric Drives and Controls

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- 1) to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them
- 2) to be trained or instructed to maintain and use adequate safety equipment
- 3) to attend a course of instruction in first aid

User

A user is a person installing, commissioning or using a product which has been placed on the market.

2.2 Explanation of Signal Words and the Safety Alert Symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is meant to draw the reader's attention to the safety instruction and identifies the hazard severity.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

A DANGER

In case of non-compliance with this safety instruction, death or serious injury will occur.

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury could occur.

A CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

2.3 General Information

2.3.1 Using the Safety Instructions and Passing Them on to Others

Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Bosch Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

Rexroth Frequency Converter Fv

Safety Instructions for Electric Drives and Controls

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, injury, electric shock or even death.

2.3.2 Requirements for Safe Use

Read the following instructions before initial commissioning of the components of the electric drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Bosch Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.
- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technology". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.
- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

The machine and installation manufacturers must

- make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,
- make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

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The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.

The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user must take into account

- European countries: In accordance with European EN standards
- United States of America (USA):
 - National Electrical Code (NEC)
 - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
 - Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
 - International Organization for Standardization (ISO)
 - International Electrotechnical Commission (IEC)

2.3.3 Hazards by Improper Use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!
- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of pressurized lines!

2.4 Instructions with Regard to Specific Dangers

2.4.1 Protection against Contact with Electrical Parts and Housings

B

This section concerns components of the electric drive and control system with voltages of **higher than 50 V**.

Contact with parts conducting voltages above 50 V can cause personal danger and electric shock. When operating components of the electric drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

High electrical voltage! Danger to life, risk of injury by electric shock or serious injury!

• Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.

Rexroth Frequency Converter Fv

Safety Instructions for Electric Drives and Controls

- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:
 - Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).
- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.

2.4.2 Protective Extra-Low Voltage as Protection Against Electric Shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

On components of an electric drive and control system provided by Bosch Rexroth, all connections and terminals with voltages between 5 and 50 volts are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection!

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Safety Instructions for Electric Drives and Controls

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Bosch Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

2.4.3 Protection against Dangerous Movements

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

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

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

The monitoring functions in the components of the electric drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property 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.

Dangerous movements! Danger to life, risk of injury, serious injury or property damage!

A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed.

As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine's range of motion and moving machine parts. Prevent personnel from accidentally entering the machine's range of motion by using, for example:
 - Safety fences
 - Safety guards
 - Protective coverings
 - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equipment works. Do not operate the machine if the emergency stopping switch is not working.

Rexroth Frequency Converter Fv

Safety Instructions for Electric Drives and Controls

- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches / OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") 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 components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

2.4.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors or permanent magnets of electric motors represent a serious danger to persons with heart pacemakers, metal implants and hearing aids.

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric components!

- Persons with heart pacemakers and metal implants are not allowed to enter the following areas:
 - Areas in which components of the electric drive and control systems are mounted, commissioned and operated.
 - Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- If it is necessary for somebody with a heart pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of implanted heart pacemakers differs so greatly 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.

2.4.5 Protection Against Contact with Hot Parts

Hot surfaces of components of the electric drive and control system. Risk of burns!

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C** (140 °F) during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can require up to 140

Safety Instructions for Electric Drives and Controls

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minutes! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.

- After switching chokes, supply units and drive controllers off, wait 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

2.4.6 Protection During Handling and Mounting

Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

Important Directions for Use

3 Important Directions for Use

3.1 Appropriate Use

Bosch Rexroth 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.



Bosch Rexroth 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 Bosch Rexroth 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.

3.2 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!

Fv Mounting

4 Fv Mounting

4.1 Mounting

The frequency converter must be sufficiently ventilated to avoid overheating. The recommended minimum vertical clearances between the frequency converter and adjacent items which may disturb the free flow of air are given below.

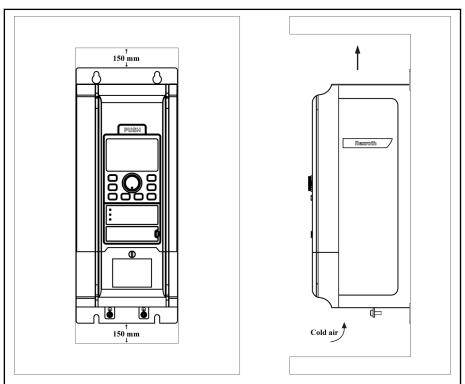


Fig.4-1: Fv mounting



- Fv must be vertically installed.
- Fv has no side ventilation hole, which enables parallel mounting of Fv with zero distance.
- If one frequency converter is arranged above the other, make sure that the upper limit of air temperature into the inlet is not exceeded (See tab. 9-2 "General technical data" on page 156).
- A baffle plate is recommended between the frequency converters to prevent the rising hot air being drawn into the upper frequency converter if the upper temperature limit is exceeded.

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Fv Mounting

A CAUTION

Fig.4-2:

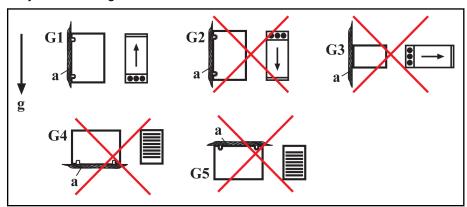
Risks of damage to the components!

Only operate the components in their allowed mounting modes.

Allowed mounting mode of the components:

Mounting mode

Only the mounting mode G1 is allowed for Fv.



a Mounting surface
g Direction of gravitational force
G1 Normal mounting mode. The natural convection supports the forced cooling air current. This avoids the generation of pockets of heat in the component.
G2 180° to normal mounting mode
G3 Turned by 90° from vertical to horizontal mounting position
G4 Bottom mounting; mounting surface on bottom of control cabinet
G5 Top mounting; mounting surface at top of control cabinet

4.2 Fv Dimensions and Figure

4.2.1 Fv Dimensions

Frame	Fv model		Dimensions [mm]									Screw	Net weight
riaille	rv illouei	В	b	Т	t	Н	h	h1	d	D	L1	size	[kg]
	0K40												
	0K75	125	75	122	1.5	275	300	315	5.5	127	5.5	M5	2.7
A	1K50	123	/3	122	1.5	2/3	300	313	5.5	121	127 5.5	IVIO	
	2K20												2.8
	4K00												4.8
В	5K50	150	100	157	1.5	330	365	380	6.5	162	6.5	M6	4.9
	7K50												4.9
С	11K0	175	100	199	2	398	432	448	6.5	204	6.5	Me	8.8
	15K0	1/3	100	199	2	390	432	440	0.5	204	6.5	M6	9.0
D	18K5	225	125	227	3.5	440	482	500	9	232	9	M8	16.5
	22K0	223	123	221	3.3	440	10 402	300	500 9	232	9	IVIO	10.5
Е	30K0	250	150	251.5	3.5	525	567	585	9	256.5	9	M8	22.0
	37K0	230	130	231.3	3.3	323	307	363	9	230.3	9	IVIO	22.0
F	45K0	325	200	265	3.5	650	690	712.5	9	270	9	M8	37.0
	55K0	323	200	200	ა.ა	030	090	1 12.3	9	210	Э	IVIO	39.0
G	75K0	450	300	302.5	4	700	754	779	11	307	11	M10	56.7
	90K0	430	300	302.5	4	/ / / /	134	119	''	307	11		58.0

Tab.4-1: Fv dimensions

Fv Mounting

Fv Figure 4.2.2

图

Please refer to the above table to select four screws for Fv mounting.

0K40 to 15K0

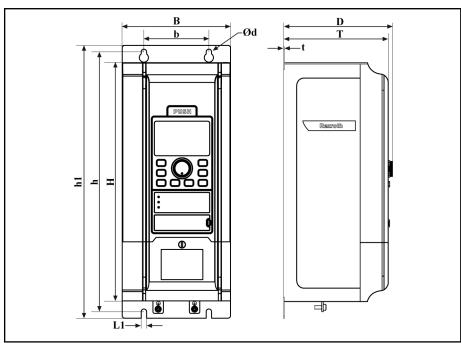
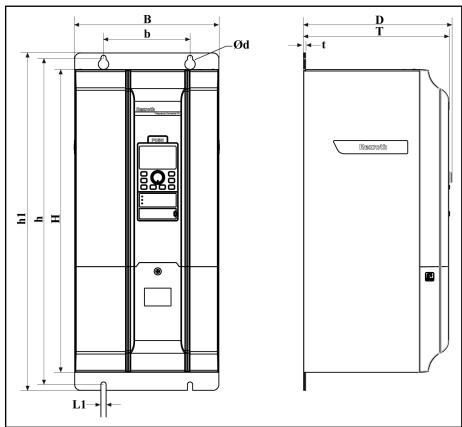


Fig.4-3: 0K40 to 15K0 figure

18K5 to 37K0



18K5 to 37K0 figure Fig.4-4:

Fv Mounting

45K0 to 90K0

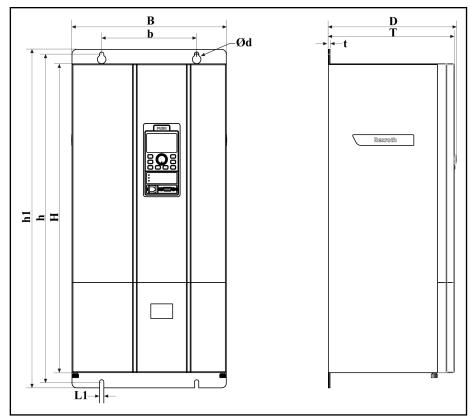


Fig.4-5: 45K0 to 90K0 figure

5 Installation

5.1 Fv Disassembly and Assembly

5.1.1 Removal and Mounting of Operating Panel

Removal of operating panel

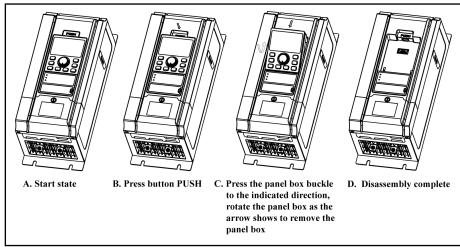


Fig.5-1: Removal of operating panel

Mounting of operating panel

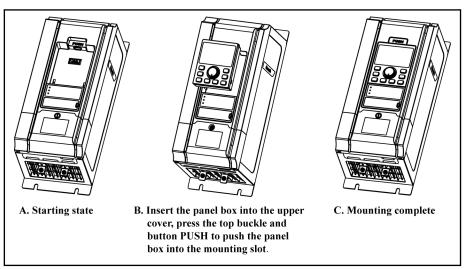


Fig.5-2: Mounting of operating panel

5.1.2 Removal and Mounting of Adapter

Removal of adapter

To remove the adapter, the panel needs to be removed first according to chapter 5.1.1 "Removal and Mounting of Operating Panel" on page 35.

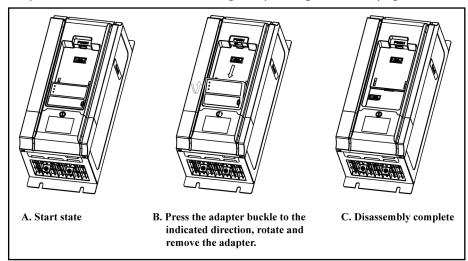


Fig.5-3: Removal of adapter

Mounting of adapter

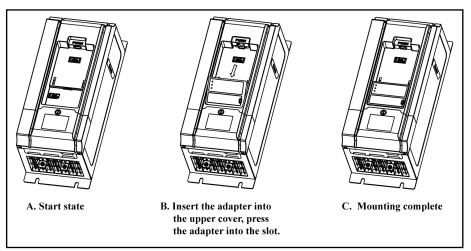


Fig.5-4: Mounting of adapter

Rexroth Frequency Converter Fv

5.2 Drive System Wiring

5.2.1 Block Diagram

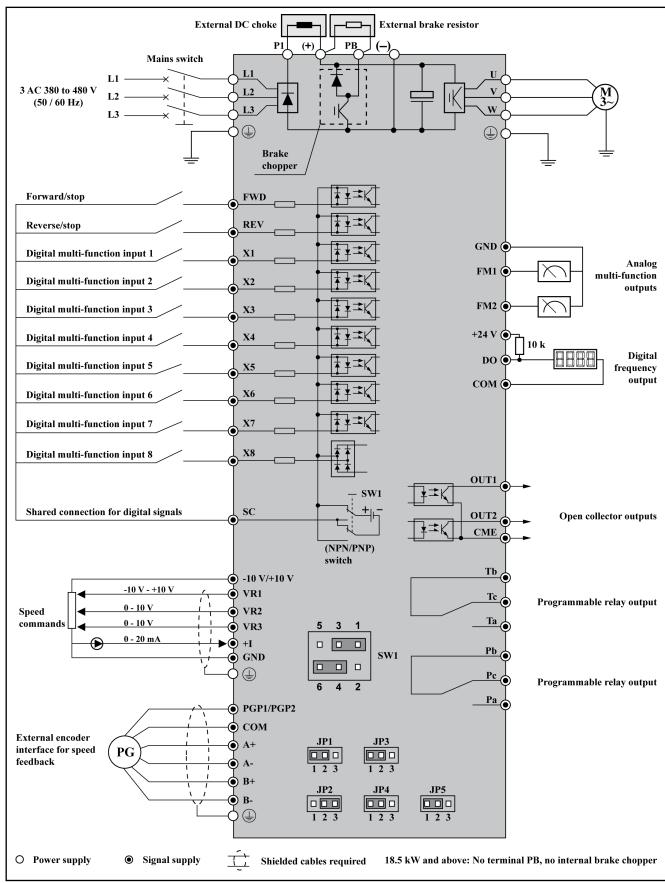


Fig.5-5: Block diagram

Rexroth Frequency Converter Fv

Installation

5.2.2 Main Circuit Wiring

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Main circuit wiring cautions

- Connect power supply only to the main circuit terminals L1, L2 and L3. Connecting power supply to other terminals will damage the frequency converter. Ensure that the power supply voltage is within the allowable voltage range specified on the nameplate.
- The grounding terminal must be properly grounded to avoid electric shock or fire and reduce interference noise.
- Insulated crimp terminals must be used to connect terminals and conductors, to ensure the reliability of connection.
- After wiring connection, remove all wire residues, which may fall into the frequency converter and cause a failure. Be careful not to allow swarf from drilling entering the frequency converter. Check the following points after the circuit connection is completed.
 - 1. Are all connections correct?
 - 2. Are there any missing connections?
 - 3. Do short circuits exist between terminals and wires or ground?
- To make changes in wiring, disconnect the power and wait for 30 minutes to allow the capacitor of the DC circuit to discharge.
- For safety concerns, wiring shall be carried out with wire sizes in accordance with relevant electrical codes.
- A fuse must be provided between the main circuit terminals (L1, L2 and L3) and the 3-phase AC input power supply. It is preferable to connect a magnetic contactor (MC) in series to ensure both the action of frequency converter protection and shutting off of power supply (Surge absorbers should be added at both sides of the magnetic contactor).
- If the wire between the frequency converter and the motor is very long, particularly with low output frequency, the voltage drop may lead to a reduced torque output by the motor.
- Nothing other than the brake resistors may be connected between the terminal (+) and PB. Do not short circuit!
- Electromagnetic interference: The 3-phase inputs/outputs of frequency converter contain harmonic components, which may interfere with nearby communication devices (e.g. AM radio receiver). Therefore, an optional radio noise filter (only for the input side) or line noise filter may be installed to minimize interference.
- Do not attach power capacitor, surge suppressor or radio noise filter to the output side of frequency converter. This may cause frequency converter failure or damage the capacitor or suppressor. Immediately remove any such device which has been installed.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code [USA] and any additional local codes.
- After connecting the power supply terminals, the motor and the control terminals, replace the cover back before switching on the power. Take account of the following instructions:
 - 1. Ensure that the power supply can provide appropriate voltage and current. Ensure that the rated current range of the circuit breaker is within that of the converter and the power supply.

- 2. It is recommended to use 4-core cables to connect the motor. Cables are connected to motor terminals PE-U-V-W.
- 3. If shielded cables are used, the shielding layer should be securely connected to the metal surface of control cabinet.



It is recommended to use shielded cables in accordance with specified EMC classification.

Main circuit wiring diagram

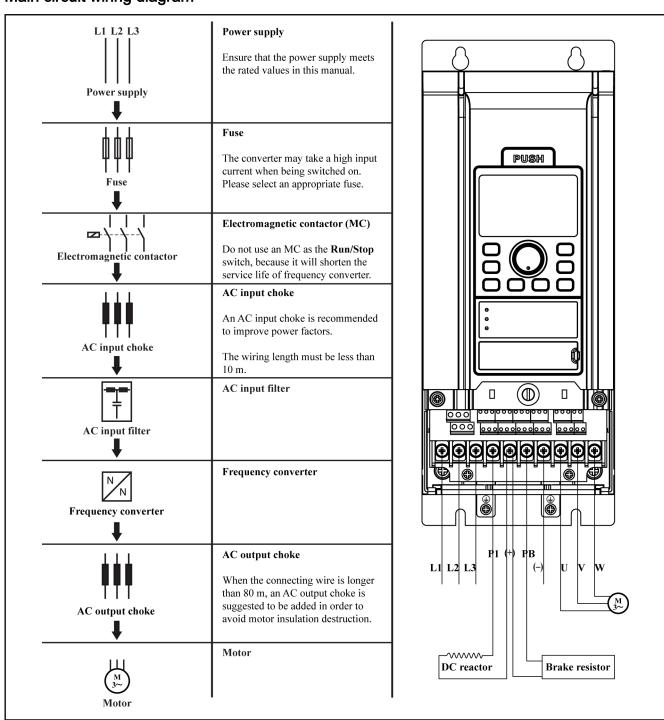


Fig.5-6: Main circuit wiring diagram



To select an appropriate fuse, please refer to chapter 5.2.4 "Cable and Fuse Dimensions" on page 43.

Main circuit wiring steps

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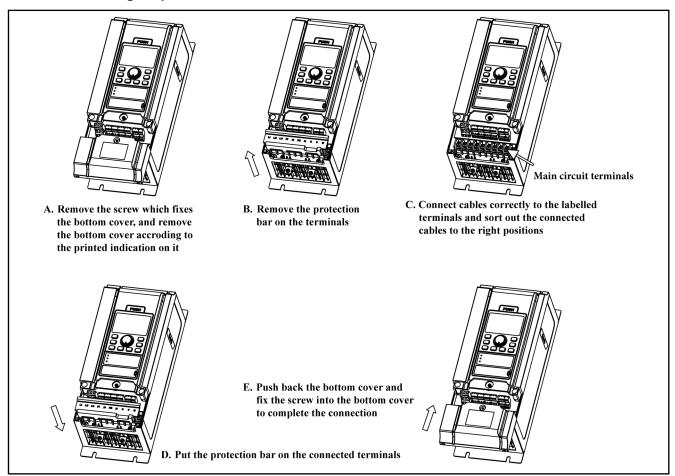


Fig.5-7: 0K40 to 15K0 main circuit wiring steps

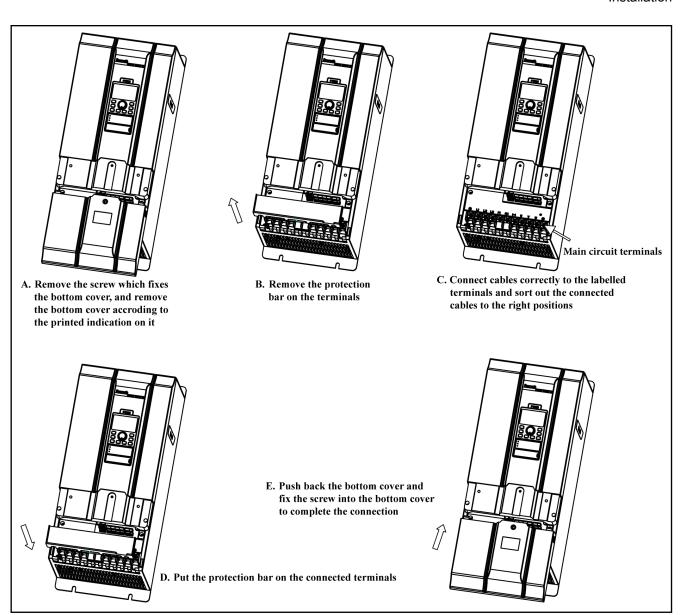


Fig.5-8: 18K5 to 37K0 main circuit wiring steps

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Installation

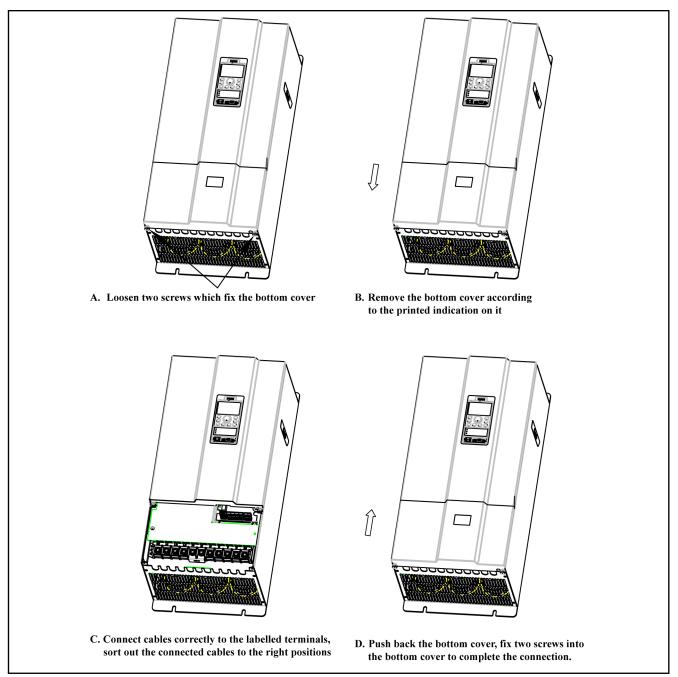


Fig.5-9: 45K0 to 90K0 main circuit wiring steps

5.2.3 Control Circuit Wiring

- Terminal GND is the common terminal for analog signals, and SC is the common terminal for switch values. Do not ground these terminals. Shielded or twisted-pair cables should be used for wiring terminals for the control circuit and must be separated from the wiring of main circuit and high current circuits (including the control circuit of 200 V relay).
- 0.3 to 0.75 mm² cables are recommended for wiring of the control circuit.
- Please strip the wire insulation for wiring of the control circuit, according
 to the dimensions given below. Too long stripping may cause short circuit of adjacent wires, and too short stripping may lead wires becoming
 loose.

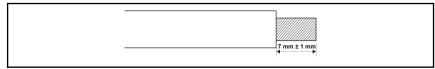


Fig.5-10: Wire stripping length

- If a post terminal or single-conductor wire is used, use a cable with a diameter of less than 0.9 mm. If the cable is larger than 0.9 mm, the screw may be stripped when being tightened up.
- Tighten up screws with typically 0.8 Nm / 7 lb-in torque after the cables are inserted into the terminals.
- Cables may become disconnected and cause incorrect operation if not tightened. However, over-tightening screws may break the component to cause short circuit and incorrect operation.

5.2.4 Cable and Fuse Dimensions

Introduction

The power cable dimensions and the fuse dimensions are based on the VDE 0298 (part 4) and the standard for the European countries EN 60204-1.

The dimension for flexible wiring is according to VDE 0298 (part 4) and for fix wiring according to VDE 0298 (part 4) or IEC 60364-5 (operating temperature at the conductor 90 $^{\circ}$ C).

The cable and fuse dimensions for USA / Canada are based on UL 508A.



The manufacturer of the machine/installation is responsible for conformity with regional provisions and other standards that are relevant for the respective application and the place of installation. Also factors, such as installation methods, grounding, insulation and over-voltage protection must be taken into consideration.

National standards, such as NFPA in the USA, regional provisions, ground, operating temperature, operating cycles, over-voltage protection and system configuration can have a decisive impact on the dimensioning of the cables and therefore they must be given priority over the above factors.



If, as a consequence of this, further requirement and cable designs arise that are not mentioned in this documentation, contact your Bosch Rexroth sales partner.

Recommendation on cable dimensioning:

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- 1. Depends on the power size of the frequency converter.
- 2. Depends on country of use (e.g. "international without USA/Canada").
- 3. Depends on installation type (e.g. B1 or B2).
- 4. In table row "Nominal current fuse", read corresponding fuse.

		Input side				
	·					
Model	International without USA/Canada					
	Naminal autrant of fuce in [A]	Installation mode B1	Installation mode B2	Installation mode E		
	Nominal current of fuse in [A]	Cable size in [mm²]	Cable size in [mm²]	Cable size in [mm²]		
0K40	6	1.5	0.75	0.75		
0K75	10	1.5	1	1		
1K50	10	1.5	1	1		
2K20	16	1.5	1	1		
4K00	20	1.5	1.5	1.5		
5K50	25	2.5	2.5	2.5		
7K50	25	4	4	2.5		
11K0	40	6	6	6		
15K0	50	10	10	10		
18K5	63	16	16	10		
22K0	80	16	16	10		
30K0	100	25	25	25		
37K0	125	35	35	25		
45K0	160	50	50	35		
55K0	200	50	70 / 2*35	50		
75K0	250	95 / 2*50	120 / 2*50	70 / 2*35		
90K0	315	120 / 2*50	150 / 2*70	95 / 2*50		

Tab.5-1: Recommended cable dimensions_input side_international without USA/Canada



- 1. Input side and Output side: The dimensioning is based on the supply voltage of 3 x 380 VAC;
- 2. For screw torque information, see the following tables.
- 3. For "Installation mode", see fig. 5-11 "Cable installation types (cf. IEC 60364-5-52; DIN VDE 0298-4; EN 60204-1)" on page 47.

			Input side				
	USA/Canada						
Model				Input	:PE [®]		
Model	Nominal current of fuse in [A]	Cable size in [AWG]	Screw torque for power cable terminals in [Nm / lb-in] (screw size)	Cable size in [mm²/AWG]	Torque in [Nm / lb-in] (screw size)		
0K40	6	AWG14	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
0K75	6	AWG14	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
1K50	10	AWG14	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
2K20	16	AWG14	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
4K00	25	AWG12	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
5K50	40	AWG10	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
7K50	40	AWG10	1.7 / 15 (M4)	6 / 8	1.7 / 15 (M4)		
11K0	70	AWG8	2.7 / 24 (M5)	10 / 8	2.0 / 18 (M5)		
15K0	80	AWG6	2.7 / 24 (M5)	10 / 6	2.0 / 18 (M5)		
18K5	80	AWG6	2.5/22 (M6)	10 / 6	2.5/22 (M6)		
22K0	80	AWG6 [®]	2.5/22 (M6)	10 / 6	2.5/22 (M6)		
30K0	100	2*AWG6	2.5/22 (M6)	16 / 6	2.5/22 (M6)		
37K0	125	2*AWG6	2.5/22 (M6)	25 / 4	2.5/22 (M6)		
45K0	150	AWG1	8/71 (M8)	35 / 1	8/71 (M8)		
55K0	175	AWG1/0	8/71 (M8)	50 / 1/0	8/71 (M8)		
75K0	225	AWG3/0 / 2*AWG1	15 to 20 / 133 to 177 (M10)	70/2*35 / 2/0 / 2*1	15 to 20 / 133 to 177 (M10)		
90K0	300	250 kcmil / 2*AWG1/0	15 to 20 / 133 to 177 (M10)	95/2*50 / 3/0 / 2*1/0	115 to 20 / 133 to 177 (M10)		

Tab.5-2: Recommended cable dimensions_input side_USA/Canada



 $^{^{\}odot}\!\!:$ For 22K0 (22 kW) frequency converters, only AWG 6 cable of the copper 75 $^{\circ}\!\!$ C and above can be used.

^②: The cables connecting to PE terminal should assemble the UL certificated wire connector which has suitable rating for wire gauge!

			Output side		
	International without USA/Canada	USA/Canada			
Model			0	Outpu	t PE®
	Cable size in [mm²]	Cable size in [AWG]	Screw torque for power cable terminals in [Nm / lb-in] (screw size)	Cable size in [mm²/AWG]	Torque in [Nm / lb-in] (screw size)
0K40	0.75 [©]	AWG14	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
0K75	1 [©]	AWG14	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
1K50	1 [©]	AWG14	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
2K20	1 [®]	AWG14	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
4K00	1 [®]	AWG14	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
5K50	1 [®]	AWG12	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
7K50	2.5 ^①	AWG10	1.7 / 15 (M4)	6/8	1.7 / 15 (M4)
11K0	6 ^①	AWG8	2.7 / 24 (M5)	10 / 8	2.0 / 18 (M5)
15K0	6 ^①	AWG8	2.7 / 24 (M5)	10 / 6	2.0 / 18 (M5)
18K5	10 [©]	AWG6	2.5/22 (M6)	10 / 6	2.5/22 (M6)
22K0	10 [©]	AWG6	2.5/22 (M6)	10 / 6	2.5/22 (M6)
30K0	16 [©]	2*AWG6	2.5/22 (M6)	16 / 6	2.5/22 (M6)
37K0	25 [©]	2*AWG6	2.5/22 (M6)	25 / 2x6	2.5/22 (M6)
45K0	35 [©]	AWG1	8/71 (M8)	35 / 1	8/71 (M8)
55K0	35 [©]	AWG1/0	8/71 (M8)	50 / 1/0	8/71 (M8)
75K0	70 / 2*35 [©]	AWG3/0 / 2*AWG1	15 to 20 / 133 to 177 (M10)	70/2*35 / 2/0 / 2*1	15 to 20 / 133 to 177 (M10)
90K0	95 / 2*50 [©]	250 kcmil / 2*AWG1/0	15 to 20 / 133 to 177 (M10)	95/2*50 / 3/0 / 2*1/0	115 to 20 / 133 to 177 (M10)

Tab.5-3: Recommended cable dimensions_output side



- ①: Installation Mode E
- ²: Installation Mode B2
- [®]: The cables connecting to PE terminal should assemble the UL certificated wire connector which has suitable rating for wire gauge!

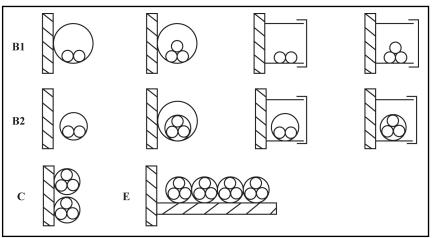
Dimensioning variables of the table values

1. Installation types:

- B1 according to IEC 60364-5-52, e.g. stranded wires routed in cable duct
- B2 according to IEC 60364-5-52, e.g. multi-core line routed in cable duct
- E according to EN 60204-1, e.g. multi-core line routed on open cable tray
- According to NFPA 79 (external wiring), UL 508A (internal wiring), NEC, NFPA 70:
 - 1 cable with 3 conductors, 1 neutral conductor and 1 equipment grounding conductor
 - Routed in pipe on the wall

Internal wiring: Routing inside of control cabinet or inside of devices.

Field wiring: Routing of cross sections of terminal connectors wired by the user (in the field).



B1 Conductors in installation pipes and in installation channels that

can be opened

B2 Cables or lines in installation pipes and in installation channels

that can be opened

C Cables or lines on walls

E Cables or lines on open cable trays

Fig.5-11: Cable installation types (cf. IEC 60364-5-52; DIN VDE 0298-4;

EN 60204-1)

2. Recommendation for design of the fuses:

 International except for USA/Canada: Class gL-gG; 500 V, 690 V; design NH, D (DIAZED) or D0 (NEOZED).

Characteristics

In the case of error (e.g. ground error at connections L+, L-), fuses of characteristic **gL** (general-purpose fuse link for cables and lines) and **gG** (general-purpose fuse link for general installations) protect the **lines** in the frequency converter system.

To **protect the semiconductors** in the frequency converters, you can use fuses of characteristic **gR**.

USA/Canada: Class J; 600 V

Wiring dimensions for terminals

Fv model	Frame	Terminal type	Wiring dimensions [AWG]
0K40	Α	Main circuit terminals are shown as fig. 5-12 "Main circuit terminals illustra-	10 to 20
0K75	Α	tion_0K40 to 15K0" on page 49	
1K50	Α	Control circuit terminals are shown as	
2K20	Α	fig. 5-14 "Control circuit terminals_1" on page 52	
4K00	В	fig. 5-15 "Control circuit terminals 2" on page 52	16 to 26
5K50	В	fig. 5-16 "Control circuit terminals_3" on page 52	
7K50	В	ng. c . c . c . c . c . c . c . c . c . c	
		Main circuit terminals are shown as fig. 5-12 "Main circuit terminals illustration_0K40 to 15K0" on page 49	4 to 10
11K0		Control circuit terminals are shown as	
15K0	С	fig. 5-14 "Control circuit terminals_1" on page 52	16 to 26
		fig. 5-15 "Control circuit terminals_2" on page 52	16 to 26
		fig. 5-16 "Control circuit terminals_3" on page 52	
18K5	D	Main circuit terminals are shown as fig. 5-13 "Main circuit terminals illustration_18K5 and above" on page 49	2 to 12
22K0	D	Control circuit terminals are shown as	
30K0	E	fig. 5-14 "Control circuit terminals_1" on page 52	16 to 26
37K0	E	fig. 5-15 "Control circuit terminals_2" on page 52	10 10 20
		fig. 5-16 "Control circuit terminals_3" on page 52	
		Main circuit terminals are shown as fig. 5-13 "Main circuit terminals illustration_18K5 and above" on page 49	1 / 0 to 8
45K0	_	Control circuit terminals are shown as	
55K0	F	fig. 5-14 "Control circuit terminals_1" on page 52	46.4- 26
		fig. 5-15 "Control circuit terminals_2" on page 52	16 to 26
		fig. 5-16 "Control circuit terminals_3" on page 52	
		Main circuit terminals are shown as fig. 5-13 "Main circuit terminals illustration_18K5 and above" on page 49	4 to 4 / 0
75K0		Control circuit terminals are shown as	
90K0	G	fig. 5-14 "Control circuit terminals_1" on page 52	40 1- 00
		fig. 5-15 "Control circuit terminals_2" on page 52	16 to 26
		fig. 5-16 "Control circuit terminals_3" on page 52	
L	ļ	1	

Tab.5-4: Wiring dimensions for terminals

5.3 Wiring Terminals Description

5.3.1 Main Circuit Terminals

Main circuit terminals description

Terminal	Description
L1, L2, L3	Mains power supply inputs
U, V, W	Frequency converter outputs (to be connected to the motor)
РВ	Reserved terminal for external braking resistor
P1, (+)	DC choke inputs or DC positive bus outputs
(-)	DC negative bus output
(1)	Grounding

Tab.5-5: Main circuit terminals description

Main circuit terminals illustration

0K40 to 15K0

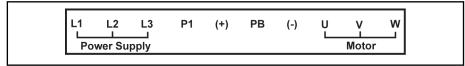


Fig.5-12: Main circuit terminals illustration_0K40 to 15K0

18K5 and above

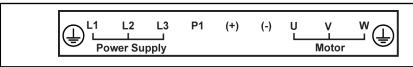


Fig.5-13: Main circuit terminals illustration_18K5 and above

Control Circuit Terminals 5.3.2

Control circuit terminals description

Туре	Terminal	Signal function	Description	Signal requirement	
	FWD	Forward/Stop	See parameters b1.02, E0.00		
onts	REV	Reverse/Stop	See parameters b1.02, E0.00	24 VDC 8 mA inputs via opto-	
Digital inputs	X1 - X8 Multiple speed commands		Activated with "closed", see parameters E0.01 to E0.08	electric couplers; Depends on the position of	
Ö	SC	Shared connection for digital signals	Isolated from GND	NPN/PNP jumper SW1	
	±10 V	Supply voltage for external frequency setpoint value specified	Power supply for speed commands	±10 V (Max. current 10 mA)	
outs	VR1		Analog voltage frequency input 1	Input voltage range: -10 to 10 V Input resistance: 100 k Ω Resolution: 1 / 2000	
g inp	VR2		Analog voltage frequency input 2	Input voltage range: 0 to 10 V	
Analog inputs	VR3	Analog frequency commands	Analog voltage frequency input 3	Input resistance: 100 kΩ Resolution: 1 / 2000	
	+1		Analog current frequency input	Input current range: 0 to 20 mA Input resistance:165 Ω Resolution: 1 / 1000	
	GND	Frame potential (0 V)	Isolated from COM	-	

Туре	Terminal	Signal function	Description	Signal requirement
	OUT1-CME OUT2-CME	Open collector output 1 Open collector output 2	Can be programmed as multiple function digital outputs, see parameters E1.00, E1.01.	Open collector outputs: Max. output voltage: +24 VDC Max. current: 50 mA
	DO-COM	Digital frequency output	Can be programmed as multiple function pulse outputs, see E1.16.	Open collector outputs via opto- couplers: Max. output frequency 50 kHz (set by E1.17); Max. output voltage: 24 VDC
Digital outputs	Ta Tc	Relay changeover 1 contacts	Programmable multi-function relay outputs, see parameter E5.04 Ta - Tb always open	Rated capacity of contact trans- mitter:
Digita	Tb	Relay 1 shared contact	Tb - Tc always closed (Tb is the shared terminal)	250 VAC 3 A 30 VDC 3 A
	Pa Pc	Relay changeover 2 contacts	Programmable multi-function relay outputs, see parameter E1.02 Pa – Pb always open	Rated capacity of contact transmitter:
	Pb	Relay 2 shared contact	Pb - Pc always closed (Pb is the shared terminal)	250 VAC 3 A 30 VDC 3 A
	+24 V	DC 24 V power supply positive	COM is DC 24 V power supply negative	_
	FM1-GND	Analog multi-function output 1		Output voltage / current can be set via JP3 for FM1and JP4 for
Analog outputs	FM2-GND	Analog multi-function output 2	Programmable analog output with multiple functions. See parameters E1.10, E1.12, E1.13, E1.15 and E5.05 to E5.12	FM2: FM1 output voltage: -10 to 10 V FM2 output voltage: 0 to 10 V Output current: 0 to 20 mA
	PGP1-COM	Supply voltage +24 V	Voltage supply 1 for the encoder	Max. output current: 100 mA
Encoder signals	PGP2-COM	Supply voltage 5 / 12 V	Voltage supply 2 for the encoder (Switch supply voltage with JP5)	Max. output current: 200 mA
er si	A+	Encoder signal A		
ncod	A-	Lilouei Signal A	See fig. 5-21 "Encoder jumper	Encoder supply voltage range of differential inputs: 5 to 24 V
<u>ü</u>	B+ B-	Encoder signal B	JP5" on page 55	Max. input frequency: 200 kHz

Tab.5-6: Control circuit terminals description

Control circuit terminals illustration

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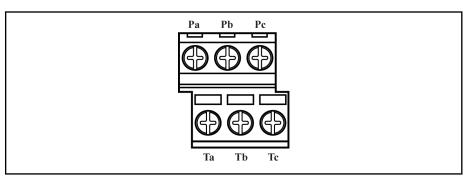


Fig.5-14: Control circuit terminals_1

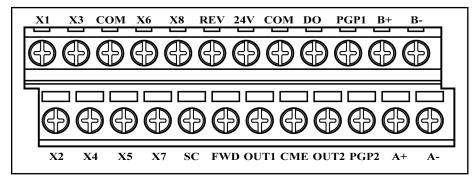


Fig.5-15: Control circuit terminals_2

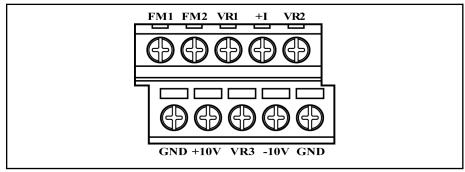


Fig.5-16: Control circuit terminals_3

Analog input terminals (±10 V, VR1, VR2, GND, +I)

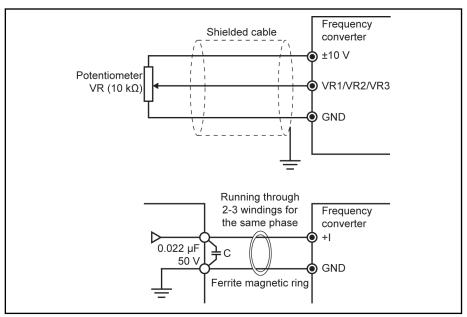


Fig.5-17: Analog input terminals (±10 V, VR1, VR2, VR3, GND, +I)



- 1. For connection of low level analog signals, which are easily affected by external interference, the wiring length should be as short as possible (less than 20 m), shielded cables must be used.
- Incorrect operation may occur due to interference on the analog signal. In such cases, connect a capacitor and ferrite core at the side of output of the analog signal, as shown above.

5.3.3 Jumper Wiring

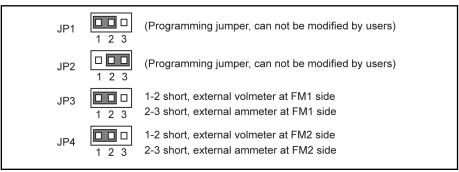


Fig.5-18: Jumper description

Shown above are factory defaults.

5.3.4 NPN/PNP Jumper SW1

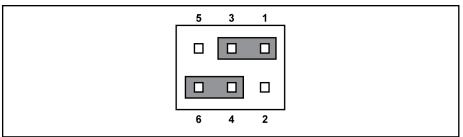


Fig.5-19: NPN/ PNP jumper SW1

B

The factory default setting of the jumper is NPN (Jumper contact at 1-3, 4-6).

The jumper SW1 determines:

- 1. The internal 24 V power supply or an external 24 V power supply is used for the inputs.
- 2. The inputs are activated by connection of 24 V to an input (PNP / active input) or connection of 0 V to an input (NPN / passive input).

Modes and signal inputs

The jumper SW1 can switch between 0 V (NPN / passive input) and +24 V (PNP / active input) inputs, respective external +24 V power supply is also available, which improves the flexibility of signal input mode.

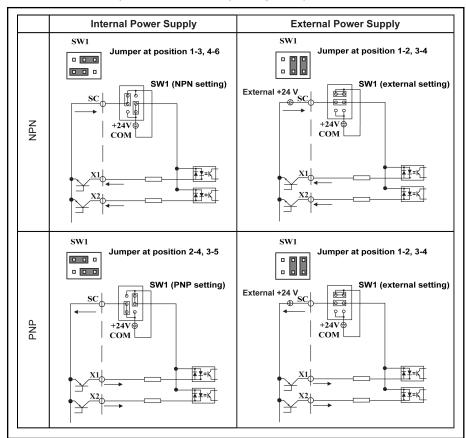


Fig.5-20: NPN/PNP modes and signal inputs

5.3.5 Encoder Signal Selection

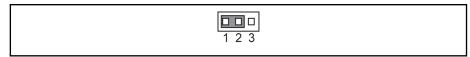


Fig.5-21: Encoder jumper JP5

The factory default position of jumper JP5 is at 1-2.

Encoder input signals are set by jumper JP5:

Position 1-2: 5 V encoder power supply is provided by PGP2;

Position 2-3: 12 V encoder power supply is provided by PGP2.

The wiring of the encoder is described in the table below:

Encoder power supply		Encoder signal	Fv ter	Deference	
Supply option	Voltage	Encoder signal	Encoder signal wire	Other connection	Reference
	PGP1 (24 V)	А, В	A-, B-	A+, B+ connected to PGP1	Wiring 1
Internal		A+, A-, B+, B-	A+, A-, B+, B-	-	Wiring 2
internai	PGP2 (5 V / 12 V)	A, B	A-, B-	A+, B+ connected to PGP2	Wiring 3
			A+, A-, B+, B-	-	Wiring 4
External	5 to 24 V	А, В	A-, B-	A+, B+ connected to external power supply	Wiring 5
		A+, A-, B+, B-	A+, A-, B+, B-	-	Wiring 6

Tab.5-7: Encoder wiring description

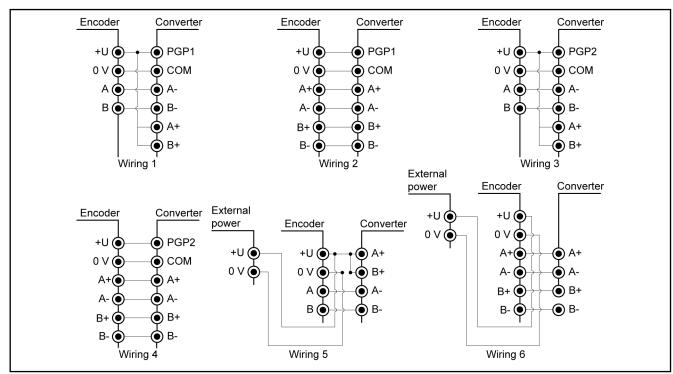


Fig.5-22: Encoder wiring figure

6 Commissioning

6.1 Operating Panel

6.1.1 Overview

The operating panel is at the center of the frequency converter and composed of two areas: display and keys. The display shows mode settings and operation state of the frequency converter. The keys allow the user to program the frequency converter.

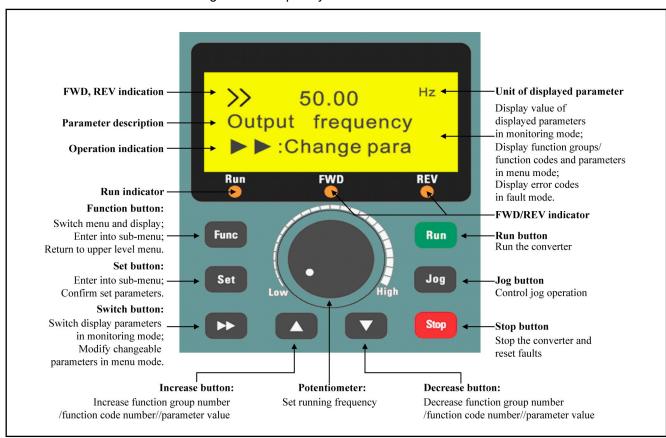


Fig.6-1: Fv operating panel

6.1.2 3-Level Menu Structure

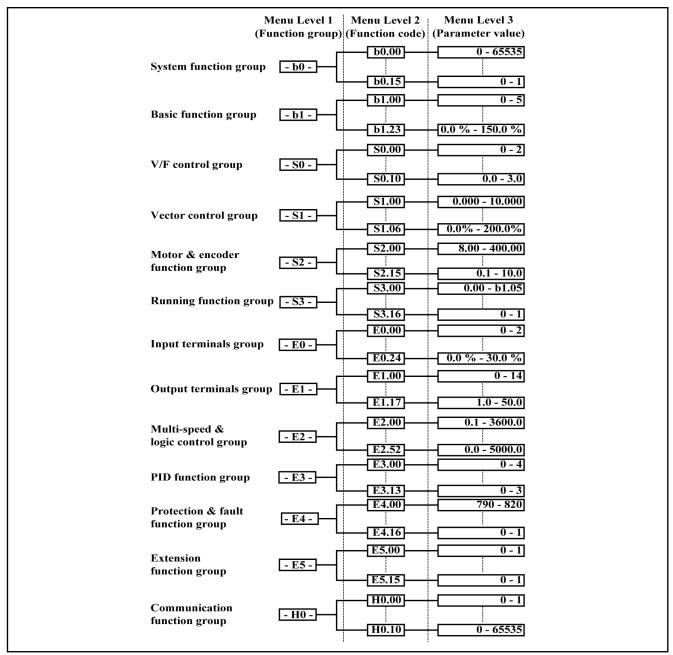


Fig.6-2: 3-level menu structure

B

The digital operating panel can be used to toggle between menu options, set parameters and reset the frequency converter after error with buttons **Func**, **Set**, \blacktriangle and \blacktriangledown .

6.1.3 Operation Mode Description

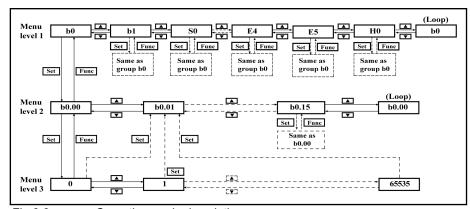


Fig.6-3: Operation mode description

6.1.4 Example of Operating Panel Operation

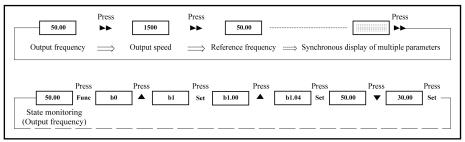


Fig.6-4: Example of operating panel operation

6.2 Commission Process

6.2.1 Check and Preparation before Commissioning

- 1. Check if the wiring is correct. Particularly, ensure that the output terminals U, V and W of the frequency converter are not connected to the power supply and that the ground terminal is well grounded.
- 2. Ensure that there are no short circuits between terminals, live terminals or short circuit to ground.
- 3. Ensure that terminal connections, connectors and screws are secure.
- 4. Ensure the motor is not connected to other loads.
- Check that all inputs are off before powering on, to ensure that the frequency converter will be started as expected and no unexpected action occurs.
- 6. Make the following checks after powering on:
 - The set frequency flashes on the display (without error indication); if "software doesn't match" is displayed, it indicates the software version of operating panel and control board doesn't match, for which you need to consult the service.
 - The displayed parameters match with the field application.

Rexroth Frequency Converter Fv

Commissioning

6.2.2 **Notes on Commissioning**

Bosch Rexroth AG

- 1. The frequency converter has no internal contactor, and will be energized once the power supply is connected. When the Run key is pressed down (or the control through terminals is selected), the frequency converter will generate output.
- 2. By factory default, the frequency converter initially displays output frequency after being energized. You may change it to another parameter by changing the factory default of parameter b0.08. The factory defaults are based on standard applications with standard motors.
- 3. The frequency command of the frequency converter is set to be 0.00 Hz upon delivery, meaning that the motor will remain static. To start the motor, the frequency converter settings must be changed with the operating panel.



Ensure the enclosure is in place before the device is powered on. Wait for 30 minutes after powering off, to allow the DC capacitor being discharged, and do not remove the upper cover during the period.

6.2.3 Fv Basic Parameter Fast Setting

Use the operating panel to set the necessary parameters based on the application loads and specifications, to allow the frequency converter to start rapidly. A basic generic parameter fast setting table is given below:

Function code	Name	Setting range	Minimum unit	Factory default	Attribute
b0.04	Converter input supply voltage	380 to 480 V	1 V	380 V	•
b1.09	Acceleration time 1	0.1 to 3,600.0s	0.1s	10.0s	\$
b1.10	Deceleration time 1	0.1 to 3,600.0s	0.1s	10.0s	\$
S2.00	Rated motor frequency	8.00 to 400.00 Hz	0.01 Hz	50.00 Hz	•
S2.01	Rated motor rotation speed	1 to 24,000 rpm	1 rpm	1,440 rpm	•
S2.02	Rated motor power	0.4 to 1,000.0 kW	0.1 kW	Depends on model	•
S2.03	Rated motor voltage	0 to 480 V	1 V	Depends on model	•
S2.04	Rated motor current	0.1 to 1,000.0 A	0.1 A	Depends on model	•

Tab.6-1: Basic parameter fast setting

Rexroth Frequency Converter Fv

Commissioning

6.2.4 Example: Commissioning of Frequency Converter with Potentiometer

The factory default output frequency setting of Fv is "Set by operating panel potentiometer".

Sequence	Operation	Description
1	Rotate the potentiometer counterclockwise (leftwards) to the greatest extent.	The initial frequency value is 0.00
2	Press Run key	Enter the command for running, with 0.00 displayed
3	Rotate the potentiometer clockwise (rightwards) slowly and the displayed value starts to change, until 5.00 is displayed	The motor starts to run
4	Observe: • if the motor runs in the correct direction • if the motor runs smoothly • if there is any abnormal noise or problem	Observe the running: If any abnormality occurs, stop the motor immediately by shutting off the power. Restart commissioning only after the error causes have been removed.
5	Rotate the potentiometer clockwise (rightwards)	The motor accelerates
6	Rotate the potentiometer counterclockwise (leftwards)	The motor decelerates
7	Press Stop key	Enter the command for stopping. The motor stops.

Tab.6-2: Commissioning of converter with potentiometer

B

The factory default of the frequency control commands is "Set control commands by operating panel".

6.3 Restore Parameters to Factory Defaults

If the frequency converter fails to run the motor due to incorrect parameter settings, a simple solution is to initialize the parameters to factory defaults. Set [b0.02]=1 will start initialization to restore factory defaults.

Please be sure that the parameter settings after factory defaults restore match with the motor and the field application. Adjust the parameter settings after factory defaults restore if necessary.

Output voltage / frequency	3Ф / 380 V / 50 Hz SVPWM wave
Operating frequency	0 to 50 Hz
Acceleration / Deceleration time	Linear , Acceleration for 10s / Deceleration for 10s
Protection mode in case of motor overload	Rated motor current × 100 %
Operating panel options	Run, Stop control starting and stopping; panel potentiometer sets output frequency

Tab.6-3: Factory defaults

6.4 Solutions for Simple Error during Commissioning

Simple errors during commissioning	Solutions
Over current occurs during acceleration (O.C2)	Increase the acceleration time
Over voltage occurs during deceleration (O.E3)	Increase the deceleration time
Over current occurs immediately after pressing the Run key (O.C2)	Incorrect wiring. Check if U, V, W outputs of the main circuit are shorted or grounded
The motor runs in the direction opposite to the desired one	Change the sequence of any two phases of U, V and W
The motor vibrates and runs in uncertain directions after each starting	One phase of U, V and W is disconnected (output phase loss)

Tab.6-4: Simple errors and respective solutions

6.5 Notes on Frequent Start and Stop

- 1. Do not use the electromagnetic contactor KM connected prior to terminals L1, L2 and L3 to start or stop the motor to avoid early aging and damage of the filter capacitor. External terminals **FWD**, **REV** and X1 to X8 may be used to start and stop the frequency converter.
- 2. The current limiting resistor for capacitor charging may be damaged due to frequent start and stop of the motor with the electromagnetic contactor KM connected prior terminals L1, L2 and L3.

7.1 Main Functions

7.1.1 Control Command

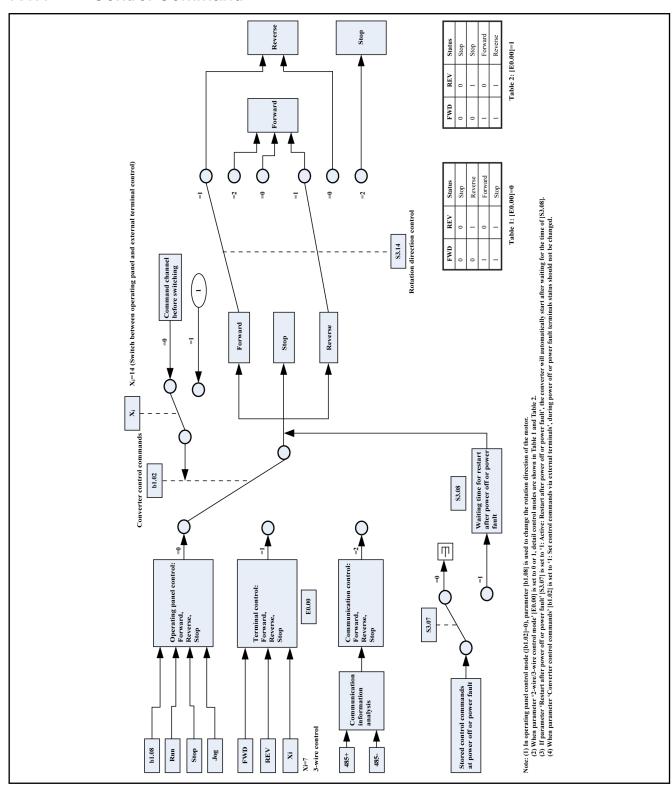


Fig.7-1: Control command

7.1.2 Frequency Setting

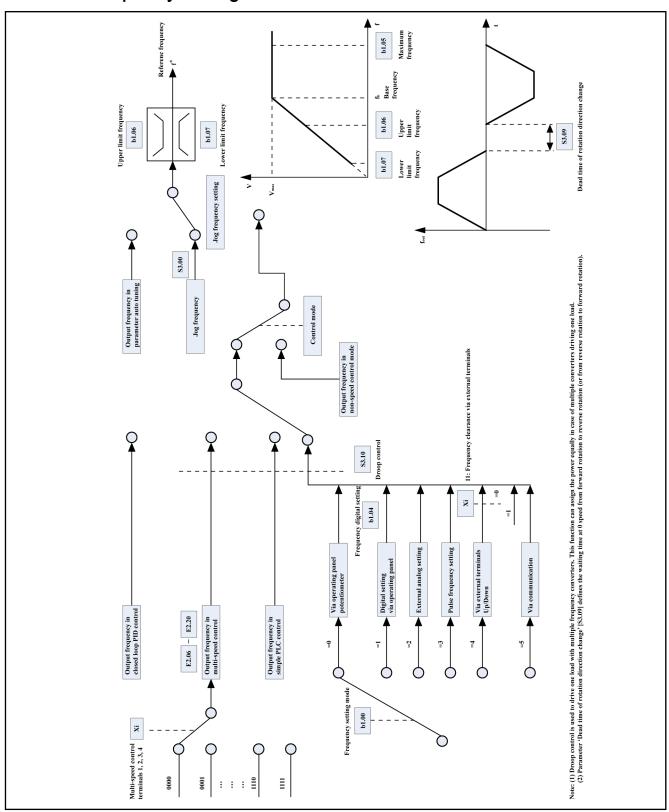


Fig.7-2: Frequency setting

7.1.3 Start Control

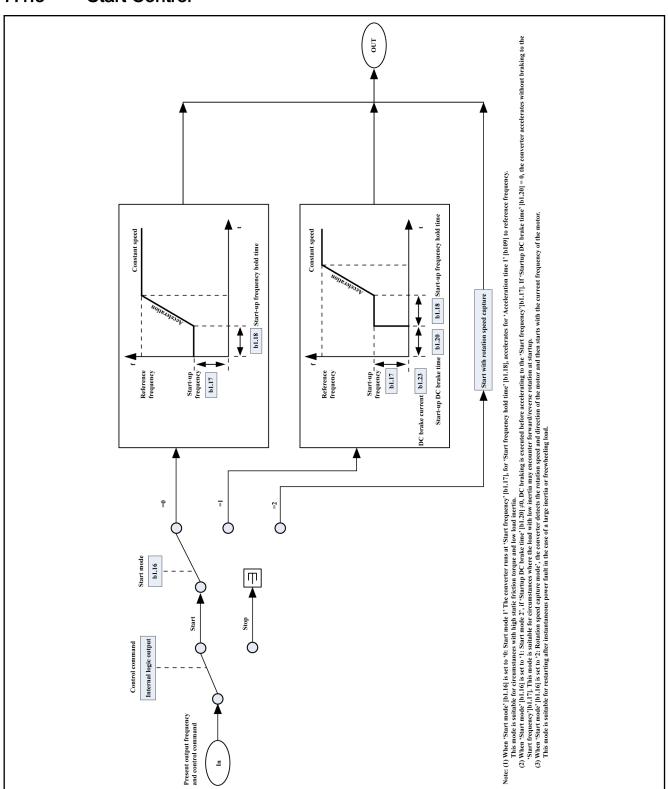


Fig.7-3: Start control

7.1.4 **Stop Control**

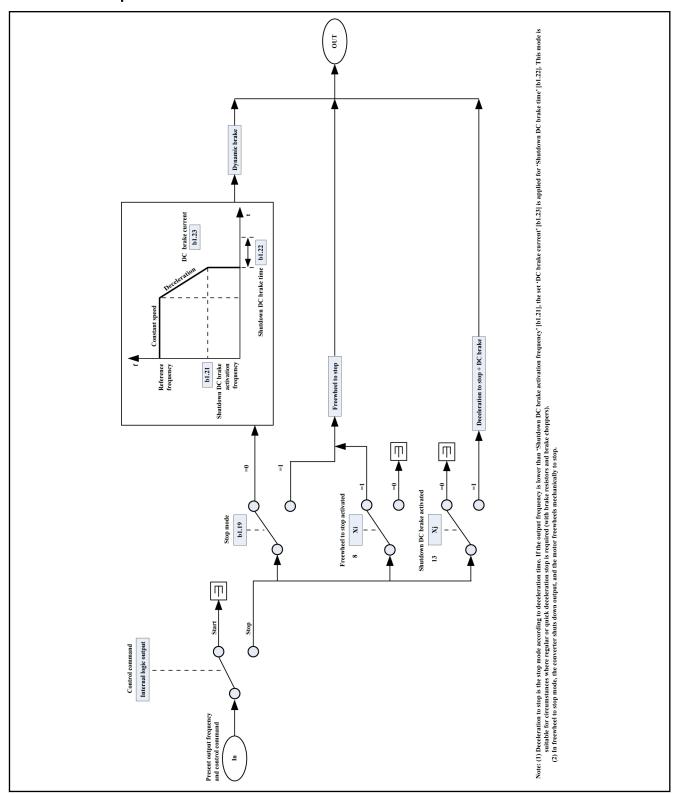


Fig.7-4: Stop control

7.1.5 Linear/S-curve Acceleration/Deceleration

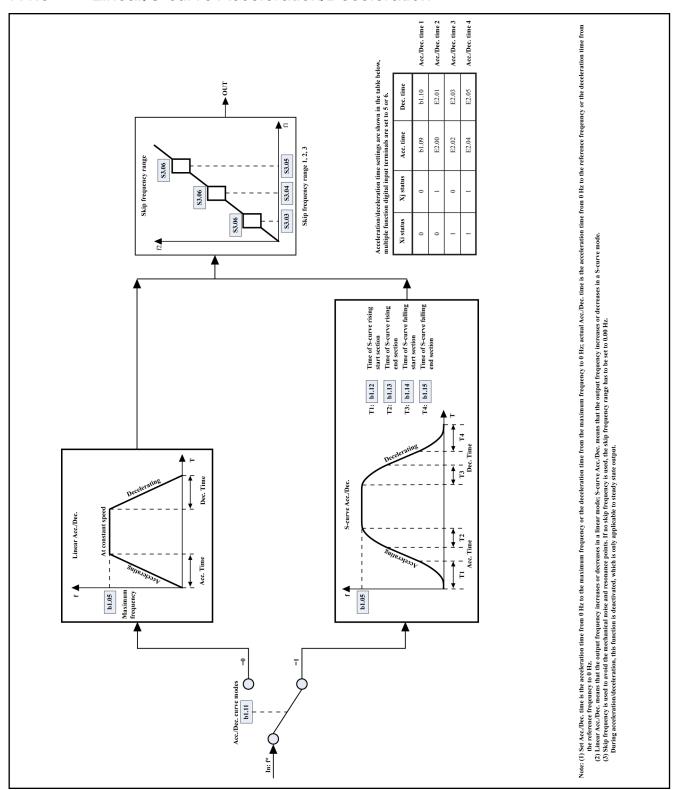


Fig.7-5: Linear/S-curve acceleration/deceleration

7.1.6 **Logic Control**

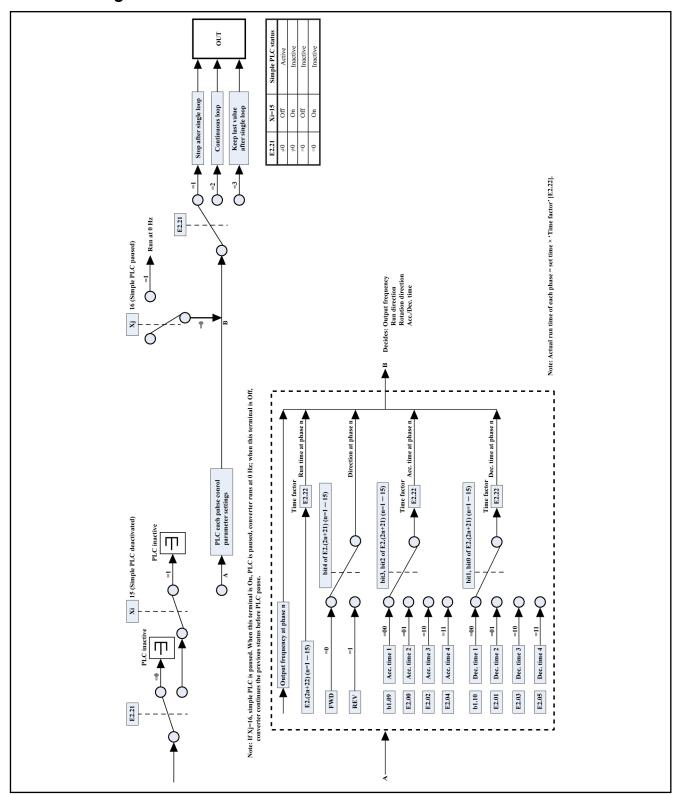


Fig.7-6: Logic control

7.1.7 PID Control

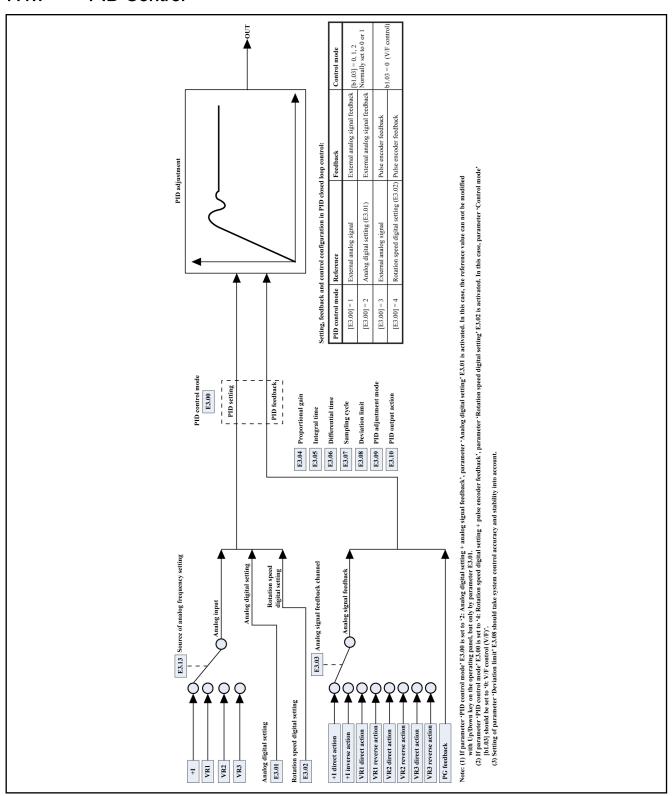


Fig.7-7: PID control

Frequency Setting via Analog and Pulse Inputs 7.1.8

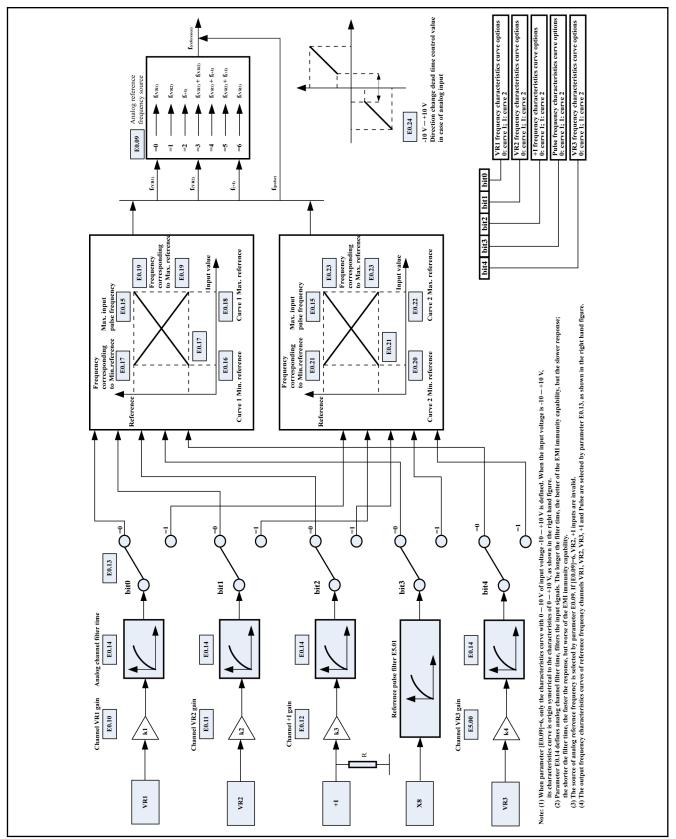


Fig.7-8: Frequency setting via analog and pulse inputs

7.1.9 Multiple Function Digital Inputs

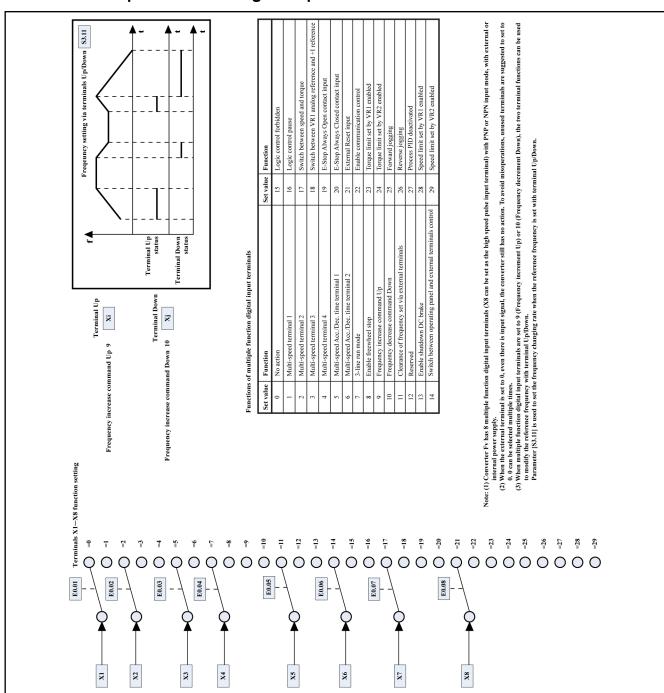


Fig.7-9: Multiple function digital inputs

Analog Outputs 7.1.10

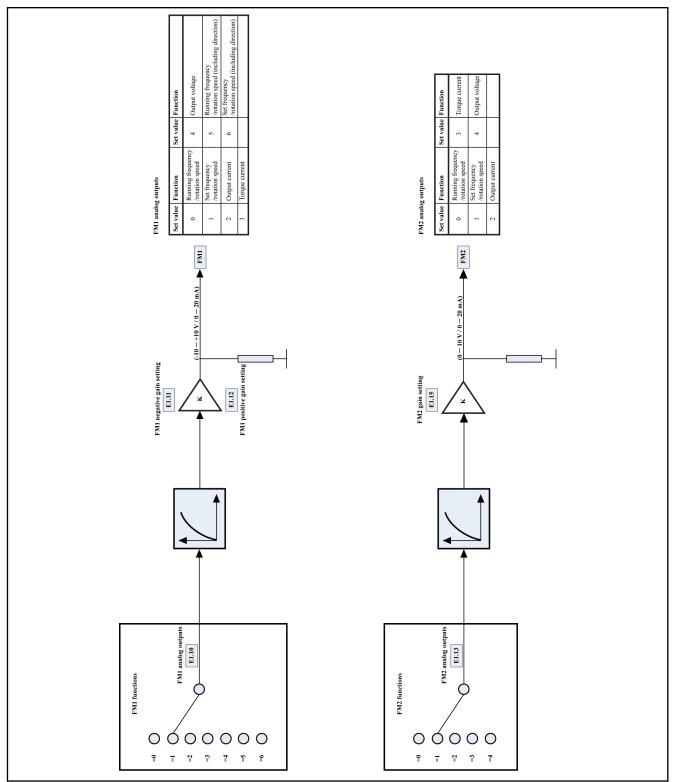


Fig.7-10: Analog outputs

7.1.11 Digital Outputs

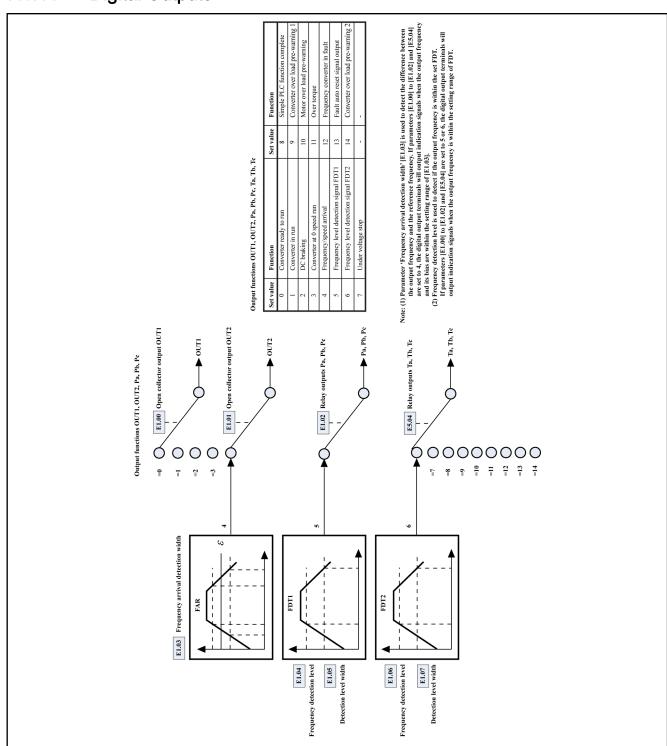


Fig.7-11: Digital outputs

Rexroth Frequency Converter Fv

Parameter Settings

7.2 Description of Attribute Symbols in Parameter Tables

The meaning of attribute symbols in the parameter tables are explained in the table below.

Parameter attribute	Description
♦ Parameter setting can be modified when the frequency converter is in run or stop mode.	
•	Parameter setting cannot be modified when the frequency converter is in run mode.
0	Parameter setting is a calculated, measured or recorded value which cannot be modified.

Tab.7-1: Parameter attributes and descriptions



Code: means function / parameter code, written in bx.xx, Sx.xx, Ex.xx and Hx.xx.

Value of function / parameter code: written in [bx.xx], [Sx.xx], [Ex.xx] and [Hx.xx].

Default: values that correspond to the factory default upon initialization at 50 Hz.

Attrb.: means attribute.

7.3 Parameters Functions

7.3.1 Category b: Basic Parameters

Group b0: System parameters

Code	Name	Setting range	Min.unit	Default	Attrib.
b0.00	User password	0 to 65535	1	0	♦
b0.01	LCD language	0: Chinese; 1: English	1	0	♦
		0: No action			
b0.02	Restore factory default	1: Restore parameters to factory default	1	0	•
	, , , , , , , , , , , , , , , , , , , ,	Note: The value is automatically set to 0 after restoring factory default.	·		
		0: No action			
		1: Copy from frequency converter to operating panel			
b0.03	Parameter copy	2: Copy from operating panel to frequency converter	1	0	•
		Note: The value is automatically set to 0 after parameter copy.			
b0.04	Mains voltage	380 to 480 V	1 V	380 V	•
b0.05	PWM frequency	1.0 to 15.0 kHz	0.1 kHz	Depends on model	*
b0.06	Automatic adjustment of PWM frequency	0: OFF; 1: On	1	1	•
b0.07	LCD backlight mode	0: Energy saving; 1: Always on	1	0	\$
b0.08	LCD display in run mode	0.45, 47	1	0	\$
b0.09	LCD display in stop mode	0 to 17	1	2	\$
b0.10	Scale factor of user-defined value	0.1 % to 1,000.0 %	0.1 %	100.0 %	>
b0.11	Parameter filter setting	0: b Parameters; 1: b, S Parameters	1	0	*
00.11	Parameter liner setting	2: b, S, E Parameters; 3: b, S, E, H Parameters	1	0	
b0.12	Heat sink temperature	25 to 100 °C	1 ℃	Measured	0
b0.13	Total running time	0 to 65535 hours	1 hour	0 hour	0
b0.14	Firmware version	Read-only	_	_	0
b0.15	Reserved	0, 1	1	0	•
	1	· ·	1		

Setting range of parameters b0.08 and b0.09:

- 0: Output frequency; 1: Output rotation speed; 2: Set frequency
- 3: Set rotation speed; 4: Output voltage; 5: Output current
- 6: Output power; 7: DC bus voltage; 8: Torque current
- 9: Excitation current; 10: User-defined reference value
- 11: User-defined output value; 12: Reference torque
- 13: Digital inputs status; 14: Encoder speed feedback
- 15: Torque limit setting; 16: Speed limit setting; 17: Multi-monitoring display

Group b1: Basic parameters

Basic parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
		0: Set by operating panel potentiometer			
		1: Set by operating panel			
b1.00	Frequency setting mode	2: Set by analog inputs	1	0	
51.00	Trequency setting mode	3: Set by pulse frequency	'	O	
		4: Set by digital inputs Up/Down			
		5: Set by communication			
		0: Not saved when powered off or stopped			
b1.01	Saving options of digital set	1: Not saved when powered off; saved when stopped	1	0	
01.01	frequency	2: Saved when powered off; not saved when stopped	'		
		3: Saved when powered off or stopped			
	Frequency converter control commands	0: Set control commands by operating panel			
b1.02		1: Set control commands by digital inputs	1	0	•
		2: Set control commands by communication			
		0: V/F control (V/F)			
b1.03	Control mode	1: Sensorless vector control (SVC)	1	0	•
		2: Field oriented vector control (FOC)			
b1.04	Digital set frequency	[b1.07] to [b1.06]	0.01 Hz	50.00 Hz	♦
b1.05	Maximum frequency	50.00 to 400.00Hz	0.01 Hz	50.00 Hz	•
b1.06	Upper frequency	[b1.07] to [b1.05]	0.01 Hz	50.00 Hz	♦
b1.07	Lower frequency	0.00 Hz to [b1.06]	0.01 Hz	0.00 Hz	♦
b1.08	Operating panel controlled direction	0: Forward rotation; 1: Reverse rotation	1	0	*

Acceleration / Deceleration time and modes

Code	Name	Setting range	Min. unit	Default	Attrib.
b1.09	Acceleration time 1	0.1 to 3,600.0s	0.1s	10.0s	\$
b1.10	Deceleration time 1	0.1 to 3,600.0s	0.1s	10.0s	\$
b1.11	Acceleration/deceleration mode	0: Linear mode; 1: S-curve mode	1	0	•
b1.12	Time of S-curve rising section 1	0.0 % to 40.0 % (of 'Acceleration time 1' [b1.09])	0.1 %	20.0 %	•
b1.13	Time of S-curve rising section 3	0.0 % to 40.0 % (of 'Acceleration time 1' [b1.09])	0.1 %	20.0 %	•
b1.14	Time of S-curve falling section 4	0.0 % to 40.0 % (of 'Deceleration time 1' [b1.10])	0.1 %	20.0 %	•
b1.15	Time of S-curve falling section 6	0.0 % to 40.0 % (of 'Deceleration time 1' [b1.10])	0.1 %	20.0 %	•

Start or stop parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
b1.16 Start mode	Start made	0: Start mode 1; 1: Start mode 2	1	0	
	Start mode	2: Rotation speed capture mode	1		
b1.17	Start frequency	0.00 to 15.00 Hz	0.01 Hz	0.50 Hz	•
b1.18	Start frequency hold time	0.0 to 10.0s	0.1s	0.0s	•
b1.19	Stop mode	0: Decelerate to stop; 1: Freewheel to stop	1	0	•

DC brake

Code	Name	Setting range	Min. unit	Default	Attrib.
b1.20	Startup DC brake time	0.0 to 20.0s (0.0 deactivates DC braking)	0.1s	0.0s	•
b1.21	Shutdown DC brake activation frequency	0.00 to 10.00 Hz	0.01 Hz	0.00 Hz	•
b1.22	Shutdown DC brake time	0.0 to 20.0s (0.0 deactivates DC braking)	0.1s	0.0s	•
b1.23	DC brake current	0.0 % to 150.0 % (of rated frequency converter current)	0.1 %	0.0 %	•

Category S: Standard Parameters 7.3.2

Group S0: V/F control

Code	Name	Setting range	Min. unit	Default	Attrib.
S0.00	V/F mode	0: Linear mode; 1: Square mode 2: User-defined multipoint mode	1	0	•
S0.01	V/F frequency 1	0.00 Hz to [S0.03]	0.01 Hz	0.00 Hz	•
S0.02	V/F voltage 1	0.0 % to 120.0 % (of 'Rated motor voltage' [S2.03])	0.1 %	0.0 %	•
S0.03	V/F frequency 2	[S0.01] to [S0.05]	0.01 Hz	0.00 Hz	•
S0.04	V/F voltage 2	0.0 % to 120.0 % (of 'Rated motor voltage' [S2.03])	0.1 %	0.0 %	•
S0.05	V/F frequency 3	S0.03 to [b1.05]	0.01 Hz	0.00 Hz	•
S0.06	V/F voltage 3	0.0 % to 120.0 % (of 'Rated motor voltage' [S2.03])	0.1 %	0.0 %	•
S0.07	Slip compensation	0.00 to 10.00 Hz	0.01 Hz	0.00 Hz	•
S0.08	Torque increase	0.0 % to 20.0 % (of rated frequency converter voltage) • 0.0 %: Automatic increase • 0.1 % to 20.0 %: Manual increase	0.1 %	0.1 %	•
S0.09	Automatic voltage stabilization	0: Not active 1: Always active 2: Not active during deceleration and braking	1	0	•
S0.10	Oscillation suppression gain	0.0 to 3.0 (0.0: deactivated)	0.1	0.3	♦

Group S1: Vector control

Code	Name	Setting range	Min. unit	Default	Attrib.
S1.00	Speed feedback proportional gain	0.000 to 10.000	0.001	1.000	•
S1.01	Speed feedback integral time	0.000 to 10.000s (0.000 means inactive)	0.001s	1.000s	•
S1.02	Torque limit	0.0 % to 200.0 % (of rated motor current)	0.1 %	150.0 %	•
S1.03	Slip compensation gain	50.0 % to 250.0 %	0.1 %	100.0 %	•
S1.04	Torque control selection	0: Inputs control; 1: Always active	1	0	•
S1.05	Torque control reference	0: Input +I; 1: Input VR1; 2: Digital setting 3: Set by communication	1	0	•
S1.06	Torque digital setting	0.0 % to 200.0 %	0.1 %	100.0 %	\$

Group S2: Motor and encoder parameters

Motor nameplate parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
S2.00	Rated motor frequency	8.00 to 400.00 Hz	0.01 Hz	50.00 Hz	+
S2.01	Rated motor rotation speed	1 to 24,000 rpm	1 rpm	1,440 rpm	+
S2.02	Rated motor power	0.4 to 1,000.0 kW	0.1 kW		+
S2.03	Rated motor voltage	0 to 900 V	1 V	Depends on model	+
S2.04	Rated motor current	0.1 to 1,000.0 A	0.1 A		•

Motor parameters and adjustment

Code	Name	Setting range	Min. unit	Default	Attrib.
S2.05	Stator resistance factor	0.00 % to 50.00 %	0.01 %		•
S2.06	Rotator resistance factor	0.00 % to 50.00 %	0.01 %		•
S2.07	Leakage inductance factor	0.00 % to 50.00 %	0.01 %	Depends on model	•
S2.08	Mutual inductance factor	0.0 % to 2,000.0 %	0.1 %		•
S2.09	No-load current	0.0 to 1,000.0 A	0.1 A		•
		0: No action		0	
		1: Auto tuning with running motor			
		2: Auto tuning with static motor			
S2.10	Parameter auto-tuning	Warning: Motor load has to be removed before using auto-tuning function.	1		•
		Note: The value is automatically set to 0 after auto-tuning.			
S2.11	Reserved	0, 1	1	0	•

Encoder parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
S2.12	Pulses per revolution of pulse encoder	1 to 20,000	1	1,024	•
S2.13	Pulse encoder direction reverse	0: No reverse; 1: Reverse	1	0	•
S2.14	Pulse encoder error detection extent	0.0 to 1,000.0 rpm (0.0 rpm: No break protection)	0.1 rpm	0.0 rpm	•
S2.15	Pulse encoder error detection time	0.1 to 10.0s	0.1s	1.0s	•

Group S3: Control parameters

Jog

Code	Name	Setting range	Min. unit	Default	Attrib.
S3.00	Jog frequency	0.00 Hz to [b1.05]	0.01 Hz	5.00 Hz	•
S3.01	Jog acceleration time	0.1 to 3,600.0s	0.1s	5.0s	\$
S3.02	Jog deceleration time	0.1 to 3,600.0s	0.1s	5.0s	\$

Skip frequency

Code	Name	Setting range	Min. unit	Default	Attrib.
S3.03	Skip frequency 1	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	•
S3.04	Skip frequency 2	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	•
S3.05	Skip frequency 3	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	•
S3.06	Skip frequency range	0.00 to 30.00 Hz	0.01 Hz	0.00 Hz	•

Restart after power off or power fault

Code	Name	Setting range	Min. unit	Default	Attrib.
S3.07	Restart after power off or power fault	0: Deactivated; 1: Activated	1	0	•
S3.08	Waiting time to restart after power off or power fault	0.1 to 10.0s	0.1s	1.0s	•

Other parameters in Group S3

Code	Name	Setting range	Min. unit	Default	Attrib.
S3.09	Direction change dead time	0.0 to 3,600.0s	0.1s	4.0s	•
S3.10	Droop control	0.00 to 10.00 Hz	0.01 Hz	0.00 Hz	•
S3.11	Setting velocity by Up/Down	0.01 to 100.00 Hz/s	0.01 Hz/s	0.08 Hz/s	\$
S3.12	Brake chopper threshold	600 to 785 V	1 V	770 V	•
S3.13	Braking duty cycle	0 % to 100 %	1 %	100 %	•
S3.14	Motor rotation direction	Standard motor direction Reverse standard motor direction Deactivate reverse motor rotation	1	0	•
S3.15	Stop key validity	Valid only for operating panel control Valid for all control means	1	1	•
S3.16	Fan control	0: Temperature controlled 1: Always on	1	0	\$

Rexroth Frequency Converter Fv

Parameter Settings

7.3.3 Category E - Extended Parameters

Group E0: Analog and digital inputs

Multi- function digital inputs

Code	Name	Setting range	Min. unit	Default	Attrib.
		0: Forward/Stop, Reverse/Stop			
E0.00	2-wire/3-wire control mode	1: Forward/Reverse, Run/Stop	1	0	•
		2: 3-wire control			
E0.01	Digital input X1				
to	to	0 to 29	1	0	•
E0.08	Digital input X8				

Setting range of parameters E0.00 to E0.08:

- 0: Inactive (allows multiple selection)
- 1: Multi-speed control 1
- 2: Multi-speed control 2
- 3: Multi-speed control 3
- 4: Multi-speed control 4
- 5: Acceleration/deceleration time 1
- 6: Acceleration/deceleration time 2
- 7: 3-wire control
- 8: Freewheel to stop
- 9: Frequency increment Up
- 10: Frequency decrement Down
- 11: Set frequency to 0
- 12: Reserved
- 13: Activate shutdown DC brake
- 14: Switch between operating panel and digital inputs control
- 15: Logic control deactivated
- 16: Logic control paused
- 17: Switch between speed and torque control
- 18: Switch between VR1 and +I analog reference
- 19: External error N.O. contact input
- 20: External error N.C. contact input
- 21: External Reset input
- 22: Activate communication control
- 23: Torque limit set by VR1 enabled
- 24: Torque limit set by VR2 enabled
- 25: Forward jogging
- 26: Reverse jogging
- 27: Process PID deactivated
- 28: Speed limit set by VR1 enabled
- 29: Speed limit set by VR2 enabled

Analog inputs

Code	Name	Setting range	Min. unit	Default	Attrib.
E0.09	Source of analog frequency setting	0 to 7	1	0	+
E0.10	VR1 channel amplification factor k1	0.00 to 10.00	0.01	1.00	•
E0.11	VR2 channel amplification factor k2	0.00 to 10.00	0.01	1.00	+
E0.12	+I channel amplification factor k3	0.00 to 10.00	0.01	1.00	•
E0.13	Reference frequency curve	0 to 31	1	0	•
E0.14	Analog channel filter time	0.000 to 2.000s	0.001s	0.100s	•
E0.15	Maximum input pulse frequency	1.0 to 50.0 kHz	0.1 kHz	20.0 kHz	•
E0.16	Curve 1 minimum reference	0.0 % to [E0.18]	0.1 %	0.0 %	•
E0.17	Frequency corresponding to curve 1 minimum reference	0.00 Hz to [b1.06]	0.01 Hz	0.00 Hz	•
E0.18	Curve 1 maximum reference	[E0.16] to 100.0 %	0.1 %	100.0 %	•
E0.19	Frequency corresponding to curve 1 maximum reference	0.00 Hz to [b1.06]	0.01 Hz	50.00 Hz	•
E0.20	Curve 2 minimum reference	0.0 % to [E0.22]	0.1 %	0.0 %	•
E0.21	Frequency corresponding to curve 2 minimum reference	0.00 Hz to [b1.06]	0.01 Hz	0.00 Hz	•
E0.22	Curve 2 maximum reference	[E0.20] to 100.0 %	0.1 %	100.0 %	•
E0.23	Frequency corresponding to curve 2 maximum reference	0.00 Hz to [b1.06]	0.01 Hz	50.00 Hz	•
E0.24	Analog reference forward/reverse dead zone control value at -10 to +10 V	0.0 % to 30.0 %	0.1 %	0.0 %	•

Setting range of parameter E0.09:

0: k1 × VR1

1: k2 × VR2

2: $k3 \times (+1)$

3: k1 × VR1 + k2 × VR2

4: $k1 \times VR1 + k3 \times (+1)$

5: $k2 \times VR2 + k3 \times (+I)$

6: k1 × VR1 (only valid for -10 to +10 V forward/reverse control)

7: k4 × VR3

Setting range of parameter E0.13:

bit4: VR3 reference frequency characteristic curve

0: Curve 1; 1: Curve 2

bit3: Pulse reference frequency characteristic curve

0: Curve 1; 1: Curve 2

bit2: +I reference frequency characteristic curve

0: Curve 1; 1: Curve 2

bit1: VR2 reference frequency characteristic curve

0: Curve 1; 1: Curve 2

bit0: VR1 reference frequency characteristic curve

0: Curve 1; 1: Curve 2

Rexroth Frequency Converter Fv

Parameter Settings

Group E1: Digital and analog outputs

Multi-function digital outputs

Code	Name	Setting range	Min. unit	Default	Attrib.
E1.00	Open collector output OUT1		1	1	•
E1.01	Open collector output OUT2	0 to 14	1	1	•
E1.02	Relay outputs Pa, Pb and Pc		1	1	•
E1.03	Frequency arrival detection width	0.0 % to 20.0 % (of maximum frequency [b1.05])	0.1 %	5.0 %	♦
E1.04	Frequency detection level FDT1	0.0 % to 100.0 % (of maximum frequency [b1.05])	0.1 %	90.0 %	\$
E1.05	Frequency detection level FDT1 width	0.0 % to 100.0 % (of maximum frequency [b1.05])	0.1 %	5.0 %	♦
E1.06	Frequency detection level FDT2	0.0 % to 100.0% (of maximum frequency [b1.05])	0.1 %	50.0 %	♦
E1.07	Frequency detection level FDT2 width	0.0 % to 100.0 % (of maximum frequency [b1.05])	0.1 %	5.0 %	♦
E1.08	Frequency converter over load pre-warning 1 level setting	20.0 % to 100.0 % (of rated frequency converter current)	0.1 %	100.0 %	*
E1.09	Motor over load pre-warning level setting	100.0 % to 250.0 % (of rated motor current)	0.1 %	100.0 %	♦

Setting range of parameters E1.00 to E1.02:

- 0: Frequency converter is ready to run
- 1: Frequency converter is running
- 2: DC brake active
- 3: Frequency converter runs at zero speed
- 4. Frequency/speed arrival signal
- 5. Frequency level detection signal (FDT1)
- 6. Frequency level detection signal (FDT2)
- 7: Logic control phase completed
- 8: Under voltage stop
- 9: Frequency converter over load pre-warning 1
- 10: Motor over load pre-warning
- 11: Over torque
- 12: Frequency converter in error
- 13: Error auto reset signal output
- 14: Frequency converter over load pre-warning 2

Analog outputs

Code	Name	Setting range	Min. unit	Default	Attrib.
		0: Output frequency / rotation speed			
		1: Set frequency / rotation speed			
		2: Output current			
E1.10	FM1 analog output	3: Torque current	1	0	
	analog carpat	4: Output voltage			
		5: Output frequency / rotation speed (including direction)	ec-		
		6: Set frequency / rotation speed (including direction)			
E1.11	FM1 negative gain setting	0.00 to 10.00	0.01	1.00	♦
E1.12	FM1 positive gain setting	0.00 to 10.00	0.01	1.00	♦
		0: Output frequency / rotation speed			
		1: Set frequency / rotation speed			
E1.13	FM2 analog output	2: Output current	1	1	♦
		3: Torque current			
		4: Output voltage			
E1.14	Reserved	0, 1	1	0	•
E1.15	FM2 gain setting	0.00 to 10.00	0.01	1.00	*

DO pulse outputs

Code	Name	Setting range	Min. unit	Default	Attrib.
E1.16	Pulse outputs	0: Output frequency			
		1: Output voltage	1	0	♦
		2: Output current			
E1.17	Maximum output	1 0 to 50 0 kHz	0.1 kHz	10.0 kHz	♦
	pulse frequency	1.0 to 50.0 kHz		10.0 KHZ	Ť

Group E2: Multi-Speed and logic control

Acceleration/deceleration time

Code	Name	Setting range	Min. unit	Default	Attrib.
E2.00	Acceleration time 2	0.1 to 3,600.0s	0.1s	10.0s	\$
E2.01	Deceleration time 2	0.1 to 3,600.0s	0.1s	10.0s	\$
E2.02	Acceleration time 3	0.1 to 3,600.0s	0.1s	10.0s	\$
E2.03	Deceleration time 3	0.1 to 3,600.0s	0.1s	10.0s	\$
E2.04	Acceleration time 4	0.1 to 3,600.0s	0.1s	10.0s	\$
E2.05	Deceleration time 4	0.1 to 3,600.0s	0.1s	10.0s	♦

Rexroth Frequency Converter Fv

Parameter Settings

Multi-speed frequency

Code	Name	Setting range	Min. unit	Default	Attrib.
E2.06	Multi-speed frequency 1	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.07	Multi-speed frequency 2	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.08	Multi-speed frequency 3	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.09	Multi-speed frequency 4	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.10	Multi-speed frequency 5	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.11	Multi-speed frequency 6	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.12	Multi-speed frequency 7	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.13	Multi-speed frequency 8	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.14	Multi-speed frequency 9	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.15	Multi-speed frequency 10	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.16	Multi-speed frequency 11	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.17	Multi-speed frequency 12	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.18	Multi-speed frequency 13	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.19	Multi-speed frequency 14	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$
E2.20	Multi-speed frequency 15	[b1.07] to [b1.06]	0.01 Hz	0.00 Hz	\$

Logic control

Code	Name	Setting range	Min. unit	Default	Attrib.
E2.21	Logio control modo	0: Inactive; 1: Mode 1	1	0	
EZ.Z I	Logic control mode	2: Mode 2; 3: Mode 3	'	U	•
E2.22	Logic control time factor	1 to 60	1	1	+
E2.23	Stage 1 action selection	0 to 31	1	0	•
E2.24	Stage 1 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.25	Stage 2 action selection	0 to 31	1	0	•
E2.26	Stage 2 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.27	Stage 3 action selection	0 to 31	1	0	•
E2.28	Stage 3 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.29	Stage 4 action selection	0 to 31	1	0	•
E2.30	Stage 4 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.31	Stage 5 action selection	0 to 31	1	0	•
E2.32	Stage 5 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.33	Stage 6 action selection	0 to 31	1	0	•
E2.34	Stage 6 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.35	Stage 7 action selection	0 to 31	1	0	•
E2.36	Stage 7 running time	0.0 to 5,000.0s	0.1s	0.0s	•

Code	Name	Setting range	Min. unit	Default	Attrib.
E2.37	Stage 8 action selection	0 to 31	1	0	•
E2.38	Stage 8 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.39	Stage 9 action selection	0 to 31	1	0	•
E2.40	Stage 9 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.41	Stage 10 action selection	0 to 31	1	0	•
E2.42	Stage 10 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.43	Stage 11 action selection	0 to 31	1	0	•
E2.44	Stage 11 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.45	Stage 12 action selection	0 to 31	1	0	•
E2.46	Stage 12 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.47	Stage 13 action selection	0 to 31	1	0	•
E2.48	Stage 13 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.49	Stage 14 action selection	0 to 31	1	0	•
E2.50	Stage 14 running time	0.0 to 5,000.0s	0.1s	0.0s	•
E2.51	Stage 15 action selection	0 to 31	1	0	•
E2.52	Stage 15 running time	0.0 to 5,000.0s	0.1s	0.0s	•

Group E3: PID control

Code	Name	Setting range	Min. unit	Default	Attrib.	
		0: PID control inactive				
		1: Analog input + analog feedback				
E3.00	PID control mode	2: Analog digital setting + analog feedback	1 1	0		
		3: Analog input + pulse encoder feedback	.	·		
		4: Rotation speed digital setting + pulse encoder feedback		1		
E3.01	Analog digital setting	0.00 to 10.00 V	0.01 V	0.00 V	♦	
E3.02	Rotation speed digital setting	0 to 24,000 rpm	1 rpm	0 rpm	>	
	3 Analog feedback channel	0: +I direct action				
		1: +I inverse action				
		2: VR1 direct action				
E3.03		3: VR1 inverse action	1	0		
L3.03		4: VR2 direct action	'	U		
		5: VR2 inverse action				
		6: VR3 direct action				
		7: VR3 inverse action				
E3.04	P: Proportional gain	0.000 to 10.000	0.001	1.500	♦	
E3.05 Ti: Integral time 0.00 to 100.00s (0.00 re		0.00 to 100.00s (0.00 represents no integral)	0.01s	0.00s	♦	
E3.06	d: Derivative time 0.00 to 100.00s (0.00 represents no derivative)		0.01s	0.00s	♦	

Rexroth Frequency Converter Fv

Parameter Settings

Code	Name	Setting range	Min. unit	Default	Attrib.
E3.07	T: Sampling period	0.01 to 100.00s	0.01s	0.50s	♦
E3.08	Deviation limit	0.0 % to 20.0 % (of closed loop reference)	0.1 %	2.0 %	\$
E3.09	PID adjustment mode	0: Stop integral adjustment, when output frequency reaches upper/lower limit frequency	1	0	
		1: Continue integral adjustment, when output frequency reaches upper/lower limit frequency			
E3.10	PID output action	0: Direct action; 1: Inverse action	1	0	•
E3.11	PID feedforward	0: Deactivated; 1: Activated	1	0	+
E3.12 PID feedforward limit		0.00 to 5.00 Hz	0.01 Hz	1.00 Hz	•
E3.13	PID analog signal channel	0: +I; 1: VR1; 2: VR2; 3: VR3	1	1	•

Group E4: Protection and error parameters

Protection parameters

Code	Name	Setting range		Default	Attrib.
E4.00	Software over voltage protection threshold	790 to 820 V		810 V	•
E4.01	Stall over voltage function	0: Deactivated; 1: Activated	1	0	•
E4.02	Stall over voltage protection level	120.0 % to 150.0 % (of rated frequency converter peak voltage)	0.1%	130.0%	•
E4.03	Stall over current protection level	20.0 % to 200.0 % (of rated frequency converter output current)	0.1%	150.0%	•
E4.04	Motor over load protection	Inactive Heat protection active at low-speed Heat protection inactive at low-speed	1	1	\$
E4.05	Motor over load protection factor	50.0 % to 110.0 %	0.1 %	100.0 %	\$
E4.06	Type of temperature sensor for motor over heat protection	0: PTC temperature sensor 1: NTC temperature sensor	1	0	•
E4.07	Input channel options of motor over heat protection	0: Deactivated; 1: VR1; 2: VR2; 3: VR3	1	0	\$
E4.08	Motor over heat reference	0.0 to 10.0 V	0.1 V	2.0 V	•
E4.09	Phase loss protection	0: Both input and output phase loss protection active 1: Only input phase loss protection active 2: Only output phase loss protection active 3: Neither input or output loss protection active	1	0	*
E4.10	4.10 Reserved 0, 1		1	0	•

Error parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
E4.11	Number of error reset attempts	0 to 3 (0: Inactive for auto reset)	1	0	•
E4.12	Interval between reset attempts	2 to 60s	1s	10s	•
E4.13	Last error		1	0	0
E4.14	2 nd last error	0 to 24	1	0	0
E4.15	3 rd last error		1	0	0
		0: Inactive; 1: Delete error record			
E4.16	Delete error record	Note: The value is automatically set to 0 after the operation.	1	0	•

Setting range of parameters E4.13 to E4.15:

- 0: No error record
- 1: Over current at constant speed (O.C.-1)
- 2: Over current during acceleration (O.C.-2)
- 3: Over current during deceleration (O.C.-3)
- 4: Over voltage at constant speed (O.E.-1)
- 5: Over voltage during acceleration (O.E.-2)
- 6: Over voltage during deceleration (O.E.-3)
- 7: Frequency converter over load (O.L.-1)
- 8: Motor over load (O.L.-2); 9: CPU read/write error (R.E.)
- 10: Operating panel read/write error (KEY-)
- 11: External device error (E.-St)
- 12: Communication error (R.S.)
- 13: Circuit disconnection (C.F.)
- 14: Pulse encoder speed detection error (PULS)
- 15: Motor overheat (M.O.H.); 16: EMI error (CPU-)
- 17: Short circuit (S.C.) ;18: Reserved
- 19: L1, L2, L3 input phase loss (IPH.L)
- 20: U, V, W output phase loss (OPH.L)
- 21: Frequency converter overheat (C.O.H.)
- 22: Parameter setting error (PRSE)
- 23: Parameter auto-tuning error (TUNE)
- 24: Frequency converter over load pre-warning 2 (O.L.-3)

Group E5: Extended parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
E5.00	VR3 channel amplification factor k4	0.00 to 10.00	0.01	1.00	•
E5.01	Pulse input filtering time	0 to 9	1	0	•
E5.02	Reserved	0, 1	1	0	•
E5.03	Reserved	0, 1	1	0	•
E5.04	Relay Ta, Tb and Tc output	0 to 14	1	12	•
E5.05	FM1 output lower limit	0.0 % to [E5.07]	0.1 %	0.0 %	♦
E5.06	Output corresponding to [E5.05]	0.00 to 10.00 V	0.01 V	0.00 V	♦
E5.07	FM1 output upper limit	[E5.05] to 100.0 %	0.1 %	100.0 %	*
E5.08	Output corresponding to [E5.07]	0.00 to 10.00 V	0.01 V	10.00 V	♦
E5.09	FM2 output lower limit	0.0 % to [E5.11]	0.1 %	0.0 %	♦
E5.10	Output corresponding to [E5.09]	0.00 to 10.00 V	0.01 V	0.00 V	♦
E5.11	FM2 output upper limit	[E5.09] to 100.0 %	0.1 %	100.0 %	♦
E5.12	Output corresponding to [E5.11]	0.00 to 10.00 V	0.01 V	10.00 V	♦
E5.13	Delay time for frequency converter overload pre-warning 1	0.0 to 20.0s	0.1s	2.0s	•
E5.14	Reserved	0, 1	1	0	•
E5.15	Reserved	0, 1	1	0	•

Setting range of parameter E5.04:

- 0: Frequency converter is ready to run
- 1: Frequency converter is running
- 2: DC brake active
- 3: Frequency converter runs at zero speed
- 4: Frequency / speed arrival signal
- 5: Frequency level detection signal FDT1
- 6: Frequency level detection signal FDT2
- 7: Logic control phase completed
- 8: Under voltage stop
- 9: Frequency converter overload pre-warning 1
- 10: Motor overload pre-warning
- 11: Over torque
- 12: Frequency converter in error
- 13: Error auto reset signal output
- 14: Frequency converter overload pre-warning 2

Category H: Advanced Parameters 7.3.4

Group H0: Communication parameters

Code	Name	Setting range	Min. unit	Default	Attrib.
H0.00	Communication protocol	0: ModBus; 1: PROFIBUS	1	0	•
H0.01	Baud rate	0: 1200 bps; 1: 2400 bps; 2: 4800 bps 3: 9600 bps; 4: 19200 bps; 5: 38400 bps	1	3	•
H0.02	Data format	0: N, 8, 2 (1 start bit, 8 data bits, 2 stop bits, without check) 1: E, 8, 1 (1 start bit, 8 data bits, 1 stop bit, even check) 2: O, 8, 1 (1 start bit, 8 data bits, 1 stop bit, odd check)	1	0	•
H0.03	Local address	ModBus: 0 to 247 (0 represents broadcast address) PROFIBUS: 0 to 126 (0 means deactivated)	1	0	•
H0.04	PZD4, PZD3 setting	0 to 255	1	0	•
H0.05	PZD6, PZD5 setting	0 to 255	1	0	•
H0.06	PZD8, PZD7 setting	0 to 255	1	0	•
H0.07	PZD10, PZD9 setting	0 to 255	1	0	+
H0.08	Communication disconnection detection time	0.0 to 60.0s (0.0: deactivated)	0.1s	10.0s	•
H0.09	Communication disconnection action	0: Stop; 1: Keep running	1	0	•
H0.10	Reserved	0 to 65535	1	0	•

7.4 Notes on Function Groups

7.4.1 Category b: Basic Parameters

Group b0: System parameters

b0.00	User password		Factory default	0
50.00	Setting range	0 to 65535	Minimum unit	1

User password protects frequency converter parameters from being modified by unauthorized people.

- Set password: Set a number between 1 to 65535 to activate the user password function.
- Delete password: Enter the correct user password and set [b0.00] = 0 to deactivate the password.
- Modify password: Enter the correct user password and set a new number between 1 to 65535 to modify the user password.



- 1. After a user password has been set, users may only read but not modify nor copy parameters if an incorrect password is entered.
- Please contact the manufacturer if you forget the set password

b0.01	LCD language		Factory default	0
50.01	Setting range	0 to 1	Minimum unit	1

LCD / Menu language is available in

- 0: Chinese
- 1: English

b0.02	Restore f	actory default	Factory default	0
50.02	Setting range	0 to 1	Minimum unit	1

- 0: No action
- 1: Restore factory default



- 1. All parameters (except S2.00 to S2.09 and E4.13 to E4.15) will be restored to factory defaults.
- 2. b0.02 is automatically set to 0 after the parameters have been set to factory defaults.

b0.03	Paran	neter copy	Factory default	0
50.03	Setting range	0 to 2	Minimum unit	1

- 0: No action
- 1: Copy parameters from frequency converter to operating panel
 Parameter settings of the frequency converter (except E4.13 to E4.15)
 will be uploaded to the operating panel.
- 2: Copy parameters from operating panel to frequency converter
 Parameter settings of the frequency converter (except E4.13 to E4.15) will be downloaded to the frequency converter.

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- 1. b0.03 is automatically set to 0 after parameters have been copied.
- 2. Any other operations are invalid in parameter copy process.

b0.04	Main	s voltage	Factory default	380 V
50.04	Setting range	380 to 480 V	Minimum unit	1 V

b0.05	PWM frequency		Factory default	Depends on model
	Setting range	1.0 to 15.0 kHz	Minimum unit	0.1 kHz

- Used to set the PWM frequency. (The setting of this parameter may also avoid resonance point of mechanical constructions.)
 - A higher PWM frequency may
 - to motor: reduce the noise, power loss and temperature.
 - to frequency converter: increase power loss and temperature.
 - A lower PWM frequency may
 - reduce line to ground current leakage, the interference caused by the frequency converter.
 - increase the higher harmonic component of output current, motor power loss and temperature.
- The factory default values and effective adjustable ranges of Fv PWM frequency are shown in the table below.

Model	Default value of	Effective adjustable range
Model	PWM frequency [kHz]	of PWM frequency [kHz]
0K40 to 7K50	8.0	1.0 to 15.0
11K0 to 22K0	6.0	1.0 to 12.0
30K0 to 37K0	3.0	1.0 to 8.0
45K0 to 90K0	2.0	1.0 to 4.0

Tab.7-2: Factory default values and effective adjustable ranges of Fv PWM frequency



For the temperature, voltage and current derating figures related to PWM frequency, see chapter 9.3 "Derating of Electrical Data" on page 157.

b0.06	1	stment of PWM fre- uency	Factory default	1
	Setting range	0: OFF; 1: On	Minimum unit	1

The frequency converter can automatically adjust the PWM frequency based on its own temperature.

	LCD ba	cklight mode	Factory default	0	
	b0.07	Setting range	0: Energy saving 1: Always on	Minimum unit	1

• 0: Energy saving

The LCD backlight will be inactive automatically if no key has been pressed for 80 seconds. If the LCD backlight is inactive, the first key press will activate the backlight, press again to execute the command.

1: Always on

The LCD backlight will be always active.

B

It is recommended to set the LCD backlight mode to "1: Always on" when [b1.02] = 1 or 2.

b0.08	LCD display in run mode		Factory default	0
	Setting range	0 to 17	Minimum unit	1
b0.09	LCD displa	y in stop mode	Factory default	2
	Setting range	0 to 17	Minimum unit	1

- 0: Output frequency
- 1: Output rotation speed
- 2: Set frequency
- 3: Set rotation speed
- 4: Output voltage
- 5: Output current
- 6: Output power
- 7: DC bus voltage
- 8: Torque current
- 9: Excitation current
- 10: User-defined reference value
- 11: User-defined output value
- 12: Reference torque
- 13: Digital inputs status
- 14: Encoder speed feedback
- 15: Torque limit setting
- 16: Speed limit setting
- 17: Multi-monitoring display

When [b0.08] or [b0.09] = 13, "Digital inputs status" is displayed as a decimal value which represents OPEN or CLOSED of 10 digital inputs X1 to X8, FWD and REV. The value of "Digital inputs status" is 0 to 3377.

For example, if "1234" is displayed to indicate the "Digital inputs status", the respective status of each digital input is shown as the table below.

	Displayed value					123	4				
	l. :4	4 th nu	ımber	3 rd nun	nber		2 nd number		1 st number		
	bit (x 1		00 +)	(x 100) +)		(x 10 +)			(x 1)	
		()	0			0			0	
lal		,	1	1			1			1	
Decimal		2	2	2			2			2	
		;	3	3			3			3	
	bit value				4 4		4				
							5			5	
							6			6	
							7			7	
		0	0	0	0	0	0	0	0	0	0
		0	1	0	1	0	0	1	0	0	1
		1	0	1	0	0	1	0	0	1	0
ary	1.4	1	1	1	1	0	1	1	0	1	1
Binary	bit value					1	0	0	1	0	0
						1	0	1	1	0	1
						1	1	0	1	1	0
						1	1	1	1	1	1
	Digital input	REV	FWD	X8	X7	X6	X5	X4	Х3	X2	X1
	Status	OPEN	CLOSED	CLOSED	OPEN	OPEN	CLOSED	CLOSED	CLOSED	OPEN	OPEN

Tab.7-3: Explanation to displayed value of digital inputs status

When [b0.08] or [b0.09] = 17, the monitoring values displayed in the LCD panel from top to bottom are: output frequency, output current, DC bus voltage, output voltage, output rotation speed and output power.

There are totally 18 status parameters, all of which can be displayed by switching ► in either running or stopping mode.

b0.10	Scale factor of	user-defined value	Factory default	100.0 %
	Setting range	0.1 % to 1,000.0 %	Minimum unit	0.1 %

- Valid only for 'LCD display value in run mode' [b0.08] or 'LCD display value in stop mode' [b0.09] = 10 or 11.
- 'LCD display value in run mode' [b0.08] or 'LCD display value in stop mode' [b0.09] equals to 'User-defined value' multiplied by 'Scale factor of user-defined value' [b0.10].

b0.11	Paramete	er filter setting	Factory default	0
50.11	Setting range	0 to 3	Minimum unit	1

Only parameters of the selected groups are visible.

Rexroth Frequency Converter Fv

Parameter Settings

b0.11	Parameter groups to be read and set
0	b
1	b, S
2	b, S, E
3	b, S, E, H

Tab.7-4: Parameter filter range

	b0.12	Heat sink	temperature	Factory default	Measured value
	Setting range	25 to 100 °C	Minimum unit	1 °C	

- Displays the IGBT and heat sink temperature (in °C).
 - '---' is displayed when the temperature is lower than 25 °C.
 - Overheat protection is activated at 85 °C.

b0.13	Total ru	unning time	Factory default	0 hour
	Setting range	0 to 65535 hours	Minimum unit	1 hour

Displays the total running time of the frequency converter.

B

b0.13 will not be reset with 'Restore factory default' b0.02.

b0.14	Firmware version		Factory default	-
	Setting range Read-only		Minimum unit	-
b0.15	Re	served	Factory default	0
	Setting range	0, 1	Minimum unit	1

Group b1: Basic parameters

		Frequency setting mode		0
		0: Set by operating panel potentiometer		
		1: Set by operating panel		
b1.00	Setting	2: Set by analog inputs	Minimum unit	1
	range	3: Set by pulse frequency	William unit	'
		4: Set by digital inputs Up/Down		
		5: Set by communication		

- 0: Set by operating panel potentiometer
 Set the frequency by adjusting the operating panel's potentiometer.
- 1: Set by operating panel
 - Use the value of parameter b1.04 as the set frequency.
 - Use ▲ and ▼ keys to change the output frequency value when the frequency converter is in run mode.

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In run mode

In the case of power fault or undervoltage, if 'Digital set frequency saving' [b1.01] = 2 or 3, the current running frequency will be saved in parameter b1.04.

In stop mode

If 'Digital set frequency saving' [b1.01] = 1 or 3, the current running frequency will be saved in parameter b1.04.

2: Set by analog inputs

Set the frequency by external analog signals using the independent channels VR1, VR2, VR3 and +I.



1. VR1 for 0 to 10 V or -10 to +10 V

Unipolar analog signal

Input of negative level signals will be processed as absolute values without motor direction information.

Bipolar analog signal Input of bipolar level signals will be processed as values with motor direction information.

- 2. VR2 / VR3 for 0 to 10 V
- 3. +I is for 0 to 20 mA (with channel input resistance of 165 Ω).
- 4. For details of analog inputs settings, see parameters E0.09 to E0.24.

3: Set by pulse frequency

Set output frequency by external pulse frequency signals using digital input X8 (signal range is 9 to 30 V, maximum pulse frequency of 50 kHz).



Please also set 'Maximum input pulse frequency' E0.15. 'Digital input X8' E0.08 is automatically set to 0 (invalid).

4: Set by digital inputs Up/Down

Set output frequency by digital inputs

Step 1

Define any 3 digital inputs in parameters E0.01 to E0.08

- set one input to 9: Frequency incremental Up command
- set one input to 10: Frequency decrement Down command
- set one input to 11: Set frequency to 0
- Step 2

Set 'Frequency changing rate' S3.11 for the frequency change rate of the digital inputs Up/Down.

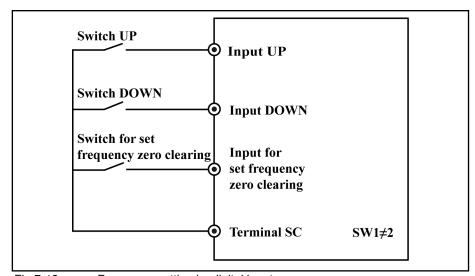


Fig.7-12: Frequency setting by digital inputs

Input for set frequency zero clearing		Open			Closed
Input Up	Open		Closed		Open/
Input Down	Open	Closed	Open	Closed	Closed
Output frequency reaction	Hold	Decrease	Increase	Hold	Zero

Tab.7-5: Relationship between terminal status and frequency converter set frequency



- Digital inputs **Up**, **Down** and **the input for set frequency zero clearing** are only active in run mode.
- At power on, b1.04 is used as start-up frequency.
- In run mode

In the case of power fault or undervoltage, if 'Digital set frequency saving' [b1.01] = 2 or 3, the current running frequency will be saved in parameter b1.04.

In stop mode
 If 'Digital set frequency saving' [b1.01] = 1 or 3, the current running frequency will be saved in parameter b1.04.

5: Set by communication

Set output frequency by communication with the external computer or internal logic control (see parameters in Group H).

b1.01	Saving option	ons of digital set frequency	Factory default	0
51.01	Setting range	0 to 3	Minimum unit	1

- 0: Not saved in b1.04 when powered off or stopped
- 1: Not saved in b1.04 when powered off; saved when stopped
- 2: Saved in b1.04 when powered off; not saved when stopped
- 3: Saved in b1.04 when powered off or stopped

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b1.02	Frequency converter control commands		Factory default	0
01.02	Setting range	0, 1, 2	Minimum unit	1

Used to set input modes of frequency converter control commands. Control commands include run, stop, forward, reverse, Jog, etc.

0: Set control commands by operating panel

Use operating panel keys (Run, Stop and Jog, etc.) to control run, stop, etc.

1: Set control commands by digital inputs

Use digital inputs FWD, REV, etc. to control run, stop, forward or reverse, etc. See parameters in group E0.

2: Set control commands by communication

Use communication to control run, stop, forward or reverse, etc. See the instructions for communication in chapter 12 "Communication Protocols" on page 201.



If [b1.02] = 1 or 2, the **Stop** key on the operating panel can be enabled with S3.15.

b1.03		Control mode	Factory default	0
D1.03	Setting range	0, 1, 2	Minimum unit	1

0: V/F control (V/F)

This mode is applicable to most applications. Select this mode if it is impossible to conduct auto-tuning or obtain accurate motor parameters.

- V/F control without pulse encoder: is used to drive multiple motors with one frequency converter.
- V/F control with pulse encoder: is used when high accuracy of speed control is required. See parameters S2.12 to S2.15 for related settings.



In V/F control mode, set control parameters in group S0.

1: Sensorless vector control (SVC)

For high performance applications where no pulse encoder is necessary, while high torque at low-frequency and high accuracy of speed control are required.

- 2: Field oriented vector control (FOC)
 - For high accuracy applications with speed and torque control.
 - A pulse encoder is necessary. See parameters S2.12 to S2.15 for related settings.



- Accurate motor parameters are required for vector control. Motor parameters can be obtained by auto-tuning function, see parameters S2.00 to S2.10 for related settings. If autotuning is impossible and the accurate motor parameters are known, first set parameters S2.00 to S2.04 with values found on the motor nameplate, and then set parameters S2.05 to S2.09.
- 2. In vector control mode, please set the parameters of rotation speed controller to obtain good static and dynamic control. See parameters S1.00 and S1.01 for related information.
- 3. In vector control mode, one frequency converter can only drive one motor.
- 4. In V/F control mode, see parameters in group S for related settings.

b1.04	Digital set frequency		Factory default	50.00 Hz
51.04	Setting range	b1.07 to b1.06	Minimum unit	0.01 Hz



If "Frequency setting mode" [b1.00] = 1, value of b1.04 is the set frequency.

b1.05	Maximu	m frequency	Factory default	50.00 Hz
	Setting range	50.00 to 400.00 Hz	Minimum unit	0.01 Hz
b1.06	Upper frequency		Factory default	50.00 Hz
	Setting range	[b1.07] to [b1.05]	Minimum unit	0.01 Hz
h1 07	Lower	frequency	Factory default	0.00 Hz
b1.07	Setting range	0.00 Hz to [b1.06]	Minimum unit	0.01 Hz

- b1.05 is the maximum allowed output frequency of the frequency converter.
- The "Upper frequency" b1.06 and "Lower frequency" b1.07 represent the maximum and minimum allowed output frequency set according to the requirements in applications.

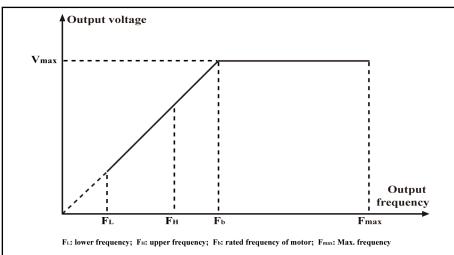


Fig.7-13: Maximum frequency_upper frequency_lower frequency

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b1.08	Operating panel controlled direction		Factory default	0
D1.00	Setting range	0, 1	Minimum unit	1

This parameter is used to change the rotation direction of motor when running commands are set by the operating panel ([b1.02] = 0).

- 0: Forward rotation
- 1: Reverse rotation

b1.09	Acceleration time 1		Factory default	10.0s
51.09	Setting range 0.1 to 3,600.0s		Minimum unit	0.1s
b1.10	Deceleration time 1		Factory default	10.0s
51.10	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s

- The acceleration time is the duration, in which the frequency converter changes the output frequency from 0 Hz to 'Maximum frequency' [b1.05]. Shown as T1 in figure below.
- The deceleration time is the duration, in which the frequency converter changes the output frequency from 'Maximum frequency' [b1.05] to 0 Hz. Shown as T2 in figure below.

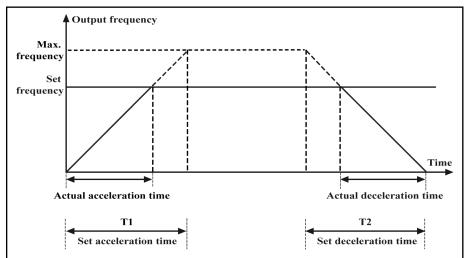


Fig.7-14: Acceleration time 1 & Deceleration time 1

 4 groups of acceleration/deceleration time are available, which can be selected via digital inputs. See parameters E0.01 to E0.08 and E2.00 to E2.05.

b1.11	Acceleration/deceleration mode		Factory default	0
D1.11	Setting range	0, 1	Minimum unit	1

This parameter sets the acceleration/deceleration mode of the frequency converter to linear or S-Curve in start, stop, forward or reverse, acceleration or deceleration processes.

• 0: Linear mode

The output frequency is increased or decreased linearly as shown in figure below.

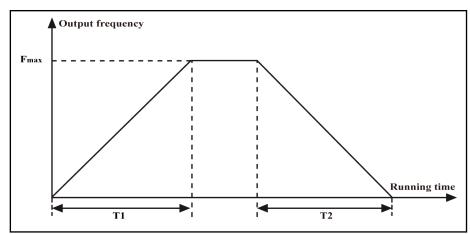


Fig.7-15: Linear acceleration/deceleration mode

1: S-curve mode

The output frequency is increased or decreased in an S-curve as shown in figure below.

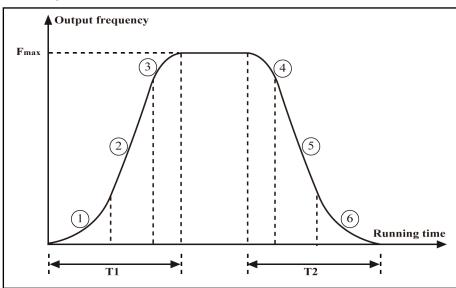


Fig.7-16: S-curve acceleration/deceleration mode

The S-curve mode is used to achieve smooth start or stop.

b1.12	Time o	Time of S-curve rising section 1		20.0 %
	Setting range	0.0 % to 40.0 %	Minimum unit	0.1 %
	Setting range	(of 'Acceleration time 1' [b1.09])	William and	0.1 /6
	Time of S-curve rising section 3		Factory default	20.0 %
b1.13	Setting range	0.0 % to 40.0 %	Minimum unit	0.1 %
	Setting range	(of 'Acceleration time 1' [b1.09])	William and	0.1 /6
	Time o	of S-curve falling section 4	Factory default	20.0 %
b1.14	Setting range	0.0 % to 40.0 %	Minimum unit	0.1 %
	Setting range	(of 'Deceleration time 1' [b1.10])	William Will	0.1 /6

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	Time of S-curve falling section 6		Factory default	20.0 %
b1.15	0.0 % to 40.0 %	Minimum unit	0.1 %	
	Setting range	(of 'Deceleration time 1' [b1.10])	wiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	0.1 %

Parameters b1.12 to b1.15 are used to define the acceleration and deceleration settings of the S-curve.

b1.16	Start mode		Factory default	0
		0: Start mode 1		
51.10	Setting range	1: Start mode 2	Minimum unit	1
		2: Rotation speed capture mode		
b1.17	Start frequency		Factory default	0.50 Hz
01.17	Setting range	0.00 to 15.00 Hz	Minimum unit	0.01 Hz
b1.18	Sta	art frequency hold time	Factory default	0.0s
D1.10	Setting range	0.0 to 10.0s	Minimum unit	0.1s

Following start modes are available for different applications.

0: Start mode 1

- The frequency converter runs at 'Start frequency' [b1.17], for 'Start frequency hold time' [b1.18], accelerates for 'Acceleration time 1' [b1.09] to set frequency.
- This mode is suitable for circumstances with high static friction torque and low load inertia.

• 1: Start mode 2

- If 'Startup DC brake time' [b1.20] ≠ 0, DC brake is executed before accelerating to 'Start frequency' [b1.17]. If 'Startup DC brake time' [b1.20] = 0, the frequency converter accelerates without braking to 'Start frequency' [b1.17].
- This mode is suitable for circumstances where the load may encounter forward/reverse rotation when the frequency converter is in stop mode.

• 2: Rotation speed capture mode

- The frequency converter detects the rotation speed and direction of the motor and then starts with the current frequency of the motor.
- This mode is suitable for restarting after instantaneous power fault in the case of a large inertia or freewheeling load, in which the motor can be restarted without impact.

B

At startup, if the set frequency is lower than the 'Start frequency' [b1.17], the frequency converter first accelerates to 'Start frequency' [b1.17], after 'Start frequency hold time' [b1.18], the frequency converter decelerates to the set frequency.

		Stop mode	Factory default	0
b1.19		0: Decelerate to stop	Minimum unit	4
	Setting range	1: Freewheel to stop	William and	Į.

• 0: Decelerate to stop

The frequency converter decelerates to stop according the deceleration time.



- In case of too fast deceleration an error may happen, extend the deceleration time or calculate if additional brake units / resistors are required.
- 2. If the output frequency is lower than 'Shutdown DC brake activation frequency' [b1.21], the set 'DC brake current' [b1.23] is applied, for 'Shutdown DC brake time' [b1.22]. This mode is suitable for circumstances where regular or quick deceleration stop is required (with brake resistors or brake units).

1: Freewheel to stop

Once the stop command is activated, the frequency converter shuts down output, and the motor freewheels mechanically to stop.

b1.20	Startup DC brake time		Factory default	0.0s
01.20	Setting range	0.0 to 20.0s	Minimum unit	0.1s

- If 'Start mode' [b1.16] is '1: Start mode 2', apply 'DC brake current' [b1.23] for 'Startup DC brake time' [b1.20].
- If 'Startup DC brake time' [b1.20] is 0.0s, the frequency converter starts directly without DC brake. The larger the DC brake current, the larger the braking force is. The setting needs take the withstanding capability of the motor into account.

b1.21	Shutdown DC	brake activation frequency	Factory default	0.00 Hz
01.21	Setting range	0.00 to 10.00 Hz	Minimum unit	0.01 Hz

	b1.22	Shutdown DC brake time		Factory default	0.0s
		Setting range	0.0 to 20.0s	Minimum unit	0.1s

Used to set the time for applying the DC brake current during the stop process. If parameter b1.22 is set to 0.0s, no DC brake is done, and the frequency converter stops according to '0: Decelerate to stop' of 'Stop mode' [b1.19]. When digital input Xi = 13, parameter b1.22 is deactivated.

		DC brake current		Factory default	0.0 %
b1.2	3	Setting range	0.0 % to 150.0 % (of 'Rated frequency converter current')	Minimum unit	0.1 %

 When the frequency converter starts in the DC brake mode or shutdown DC brake is active, b1.23 is used to control the braking current and is set in a percentage of the rated frequency converter current.

7.4.2 Category S: Standard Parameters

Group S0: V/F control

Parameters of group S0 are only valid when 'Control mode' [b1.03] is '0: V/F control'.

	V/F mode		Factory default	0
S0.00		0: Linear mode		
00.00	Setting range	1: Square mode	Minimum unit	1
		2: User-defined multipoint mode		

• 0: Linear mode

Suitable for constant torque load (shown as curve 0 in figure below)

1: Square mode

Suitable for variable torque loads (shown as curve 1 in figure below)

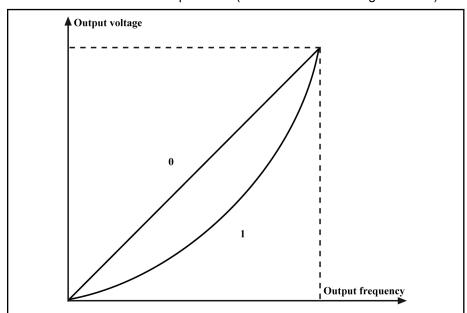


Fig.7-17: Linear and square V/F curves

• 2: User-defined multipoint mode

Used to set a user defined V/F curve with parameters S0.01 to S0.06. Suitable for special applications (shown in figure below).

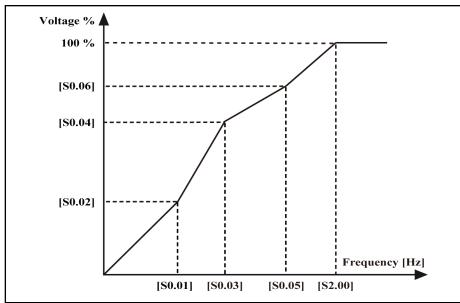


Fig.7-18: User defined V/F curve

	V/F frequency 1		Factory default	0.00 Hz
S0.01	Setting range	0.00 Hz to [S0.03]	Minimum unit	0.01 Hz
		V/F voltage 1	Factory default	0.0 %
S0.02	Setting	0.0 % to 120.0 %	Minimum unit	0.1 %
	range	(of 'Rated motor voltage' [S2.03])	William and	U. I %
		V/F frequency 2	Factory default	0.00 Hz
S0.03	Setting	[S0.01] to [S0.05]	Minimum unit	0.01 Hz
	range	[50.01] to [50.00]	wiii iii iii ii ii ii ii ii ii ii ii ii	0.01112
	V/F voltage 2		Factory default	0.0 %
S0.04	Setting	0.00 % to 120.0 %	Minimum unit	0.1 %
	range	(of 'Rated motor voltage' [S2.03])	William dint	0.1 /6
		V/F frequency 3	Factory default	0.00 Hz
S0.05	Setting	[S0.03] to [b1.05]	Minimum unit	0.01 Hz
	range	[30.03] to [01.03]	William and	0.01112
S0.06		V/F voltage 3	Factory default	0.0 %
	Setting	0.00 % to 120.0 %	Minimum unit	0.1 %
	range	(of 'Rated motor voltage' [S2.03])	IVIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	0.1 /0

▲ CAUTION

Excessive low-frequency voltages may cause the motor to overheat or result in motor damage. The frequency converter may stall due to over current or may activate over current protection!

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00.07		Slip compensation	Factory default	0.00 Hz
S0.07	Setting	0.00 to 10.00 Hz	Minimum unit	0.01 Hz
	range			1 12

- Compensates the speed difference of the motor and the output of the frequency converter caused by the load in case of V/F control so that the rotor speed gets closer to that of the synchronous speed at its rated load
- Improves the mechanical behavior of the motor. Should be set according to the rated motor slip frequency shown on motor plate.

		Torque increase	Factory default	0.1 %
S0.08	Setting range	0.0 % to 20.0 % (of rated frequency converter voltage): • 0.0 %: Automatic increase • 0.1 % to 20.0 %: Manual in-	Minimum unit	0.1 %
		crease		

• 0.0 %: Automatic increase

Determines automatically the percentage of output voltage increase based on output frequency and load current.

The linear and square V/F curve automatic torque increase are shown in figures below.

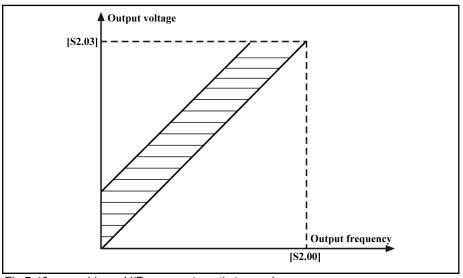


Fig.7-19: Linear V/F curve automatic torque increase

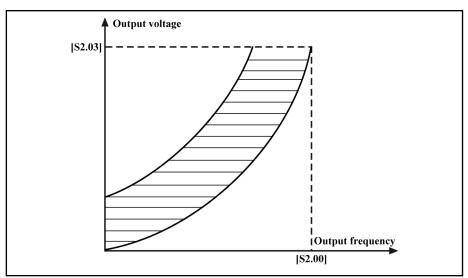


Fig.7-20: Square V/F curve automatic torque increase

• 0.1 % to 20.0 %: Manual increase

Used to increase the frequency converter's output voltage and compensate the stator voltage decrease, to generate sufficient torque and improve the low-frequency torque characteristics of V/F control.

Large increase may cause high current leading to motor over heat and may result in motor damage or frequency converter protection.

Linear and square V/F curve manual torque increase are shown in figures below.

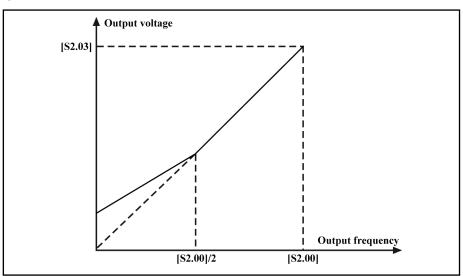


Fig.7-21: Linear V/F curve manual torque increase

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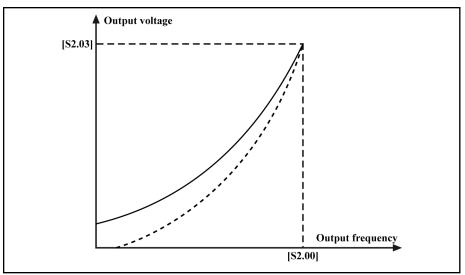


Fig. 7-22: Square V/F curve manual torque increase

		Automatic voltage stabilization	Factory default	0
S0.09	Setting	0: Not active		
		1: Always active	Minimum unit	1
	range	2: Not active during deceleration and braking		

Used to keep the output voltage constant within the output capability when the supply voltage is different than the rated voltage of the frequency converter.

- 0: Not active
- 1: Always active

Select this option if brake resistor is in place or no quick deceleration is necessary.

2: Not active during deceleration and braking

Select this option if quick deceleration is necessary and no brake resistor is in place, which can reduce significantly the possibility of over voltage warnings.

S0.10	Oscilla	tion constraint gain	Factory default	0.3
30.10	Setting range	0.0 to 3.0	Minimum unit	0.1

When the motor reaches the mechanical resonance point, the frequency converter output current has surge. In this situation, increase the value of this parameter steadily can constrain current surge effectively till the elimination of the motor oscillation.

Group S1: Vector control

Speed Speed		dback proportional gain	Factory default	1.000
31.00	Setting range	0.000 to 10.000	Minimum unit	0.001
	Speed feedback integral time		Factory default	1.000s
S1.01	Setting range	0.000 to 10.000s (0.000 means inactive)	Minimum unit	0.001s

Used to adjust the speed dynamic response characteristics of vector control.

- Larger proportional gain leads to faster response.
- Too large proportional gain may cause oscillation.
- Smaller proportional gain leads to slower response.
- Larger integral time leads to slower dynamic response of the system and the control on external disturbance is weakened.
- Smaller integral time leads to faster dynamic response of the system.
- Excessively small integral time may cause oscillation.

If the factory defaults can not meet the application requirements, the parameters can be adjusted in the following manner:

- The proportional gain should be increased without causing oscillation.
- The integral time should be decreased to allow the system to have quick response and smaller overshoot.

Improper settings may lead to excessive speed overshoot or overvoltage errors during fall back from the overshoot.

S1.02		Torque limit	Factory default	150.0 %
31.02	Setting range	0.0 % to 200.0 %	Minimum unit	0.1 %

Used to limit the maximum torque current of the frequency converter during startup or braking. The limit value is a percentage of rated motor current.

If a large brake torque is required, apply the torque limit function together with dynamic brake.

Q1	.03	Slip co	ompensation gain	Factory default	100.0 %
31	.03	Setting range	50.0 % to 250.0 %	Minimum unit	0.1 %

Used to maintain constant motor speeds with load changes. When the load increases, the motor slip increases, and the rotation speed decreases.

Increase this value when the motor is heavily loaded and has a low speed, and vice versa.

	Torqu	e control selection	Factory default	0
S1.04	Setting range	0: Digital inputs control	Minimum unit	1
	Jetting range	1: Always active	William drift	'

0: Digital inputs control

The multi-function digital inputs can be used to switch between torque control and speed control (see parameters in group E0).

- Speed control
 - Speed commands are used to control motor actions and the speed controller is active.
 - Output frequency changes according to set frequency and the output torque changes with the load torque.
 - The output torque is limited by 'Torque limit' [S1.02]. If the load torque is larger than 'Torque limit' [S1.02], the output frequency will be different from set frequency because of torque limitation.

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Torque control

- Speed controller is inactive and the output torque changes according to the torque set by "Torque control reference" [S1.05].
- Output frequency changes with the load speed.
- The output frequency is limited by 'Upper frequency' [b1.06].
 If the load speed is larger than 'Upper frequency' [b1.06], the output torque will be different from the set torque because of speed limitation.

1: Always active

Torque control is always active.

Torque control is only active when 'Control mode' [b1.03] is '2: Field oriented vector control (FOC)'.

	Torque	e control reference	Factory default	0
04.05		0: Input +I		
S1.05 Setting range	1: Input VR1	Minimum unit	1 1	
		2: Digital setting		-
		3: Set via communication		

Used to select the source of reference torque in torque control mode.

• 0: Input +I

- The reference torque is set with the analog terminal +I.
- The maximum value of +I input current corresponds to 200 % of the rated torque.
- +I can only generate positive torque.

• 1: Input VR1

- The reference torque is set with the analog terminal VR1.
- The maximum value of VR1 input voltage corresponds to 200 % of the rated torque.
- VR1 can set positive and negative torque. In this case, the torque direction is determined by the polarity of the input voltage regardless settings of 'Operating panel controlled direction' b1.08 and 'Motor standard rotation direction' S3.14.
- When [b1.03] = 2 , [S1.05] = 1, if setting [E0.01] to [E0.08] = 28 and the torque control is activated, the frequency converter will show the error "PRSE".

2: Digital setting

The torque command is set by parameter S1.06.

• 3: Set by communication

The torque command is set by communication. The settings of 0 to 2,000 correspond to 0.0 % to 200.0 % of rated torque. See chapter 12 "Communication Protocols" on page 201.

S1.06	Torq	ue digital setting	Factory default	100.0 %
01.00	Setting range	0.0 % to 200.0 %	Minimum unit	0.1 %

When 'Torque control reference' S1.05 is set as 2 and the torque control function is activated, the value of S1.06 is the torque control command. The

Rexroth Frequency Converter Fv

Parameter Settings

value of this parameter is a percentage of the frequency converter rated torque.

Group S2: Motor and encoder parameters

S2.00	Rated motor frequency		Factory default	50.00 Hz
	Setting range	8.00 to 400.00 Hz	Minimum unit	0.01 Hz
S2.01	Rated moto	r rotation speed	Factory default	1,440 rpm
32.01	Setting range	1 to 24,000 rpm	Minimum unit	1 rpm
S2.02	Rated motor power		Factory default	Depends on model
	Setting range	0.4 to 1,000.0 kW	Minimum unit	0.1 kW
S2.03	Rated motor voltage		Factory default	Depends on model
	Setting range	0 to 900 V	Minimum unit	1 V
S2.04	Rated motor current		Factory default	Depends on model
-	Setting range	0.1 to 1,000.0 A	Minimum unit	0.1 A

Set parameters S2.00 to S2.04 according to the nameplate of the motor. The rated motor power should be the same or one class lower than the rated power of the frequency converter. Otherwise the performance could be affected.

S2.05	Stator resistance factor		Factory default	Depends on model
	Setting range	0.00 % to 50.00 %	Minimum unit	0.01 %
S2.06	Rotor resistance factor		Factory default	Depends on model
	Setting range	0.00 % to 50.00 %	Minimum unit	0.01 %
S2.07	Leakage inductance factor		Factory default	Depends on model
	Setting range	0.00 % to 50.00 %	Minimum unit	0.01 %
S2.08	Mutual inductance factor		Factory default	Depends on model
	Setting range	0.0 % to 2,000.0 %	Minimum unit	0.1 %
S2.09	No-load current		Factory default	Depends on model
	Setting range 0.0 to 1,000.0 A		Minimum unit	0.1 A
S2.10	Parameter auto-tuning		Factory default	0
JZ. 10	Setting range	0, 1, 2	Minimum unit	1

The motor parameters (S2.00 to S2.04) must be set according to the motor nameplate before using 'Parameter auto-tuning' [S2.10].

- [S2.10] = 0: No action
- [S2.10] = 1: Auto tuning with running motor

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'Auto tuning with running motor' can ensure the dynamic control performance of the frequency converter. Before using 'Auto tuning with running motor, any load must be removed from the motor. Parameters S2.05 to S2.09 will be updated during auto tuning.

[S2.10] = 2: Auto tuning with static motor Parameters S2.05 to S2.07 will be updated during auto tuning.



- 1. 'Parameter auto-tuning' [S2.10] is '1: Auto tuning with running motor' and over current or over voltage occurs, increase the parameters 'Acceleration time 1' [b1.09] and 'Deceleration time 1' [b1.10].
- 2. 'Parameter auto-tuning' [S2.10] is '2: Auto tuning with static motor', ensure the motor is stopped before starting auto-tuning; otherwise auto-tuning may end in abnormal results.
- 3. In applications where it is not possible to use auto-tuning, accurate motor parameter values must be entered to parameters S2.00 to S2.09. However, the motor's nameplate parameters must be entered first.

S2.11	Reserved		Factory default	0
52.11	Setting range	0, 1	Minimum unit	1
S2.12	Pulses per re	evolution of pulse encoder	Factory default	1,024
52.12	Setting range	1 to 20,000	Minimum unit	1
S2.13	Pulse encoder direction reverse		Factory default	0
32.13	Setting range	0, 1	Minimum unit	1
	Pulse encod	der error detection extent	Factory default	0.0 rpm
S2.14	Setting range	0.0 to 1,000.0 rpm (0.0: No break protection)	Minimum unit	0.1 rpm
S2.15	Pulse encoder error detection time		Factory default	1.0s
32.13	Setting range	0.1 to 10.0s	Minimum unit	0.1s

Set parameters S2.12 to S2.15 in the case of vector control with speed sensor or pulse encoder feedback V/F control.

- Parameter S2.12 is used to set the number of pulses per revolution of the pulse encoder.
- Parameter S2.13 is used to change the phase sequence, if the encoder phases are reversely connected.
- If the set frequency is larger than 'Pulse encoder error detection extent' [S2.14] and the actual speed is smaller than 'Pulse encoder error detection extent' [S2.14] and lasts for 'Pulse encoder error detection time' [S2.15], the frequency converter will apply error protection to the pulse encoder.

Group	S3:	Control	parameters
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S3.00	Jog frequency		Factory default	5.00 Hz
33.00	Setting range	0.00 Hz to [b1.05]	Minimum unit	0.01 Hz
S3.01	Jog acceleration time		Factory default	5.0s
	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
S3.02	Jog deceleration time		Factory default	5.0s
	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s

- Parameter S3.00 is used to set jog frequency.
- Parameters S3.01 and S3.02 are used to define the jog acceleration and deceleration time, as shown in figure below.

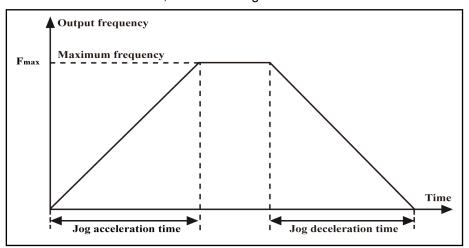


Fig.7-23: Jog frequency setting

The frequency converter allows jog when power is on. Jog can be set by operating panel or external computer.



Jog is deactivated in torque control mode.

S3.03	Skip frequency 1		Factory default	0.00 Hz
33.03	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
S3.04	Skip frequency 2		Factory default	0.00 Hz
33.04	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
S3.05	Skip frequency 3		Factory default	0.00 Hz
33.03	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
S3.06	Skip fred	luency range	Factory default	0.00 Hz
33.00	Setting range	0.00 to 30.00 Hz	Minimum unit	0.01 Hz

- Three skip frequencies may be set to avoid mechanical resonance points
 - If the output frequency falls within the skip frequency range, the output frequency will be automatically set to the upper or lower limit of the skip frequency range.
 - If no skip frequency is used, the skip frequency range needs to be set as 0.00 Hz.

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This function is inactive during acceleration/deceleration (only available

 Do not make the three skip frequency ranges overlap or nest in each other.

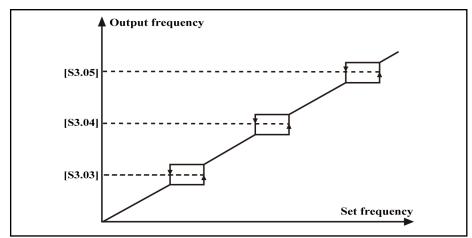


Fig.7-24: Skip frequencies and ranges

for steady state output).

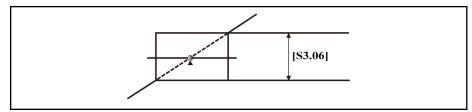


Fig.7-25: Frequency output forbidden point

S3.07	Restart after power off or power fault		Factory default	0
33.07	Setting range	0, 1	Minimum unit	1
S3.08	Waiting time to restart after power off or power fault		Factory default	1.0s
	Setting range	0.1 to 10.0s	Minimum unit	0.1s

This function allows automatic running of the frequency converter if power on after power off or power fault.

- 0: Deactivated: No restart after power off or power fault.
- 1: Activated: Restart after power off or power fault.
 - For a running frequency converter, when 'Frequency converter control commands' b1.02 is '0: Set control commands by operating panel' and no stop signal input:
 - If parameter [S3.07] = 1, the frequency converter will automatically start after waiting for the time of [S3.08].
 - If parameter [S3.07] = 0, the frequency converter only starts after the Run key is pressed down.
 - For a running frequency converter, when 'frequency converter control commands' [b1.02] is '1: Set control commands by digital inputs' or '2: Set control commands by communication' and there is running command input:
 - If parameter [S3.07] = 1, the frequency converter will automatically start after waiting for the time of [S3.08].

Rexroth Frequency Converter Fv

Parameter Settings

- If parameter [S3.07] = 0, the frequency converter only starts after reissuing the running command.
- When 'frequency converter control commands' [b1.02] is '1: Set control commands by digital inputs', do not change the state of digital inputs during power off or power fault.

S3.09	Direction change dead time		Factory default	4.0s
00.00	Setting range	0.0 to 3,600.0s	Minimum unit	0.1s

Waiting time when the frequency converter switches from forward rotation to reverse rotation, and vice versa, while the rotation speed is zero.

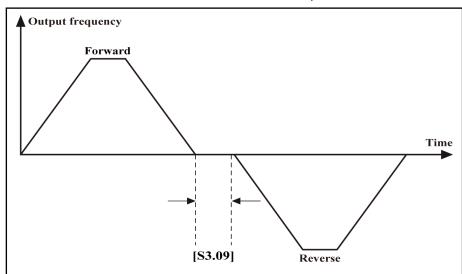


Fig.7-26: Direction change dead time

S3.10	Droc	Droop control		0.00 Hz
00.10	Setting range	0.00 to 10.00 Hz	Minimum unit	0.01 Hz

Used to change the decrease value of the output frequency.

This function is suitable for circumstances where multiple frequency converters are used to drive the same load and allows even distribution of the output power.

 When a frequency converter is subject a too heavy load, the frequency converter will automatically reduce its output frequency to reduce the load according to the parameter setting.

Change the value gradually in case of adjustment. The relationship between the load and output frequency is shown in figure below.

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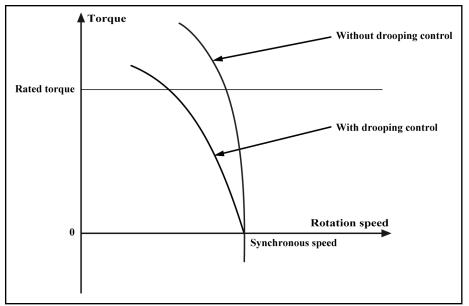


Fig.7-27: Droop control

S3.11	Setting velocity of Up/Down		Factory default	0.08 Hz/s
55.11	Setting range	0.01 to 100.00 Hz/s	Minimum unit	0.01 Hz/s

Used to set the frequency changing rate when the frequency is set with the digital inputs Up/Down or the ▲/▼ keys of the operating panel.

S3.12	Brake chopper threshold		Factory default	770 V
	Setting range	600 to 785 V	Minimum unit	1 V
S3.13	Braking duty cycle		Factory default	100 %
00.10	Setting range	0 % to 100 %	Minimum unit	1 %

- Only for models with internal choppers, resistance and power of brake resistors need to be considered.
- A suitable brake voltage set via 'Brake chopper threshold' [S3.12] executes a fast brake to stop.
- Braking duty cycle = (Brake on time / Brake cycle) × 100 %
- Parameters S3.12 and S3.13 are used together. The braking duty cycle needs to be set appropriately according to loads.

S3.14	Motor standard rotation direction		Factory default	0
33.14	Setting range	0, 1, 2	Minimum unit	1

Used to change the standard rotation direction of the motor, same function like adjusting any two wires (U, V and W) of the motor.

- 0: Standard motor direction
- 1: Reverse standard motor direction
- 2: Deactivate reverse motor rotation

S3.15	Stop	key validity	Factory default	1
00.10	Setting range	0, 1	Minimum unit	1

0: Valid only for operating panel control

Stop key is only valid when 'frequency converter control commands' b1.02 is set to '0: Set control commands by operating panel'.

• 1: Valid for all control means

Stop key is valid for all settings of 'frequency converter control commands' b1.02.



- **Stop** key as an error reset key is valid for all settings of 'frequency converter control commands' b1.02.
- If the frequency converter is controlled by external commands and stopped with the **Stop** key, the external commands have to be disabled and then re-enabled before restarting the frequency converter.

S3.16	Fan control		Factory default	0
33.10	Setting range	0, 1	Minimum unit	1

0: Temperature controlled

Automatically controls the start and stop of the cooling fan according to the detected temperature of the heat sink.

1: Always on

The fan is always active when the frequency converter is running.

Category E: Extended Parameters 7.4.3

Group E0: Analog and digital inputs

E0.00	2-wire / 3-wire control mode		Factory default	0
L0.00	Setting range	0, 1, 2	Minimum unit	1

0: Forward/Stop, Reverse/Stop

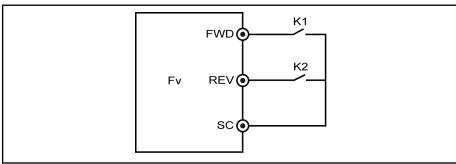
FWD	REV	Status
0	0	Stop
0	1	Reverse
1	0	Forward
1	1	Stop

Tab.7-6: 2-wire control mode 1

1: Forward/Reverse, Run/Stop

FWD	REV	Status
0	0	Stop
0	1	Stop
1	0	Forward
1	1	Reverse

Tab.7-7: 2-wire control mode 2



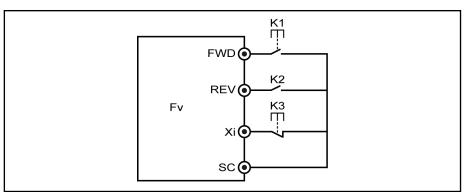
is N.O. switch, which is activated with pulse edges K1 K2 is for direction selection (0: forward; 1: reverse)

cannot be set as 1-2, 3-4

SW1 jumper position

Fig.7-28: 2-wire control mode

2: 3-wire control



is N.O. switch, which is activated with pulse edges is N.C. switch, which is activated with pulse edges is for direction selection (0: forward; 1: reverse) per cannot be set as 1-2, 3-4

SW1 jumper position

3-wire control mode

B

Fig.7-29:

K1

K3

K2

If one of the digital inputs Xi (I = 1 to 8) is set to 7, "3-wire control" is selected.

E0.01	Digita	ıl input X1	Factory default	0
L0.01	Setting range 0 to 29		Minimum unit	1
E0.02	Digita	l input X2	Factory default	0
€0.02	Setting range	0 to 29	Minimum unit	1
E0.03	Digita	l input X3	Factory default	0
E0.03	Setting range	0 to 29	Minimum unit	1
E0.04	Digita	l input X4	Factory default	0
€0.04	Setting range	0 to 29	Minimum unit	1
E0.05	Digital input X5		Factory default	0
E0.05	Setting range	0 to 29	Minimum unit	1
E0.06	Digital input X6		Factory default	0
E0.00	Setting range	0 to 29	Minimum unit	1
E0.07	Digita	l input X7	Factory default	0
⊑0.07	Setting range	0 to 29	Minimum unit	1
E0.08	Digita	I input X8	Factory default	0
E0.08	Setting range	0 to 29	Minimum unit	1

8 multifunction digital inputs (X8 can be used as a high-speed pulse input) are available with PNP and NPN input modes and with either internal or external power supply.

• 0: Inactive

The frequency converter is inactive even if there is input signal. Unused inputs are suggested to be set to 0 (inactive) to avoid malfunction, multiple selection is possible.

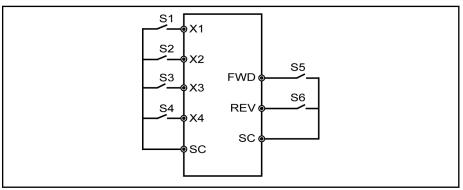
- 1: Multi-speed control 1
- 2: Multi-speed control 2

- 3: Multi-speed control 3
- 4: Multi-speed control 4



16 multi-speeds are available with the combinations of the four inputs.

For example, if digital inputs X1, X2, X3 and X4 are set as multi-speed inputs: [E0.01] = 1, [E0.02] = 2, [E0.03] = 3 and [E0.04] = 4, multi-speed control can be set with external switches. Run, Stop and direction can be set with FWD and REV, as shown in figure below.



SW1 jumper position

cannot be set as 1-2, 3-4

Fig. 7-30:

Multi-speed control wiring

Multi-speed frequencies can be set with the combination of switches S1, S2, S3 and S4. The control process is shown in figure below.

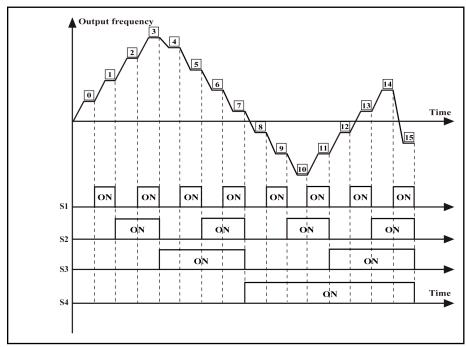


Fig. 7-31: Multi-speed control process

Com	Combination of digital inputs			Colored fraguency	Corresponding
S4	S3	S2	S1	Selected frequency	parameter
OFF	OFF	OFF	OFF	Multi-speed frequency 0	b1.00
OFF	OFF	OFF	ON	Multi-speed frequency 1	E2.06
OFF	OFF	ON	OFF	Multi-speed frequency 2	E2.07
OFF	OFF	ON	ON	Multi-speed frequency 3	E2.08
OFF	ON	OFF	OFF	Multi-speed frequency 4	E2.09
OFF	ON	OFF	ON	Multi-speed frequency 5	E2.10
OFF	ON	ON	OFF	Multi-speed frequency 6	E2.11
OFF	ON	ON	ON	Multi-speed frequency 7	E2.12
ON	OFF	OFF	OFF	Multi-speed frequency 8	E2.13
ON	OFF	OFF	ON	Multi-speed frequency 9	E2.14
ON	OFF	ON	OFF	Multi-speed frequency 10	E2.15
ON	OFF	ON	ON	Multi-speed frequency 11	E2.16
ON	ON	OFF	OFF	Multi-speed frequency 12	E2.17
ON	ON	OFF	ON	Multi-speed frequency 13	E2.18
ON	ON	ON	OFF	Multi-speed frequency 14	E2.19
ON	ON	ON	ON	Multi-speed frequency 15	E2.20

Tab.7-8: Multi-speed digital inputs

- 5: Acceleration/deceleration time 1
- 6: Acceleration/deceleration time 2

Four options of acceleration/deceleration time are available with the combinations of the two inputs, as shown in table below.

Combination of digital inputs		Selected	Corresponding
Acc./Dec. time 2	Acc./Dec. time 1	acceleration /deceleration time	parameter
OFF	OFF	Acceleration time 1	b1.09
Oli	011	Deceleration time 1	b1.10
OFF	ON -	Acceleration time 2	E2.00
OFF		Deceleration time 2	E2.01
ON	OFF	Acceleration time 3	E2.02
ON	OFF	Deceleration time 3	E2.03
ON	ON	Acceleration time 4	E2.04
	ON	Deceleration time 4	E2.05

Tab.7-9: Multi-speed acceleration/deceleration time

• 7: 3-wire control

Used to control the frequency converter in 3-wire control mode. See parameter E0.00.

8: Freewheel to stop

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- Used for large inertia loads without requirement to stop time.
- The frequency converter blocks output and the motor's stopping is not controlled by the frequency converter.
- 9: Frequency increment Up
- 10: Frequency decrement **Down**

These two inputs are used to change the set frequency with digital inputs Up/Down. See parameters b1.00 and S3.11.

11: Set frequency to 0

Used to clear the frequency set by digital inputs Up/Down and change the set frequency to 0.

- 12: Reserved
- 13: Activate DC brake

When the frequency converter is decelerating to stop, if the output frequency reaches the shutdown DC brake activation frequency, this input is active and the frequency converter directly switches to the shutdown DC brake status. See parameters b1.21 and b1.23. Parameter b1.22 is inactive in this case.

- 14: Switch between operating panel and digital inputs control Used to switch between control with operating panel and with digital inputs, when [b1.02] = 0 or [b1.02] = 1.
- 15: Logic control deactivated Used to control the operation of logic control.

[E2.21]	Xi = 15	Logic control status
≠ 0	OFF	Running (Factory default)
≠ 0	On	Inactive
= 0	OFF	Inactive
= 0	On	Inactive

Tab. 7-10: Logic control status

16: Logic control paused

When the digital input is of On, the logic control is paused and the frequency converter runs at zero speed; when the digital input is of OFF, the frequency converter resumes the status before the logic control pause.

17: Switch between speed control and torque control

Used to switch between speed control and torque control in vector control with feedback. The related parameter is \$1.04.

- When parameter [S1.04] = 0, the digital input is disconnected to activate speed control; and when the digital input is connected to activate torque control.
- When parameter [S1.04] =1, torque control is always on regardless of the status of the digital inputs.
- 18: Switch between VR1 analog reference and +I analog reference The switching rule is shown in table below.

Parameter setting	Digital input is OFF	Digital input is ON
[b1.00] = 2 , [E0.09] = 0	Reference channel	Reference channel
(k1 × VR1)	is k1 × VR1	is k3 × (+I)
[b1.00] = 2 , [E0.09] = 1	Inactive	Inactive
(k2 × VR2)	mactive	mactive
[b1.00] = 2 , [E0.09] = 2	Reference channel	Reference channel
(k3 × (+l))	is k3 × (+I)	is k1 × VR1
[b1.00] = 2 , [E0.09] = 3	Reference channel	Reference channel
(k1 × VR1 + k2 × VR2)	is k1 × VR1 + k2 × VR2	is k3 × (+I) + k2 × VR2
[b1.00] = 2 , [E0.09] = 4	Inactive	Inactive
(k1 × VR1 + k3 × (+I))	mactive	mactive
[b1.00] = 2 , [E0.09] = 5	Reference channel	Reference channel
(k2 × VR2 + k3 × (+I))	is k2 × VR2 + k3 × (+I)	is k2 × VR2 + k1 × VR1
[b1.00] = 2 , [E0.09] = 6	Inactive	Inactive
(k1 × VR1)		

Tab.7-11: Switch between VR1 analog reference and +I analog reference



- k1: VR1 channel amplification factor, see parameter E0.10.
- k2: VR2 channel amplification factor, see parameter E0.11.
- k3: +I channel amplification factor, see parameter E0.12.
- 19: External error N.O. contact input
- 20: External error N.C. contact input

When an external error signal is sent to the frequency converter, the frequency converter responses with 'E.-St' alarm and stops. This is to facilitate the monitoring and interlinking of the external devices.

- 21: External Reset input
 - Same like reset by operating panel.
 - Allows remote error reset.
- 22: Activate communication control
 - Used to switch between control by operating panel and by communication, when [b1.02] = 0.
 - Used to switch between control by digital inputs and by communication, when [b1.02] = 1.
- 23: Torque limit set by VR1 enabled

Used to enable the VR1 analog channel to set the torque limit when the frequency converter works in speed mode.

VR1, 0 to 10 V corresponding torque: 0 % to 200 %

• 24: Torque limit set by VR2 enabled

Used to enable the VR2 analog channel to set the torque limit when the frequency converter works in speed mode.

VR2, 0 to 10 V corresponding torque: 0 % to 200 %

25: Forward jogging

Used to enable forward jogging.

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26: Reverse jogging

Used to enable reverse jogging.

The logic relation between forward/reverse jogging frequency and running frequency is shown as below:

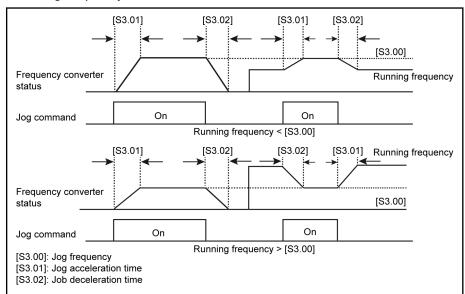


Fig. 7-32: Relation between forward/reverse jogging frequency and running frequency

• 27: Process PID deactivated

- When [E0.01] to [E0.08] = 27 and the corresponding multi-function digital input terminal is closed, or when [E3.00] = 0, the PID function is deactivated and the frequency converter runs with set frequency, which is decided by E3.00.
- When [E3.11] = 0, the set frequency is decided by E3.00.
 - When [E3.00]=0, the set frequency is decided by b1.00.
 - When [E3.00]=1 or 3, the set frequency is analog signal input.
 - When [E3.00]=2, the set frequency is analog digital setting.
 - When [E3.00]=4, the set frequency is rotation speed digital setting.
- When [E3.11] = 1, the set frequency is decided by b1.00.

Process PID control is illustrated as below:

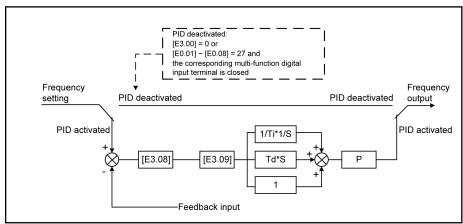


Fig.7-33: PID control

• 28: Speed limit set by VR1 enabled

Used to enable the VR1 analog channel to set the speed limit when the frequency converter works in torque mode.

VR1, 0 to 10 V corresponding speed: (0 % to 100 %) × [b1.06]

• 29: Speed limit set by VR2 enabled

Used to enable the VR2 analog channel to set the speed limit when the frequency converter works in torque mode.

VR2, 0 to 10 V corresponding speed: (0 % to 100 %) \times [b1.06]

	Source of	f analog frequency setting	Factory default	0
		0: k1 × VR1 1: k2 × VR2		
		1. k2 × VR2 2: k3 × (+I)		
		3: k1 × VR1 + k2 × VR2		
E0.09		4: k1 × VR1 + k3 × (+I)		
	Setting range	5: k2 × VR2 + k3 × (+I)	Minimum unit	1
		6: k1 × VR1		
		(only valid for -10 to +10 V forward/reverse control)		
		7: k4 × VR3		
E0.10	VR1 chan	nel amplification factor k1	Factory default	1.00
□ □0.10	Setting range	0.00 to 10.00	Minimum unit	0.01
E0.11	VR2 chan	nel amplification factor k2	Factory default	1.00
_ ⊑0.11	Setting range	0.00 to 10.00	Minimum unit	0.01
E0.12	+I chann	el amplification factor k3	Factory default	1.00
EU.12	Setting range	0.00 to 10.00	Minimum unit	0.01
E0.13	Refer	ence frequency curve	Factory default	0
□ □0.13	Setting range	0 to 31	Minimum unit	1
E0.14	Anal	og channel filter time	Factory default	0.100s
□ □ 0.14	Setting range	0.000 to 2.000s	Minimum unit	0.001s
E0.15	Maximu	m input pulse frequency	Factory default	20.0 kHz
L0.13	Setting range	1.0 to 50.0 kHz	Minimum unit	0.1 kHz
E0.16	Curve	1 minimum reference	Factory default	0.0 %
L0.10	Setting range	0.0 % to [E0.18]	Minimum unit	0.1 %
E0.17	Frequency corr reference	esponding to curve 1 minimum	Factory default	0.00 Hz
	Setting range	0.00 Hz to [b1.06]	Minimum unit	0.01 Hz
E0.18	Curve	1 maximum reference	Factory default	100.0 %
Ευ.18	Setting range	[E0.16] to 100.0%	Minimum unit	0.1 %

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E0.19	Frequency correreference	esponding to curve 1 maximum	Factory default	50.00 Hz
	Setting range	0.00 Hz to [b1.06]	Minimum unit	0.01 Hz
E0.20	Curve	2 minimum reference	Factory default	0.0 %
LU.20	Setting range	0.0 % to [E0.22]	Minimum unit	0.1 %
E0.21	Frequency correreference	esponding to curve 2 minimum	Factory default	0.00 Hz
	Setting range	0.00 Hz to [b1.06]	Minimum unit	0.01 Hz
E0.22	Curve	2 maximum reference	Factory default	100.0 %
□ □0.22	Setting range	[E0.20] to 100.0 %	Minimum unit	0.1 %
E0.23	Frequency corresponding to curve 2 maximum reference		Factory default	50.00 Hz
	Setting range	0.00 Hz to [b1.06]	Minimum unit	0.01 Hz
E0.24	Analog reference control value at	e forward/reverse dead zone -10 to +10 V	Factory default	0.0 %
	Setting range	0.0 % to 30.0 %	Minimum unit	0.1 %

 When VR1, VR2, VR3, +I or pulse frequency (PULSE) input is used as reference frequency channel, the relationship between reference channel and reference frequency is shown in figure below.

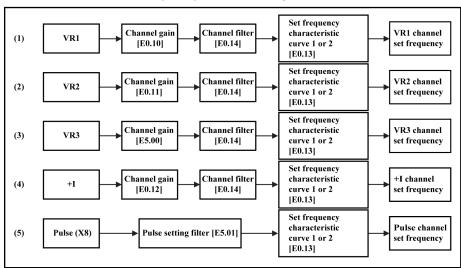


Fig.7-34: Reference frequency channel and reference frequency

For reference frequency signals after gain and filter processing, their relationship with the set frequencies is determined by curve 1 or curve 2.
 Curve 1 is defined with E0.16 to E0.19, and curve 2 is defined with E0.20 to E0.23. Either of them can independently realize direct and inverse actions, as shown in figure below.

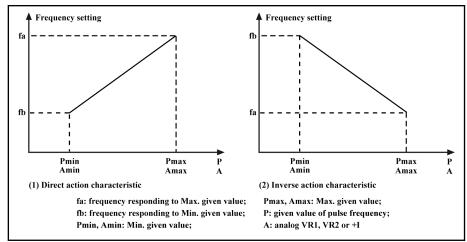


Fig.7-35: Output frequency characteristics curves

- Analog input A being 100 % corresponds to 10 V or 20 mA, and pulse frequency P being 100 % corresponds to the maximum input pulse frequency defined with E0.15.
- Parameter E0.13 is used to select output frequency characteristic curves for VR1, VR2, VR3, +I and PULSE frequency reference channels, as shown in figure below.

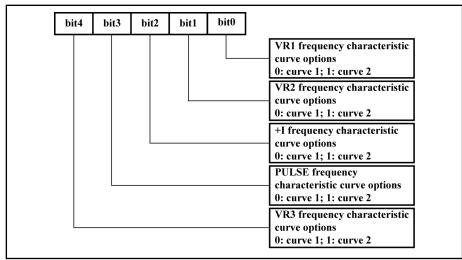


Fig. 7-36: Reference frequency curve selection

- Parameter E0.14 is used to define the analog channel filter time constant for filtering processing of input signals. Longer filter time means stronger anti-interference capability and slower response; shorter filtering time means weaker anti-interference capability and faster response.
- Parameter E0.09 is used to select the source of analog reference frequency. VR2, VR3 and +I inputs are inactive if [E0.09] = 6.
- If [E0.09] = 6, VR1 input inverse frequency characteristic curve is deactivated.
- If [E0.09] = 6 and the voltage range of VR1 analog input is -10 V to 0 V to +10 V, direction information exists. In this case, the direction control by operating panel or digital inputs is automatically deactivated, and is not subject to the rotation direction parameter S3.14, and the dead zone is determined with E0.24.

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If [E0.09] = 6, parameter E0.24 can be used to define the forward and reverse rotation dead zone of the motor, i.e. the range for treating input signals as zero, as shown in figure below.

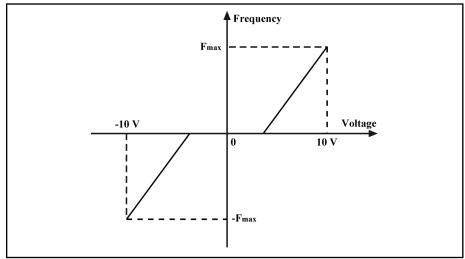


Fig.7-37: Reference frequency and analog input voltage when [E0.09] = 6

For example, if [E0.24] = 10.0 % when [E0.09] = 6, analog input signals within the range of -1 to +1 V will be treated as zero, 1 to 10 V corresponds to 0 Hz to maximum frequency, -1 to -10 V corresponds to 0 Hz to minus maximum frequency. The dead zone range is -1 to +1 V in this case.

Group E1: Analog and digital outputs

E1.00	Open collec	tor output OUT1	Factory default	1
L1.00	Setting range	0 to 14	Minimum unit	1
E1.01	Open collector output OUT2		Factory default	1
E1.01	Setting range	0 to 14	Minimum unit	1
E1 02	Relay output	ts Pa, Pb and Pc	Factory default	1
E1.02	Setting range	0 to 14	Minimum unit	1

Open collector outputs OUT1 and OUT2 and the relay outputs are described as below:

0: Frequency converter is ready to run

Output indicating signal when the frequency converter is free of error and ready to run after the main circuit and the control circuit power supplies have been established.

1: Frequency converter is running

Output indicating signal when the frequency converter is running and has frequency output.

2: DC brake active

Output indicating signal when the frequency converter is in DC braking process.

3: Frequency converter runs at zero speed

Output indicating signal when the frequency converter runs at 0 Hz.

4: Frequency/speed arrival signal

See related parameter 'Frequency arrival detection width' E1.03.

• 5: Frequency level detection signal (FDT1) See related parameters E1.04 to E1.05.

• 6: Frequency level detection signal (FDT2) See related parameters E1.06 to E1.07.

7: Logic control phase completed

Pulse output indicating signal when each phase is complete in logic control.

8: Under voltage stop

Output indicating signal when the frequency converter is at under voltage.

• 9: Frequency converter over load pre-warning 1

Output indicating signal after the output current exceeds the set value of parameter E1.08 for the time set by E5.13.

• 10: Motor over load pre-warning

Output indicating signal when the output current exceeds the set value of parameter E1.09 'Motor over load pre-warning level setting'.

• 11: Over torque

Output indicating signal when the motor torque exceeds the torque limit settings in vector control.

• 12: Frequency converter in error

Output indicating signal when the frequency converter is in error.

13: Error auto reset signal output

Output indicating signal when the frequency converter tries to auto reset.

• 14: Frequency converter over load pre-warning 2

Output indicating signal when load of K1 times rated current is applied to the frequency converter for T1 seconds and warning message O.L.-3 occurs on panel at the same time. Error message O.L.-1 occurs if the same load keeps for another T2 seconds. The relationship of T1, T2 and K1 are shown below:

Load K1 (%)	T1/s	T2/s
110 to 115	3600	360
116 to 120	1800	180
121 to 130	600	60
131 to 140	300	30
141 to 150	60	6
151 to 160	30	3
161 to 170	20	2
171 to 180	10	1
181 to 190	5	0.5
191 to 200	1	0.1

Tab.7-12: K1, T1 and T2 relationship

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	Frequer	ncy arrival detection width	Factory default	5.0 %
E1.03	Setting range	0.0 % to 20.0 %	Minimum unit	0.1.0/
		(of 'maximum frequency' [b1.05])	William and	U. I /0

Used to detect the difference between the output frequency and the set frequency.

If parameters E1.00 to E1.02 are set to '4: Frequency/speed arrival signal', the difference between the output frequency and the set frequency is within the setting range of this parameter, and the output indicating signals are shown in figure below.

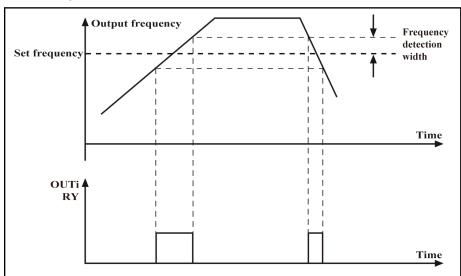


Fig.7-38: Frequency arrival signal

	F	requency detection level FDT1	Factory default	90.0 %
E1.04	Setting	0.0 % to 100.0 %		0.1 %
	range	(of 'maximum frequency' [b1.05])	William and	0.1 /6
	Frequency detection level FDT1 width		Factory default	5.0 %
E1.05	Setting	0.0 % to 100.0 %	Minimum unit	0.1 %
	range	(of 'maximum frequency' [b1.05])	William arm	0.1 /6
	Frequency detection level FDT2		Factory default	50.0 %
E1.06	Setting	0.0 % to 100.0 %	Minimum unit	0.1 %
	range	(of 'maximum frequency' [b1.05])	William arm	0.1 /6
	Fred	Frequency detection level FDT2 width		5.0 %
E1.07	Setting	0.0 % to 100.0 %	Minimum unit	0.1 %
	range	(of 'maximum frequency' [b1.05])	iviii iii iii di iii	0.1 /6

Used to detect if the output frequency is within the setting range of FDT.

• Output indicating signal when parameters E1.00 to E1.02 are set to '5: Frequency level detection signal (FDT1)' or '6: Frequency level detection signal (FDT2)', and the frequency converter output frequency is within the corresponding FDT range.

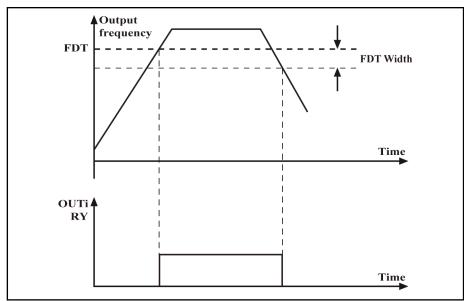


Fig. 7-39: Frequency level detection signal

	Frequency co	nverter over load pre-warning 1 level setting	Factory default	100.0 %
E1.08	Setting range	20.0 % to 100.0 % (of rated frequency converter current)	Minimum unit	0.1 %

Output indicating signal when parameters E1.00 to E1.02 or E5.04 are set to '9: Frequency converter over load pre-warning 1' and the frequency converter output current exceeds the value '[E1.08] × frequency converter rated current' over the time set by [E5.13].

	Motor over I	oad pre-warning level setting	Factory default	100.0 %
E1.09	Setting range	100.0 % to 250.0 %	Minimum unit 0.1 %	
		(of rated motor current)		

Output indicating signal when parameters E1.00 to E1.02 are set to '10: Motor over load pre-warning', and the frequency converter output current exceeds the value '[E1.09] × motor rated current'.

E1.10	FM1 analog output		Factory default	0
L1.10	Setting range	0 to 6	Minimum unit	1
E1.11	FM1 negative gain setting		Factory default	1.00
L1.11	Setting range	0.00 to 10.00	Minimum unit	0.01
E4 42	FM ²	1 positive gain setting	Factory default	1.00
E1.12	Setting range	0.00 to 10.00	Minimum unit	0.01

The output range of the analog output terminal FM1 can be set by parameters E5.05 to E5.08.

- Output voltage signal: -10 to 10 V
- Output current signal: 0 to 20 mA

Either voltage or current signals are determined with JP3 and JP4 on the control board:

- If JP3 is set to 1–2, FM1 outputs voltage signals; if JP3 is set to be 2–3, FM1 outputs current signals.
- If JP4 is set to 1–2, FM2 outputs voltage signals; if JP4 is set to be 3–4, FM2 outputs current signals.
- Analog outputs are set with parameter 'FM1 analog outputs' E1.10, as shown in table below.

[E1.10	Outputs	Range
0	Output frequency / rotation speed	0 to maximum output frequency, corresponding to analog outputs set by E5.06 to E5.08
1	Reference frequency / rotation speed	0 to maximum reference frequency, corresponding to analog outputs set by E5.06 to E5.08
2	Output current	0 to 2 times of rated current, corresponding to analog outputs set by E5.06 to E5.08
3	Torque current	0 % to 200 % of rated torque current, corresponding to analog outputs set by E5.06 to E5.08
4	Output voltage	0 to 1.2 times of rated voltage, corresponding to analog outputs set by E5.06 to E5.08
5	Output frequency / rotation speed (including direction)	0 to maximum output frequency, corresponding to analog outputs set by E5.06 to E5.08 (0 to 10 V at forwarding, -10 V to 0 at reversing)
6	Reference frequency / rotation speed (including direction)	0 to maximum reference frequency, corresponding to analog outputs set by E5.06 to E5.08 (0 to 10 V at forwarding, -10 V to 0 at reversing)

Tab.7-13: Meanings of analog outputs

Parameter 'FM1 gain setting' E1.12 is used to set the gain of FM1.

E1.13	FM2 analog output		Factory default	1
	Setting range	0 to 4	Minimum unit	1
E1.14	Reserved		Factory default	0
□ □ 1.14	Setting range	0 to 1	Minimum unit	1
E1 15	FM2 g	ain setting	Factory default	1.00
E1.15	Setting range	0.00 to 10.00	Minimum unit	0.01

The output range of the analog output terminal FM2 can be set by parameters E5.09 to E5.12. For details, refer to descriptions of parameters E1.10 to E1.12.

E1.16	Puls	e output	Factory default	0
L1.10	Setting range	0, 1, 2	Minimum unit	1
E1.17	Maximum output pulse frequency		Factory default	10.0 kHz
	Setting range	1.0 to 50.0 kHz	Minimum unit	0.1 kHz

DO pulse frequency output range: 0 kHz to [E1.17]

If parameter 'Pulse output' E1.16 is set to '0: Output frequency', when
the output frequency reaches the maximum frequency F_{max}, the corresponding set value of parameter 'Maximum output pulse frequency'
E1.17 is output via output DO.

- If parameter 'Pulse output' E1.16 is set to '1: Output voltage', when the output voltage reaches 500 V, the corresponding set value of parameter 'Maximum output pulse frequency' E1.17 is output via output DO.
- If parameter 'Pulse output' E1.16 is set to '2: Output current', when the output current reaches the rated current, half of the corresponding set value of parameter 'Maximum output pulse frequency' E1.17 is output via output DO.

Group E2: Multi-Speed and logic control

E2.00	Acceleration time 2		Factory default	10.0s
L2.00	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
E2.01	Deceler	ration time 2	Factory default	10.0s
L2.01	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
E2.02	Acceler	ration time 3	Factory default	10.0s
LZ.02	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
E2.03	Deceleration time 3		Factory default	10.0s
L2.03	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
E2.04	Acceler	ration time 4	Factory default	10.0s
L2.04	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s
E2.05	Deceler	ration time 4	Factory default	10.0s
E2.05	Setting range	0.1 to 3,600.0s	Minimum unit	0.1s

- Acceleration/deceleration time 2, 3, 4 are defined the same meanings as that of Parameter 'Acceleration time 1' b1.09 / 'Deceleration time 1' b1.10.
- Multifunction digital input Xi is used to select different acceleration/ deceleration time, see descriptions of parameters E0.01 to E0.08.

E2.06	Multi-spe	ed frequency 1	Factory default	0.00 Hz
	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.07	Multi-spe	ed frequency 2	Factory default	0.00 Hz
L2.07	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.08	Multi-spe	ed frequency 3	Factory default	0.00 Hz
L2.00	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.09	Multi-speed frequency 4		Factory default	0.00 Hz
L2.09	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.10	Multi-speed frequency 5		Factory default	0.00 Hz
L2.10	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.11	Multi-speed frequency 6		Factory default	0.00 Hz
E2.11	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.12	Multi-spe	ed frequency 7	Factory default	0.00 Hz
LZ. 1Z	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz

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E2.13	Multi-spe	ed frequency 8	Factory default	0.00 Hz
L2.10	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.14	Multi-spee	ed frequency 9	Factory default	0.00 Hz
CZ. 14	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.15	Multi-spee	d frequency 10	Factory default	0.00 Hz
EZ.13	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.16	Multi-spee	d frequency 11	Factory default	0.00 Hz
L2.10	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
F2.17	Multi-speed frequency 12		Factory default	0.00 Hz
LZ.17	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.18	Multi-spee	d frequency 13	Factory default	0.00 Hz
EZ.10	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.19	Multi-spee	d frequency 14	Factory default	0.00 Hz
LZ.19	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz
E2.20	Multi-spee	d frequency 15	Factory default	0.00 Hz
LZ.20	Setting range	[b1.07] to [b1.06]	Minimum unit	0.01 Hz

Parameters E2.06 to E2.20 are used to set the speeds (frequencies) in each phase of multi-speed control and logic control.

Multi-speed control

16 multiple speeds (Speed 0 to Speed 15) can be set via multi-speed inputs, together with inputs forward/reverse (FWD-COM and REV-COM) and acceleration/deceleration inputs.

- Running time of each speed is decided by the hold time of corresponding logic combination.
- Output frequency is decided by parameters E2.06 to E2.20 corresponding to each speed. For details of multi-speed running, see parameters E0.01 to E0.08.

Logic control

Automatic control according the current acceleration/deceleration time, output frequency, running time and rotation direction. One cycle of logic control is shown in the figure below.

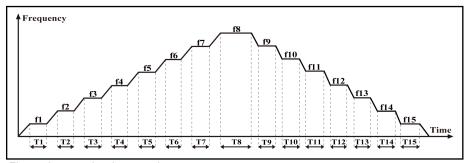


Fig.7-40: Logic control

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f1 to f15 are set by parameters E2.06 to E2.20, and T1 to T15 are set by parameters E2.22 to E2.52.

F2 21	Logic c	ontrol mode	Factory default	0
L2.21	Setting range	0, 1, 2, 3	Minimum unit	1

- 0: Inactive. Logic control is inactive.
- 1: Mode 1. Logic control stops after one cycle.
- 2: Mode 2. Frequency converter runs repeatedly, will be stopped by stop commands.
- 3: Mode 3. Frequency converter keeps running at the set frequency of the last phase after one cycle.

E2 22	Logic con	trol time factor	Factory default	1
LZ.ZZ	Setting range	1 to 60	Minimum unit	1

The actual run time of each stage is "Set time × parameter 'Logic control time factor' E2.22".

E2.23	Stage 1 action selection		Factory default	0
	Setting range	0 to 31	Minimum unit	1

- The set frequency of stage 1 is defined by parameter 'Multi-speed frequency 1' E2.06.
- Used to define running direction and acceleration/deceleration time of stage 1.
- To set '0 to 31', a binary to decimal conversion is needed based on the data format shown in the table below and the options for each bit below the table.

bit4	bit3	bit2	bit1	bit0

Tab.7-14: Binary format of parameter E2.23

- The options of each bit are listed below.
 - bit4
 - 0: Forward
 - 1: Reverse
 - bit3 and bit2
 - 00: set by parameter 'Acceleration time 1' b1.09
 - 01: set by parameter 'Acceleration time 2' E2.00
 - 10: set by parameter 'Acceleration time 3' E2.02
 - 11: set by parameter 'Acceleration time 4' E2.04
 - bit1 and bit0
 - 00: set by parameter 'Deceleration time 1' b1.10
 - 01: set by parameter 'Deceleration time 2' E2.01
 - 10: set by parameter 'Deceleration time 3' E2.03
 - 11: set by parameter 'Deceleration time 4' E2.05
- Example: Forward rotation, setting acceleration time with 'Acceleration time 2' E2.00, setting deceleration time with parameter 'Deceleration time 3' E2.03
 - Forward: bit4 = 0
 - setting acceleration time with 'Acceleration time 2' E2.00: bit3 = 0, bit2 = 1 ('bit3 and bit2' = 01)

 setting deceleration time with 'Deceleration time 3' E2.03: bit1 = 1, bit0 = 0 ('bit1 and bit0' = 10)

The binary format of the example is shown as the table below.

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Tab.7-15: Example binary format

Conversion of binary format to decimal format:

 $[E2.23] = 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 6$

E2.24	Stage 1	running time	Factory default	0.0s
LZ.Z7	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s

Used to set the running time of stage 1, related parameter 'Logic control time factor' E2.22.

E2.25	Stage 2 a	ction selection	Factory default	0
E2.25	Setting range	0 to 31	Minimum unit	1
E2.26	Stage 2	running time	Factory default	0.0s
E2.20	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.27	Stage 3 action selection		Factory default	0
LZ.Z1	Setting range	0 to 31	Minimum unit	1
E2.28	Stage 3	running time	Factory default	0.0s
LZ.20	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.29	Stage 4 a	ction selection	Factory default	0
E2.29	Setting range	0 to 31	Minimum unit	1
E2.30	Stage 4	running time	Factory default	0.0s
E2.30	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.31	Stage 5 action selection		Factory default	0
LZ.31	Setting range	0 to 31	Minimum unit	1
E2.32	Stage 5 running time		Factory default	0.0s
LZ.32	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.33	Stage 6 a	ction selection	Factory default	0
E2.33	Setting range	0 to 31	Minimum unit	1
E2.34	Stage 6	running time	Factory default	0.0s
E2.34	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.35	Stage 7 action selection		Factory default	0
L2.33	Setting range	0 to 31	Minimum unit	1
E2.36	Stage 7	running time	Factory default	0.0s
LZ.30	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.37	Stage 8 a	ction selection	Factory default	0
EZ.31	Setting range	0 to 31	Minimum unit	1

E2.38	Stage 8	running time	Factory default	0.0s
L2.00	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.39	Stage 9 action selection		Factory default	0
LZ.39	Setting range	0 to 31	Minimum unit	1
E2.40	Stage 9 running time		Factory default	0.0s
E2.40	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.41	Stage 10 a	action selection	Factory default	0
E2.41	Setting range	0 to 31	Minimum unit	1
F0.40	Stage 10	running time	Factory default	0.0s
E2.42	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E0.40	Stage 11 a	action selection	Factory default	0
E2.43	Setting range 0 to 31 Minimum		Minimum unit	1
E2.44	Stage 11	running time	Factory default	0.0s
E2.44	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.45	Stage 12 action selection		Factory default	0
EZ.43	Setting range	0 to 31	Minimum unit	1
E2.46	Stage 12 running time		Factory default	0.0s
⊏2.40	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.47	Stage 13 a	action selection	Factory default	0
⊏2.47	Setting range	0 to 31	Minimum unit	1
E2.48	Stage 13	running time	Factory default	0.0s
⊏2.40	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
E2.49	Stage 14 action selection		Factory default	0
⊏2.49	Setting range	0 to 31	Minimum unit	1
F0.50	Stage 14	running time	Factory default	0.0s
E2.50	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
F2.54	Stage 15 a	action selection	Factory default	0
E2.51	Setting range	0 to 31	Minimum unit	1
F2 F2	Stage 15	running time	Factory default	0.0s
E2.52	Setting range	0.0 to 5,000.0s	Minimum unit	0.1s
			1	1

- To set stage 2 to stage 15, please refer to the description for stage 1.
- If the running time of a stage is set to 0, logic control will skip this stage.
- If parameter 'Motor standard rotation direction' S3.14 is set to '2: Deactivate reverse motor rotation', logic control will stop immediately when a reverse rotation command is executed.
- For logic control with external inputs, see parameters E0.01 to E0.08.

Group E3: PID control

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PID control is a common used process control approach suitable for flow control, pressure control and temperature control.

Based on proportional, integral and differential calculations of the difference between the reference and the feedback, a negative feedback system can be formed with the adjustment of the frequency converter output frequency to limit the difference from the reference. The basic control principle is shown in figure below.

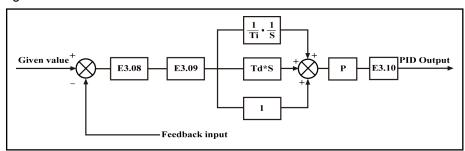


Fig.7-41: Process PID control

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P represents the proportion gain, Ti represents the integral time and Td represents the differential time.

E3.00	PID control mode		Factory default	0
L3.00	Setting range	0, 1, 2, 3, 4	Minimum unit	1

- 0: PID control inactive
- 1: Analog input + analog feedback
- 2: Analog digital setting + analog feedback
- 3: Analog input + pulse encoder feedback
 In this mode, parameter 'Control mode' b1.03 needs to be set as '0: V/F control'.
- 4: Rotation speed digital setting + pulse encoder feedback
 In this mode, parameter 'Control mode' b1.03 needs to be set as '0: V/F control'.

E3.01	Analog o	digital setting	Factory default	0.00 V
25.01	Setting range	0.00 to 10.00 V	Minimum unit	0.01 V

Active when parameter 'PID control mode' E3.00 is set to '2: Analog digital setting + analog feedback'.

E3.02	Rotation speed digital setting		Factory default	0 rpm
L3.02	Setting range	0 to 24,000 rpm	Minimum unit	1 rpm

- Active when parameter 'PID control mode' E3.00 is set to '4: Rotation speed digital setting + pulse encoder feedback'.
- In closed loop PID control, configuration of reference, feedback and control mode is shown in table below.

PID control mode	Reference	Feedback	Frequency converter control mode
[E3.00]=1	External analog input	External analog signal feedback	[b1.03]=0, 1, 2
[E3.00]=2	Analog digital setting E3.01	External analog signal feedback	0 or 1 in most cases
[E3.00]=3	External analog input	Pulse encoder feedback	[b1.03]=0
[E3.00]=4	Rotation speed digital setting E3.02	Pulse encoder feedback	(V/F control)

Tab.7-16: Configuration in closed loop PID control

E3.03		Analog feedback channel		Factory default	0
	0.00	Setting range	0 to 3	Minimum unit	1

Used to select analog feedback channel when [E3.00] = 1 or 2:

- 0: +I direct action is the feedback in the PID control
- 1: +I inverse action is the feedback in the PID control
- 2: VR1 direct action is the feedback in the PID control
- 3: VR1 inverse action is the feedback in the PID control
- 4: VR2 direct action is the feedback in the PID control
- 5: VR2 inverse action is the feedback in the PID control
- 6: VR3 direct action is the feedback in the PID control
- 7: VR3 inverse action is the feedback in the PID control

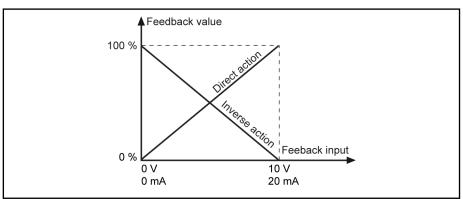


Fig.7-42: Feedback modes

E3.04	P: Proportional gain		Factory default	1.500
L3.04	Setting range	0.000 to 10.000	Minimum unit	0.001
		Ti: Integral time	Factory default	0.00s
E3.05	Setting range	0.00 to 100.00s	Minimum unit	0.01s
	ocumy range	(0.00 represents no integral)	William Chile	0.013

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	Td: Derivative time		Factory default	0.00s
E3.06	Setting range	0.00 to 100.00s (0.00 represents no derivative)	Minimum unit	0.01s
E3.07	T: Sampling period		Factory default	0.50s
	Setting range	0.01 to 100.00s	Minimum unit	0.01s

Used to set PID control parameters.

P: Proportional gain

Used to eliminate deviation

- Larger P means larger scale and faster response, but too large P leads to oscillation.
- P cannot eliminate deviation completely.
- Ti: Integral time

Used to eliminate remained deviation

- Smaller Ti means faster response of frequency converter to deviation changes, but too mall Ti leads to oscillation.
- Td: Derivative time

Used to respond fast to changes of deviation between reference and feedback exists in the system.

Larger Td means faster response, but too large Td leads to oscillation.

E3.08		Deviation limit	Factory default	2.0 %
	Setting range	0.0 % to 20.0 %	Minimum unit	0.1 %
		(of closed loop reference)		

Used to set the limit of the deviation between reference signals and feedback signals to stop internal PID control and keep stable output.

PID control stops when feedback deviation is within the range of 'Deviation limit' [E3.08].

Control accuracy and stability of the system should be taken into account in setting of parameter 'Deviation limit' E3.08.

E3.09	PID adjustment mode		Factory default	0
L3.09	Setting range	0 to 1	Minimum unit	1

In closed loop PID control, if the output value reaches parameter 'Upper frequency' [b1.06] or 'Lower frequency' [b1.07], the integral loop has two options:

0: Stop integral adjustment

The integral value remains unchanged.

- When the difference between reference value and feedback value changes, the integral value will change immediately with the changing trend.
- 1: Continue integral adjustment

The integral value responds simultaneously to the difference change between the reference value and the feedback value.

 When the difference between the reference values and the feedback value changes, more time is needed to compensate the impact of continuous integral adjustment for the integral value to follow the changing trend.

E3	3 10		PID output action	Factory default	0
	E3.10	Setting range	0 to 1	Minimum unit	1

- 0: Direct action
- 1: Inverse action

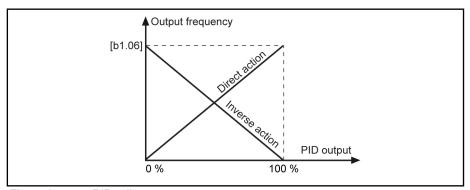


Fig.7-43: PID adjustment

E3.11	PID feedforward activation		Factory default	0
	Setting range 0 to 1		Minimum unit	1
E3.12	PID feedforward limit		Factory default	1.00 Hz
	Setting range 0.00 to 5.00 Hz		Minimum unit	0.01 Hz

Used to set the frequency / speed input by adding the fine tuning signal of PID output and the main frequency setting.

- 0: PID feedforward deactivated. If "PID control mode" [E3.00] ± 0, the given frequency is set by PID output; if [E3.00] = 0, the given frequency is set by parameter "Frequency setting mode" b1.00.
- 1: PID feedforward activated. If "PID control mode" [E3.00] ≠ 0, the given frequency is set by the result of PID output plus the main frequency setting; if [E3.00] = 0, the given frequency is set by parameter "Frequency setting mode" b1.00.

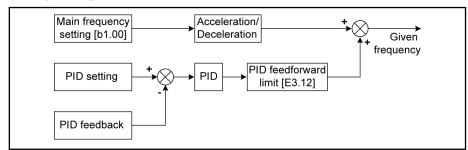


Fig.7-44: PID feedforward

E3.13	PID analog signal setting channel		Factory default	0
L3.13	Setting range	0 to 1	Minimum unit	1

Used to select the analog signal setting channel when E3.00 is set as 1 or 3:

- 0: the PID given value is from terminal +I
- 1: the PID given value is from terminal VR1
- 2: the PID given value is from terminal VR2
- 3: the PID given value is from terminal VR3

Group E4: Protection parameters

E4.00	Software over voltage protection threshold		Factory default	810 V
	Setting range	790 to 820 V	Minimum unit	1 V
	Stall over voltage function		Factory default	0
E4.01	Setting range	0 to 1	Minimum unit	1
E4.02	Stall over voltage protection level		Factory default	130.0 %
		120.0 % to 150.0 %		
	Setting range	(of rated frequency converter peak voltage)	Minimum unit	0.1 %

- Parameter 'Stall over voltage function' E4.01 is used to activate or deactivate stall over voltage function.
 - 0: Deactivated
 - 1: Activated
- In stall over voltage protection, frequency converter detects the bus voltage during deceleration and compares it with 'Stall over voltage protection level' [E4.02].
- If bus voltage exceeds stall over voltage protection level, the frequency converter output frequency stops decrease.
- Only if bus voltage is lower than the stall over voltage protection level, will the frequency converter resume deceleration, as shown in figure below:

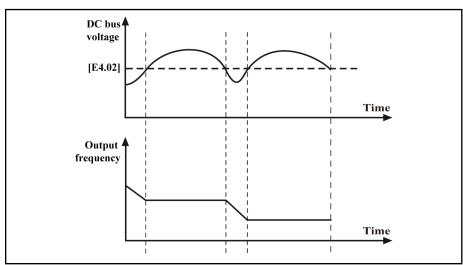


Fig.7-45: Stall over voltage protection level

	S	tall over current protection level	Factory default	150.0 %
E4.03	Setting range	20.0 % to 200.0 % (of rated frequency converter output current)	Minimum unit	0.1 %
		Currenty		

The function action will lead to longer acceleration time than set time. During acceleration:

- If the frequency converter output current exceeds 'Stall over current protection level' [E4.03], the frequency converter output frequency will stop increase
- Only if the frequency converter output current is lower than 'Stall over current protection level' [E4.03], will the frequency converter resume acceleration, to avoid stall over current.

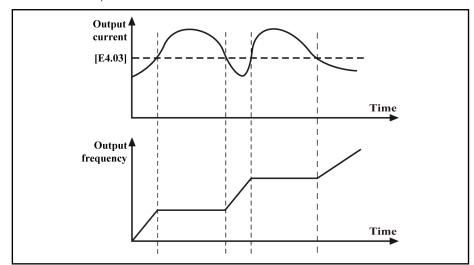


Fig.7-46: Stall over current protection level

E4.04	Motor over load protection		Factory default	1
L4.04	Setting range	0, 1, 2	Minimum unit	1

- 0: Inactive
- 1: Heat protection active at low-speed

With a normal asynchronous motor, heat dissipation is insufficient at low-speed running, the electronic heat protection value will be compensated automatically.

• 2: Heat protection inactive at low-speed

With a special motor for frequency conversion, heat dissipation will not be deteriorated at low-speed running, the electronic heat protection value automatic compensation is unnecessary.

E4.05	Motor over load protection factor		Factory default	100.0 %
L4.03	Setting range	50.0 % to 110.0 %	Minimum unit	0.1 %

 If the rated frequency converter current is different from that of the motor, motor over load protection factor needs to be set properly for effective motor protection:

Motor over load protection factor (%) = (Rated motor current / Rated frequency converter current) × 100 %

 The inverse time characteristic of over load protection is shown figure below.

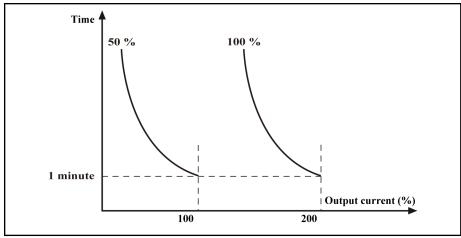


Fig.7-47: Over load protection curve

54.00	Type of temperature sensor for motor over heat protection		Factory default	0
E4.06	Setting range	0: PTC temperature sensor 1: NTC temperature sensor	Minimum unit	1



To activate this function, PTC/NTC temperature sensors need be mounted in the motor with the outputs connected to the respective frequency converter analog input terminals VR1 or VR2, see parameter E4.07.

	Input channel options of motor over heat protection		Factory default	0
E4.07	Setting range	0: Deactivated; 1: VR1 2: VR2; 3: VR3	Minimum unit	1

- The input of PTC/NTC shares the same channel with VR1 or VR2.
 Therefore the settings of E4.07 should avoid mutually exclusive settings as shown below:
 - When [E4.07] = 1, if settings are as below,
 - [E3.00] = 1 / 3 or [E3.13] = 1
 - [E3.00]=1 / 2 or [E3.03] = 2 / 3
 - [E0.01] to [E0.08] = 18 / 23 / 28
 - [b1.00] = 2 or [E0.09] = 0 / 3 / 4 / 6
 - [b1.03] = 2 or [S1.05] = 1

Fv will report error message "PRSE" after start.

- When [E4.07] = 2, if settings are as below,
 - [E3.00] = 1 / 3 or [E3.13] = 2
 - [E3.00] = 1 / 2 or [E3.03] = 4 / 5
 - [E0.01] to [E0.08] = 24 / 29
 - [b1.00] = 2 or [E0.09] = 1/3/5

Fv will report error message "PRSE" after start.

- When [E4.07] = 3, if settings are as below,
 - [E3.00] = 1 / 3 or [E3.13] = 3

- [E3.00] = 1 / 2 or [E3.03] = 6 / 7
- [b1.00] = 2 or [E0.09] = 7
- Motor overheat protection input channel shares the same filter time constant E0.14 with the analog input channel.

E4.08	Motor over heat reference		Factory default	2.0 V
L4.00	Setting range	0.0 to 10.0 V	Minimum unit	0.1 V

- When the temperature arrives at the set value of E4.08 (motor overheat reference), the motor will freewheel stop with error message "M.O.H." displayed on the operating panel.
- To activate this function, the corresponding motor over heat reference based on temperature sensor type needs to be calculated. If [E4.06] = 0, [E4.07] = 1, digital inputs +10 V, VR1 and GND are used.

The calculation formula is shown as below:

$$[E4.08] = 10 \text{ V} \times \text{@}_{PTC}//100 \text{ k}) / [R + (R_{PTC}//100 \text{ k})]$$

The wiring diagram of PTC temperature detection is shown as below:

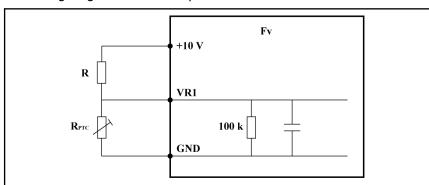


Fig.7-48: Wiring diagram of PTC temperature detection

• If a standard PTC resistor is used, the corresponding resistance of motor protection reference is 1330 Ω. If a general resistor is used, the corresponding motor protection reference is shown in the table below:

Motor overheat protection reference [E4.08] [V]	Resistance divider R [kΩ]
1.16	10.0
2.01	5.1
2.18	4.7
2.85	3.3

Tab.7-17: Motor protection reference for general resistor

E4.09	Phase lo	ss protection	Factory default	0
L4.03	Setting range	0, 1, 2, 3	Minimum unit	1

- 0: Both input and output phase loss protection active
 - Frequency converter input phase loss protection is active, and operating panel displays IPH.L.
 - Frequency converter output phase loss protection is active, and operating panel displays OPH.L.
- 1: Only input phase loss protection active

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- 2: Only output phase loss protection active
- 3: Neither input or output loss protection active

E4.10	Re	served	Factory default	0
	Setting range	0 to 1	Minimum unit	1
E4.11	Number of error reset attempts		Factory default	0
	Setting range	0 to 3	Minimum unit	1
E4.12	Interval between	en reset attempts	Factory default	10s
	Setting range	2 to 60s	Minimum unit	1s

- Automatic error reset function can be used to ensure continuous running without human intervention in the case of occasional errors, such as over current and over voltage during start or running.
- If parameter 'Number of error reset attempts' E4.11 is not set to '0: Auto reset deactivated', the frequency converter is automatically reset and restarts after the interval of 'Interval between reset attempts' E4.12.
 - 'Number of error reset attempts' E4.11 is used to set the allowed maximum times of attempts for automatic reset in case of error for each powering on;
 - 'Interval between reset attempts' E4.12 is used to set interval time between reset attempts.
- If error still exists after 'Number of error reset attempts' E4.11, the frequency converter will send an alarm and stop.
- Automatic error reset is valid to the following error types: O.C.-1, O.C.-2, O.C.-3, O.E.-1, O.E.-2, O.E.-3, O.L.-1, O.L.-2, E.-St, CPU-, C.O.H. and M.O.H..

E4.13	Las	st error	Factory default	0
	Setting range	0 to 24	Minimum unit	1
E4.14	2 nd I	ast error	Factory default	0
	Setting range	0 to 24	Minimum unit	1
E4.15	3 rd l	ast error	Factory default	0
	Setting range	0 to 24	Minimum unit	1

Used to record the recent three errors, and can be viewed after reset. For error types, see chapter 8 "Error Types and Solutions" on page 151.

E4.16	Delete error record		Factory default	0
L4.10	Setting range	0 to 1	Minimum unit	1

- 0: Inactive
- 1: Delete error record

Delete error records stored in parameters E4.13 to E4.15.

Group E5: Extended parameters

E5.00	VR3 channel ar	nplification factor k4	Factory default	1.00
	Setting range	0.00 to10.00	Minimum unit	0.01
E5.01	Pulse input filtering time		Factory default	0
	Setting range	0 to 9	Minimum unit	1
E5.02	Reserved		Factory default	0
E3.02	Setting range	0 to1	Minimum unit	1
E5.03	Re	served	Factory default	0
	Setting range	0 to1	Minimum unit	1

E5.01 is used to define the pulse channel filter time constant for processing of input signals. Longer filtering time means stronger anti-interference capability and slower response; shorter filtering time means weaker anti-interference capability and faster response.

E5.04	Relay outputs Ta, Tb and Tc		Factory default	12		
	L3.04	Setting range	0 to 14	Minimum unit	1	

See descriptions of parameters E1.00 to E1.02.

E5.05	FM1 out	out lower limit	Factory default	0.0 %
L3.03	Setting range	0.0 % to [E5.07]	Minimum unit	0.1 %
E5.06	Output corresponding to [E5.05]		Factory default	0.00 V
L3.00	Setting range	0.00 to 10.00 V	Minimum unit	0.01 V
E5.07	FM1 outp	out upper limit	Factory default	100.0 %
L3.07	Setting range	[E5.05] to 100.0 %	Minimum unit	0.1 %
E5.08	Output corres	ponding to [E5.07]	Factory default	10.00 V
L3.00	Setting range	0.00 to 10.00 V	Minimum unit	0.01 V
E5.09	FM2 out	out lower limit	Factory default	0.0 %
L3.09	Setting range	0.0 % to [E5.11]	Minimum unit	0.1 %
E5.10	Output corres	ponding to [E5.09]	Factory default	0.00 V
€5.10	Setting range	0.00 to 10.00 V	Minimum unit	0.01 V
E5.11	FM2 outp	out upper limit	Factory default	100.0 %
LJ.11	Setting range	[E5.09] to 100.0 %	Minimum unit	0.1 %
E5.12	Output corres	ponding to [E5.11]	Factory default	10.00 V
LJ. 12	Setting range	0.00 to 10.00 V	Minimum unit	0.01 V

Used to define the relationship between the outputs set by E1.10 and E1.13, and the corresponding analog outputs.

- When the outputs exceed the upper or lower limit, the frequency converter will output the voltage corresponding to the upper or lower limit.
- When output current signals are activated, 1 mA represents 0.5 V.

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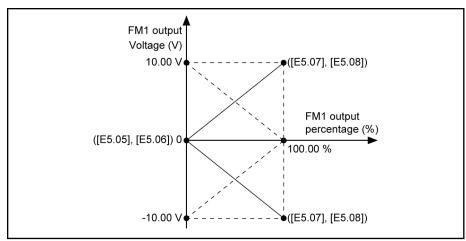


Fig.7-49: FM1 voltage output

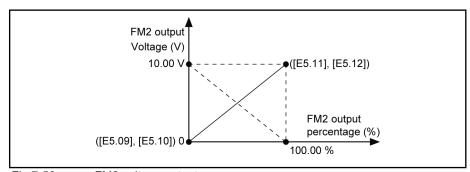


Fig.7-50: FM2 voltage output

7.4.4 Category H: Advanced Parameters

Group H0: Communication parameters

H0.00	Cor	mmunication protocol	Factory default	0
ПО.00	Setting range	0 to 1	Minimum unit	1

0: ModBus

Factory default is ModBus protocol and interface. See chapter 12.2 "ModBus Protocol" on page 201.

1: PROFIBUS

An optional Rexroth PROFIBUS adapter is needed. See chapter 12.3 "PROFIBUS Protocol" on page 216.

H0.01		Baud rate	Factory default	3
110.01	Setting range	0 to 5	Minimum unit	1

Used to select data transmission speed between external computer and frequency converter. Available baud rate includes:

- 0: 1200 bps
- 1: 2400 bps
- 2: 4800 bps
- 3: 9600 bps
- 4: 19200 bps
- 5: 38400 bps



The baud rate of frequency converter must be the same as that of external computer; otherwise, normal communication is impossible.

H0.02		Data format	Factory default	0
110.02	Setting range	0, 1, 2	Minimum unit	1

- 0: N, 8, 2 (1 start bit, 8 data bits, 2 stop bits, without check)
- 1: E, 8, 1 (1 start bit, 8 data bits, 1 stop bit, even check)
- 2: O, 8, 1 (1 start bit, 8 data bits, 1 stop bit, odd check)

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The data format of frequency converter must be the same as that of external computer; otherwise, normal communication is impossible

		Local address		Factory default	0
H0.03	Setting range	ModBus	0 to 247	Minimum unit	1
	Setting range	PROFIBUS	0 to 126	iviii iii iiii iiii iiii iiii	'

- In ModBus communication, the maximum number of frequency converters in the network is 247; 0 is broadcast address.
- In PROFIBUS communication, the maximum number of frequency converters in the network is 126; 0 is invalid address.

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The address of a frequency converter should be unique in the communication network.

H0.04	Р	ZD4, PZD3 setting	Factory default	0
110.04	Setting range	0 to 255	Minimum unit	1
H0.05	Р	ZD6, PZD5 setting	Factory default	0
110.03	Setting range	0 to 255	Minimum unit	1
H0.06	Р	ZD8, PZD7 setting	Factory default	0
110.00	Setting range	0 to 255	Minimum unit	1
H0.07	PZ	ZD10, PZD9 setting	Factory default	0
	Setting range	0 to 255	Minimum unit	1

In PROFIBUS communication, parameters H0.04 to H0.07 are used to set status variables of PZD area. See chapter 12.3.4 "Periodical Data Communication" on page 219.

	Communication	on disconnection detection time	Factory default	10.0s
H0.08	Setting range	0.0 to 60.0s	Minimum unit	0.1s
	Setting range	(0.0s: deactivated)	William and	0.15

- 0.0: communication disconnection detection is deactivated.
- 0.1 to 60.0s: if the interval between the current communication and next communication exceeds the communication disconnection detection time, the system will detect timeout and act according to parameter 'Communication disruption action' H0.09.



Normally, this parameter is deactivated. This parameter can be used to monitor the conditions of communication if continuous communication is required in a system.

H0.09	Communi	Communication disconnection action		0
110.03	Setting range	0, 1	Minimum unit	1

- 0: If communication is timeout, the motor freewheels to stop.
- 1: If communication is timeout, the motor keeps running at the set frequency.

H0.10		Reserved	Factory default	0
110.10	Setting range	0 to 65535	Minimum unit	1

Error No.	Error name and code	Possible reason	Solution
		1. Discontinuous or abnormal load in run mode	1. Check load
	rent speed 1)	2. Low mains voltage	2. Check voltage of input power supply: 3 AC 380 to 480 V (-15 % / +10 %)
1	Over current at constant speed (O.C1)	Motor power and converter power do not match	Motor power has to match with converter power
	at c	4. Too large inertia or load	4. Check motor power, converter power, load
		5. Pulse encoder error	5. Check pulse encoder and its connection
		1. Too large start frequency	1. Reduce start frequency
		2. Too large load rotation inertia, too large impact load	Increase acceleration time, reduce sudden load change
	nt ation	3. Improper motor parameter setting	3. Set motor parameters properly or auto tune motor parameters (group S2)
2	Over current during acceleration (O.C2)	4. Direct start during motor running	4. Restart after motor stop, or start with rotation speed capture (group b1)
	Ove ring	5. Too short acceleration time	5. Increase acceleration time
	np	6. Motor power and converter power do not match	6. Motor power has to match with converter power
		7. Pulse encoder error	7. Check pulse encoder and its connection
		8. Improper V/F curve	8. Adjust V/F curve setting and torque increase
	ion	Improper motor parameter setting	Set motor parameters properly or auto tune motor parameters (group S2)
	current scelerat C3)	2. Too large load rotation inertia	2. Use suitable brake components
3	ver curre y decele (O.C3)	3. Too short deceleration time	3. Increase deceleration time
	Over current during deceleration (O.C3)	Motor power and converter power do not match	4. Motor power has to match with converter power
		5. Pulse encoder error	5. Check pulse encoder and its connection
	ed	1. Acceleration / deceleration time is too short	Increase acceleration/ deceleration time
	Over voltage constant speed (O.E1)	2. Abnormal input power supply	2. Check input power supply
4	er vo ıstan O.E.	3. Too much load change	3. Use suitable brake components
	at con	4. Improper speed loop parameter setting in vector control	4. Adjust PI parameters of speed loop (group S1)
	tion	1. Acceleration time is too short	1. Increase acceleration time
	voltage accelerati .E2)	2. Abnormal input power supply	2. Check input power supply
5	Over voltage during acceleration (O.E2)	3. Direct start during motor running	Restart after motor stop, or start with rotation speed capture (group b1)

Error No.	Error name and code	Possible reason	Solution
	tion	1. Too large load rotation inertia	Use suitable brake components
6	Over voltage during deceleration (O.E3)	2. Too short deceleration time	2. Increase deceleration time
		1. Long time over load	Reduce over load time, reduce load Overload capability: 150 % of rated current for 60s 180 % of rated current for 10s
	load	2. Improper V/F curve settings	2. Adjust V/F curve settings
7	Converter over load (O.L1)	Motor power and converter power do not match	Motor power has to match with converter power
	Convert (C	4. Improper motor parameters setting	4. Set motor parameters properly or auto tune motor parameters (group S2)
		5. Direct start during motor running	5. Restart after motor stop, or start with rotation speed capture (group b1)
		6. Low mains voltage	6. Check input power supply
		7. Too short acceleration time	7. Increase acceleration time
		1. Motor locked	1. Prevent motor lock
	oad	2 Normal motor runs long time with heavy load at low speed	Use variable frequency motor or increase converter output frequency
8	Motor over load (O.L2)	3. Low voltage of input power supply	3. Check input power supply
	or over l (O.L2)	4. Improper V/F curve settings	4. Adjust V/F curve setting and torque increase
	Mot	5. Locked-rotor or sudden load increase	5. Check load
		6. Improper setting of motor over load protection factor	6. Adjust setting of motor over load protection factor (group E4)
9	CPU read/ write error (R.E.)	Error or illegal data in control board read/write	Contact with technical service
10	Operating panel read/write error (KEY-)	Error or illegal data in operating panel read/write	Contact with technical service
11	External device error (ESt)	External error caused by input signals via external terminals	Check external terminals status, check respective reason to error

Error No.	Error name and code	Possible reason	Solution
	tion	1. Device connection problem	Check device communication connection
12	Communication error (R.S.)	2. Improper baud rate setting	2. Set proper baud rate
13	Circuit disconnection (C.F.)	Current detection channel abnormal	Contact with technical service
	der n error	1. Pulse encoder error	Check operations of mechanical part and electrical part of encoder, power supply and connections
14	e encoder detection er PULS)	2. Pulse encoder connection problem	2. Replace encoder connection cable
14	Pulse encoder speed detection error (PULS)	3. Improper setting of pulse encoder	Set parameters related to pulse encoder properly
	Motor overheat (M.O.H.)	1. Continuous low speed running for a long time	1. Use a special motor
15		2. Over load	2. Reduce over load time, reduce load
		3. Temperature sensor error	Replace the temperature sensor or contact with technical service
16	EMI error (CPU-)	CPU malfunction due to external interference	Remove environmental interference or EMI
17	Short circuit (S.C.)	1. Too large output current	Check if motor short circuit, motor to earth short circuit, over load exists
	ω :2 (0)	2. Power component error	2. Contact with technical service
18		Rese	rved
	L3 input e loss H.L)	Abnormal, omitted or broken connection of converter power supply	Follow operating procedures to check power supply connections, remove omitted or broken connections
19		2. Broken fuse	2. Check fuse
	L1, L2, phas (IP	3. Imbalance in the three phases of input power supply	Check installation wiring and input voltage
	W output ase loss DPH.L)	Abnormal, omitted or broken connection of converter outputs	Check connections of frequency converter outputs, remove omitted or broken connections
20	U, V, W outp phase loss (OPH.L)	2. Imbalance in the three phases of outputs	2. Check motor
21	Fv over heat (C.O.H.)	1. Converter over heat	Reduce ambient temperature, improve ventilation and heat dissipation; clear dust, cotton wadding in air ducts; check fan and its power supply connection
	6 5	2. Temperature detection circuit error	2. Contact with technical service

Error No.	Error name and code	Possible reason	Solution
22	Parameter setting error (PRSE)	Improper setting of parameters	Check set values of parameters
	eter g error E)	Power of special or normal motor does not match with converter power	Check if the motor is special motor, check if the motor power matches with converter power
23	Parameter o-tuning er (TUNE)	2. Improper setting of motor parameters	2. Set parameters according to motor nameplate
	Paramet auto-tuning (TUNE)	3. No connection of converter with motor	3. Check motor cable connections
24	Frequency converter over load pre-warning 2	See descriptions of option 14 of parameters E1.00 to E1.02	Reduce over load time, reduce load

Tab.8-1: Error types and solutions

9 Technical Data

9.1 Electrical Data

400 V series

Fv type code	0K40	0K75	1K50	2K20	4K00	5K50	7K50
Output power [kW]	0.4	0.75	1.5	2.2	4.0	5.5	7.5
Rated input current [A]	1.6	3.7	5.1	7.6	16.0	16.5	23.5
Rated output current [A]	1.3	2.5	4.0	5.5	10.0	13.0	17.0
Apparent power [kVA]	0.8	1.6	2.6	3.6	6.5	8.5	11.0
Fv type code	11K0	15K0	18K5	22K0	30K0	37K0	45K0
Output power [kW]	11.0	15.0	18.5	22.0	30.0	37.0	45.0
Rated input current [A]	36.0	46.0	48.0	53.0	73.0	88.0	104.0
Rated output current [A]	24.0	33.0	39.0	44.0	60.0	75.0	95.0
Apparent power [kVA]	15.0	21.0	24.0	30.0	40.0	50.0	62.0
Fv type code	55K0	75K0	90K0				
Output power [kW]	55.0	75.0	90.0				
Rated input current [A]	119.0	157.0	184.0				
Rated output current [A]	110.0	152.0	176.0				
Apparent power [kVA]	75.0	100.0	116.0				

Tab.9-1: Fv electrical data

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The complete Fv type code is:

FVCA01.1-xxxx-3P4-MDA-LN-NNNN-01V01

9.2 General Technical Data

lan. d	Power supply voltage	3 AC 380 to 480 V (-15 % / +10 %) (TN-Net)	
Input	Power supply frequency	50 to 60 Hz (±5 %)	
	Rated output voltage	Corresponding to input voltage	
Output	Output frequency	0 to 400 Hz	
Output	Overland canability	150 % of rated current for 60s	
	Overload capability	180 % of rated current for 10s	
		V/F control (V/F)	
	Control mode	Sensorless vector control (SVC)	
		Field oriented vector control (FOC)	
	Speed regulation range	SVC: 100:1; FOC: 1000:1	
	Start up tarqua	SVC: 150 % × rated torque at 0.5 Hz	
	Start-up torque	FOC: 200 % × rated torque at 0 Hz	
Main	Eraguanay recolution	Analog setting: 1 / 2048 × maximum frequency	
Functions	Frequency resolution	Digital setting: 0.01 Hz	
Turicuons	Frequency setting accuracy	Analog setting: 0.05 %; digital setting: 0.01 %	
	Francisco control accounts	SVC: 0.5 % × maximum frequency	
	Frequency control accuracy	FOC: 0.05 % × maximum frequency	
	Multiple speed control	Via integrated logic control or digital inputs	
	Status messages via multi-function output signal	Outputs of Run, frequency level detection signal, frequency arrival signal, errors, etc.	
	Automatic PWM frequency adaptation	Load-dependent adaptation of PWM frequency	
	Control commands	Set by operating panel, analog and digital inputs, serial port	
Customized	Frequency setting	Set by digital operating panel, analog voltage, analog current and serial port, which can be switched at any time	
functions	Auxiliary frequency setting	Flexible frequency fine tuning and frequency source combination (see parameter E0.09)	
	Analog outputs	Analog signal output, 0 to 20 mA or 0 to 10 V or -10 to 0 V, to output physical values, such as output frequency	
Operating panel	LCD display	Easy commissioning, display Run status, parameter values and operating indications	
	LED indicator	Showing set direction, Run status	
Protection	Input phase failure protection, output phase failure protection, output short circuit protection, grounding protection, over current protection, over voltage protection, under voltage protection, overload protection, frequency converter overheat protection, motor overheat protection		
Optional parts	Brake chopper, brake resistor, remote operation adapter, communication cable for cabinet control, Mod-Bus/PROFIBUS adapter		

	Power reduction/maximum installation height	Up to 1000 m above sea level: none;
		-10 °C to 40 °C (without condensation and frost);
Environment	Ambient temperature	derating between 40 °C and 50 °C, see fig. 9-1 "Derating and ambient temperature" on page 157
	Relative humidity	< 90 % RH (without condensation)
	Shocking	< 5.9 m/s ² (0.6 g)
	Allowed pollution degree	2 (EN 50178)
Construction	Degrees of protection	IP20 (control cabinet mounting)
Construction	Cooling type	Enforced, air cooling
Mounting mode	Hanging on the wall	

Tab.9-2: General technical data

9.3 **Derating of Electrical Data**

9.3.1 **Derating and Ambient Temperature**

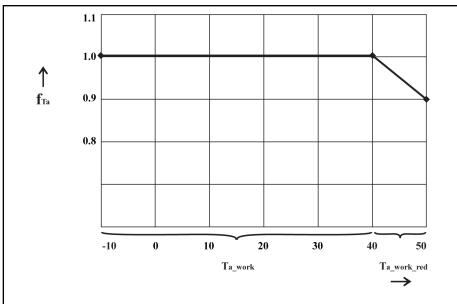
Where installation conditions differ, the following performance data are reduced in accordance with the diagram:

- Frequency converter continuous power output
- Frequency converter continuous current output

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Use outside of the indicated installation conditions is not allowed, even if the performance data are additionally reduced.

As the ambient temperature increases, the capacity utilization of the frequency converter is reduced according to the figure below.



load factor f_{Ta}

 $\mathsf{T}_{\mathsf{a_work}}$ ambient temperature range for operation with nominal data

ambient temperature range for operation with reduced nominal data $T_{a_work_red}$ Derating and ambient temperature

Fig.9-1:

9.3.2 Derating and Mains Voltage

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Reduced over current capability based on mains voltage

The Fv frequency converters are thermally dimensioned for the rated currents. This rated current is available with the specified rated voltage. With deviating voltages in the permissible range, please note the following:

- Umains<Urated: With mains voltages below the rated voltage, no higher currents may be withdrawn to keep the same dissipated power.
- Umains>Urated: With mains voltages greater than the rated voltage, a reduction of the continuous output current in the permissible range takes place to compensate for the increased switching losses.

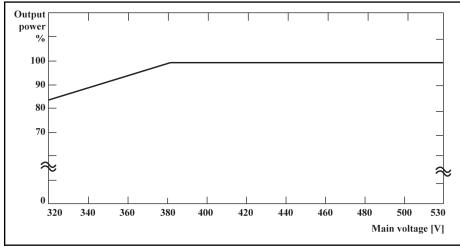


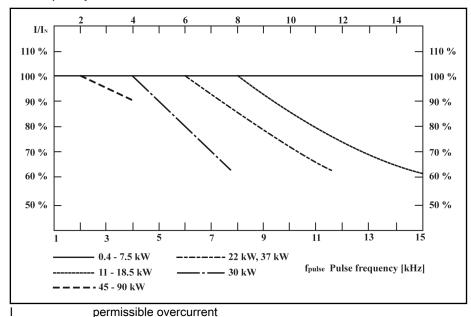
Fig.9-2: Derating and mains voltage

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At mains voltage < 380 V: 1 % power derating every 4 V.

Derating of the Output Current Depending on the Pulse Frequency 9.3.3

In case of higher pulse frequency, the current is reduced insofar that the power dissipation in power section remains more or less constant. The figure below shows the current reduction based on the pulse frequency for the different frequency converters.



rated current I_{N} Fig.9-3: Derating and output current





- with 0K40 to 7K50, the current does not need derating
- with 11K0 to 18K5 at 8.0 kHz, in 0.1 kHz steps
- with 22K0 and 37K0 at 6.0 kHz, in 0.1 kHz steps
- with 30K0 at 4.0 kHz, in 0.1 kHz steps
- with 45K0 to 90K0 at 2.0 kHz, in 0.1 kHz steps

9.4 Electromagnetic Compatibility (EMC)

9.4.1 EMC Requirements

General information

The electromagnetic compatibility (EMC) or electromagnetic interference (EMI) includes the following requirements:

- Sufficient noise immunity of an electric installation or an electric device against external electric, magnetic or electromagnetic interference via lines or through air.
- Sufficiently low noise emission of electric, magnetic or electromagnetic noise of an electric installation or an electric device to other surrounding devices via lines or through air.

Noise immunity in the drive system

Basic structure for noise immunity

The figure below illustrates the interference for definition of noise immunity requirements in the drive system.

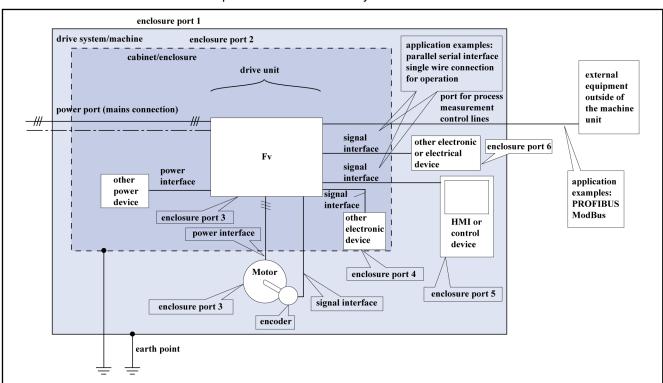


Fig.9-4: Noise immunity in the drive system

Noise immunity limit values

Place of effect	Phenom- enon	Standard	Conditions	Coupling	Test values according to standard EN 61800-3	Performance level
	ESD	IEC 61000-4-2	_	CD, AD	4 kV CD, 8 kV AD	В
Enclosure port	RF field	IEC 61000-4-3	-	Via antenna on EUT	10 V/m, 80 – 1000 MHz 3 V/m, 1400 – 2000 MHz 1 V/m, 2000 – 2700 MHz	А
	Burst	IEC 61000-4-4	-	mains connection I<100 A: CDN; I≥100 A: clamp or CN	2 kV / 5 kHz (CN or CDN) 4 kV / 2.5 kHz (clamp)	В
Power port	Surge	IEC 61000-4-5	only mains connection; I<63 A, light load test	-	line-line 1 kV line-earth 2 kV	В
	Conducted radiofrequency common mode	IEC 61000-4-6	Length>3 m	clamp	10 V, 0.15 – 80 MHz	А
Power interface	Burst	IEC 61000-4-4	Length>3 m	clamp	2 kV / 5 kHz	В
	Burst	IEC 61000-4-4	Length>3 m	clamp	1 kV / 5 kHz	В
Signal interface	Conducted radiofrequency common mode	IEC 61000-4-6	Length>3 m	clamp or CDN	10 V, 0.15 – 80 MHz	А
	Burst	IEC 61000-4-4	Length>3 m	clamp	2 kV / 5 kHz	В
Ports of process; measurement control lines	Conducted radiofrequency common mode	IEC 61000-4-6	length>3 m	clamp or CDN	10 V, 0.15 – 80 MHz	А

CD contact discharge AD air discharge

CDN coupling and decoupling network

CN coupling network

Tab.9-3: Noise immunity limit values

Evaluation criterion

Evaluation criterion	Explanation (abbreviated form from EN 61800-3)
Α	Deviations within allowed range
В	Automatic recovery after interference
С	Switched off without automatic recovery, device remains undamaged

Tab.9-4: Evaluation criterion

Noise emission of the drive system

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Causes of noise emission

Controlled variable-speed drives contain converters containing snappy semiconductors. The advantage of modifying the speed with high precision is achieved by means of pulse width modulation of the converter voltage. This can generate sinusoidal currents with variable amplitude and frequency in the motor.

The steeper voltage rises, the higher clock rate and the resulting harmonics cause unwanted but physically unavoidable emission of interference voltage and interference fields (wide band interference). The interference mainly is asymmetric interference against ground.

The propagation of this interference strongly depends on:

- configuration of the connected drives
- number of the connected drives
- conditions of mounting
- site of installation
- radiation conditions
- wiring and installation

If the interference gets from the device to the connected lines in unfiltered form, these lines can radiate the interference into the air (antenna effect). This applies to power lines, too.

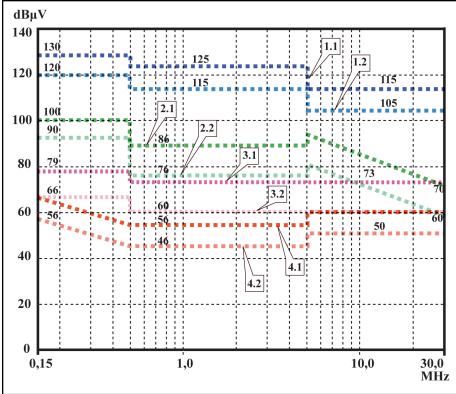
Limit values for line-based disturbances

According to IEC EN 61800-3 or CISPR 11 (corresponds to EN 55011), the limit values in the table below are distinguished. For this documentation both standards are combined in the limit value classes A2.1 to B1.

IEC / EN 61800-3	CISPR 11	Explanation	In this documentation	Curves of limit value characteristic
Category C4 2 nd environment	None	One of the following 3 requirements must have been fulfilled: Mains connection current>400 A, IT mains or required dynamic drive behavior not reached by means of EMC filter. Adjust limit values to use and operation on site.	None	-
		User has to carry out and provide evidence of EMC planning.		
Category C3 2 nd environment	Class A; group 2	limit value in industrial areas to be complied with for applications operated at supply mains with nominal currents>100 A	A2.1	1.1 1.2
Category C3 2 nd environment	Class A; group 2 I≤100 A	limit value in industrial areas to be complied with for applications operated at supply mains with nominal currents≤100 A	A2.2	2.1 2.2
Category C2 1 st environment	Class A; group 1	limit value in residential area or at facilities at low-voltage mains supplying buildings in residential areas to be complied with	A1	3.1 3.2
Category C1 1 st environment	Class B; group 1	limit value in residential areas to be complied with	B1	4.1 4.2

Tab.9-5: Limit values for line-based disturbances

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1.1 C3	2 nd environment, QP, I>100 A (class A, group 2, I>100 A)
1.2 C3	2 nd environment, AV, I>100 A (class A, group 2, I>100 A)
2.1 C3	2 nd environment, QP, I≤100 A (class A, group 2, I≤100 A)
2.2 C3	2 nd environment, AV, I≤100 A (class A, group 2, I≤100 A)
3.1 C2	1 st environment, QP (1 st environment, even if source of interference in 2 nd environment) (class A, group 1)
3.2 C2	1 st environment, AV (1 st environment, even if source of interference in 2 nd environment) (class A, group 1)
4.1 C1	1 st environment, QP (1 st environment, even if source of interference in 2 nd environment) (class B, group 1)
4.2 C1	1 st environment, AV (1 st environment, even if source of interference in 2 nd environment) (class B, group 1)
Fig.9-5:	Limit values for line-based disturbances (IEC 61800-3); limit characteristic through frequency range

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- Limit value for 1st environment is also relevant, if source of interference of 2nd environment affects 1st environment.
- Designations "class" and "group" according to CISPR 11.
- QP: measuring method quasi peak measurement.
- AV: measuring method arithmetic averaging.

Second Environment, Industrial Area

Facilities not directly connected to a low-voltage mains to supply buildings in residential areas.

If the limit values in an industrial area separated from public supply by a transformer station only have to be complied with at the property boundary or in the neighboring low-voltage mains, the filter might not be necessary. In the vicinity such as measuring sensors, measuring lines or measuring devices, it is normally required to use the interference suppression filter.

Increasing the noise immunity of a sensitive device can often be the economically better solution compared to measures of interference suppression at the drive system of installation.

First Environment

Environment containing residential areas and facilities directly connected, without interstage transformer, to a low-voltage mains supplying buildings in residential areas.

Medium-sized manufacturing plants and industrial establishments can be connected to the public low-voltage mains together with residential buildings. In this case there is a high risk for radio and television reception if there are not any measures for radio interference suppression taken. Therefore, the indicated measures are generally recommended.

Nominal Current of Supply Mains

The nominal current of the supply mains (> 100 A or ≤100 A) is specified by the local power supply company at the connection point of the mains. For industrial companies, for example, such connection points are the interconnecting stations from the power supply company.

Since it is impossible to obtain the lower limit values for residential areas with all applications by means of usual measures (like in the case of large and electrically not closed installations, longer motor cables or a large number of drives), the following note included in EN 61800-3 has to be observed.



Components of Fv drive system are products of category C3 according to IEC 61800-3. They are not provided for use in a public low-voltage mains supplying residential areas. If they are used in such a mains, high-frequency interference is to be expected. This can require additional measures of radio interference suppression.

See the following chapters for the limit classes (as per categories C1, C2, C3, C4 according to EN 61800-3) which can be reached for Bosch Rexroth Frequency Converter Fv.

9.4.2 Ensuring the EMC Requirements

Standards and laws

On the European level there are the EU Directives. In the EU states these Directives are transformed into laws valid on a national level. The relevant directive for EMC is EU Directive 2004/108/EC which was transformed on the national level in Germany into the law EMVG ("Law concerning electromagnetic compatibility of devices") of 2008-02-26.

EMC Properties of Components

Drive and control components by Rexroth are designed and built, in accordance with the present state-of-the-art of standardization, according to legal regulations of the EU Directive EMC 2004/108/EC and the German law.

The compliance with EMC standards was tested by means of a typical arrangement with a test setup conforming to standard with the indicated external mains filters. The category C3 requirements according to product standard EN 61800-3 have been complied with.

Applicability for End Product

Measurements of the drive system with an arrangement typical for the system are not in all cases applicable to the status in a machine or installation. Noise immunity and noise emission strongly depend on:

- configuration of the connected drives
- number of the connected drives
- conditions of mounting
- site of installation
- radiation conditions
- wiring and installation

In addition, the required measures depend on the requirements of electric safety technology and economic efficiency in the application.

In order to prevent interference as far as possible, notes on mounting and installation are contained in the application manuals of the components and in this documentation.

Cases to Distinguish for Declaration of EMC Conformity

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For validity of the harmonized standards, we distinguish the following cases:

Case 1: Delivery of the drive system.

According to the regulations, Rexroth drive systems are complied with product standard EN 61800-3 C3. The drive system is listed in the declaration of EMC conformity. This fulfills the legal requirements according to EMC directive.

Case 2: Acceptance test of a machine or installation with the installed drive systems.

The product standard for the respective type of machine/installation, if existing, applies to the acceptance test of the machine or installation. In the last years, some new product standards were created at present.

These new product standards contain references to the product standard EN 61800-3 for drives or specify higher-level requirements demanding increased filter and installation efforts. When the machine manufacturer wants to put the machine/installation into circulation, the product standard relevant to his machine/installation has to be complied with for his end product "machine/installation". The authorities and test laboratories responsible for EMC normally refer to this product standard.

This documentation specifies the EMC properties which can be achieved, in a machine or installation, with a drive system consisting of the standard components.

It also specifies the conditions under which the indicated EMC properties can be achieved.

9.4.3 **EMC Measures for Design and Installation**

Rules for design of installations with drive controllers in compliance with EMC

The following rules are the basics for designing and installing drives in compliance with EMC:

Mains Filter

Correctly use a mains filter recommended by Rexroth for radio interference suppression in the supply feeder of the drive system.

Control Cabinet Grounding

Connect all metal parts of the cabinet with one another over the largest possible surface area to establish a good electrical connection. This, too applies to the mounting of the external mains filter. If required, use serrated washers which cut through the paint surface. Connect the cabinet door to the control cabinet using the shortest possible grounding straps.

Line Routing

Avoid coupling routs between lines with high potential of noise and noise-free lines; therefore, signal, mains and motor lines and power cables have to be routed separately from another. Minimum distance: 10 cm. Provide separating sheets between power and signal lines. Ground separating sheets several times.

The lines with high potential of noise include:

- Lines at the mains connection (incl. synchronization connection)
- Lines at the motor connection
- Lines at the DC bus connection

Generally, interference injections are reduced by routing cables close to grounded sheet steel plates. For this reason, cables and wires should not be routed freely in the cabinet, but close to the cabinet housing or mounting panRexroth Frequency Converter Fv

Technical Data

els. Separate the incoming and outgoing cables of the radio interference suppression filter.

Interference Suppression Elements

Provide the following components in the control cabinet with interference suppression combinations:

- Contactors
- Relays
- Solenoid valves
- Electromechanical operating hours counters

Connect these combinations directly at each coil.

Twisted Wires

Twist unshielded wires belonging to the same circuit (feeder and return cable) or keep the surface between feeder and return cable as small as possible. Wires that are not used have to be grounded at both ends.

Lines of Measuring Systems

Lines of measuring systems must be shielded. Connect the shield to ground at both ends and over the largest possible surface area. The shield may not be interrupted, e.g. using intermediate terminals.

Digital Signal Lines

Ground the shields of digital signal lines at both ends (transmitter **and** receiver) over the largest possible surface area and with low impedance. This avoids low frequency interference current (in the mains frequency range) on the shield.

Analog Signal Lines

Ground the shields of analog signal lines at one end (transmitter **or** receiver) over the largest possible surface area and with lower impedance. This avoids low frequency interference current (in the mains frequency range) on the shield.

Connection of Mains Choke

Keep connection lines of the mains choke at the drive controller as short as possible and twist them.

Installation of Motor Power Cable

- Use shield motor power cable or run motor power cables in a shielded duct.
- Use the shortest possible motor power cable.
- Ground shield of motor power cable at both ends over the largest possible surface area to establish a good electrical connection;
- It is recommended to run motor lines in shielded form inside the control cabinet.
- Do not use any steel-shielded lines.
- The shield of the motor power cable must not be interrupted by mounted components, such as output chokes, sine filter or motor filters.

EMC-optimal installation in facility and control cabinet

General Information

For EMC-optimal installation, a special separation of the interference-free area (mains connection) and the interference-susceptible area (drive components) is recommended, as shown in the figures below.



- For EMC-optimal installation in the control cabinet, use a separate control cabinet panel for the drive components.
- Frequency converters need to be mounted in metal cabinet and connected to power supply with grounding.
- For frequency converters with internal filter, the maximum length of shielded cable between the motor and frequency converter is 5 m.
- For the end application system with frequency converters, the conformity of EMC directions needs to be confirmed.

Division into Areas (zones)

Exemplary arrangements in the control cabinet: See fig. 9-6 "Control Cabinet Mounting According to Interference Areas – Exemplary Arrangements" on page 169.

We distinguish three areas:

Interference-free area of control cabinet (area A):

This includes:

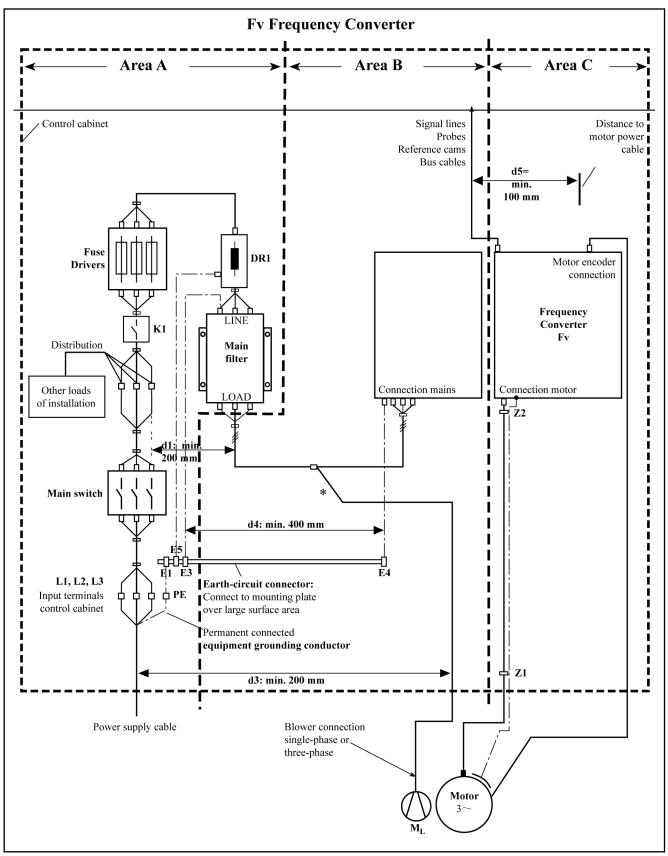
- Supply feeder, input terminals, fuse, main switch, mains side of mains filter for drives and corresponding connecting lines;
- Control voltage or auxiliary voltage connection with power supply unit, fuse and other parts unless connection is run via the mains filter of the AC drives:
- All components that are not electrically connected with the drive system.
- 2. Interference-susceptible area (area B):
 - Mains connections between drive system and mains filter for drives, mains contactor;
 - Interface lines of drive controller
- 3. Strongly interference-susceptible area (area C):
 - Motor power cables including single cores

Never run lines of one of these areas in parallel with lines of another area so that there is not any unwanted interference injection from one area to the other and that the filter is jumped with regard to high frequency. Use the shortest possible connecting lines.

Recommendation for complex systems: Install drive components in one cabinet and the control units in a second, separate cabinet.

Badly grounded control cabinet doors act as antennas. Therefore, connect the control cabinet doors to the cabinet on top, in the middle and on the bottom via short equipment grounding conductors with a cross section of at least 6 mm² or, even better, via grounding straps with the same cross section. Make sure connection points have good contact.

Control cabinet mounting according to interference areas – exemplary arrangements



E1...E5 Equipment grounding conductor or the components

External mains contactor K1

Motor blower M_L

Z1, Z2 Shield connection points for cables

Fig.9-6: Control Cabinet Mounting According to Interference Areas - Exempla-

ry Arrangements

Design and installation in area A – interference-free area of control cabinet

Arrangement of the Components in the Control Cabinet

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Comply with a distance of at least 200 mm (distance d1 in the figure):

Between components and electrical elements (switches, pushbuttons, fuses, terminal connectors) in the interference-free area A and the components in the two other areas B and C

Comply with a distance of at least 400 mm (distance d4 in the figure):

Between magnetic components (such as transformers, mains chokes and DC bus chokes that are directly connected to the power connections of the drive system) and the interference-free components and lines between mains and filter including the mains filter in area A

If these distances are not kept, the magnetic leakage fields are injected to the interference-free components and lines connected to the mains and the limit values at the mains connection are exceeded in spite of the installed filter.

Cable Routing of the Interferencefree Lines to the Mains Connec-

tion

Comply with a distance of at least 200 mm (distance d1 and d3 in the figure):

Between supply feeder or lines between filter and exit point from the control cabinet in area A and the lines in area B and C

If this is impossible, there are two alternatives:

- Install lines in shielded form and connect the shield at several points (at least at the beginning and at the end of the line) to the mounting plate or the control cabinet housing over a large surface area.
- 2. Separate lines from the other interference-susceptible lines in areas B and C by means of a grounded distance plate vertically attached to the mounting plate.

Install the shortest possible lines within the control cabinet and install them directly on the grounded metal surface of the mounting plate or of the control cabinet housing.

Mains supply lines from areas B and C must not be connected to the mains without a filter.



In case you do not observe the information on cable routing given in this section, the effect of the mains filter is totally or partly neutralized. This will cause the noise level of the interference emission to be higher within the range of 150 kHz to 40 MHz and the limit values at the connection points of the machine or installation will thereby be exceeded.

Routing and Connecting a Neutral Conductor (N) If a neutral conductor is used together with a three-phase connection, it must not be installed unfiltered in areas B and C, in order to keep interference off the mains.

Motor Blower at Mains Filter

Single-phase or three-phase supply lines of motor blowers, that are usually routed in parallel with motor power cables or interference-susceptible lines.

In drive system with only infeeding supply units, via the available three phase filter of the drive system

When switching power off, make sure the blower is not switched off.

Rexroth Frequency Converter Fv

Technical Data

Loads at Mains Filter of Drive Sys-

Only operate allowed loads at the mains filter of the drive system!

Shielding Mains Supply Lines in Control Cabinet

If there is a high degree of interference injection to the mains supply line within the control cabinet, although you have observed the above instructions (to be found out by EMC measurement according to standard), proceed as follows:

- Only use shielded lines in area A
- Connect shields to the mounting plate at the beginning and the end of the line by means of clips

The same procedure may be required for long cables of more than 2 m between the point of power supply connection of the control cabinet and the filter within the control cabinet.

Mains Filters for AC Drives

Ideally, mount the external mains filter on the parting line between area A and B. Make sure the ground connection between filter housing and housing of the drive controllers has good electrically conductive properties.

If **single-phase** loads are connected on the load side of the external filter, their current may be a maximum of 10 % of the three-phase operating current. A highly imbalanced load of the external filter would deteriorate its interference suppression capacity.

If the mains voltage is higher than 480 V, connect the external filter to the output side of the transformer and not to the supply side of the transformer.

Grounding

In the case of bad ground connections in the installation, the distance between the lines to the grounding points E1, E2 in area A and the other grounding points of the drive system should be at least d4=400 mm, in order to minimize interference injection from ground and ground cables to the power input lines.

See also "Division into Areas (zones)" on page 168.

Point of Connection for Environment Grounding Conductor at Machine, Installation, Control Cabinet

The equipment grounding conductor of the power cable of the machine, installation or control cabinet has to be permanently connected at point PE and have a cross section of at least 10 mm² or to be complemented by a second equipment grounding conductor via separate terminal connectors (according to EN 61800-5-1: 2007, section 4.3.5.4). If the cross section of the outer conductor is bigger, the cross section of the equipment grounding conductor must be accordingly bigger.

Design and installation in area B – interference –susceptible area of control cabinet

Arranging Components and Lines

Modules, components and lines in area B should be placed at a distance of at least d1=200 mm from modules and lines in area A.

Alternative: Shield modules, components and lines in area B by distance plates mounted vertically on the mounting plate from modules and lines in area A or use shield lines.

Only connect power supply units for auxiliary or control voltage connections in the drive system to the mains via a mains filter. See "Division into Areas (zones)" on page 168.

Install the shortest possible lines between drive controller and filter.

Control Voltage or Auxiliary Voltage Connection

Only in exceptional cases should you connect power supply unit and fusing for the control voltage connection to phase and neutral conductor. In this case, mount and install these components in area A far away from area B and C of the drive system.

Run the connection between control voltage connection of the drive system and power supply unit used through area B over the shortest distance.

Line Routing

Run the lines along grounded metal surfaces, in order to minimize radiation of interference fields to area A (transmitting antenna effect).

Design and installation in area C – strongly interference-susceptible area of control cabinet

Area C mainly concerns the motor power cables, especially at the connection point at the drive controller.

Influence of the Motor Power Cable The longer the motor cable, the greater its leakage capacitors. To comply with a certain EMC limit value, the allowed leakage capacitance of he mains filter is limited.

Run the shortest possible motor power cables.

Routing the Motor Power Cables and Motor Encoder Cables

Route the motor power cables and motor encoder cables along grounded metal surfaces, both inside the control cabinet and outside of it, in order to minimize radiation of interference fields. If possible, route the motor power cables and motor encoder cables in metal-grounded cable ducts.

Route the motor power cables and motor encoder cables

- with a distance of at least d5=100 mm to inference-free lines, as well as to signal cables and signal lines
 - (alternatively separated by a grounded distance plate)
- in separate cable ducts, if possible

Routing the Motor Power Cables and Mains Connection Lines

For frequency converters (drive controllers with individual mains connection), route motor power cables and (unfiltered) mains connection lines **in parallel for a maximum distance of 300 mm**. After that distance, route motor power cables and power supply cables in opposite directions and preferably in separate **cable ducts**.

Ideally, the outlet of the motor power cables at the control cabinet should be provided in a distance of at least **d3=200 mm** from the (filtered) power supply cable.

Ground connections

Housing and Mounting Plate

By means of appropriate ground connections, it is possible to avoid the emission of interference, because interference is discharged to ground on the shortest possible way.

Ground connections of the metal housings of EMC-critical components (such as filters, devices of the drive system, connection points of the cable shields, devices with microprocessor and switching power supply units) have to be well contacted over a large surface area. This also applies to all screw connections between mounting plate and control cabinet wall and to the mounting of a ground bus to the mounting plate. The best solution is to use a zinc-coated mounting plate. Compared to a lacquered plate, the connections in this area have a good long-time stability.

Connection Elements

For lacquered mounting plates, always use screw connections with tooth lock washers and zinc-coated, tinned screws as connection elements. At the connection points, remove the lacquer so that there is safe electrical contact over a large surface area. You achieve contact over a large surface area by means of bare connection surfaces or several connection screws. For screw connections, you can establish the contact to lacquered surfaces by using tooth lock washers.

Metal Surfaces

Always use connection elements (screws, nuts, plain washers) with good electroconductive surface.

Bare zinc-coated or tinned metal surfaces have **good electroconductive properties**.

Rexroth Frequency Converter Fv

Technical Data

Anodized, yellow chromatized, black gunmetal finish or lacquered metal surfaces have **bad electroconductive properties**.

Ground Wires and Shield Connections

For connecting ground wires and shield connections, it is not the cross section but the size of contact surface that is important, as the high-frequency interference currents mainly flow on the surface of the conductor.

Installing signal lines and signal cables

Line Routing

The following measures are recommend:

- Route signal and control lines separately from the power cables with a
 minimum distance of d5=100 mm (see "Division into Areas (zones)" on
 page 168) or with a grounded separating sheet. The optimum way is to
 route them in separate cable ducts. If possible, lead signal lines into the
 control cabinet at one point only.
- If signal lines are crossing power cables, route them in an angle of 90°in order to avoid interference injection.
- Ground spare cables, that are not used and have been connected, at least at both ends so that they do not have any antenna effect.
- Avoid unnecessary line lengths.
- Run cables as close as possible to grounded metal surfaces (reference potential). The ideal solution are closed, grounded cable ducts or metal pipes which, however, is only obligatory for high requirements (sensitive instrument leads).
- Avoid suspended lines or lines routed along synthetic carries, because they are functioning like reception antennas (noise immunity) and like transmitting antennas (emission of interference). Exceptional cases are flexible cable tracks over short distances of a maximum of 5 m.

Shielding

Connect the cable shield immediately at the devices in the shortest and most direct possible way and over the largest possible surface area.

Connect the shield of analog signal lines at one end over a large surface area, normally in the control cabinet at the analog device. Make sure the connection to ground/housing is short and over a large surface area.

Connect the shield of digital signal lines at both ends over a large surface area and in short form. In the case of potential differences between beginning and end of the line, run an additional bonding conductor in parallel. This prevents compensating current from flowing via the shield. The guide value for the cross section is 10 mm².

You absolutely have to equip separate connections with connectors with grounded metal housing.

In the case of non-shielded lines belongs to the same circuit, twist feeder and return cable.

General measures of radio interference suppression for relays, contactors, switches, chokes and inductive loads

If, in conjunction with electronic devices and components, inductive loads, such as chokes, contactors, relays are switched by contacts or semiconductors, appropriate interference suppression has to be provided for them:

- By arranging free-wheeling diodes in the case of d.c. operation
- In the case of a.c. operation, by arranging usual RC interference suppression elements depending on the contactor type, immediately at the inductance

Only the interference suppression element arranged immediately at the inductance does serve this purpose. Otherwise, the emitted noise level is too high which can affect the function of the electronic system and of the drive.

If possible, mechanical switches and contacts should only be realized as snap contacts. Contact pressure and contact material must be suited for the corresponding switching currents.

Slow-action contacts should be replaced by snap switches or by solid-state switches, because slow-action contacts strongly bounce and are in an undefined switching status for a long time which emits electromagnetic waves in the case of inductive loads. These waves are an especially critical aspect in the case of manometric or temperature switches.

Accessories

10 Accessories

10.1 EMC Filter

10.1.1 The Function of EMC Filter

EMC filters are used to reduce radio interference and mains pollution.

B

Fv has an optional internal EMC filter. If higher EMC class is required, please use an external EMC filter.

10.1.2 External EMC Filter Type

Fv model	External EMC filter type code
0K40	
0K75	EENEO4 4A AO75 EO009 A 490 NININI (E0009)
1K50	FENF01.1A-A075-E0008-A-480-NNNN (E0008)
2K20	
4K00	
5K50	FENF01.1A-A075-E0022-A-480-NNNN (E0022)
7K50	
11K0	FENF01.1A-A075-E0030-A-480-NNNN (E0030)
15K0	
18K5	FENF01.1A-A075-E0051-A-480-NNNN (E0051)
22K0	
30K0	FENEOA 4A AOZE FOOOO A 490 NININI (FOOOO)
37K0	FENF01.1A-A075-E0090-A-480-NNNN (E0090)
45K0	EENEO4 4A AO75 E0420 A 490 NININI (E0420)
55K0	FENF01.1A-A075-E0120-A-480-NNNN (E0120)
75K0	EENEO4 4A AO75 EO250 A 490 NININI (E0250)
90K0	FENF01.1A-A075-E0250-A-480-NNNN (E0250)

Tab.10-1: External EMC filter type



The EMC filters listed above are recommended based on tests with 10 m motor cables. If longer motor cables are needed, please use appropriate EMC filters.

Accessories

10.1.3 Technical Data

Mechanical data

Figure

B

Mounting position and distances

Only the mounting position G1 is allowed for EMC filter FENF.

Keep at least 80 mm at the top side and bottom side of EMC filter free from mounted parts.

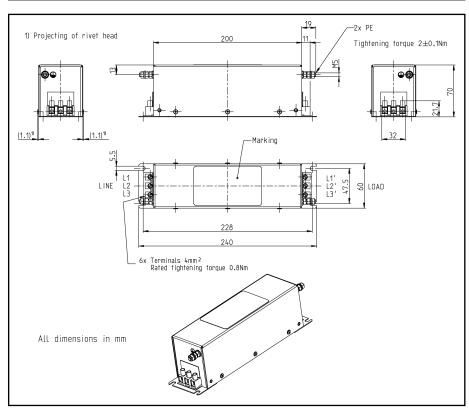


Fig.10-1: E0008

Accessories

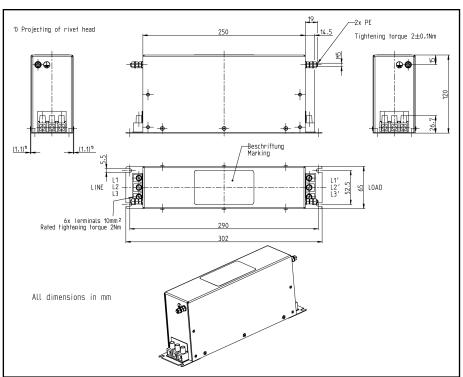


Fig. 10-2: E0022 and E0030

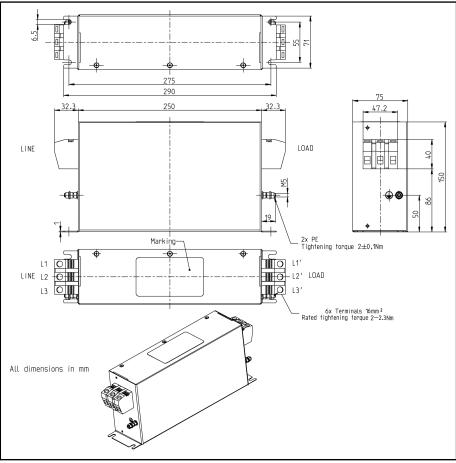


Fig. 10-3: E0051

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Accessories

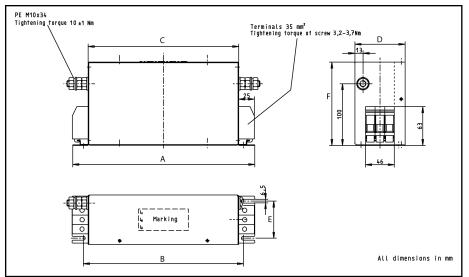
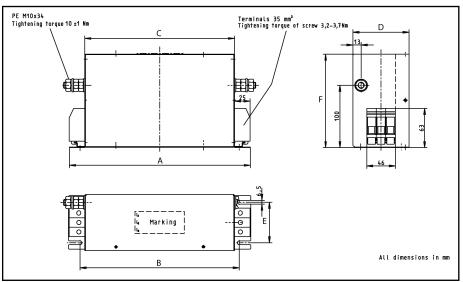


Fig. 10-4: E0090



E0120 Fig. 10-5:

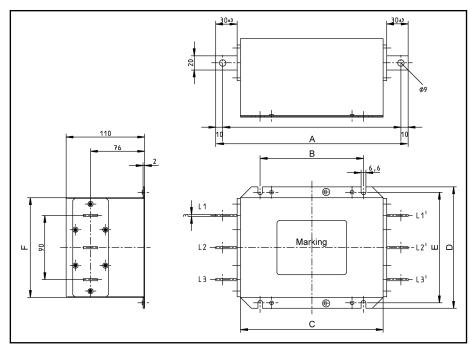


Fig. 10-6: E0250

Dimensions

EMC filter	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	PE size	PE tightening torque [Nm]	Terminal wire size [mm²]	Terminal tightening torque [Nm]
E0008	240	228	200	60	47.5	70	M5	2	4	8.0
E0022	302	290	250	65	52.5	120	M5	2	10	2
E0030	302	290	230	03	32.3	120	IVIO	2	10	2
E0051	314.6	275	250	75	55	150	M5	2	16	2 to 2.3
E0090	290	255	240	80	60	135	M10	10	35	3.2 to 3.7
E0120	290	255	240	90	65	150	M10	10	35	3.2 to 3.7
E0250	250	145	200	170	155	110	Ø6.6	6 to 9	Ø9	6 to 9

Tab. 10-2: Dimensions

Electrical data

B

Using EMC filters in mains grounded via outer conductor

When using EMC filters in **mains grounded via outer conductor**, use an isolating transformer between mains and EMC filter.

Description	Symbol	Unit	E0008	E0022	E0030	E0051	E0090	E0120	E0250			
Degree of protection				•	•	IP20	•	•				
according to IEC60529	_	_				IF ZU						
Listing according to UL standard (UL)	-	_				UL 1283						
Listing according to CSA standard (UL)	_	_				C22.2 No. 8	3					
Mass (weight)	m	kg	1.4	3.0	3.3	4.4	4.2	4.9	5.0			
Mains voltage three-phase at TNS, TN-C, TT mains	U _{LN}	V		380480								
Mains voltage three-phase at Corner- grounded-Delta mains	U _{LN}	V	Not allowed									
Mains voltage three-phase at IT mains	U _{LN}	V				Not allowed	d					
Tolerance U _{LN} (UL)	_	%			+	10 %15	%					
Input frequency (UL)	f _{LN}	Hz				5060						
Nominal current	I _{L_cont}	Α	8	22	30	51	90	120	250			
Calculation of leakage current	I _{leak}	mA	27	19	27	67	18	18	<21			
DC resistance typical value	R _{typ}	_	15 mΩ	8 mΩ	4 mΩ	2.8 mΩ	1.1 mΩ	0.9 mΩ	110 μΩ			
Required wire size according to IEC 60364-5-52; at I _{L_cont}	A _{LN}	mm ²	4	10	10	16	35	35	120 /2×70			
Required wire size according to UL 508 A (internal wiring); at I L_cont (UL)	A _{LN}	AWG	10	8	6	6 (2)	1	3/0	3/0 (2)			

Tab. 10-3: Electrical data

Rexroth Frequency Converter Fv

10.2 Brake Components

10.2.1 Brake Chopper

The function of brake chopper

A brake chopper is used to dissipate the energy produced by the motor during a braking process, resulting in an increased brake capability and faster deceleration of the load without overvoltage trips.

Internal brake chopper

Fv 0K40 to 15K0 have internal brake choppers. External brake resistors are needed to activate the braking function.

The working principle of the brake chopper is shown in figure below.

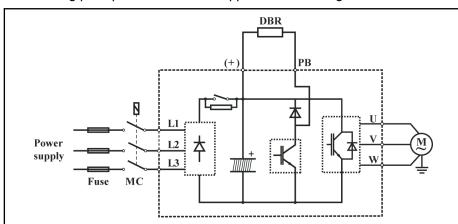


Fig. 10-7: Working principle of internal brake chopper

External brake chopper (18K5 and above models)

Technical data

	Voltage class	AC power supply 380 V - 15 %	480 V + 10 %; 50 / 60 Hz ± 5 %					
Brake o	chopper model-FELB	FELB02.1N-30K0-NNONE-A-560- NNNN (30K0)	FELB02.1N-45K0-NNONE-A-560- NNNN (45K0)					
	Peak current [A]	50	75					
Input and	Rated current [A]	15	25					
Input and output	Braking start-up voltage	630 / 660 / 690 / 730 / 760 V ± 16 V						
specifications	Maximum hysteresis	About 16 V						
	Synchronous signal	Coupled input, coupled output, up to 3 brake choppers at most can be set to operate in parallel						
Power supply	DC BUS voltage range	DC 460 to 800 V						
Duetestien	Overheat of heat sink	It is active when the temperature exc	ceeds +85 °C					
Protection	Error output	RELAY junction 0.6 A 125 VAC / 2 A 30 VDC (T1, T2)						
Indication	Power ON	When voltage (more than 100 V), on the PCB DC mains lead terminal flows in the red "POWER" indicator lights on						
functions	Braking ON	When brake chopper works, the green "BRAKING" indicator lights on						

Tab.10-4: Technical specifications

Dimensions and weight

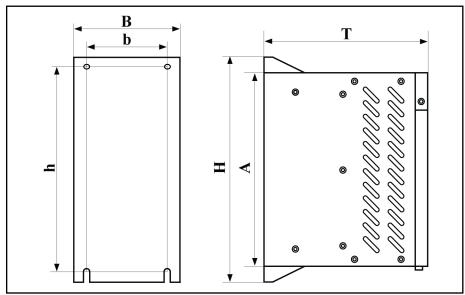


Fig. 10-8: Dimensions diagram

Brake chopper			Dimensio	ons [mm	n]		Weight [kg]	
typecode	В	Н	Т	b	h	Α	weight [kg]	
30K0	103	215	158	78	200	185	2.5	
45K0	103	213	130	70	200	100	2.5	

Tab.10-5: Dimensions and weight

Brake chopper terminals

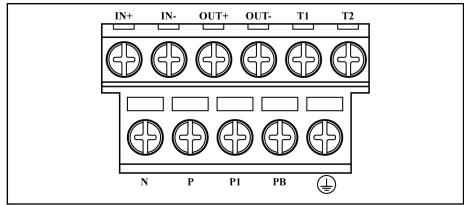


Fig. 10-9: Brake chopper terminals

Wiring on each terminal of brake choppers

Name of terminal		gn of minal	Cable size [AWG]	Screw size	Torque	
Input power supply	1	N, P	- 10 to 12			
Brake resistor	P [']	1, PB	10 10 12			
	input IN+, IN-				18 kgf–cm (15.6 in–ibf)	
Multiple units in parallel	output OUT+, OUT-		18 to 20	M4		
Error output	T.	1, T2				
Grounding			10 to 12			

Tab. 10-6: Wiring on each terminal of brake choppers

Basic wiring diagram

To avoid brake chopper damage or break down in case of overload or error conditions, please refer to the following wiring diagram. The brake chopper FELB error switch should be connected to Xi of Fv. The temperature switch of the brake resistor should be in series with the line contactor coil circuit.

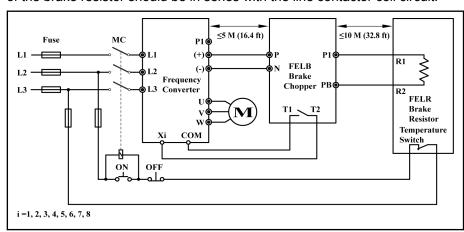


Fig. 10-10: Basic wiring diagram

Bosch Rexroth AG

Accessories



- Do not connect brake chopper input terminal -(N) to the neutral point of the power supply.
- Confirm the polarities of the brake chopper input terminals + (P) and -(N), otherwise the brake chopper will break down immediately at the startup phase of the braking process.
- The wiring distance between the brake chopper and the frequency converter should be not more than 5 m (16.4 ft). The wiring distance between brake chopper and brake resistor should be not more than 10 m (32.8 ft).

A WARNING

The brake resistor connections at the brake chopper (terminals P1 and PB) have no short circuit protection! Wrong wiring will cause damage to the components!

Please ensure the reliable grounding of the brake chopper.

The settings of the brake chopper

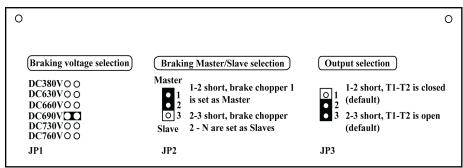


Fig. 10-11: Brake chopper settings

Selection of braking voltage

The 400 V class brake chopper has 5 operating voltages (630 V, 660 V, 690 V, 730 V, 760 V), and power supply of the brake chopper is from +(P), -(N) of the frequency converter. This setting will influence the level of the operating voltage of the brake chopper, which is an important procedure. Please switch the jumpers to the needed operating voltage position, the factory default value of JP1 is 690 V.

The input voltage of the power supply to the frequency converter [V]	380	400	415	440
Braking startup voltage [V]	660	690	730	760

Tab.10-7: Recommended startup braking voltage

Master/Slave setting:

The brake chopper sets JP2 on "MASTER" as factory setting. The master brake chopper will select "MASTER" and the slave unit will select "SLAVE" when two or more brake choppers are applied in parallel.

• Error output selection:

The temperature failure output of the brake chopper is T1-T2; operating temperature is +85 °C. T1-T2 is set normally open as factory default; if normally closed is required, please set JP3, and short circuit 1-2.

As the chart below shows, when multiple units are applied in parallel, the first brake chopper should be set as "MASTER"; all others should be set as "SLAVE".

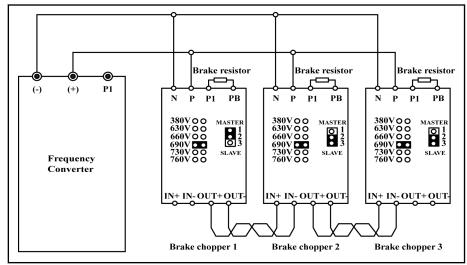


Fig. 10-12: Brake chopper wiring

Definition for braking ratio OT %

As shown in the diagram below, braking ratio OT % is the ratio of the braking time and the braking period, usually represented by percentage. When OT % is selected, the resistance and the power of brake resistor must be taken into consideration so that enough time can be ensured for the brake chopper and the brake resistor to release the heat generated in the braking process.

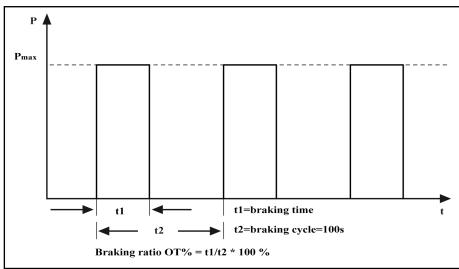


Fig. 10-13: Braking ratio

Error analysis and countermeasures

When there is abnormality with the brake chopper, the thermal protection of the brake chopper will be activated. A failure signal will be sent by the brake chopper to the frequency converter. The abnormality of the brake chopper may result in the failure and warning of the frequency. Make sure to find the cause of failure and run it after the failure is removed.

Item	Error conditions	Failure cause	Countermeasures	
1	The "POWER" light of brake chopper off	Wrong connection	Check if "MASTER" is selected and check wire connection	
		Breakdown of brake chopper IGBT	Replace brake chopper	
2	The "BRAKING" light of brake chopper off	Open circuit with brake resistor	Check brake resistor and its wirings	
		Wrongly connected wires	Check wires	
3	"Overvoltage" warning with the of frequency converter	Inadequate capacity of brake resistor and brake chopper	Check design and recalculate	
		Inappropriate brake chopper voltage selection	Set again	
	Thermal protection device of brake chop-	High braking ratio	Check design and recalculate	
4	per acts caused by overheated radiator	Environmental temperature >40 °C	Reduce environmental temperature with cooling fans	

Tab. 10-8:

Error analysis and countermeasures

10.2.2 Brake Resistor

Brief introduction

Energy regenerated when a 3-phase AC motor is decelerated (the frequency is reduced) is recovered and fed into the frequency converter. To prevent over voltage of the frequency converter, an external brake resistor may be used. A power transistor discharges the DC bus voltage energy (braking voltage threshold at approx. 770 VDC) to the brake resistor, and the energy is lost as heat.



- If a resistance lower than the recommended value (and no less than the minimum resistance) is used, contact the agent or manufacturer for calculation of resistance power.
- Safety and flammability of surrounding conditions shall be considered. Keep all items 10 cm away from the brake resistor
- A brake resistor can not work overload for a long time. 10 times of rated load should not exceed 5 seconds.
- There could be smoking for the first use of the brake resistor as its surface uses organic silicon, which is normal and does not affect the electric performance of the brake resistor.

Brake resistor selection

Brake resistors with different power ratings are available to dissipate braking energy when the frequency converter is in generator mode.

The adjacent tables list the optimal combination of frequency converter, brake chopper and brake resistor and the number of components required to operate one frequency converter with respect to a given moderating ratio OT.

$$OT = \frac{Tb}{Tc} * 100\%$$

OT (On Time percentage)
Tb Braking time

Tc Engineering cycle time in application

Fig. 10-14: Braking ratio



The frequency converter models, brake chopper types and the brake resistor types listed in the tables are abbreviations. For definition of type codes, see chapter 1.3 "Type Coding" on page 9.

Model	FELB Typecode	FELB Quantity	FELR Typecode	FELR Type	FELR Quantity
0K40	Internal	_	0080-N750R-D	750Ω/80W	1
0K75	Internal	_	0080-N750R-D	750Ω/80W	1
1K50	Internal	_	0260-N400R-D	400Ω/260W	1
2K20	Internal	_	0260-N250R-D	250Ω/260W	1
4K00	Internal	_	0390-N150R-D	150Ω/390W	1
5K50	Internal	_	0520-N100R-D	100Ω/520W	1
7K50	Internal	_	0780-N075R-D	75Ω/780W	1
11K0	Internal	_	1K04-N050R-D	50Ω/1040W	1
15K0	Internal	_	1K56-N040R-D	40Ω/1560W	1
18K5	FELB02.1N-30K0	1	04K8-N032R-A	32Ω/4.8kW	1
22K0	FELB02.1N-30K0	1	04K8-N27R2-A	27.2Ω/4.8kW	1
30K0	FELB02.1N-30K0	1	06K0-N020R-A	20Ω/6.0kW	1
37K0	FELB02.1N-45K0	1	09K6-N016R-A	16Ω/9.6kW	1
45K0	FELB02.1N-45K0	1	09K6-N13R6-A	13.6Ω/9.6kW	1
55K0	FELB02.1N-30K0	2	06K0-N020R-A	20Ω/6.0kW	2
75K0	FELB02.1N-45K0	2	09K6-N13R6-A	13.6Ω/9.6kW	2
90K0	FELB02.1N-45K0	3	06K0-N020R-A	20Ω/6.0kW	3

Tab.10-9: Brake resistor selection_OT=10 %

Model	FELB Typecode	FELB Quantity	FELR Typecode	FELR Type	FELR Quantity
0K40	Internal	-	0150-N750R-D	750Ω/150W	1
0K75	Internal	-	0150-N700R-D	700Ω/150W	1
1K50	Internal	_	0520-N350R-D	350Ω/520W	1
2K20	Internal	-	0520-N230R-D	230Ω/520W	1
4K00	Internal	_	0780-N140R-D	140Ω/780W	1
5K50	Internal	_	1K04-N090R-D	90Ω/1040W	1
7K50	Internal	-	1K56-N070R-D	70Ω/1560W	1
11K0	Internal	-	02K0-N047R-D	47Ω/2.0kW	1
15K0	Internal	_	01K5-N068R-D	68Ω/1.5kW	2
18K5	FELB02.1N-30K0	1	10K0-N028R-A	28Ω/10.0kW	1
22K0	FELB02.1N-30K0	1	10K0-N022R-A	22Ω/10.0kW	1
30K0	FELB02.1N-45K0	1	12K5-N017R-A	17Ω/12.5kW	1
37K0	FELB02.1N-45K0	1	10K0-N032R-A	32Ω/10.0kW	2
45K0	FELB02.1N-30K0	2	10K0-N024R-A	24Ω/10.0kW	2
55K0	FELB02.1N-45K0	2	12K5-N018R-A	18Ω/12.5kW	2
75K0	FELB02.1N-45K0	3	12K5-N020R-A	20Ω/12.5kW	3
90K0	FELB02.1N-45K0	3	12K5-N020R-A	20Ω/12.5kW	3

Tab.10-10: Brake resistor selection_OT=20 %

Model	FELB Typecode	FELB Quantity	FELR Typecode	FELR Type	FELR Quantity
0K40	Internal	_	0240-N750R-D	750Ω/240W	1
0K75	Internal	-	0500-N550R-D	550Ω/500W	1
1K50	Internal	-	0800-N275R-D	275Ω/800W	1
2K20	Internal	-	01K2-N180R-D	180Ω/1.2kW	1
4K00	Internal	-	02K0-N110R-D	110Ω/2.0kW	1
5K50	Internal	-	01K5-N150R-D	150Ω/1.5kW	2
7K50	Internal	-	04K5-N055R-A	55Ω/4.5kW	1
11K0	Internal	_	06K0-N040R-A	40Ω/6.0kW	1
15K0	Internal	_	08K0-N027R-A	27Ω/8.0kW	1
18K5	FELB02.1N-45K0	1	10K0-N022R-A	22Ω/10.0kW	1
22K0	FELB02.1N-45K0	1	12K5-N018R-A	18Ω/12.5kW	1
30K0	FELB02.1N-30K0	2	10K0-N27R2-A	27.2Ω/10.0kW	2
37K0	FELB02.1N-45K0	2	10K0-N022R-A	22Ω/10.0kW	2
45K0	FELB02.1N-45K0	2	12K5-N018R-A	18Ω/12.5kW	2
55K0	FELB02.1N-30K0	3	12K5-N022R-A	22Ω/12.5kW	3
75K0	FELB02.1N-45K0	4	10K0-N022R-A	22Ω/10.0kW	4
90K0	FELB02.1N-45K0	4	10K0-N022R-A	22Ω/10.0kW	4

Tab.10-11: Brake resistor selection_OT=40 %



- In the table in the manual, the recommended resistance of the brake resistor is 100 % braking torque, selected according to necessity. If the actually needed torque is not 100 %, the resistance of the brake resistor in the table should be adjusted in inverse proportion, i.e. how much the brake torque increases based on 100 %, the resistance of the brake resistor should decrease by the same amount, vice versa.
- When selecting brake resistor R_b, make sure the current I_c which flows through the resistor is less than the current output ability of the brake chopper. The current I_c through the brake resistor can be calculated by formula I_c=U_d/R_b, in which U_d is the braking operating voltage of brake chopper.
- After the adjustment of the resistance of brake resistor, the power of brake resistor should be also adjusted appropriately. The power can be calculated by formula P_{max}=U_d² / R_b. According to the actual working condition, the braking ratio OT % can be selected to reduce the power of brake resistor reasonably for intermittent braking load. The power of brake resistor can be calculated by formula P_R=K × P_{max} × OT %, in which K is the derating coefficient of brake resistor. The selection of the brake torque should be in general smaller than 150 % of the rated motor torque, or consulting the technical support for more information.

Brake resistor in aluminum housing

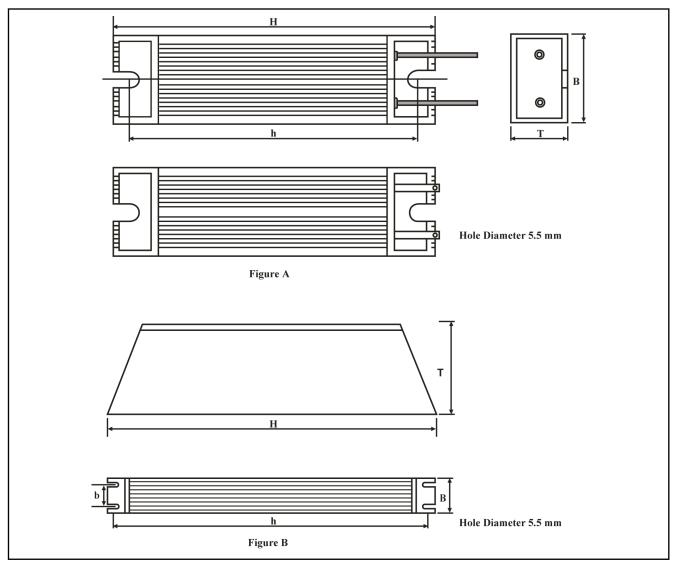


Fig. 10-15: Brake resistor in aluminum housing

Duelse veeleter	Impe-	Power			Dime	nsions	[mm]		\A/irin ~	Tomains	Cable	Net	
Brake resistor typecode	dance [Ω]	[W]	Fig.	Н	h	В	b	Т	Wiring [mm ²]	Terminal [mm]	length [mm]	weight [kg]	Туре
0520-N100R-D	100	520		335	317	60	_	30	2.5	-	500	1.03	Alumi.
0390-N150R-D	150	390		265	247	60	_	30	2.5	_	500	0.80	Alumi.
0520-N230R-D	230	520		335	317	60	_	30	2.5	_	500	1.03	Alumi.
0260-N250R-D	250	260		215	197	60	-	30	2.5	_	500	0.62	Alumi.
0520-N350R-D	350	520	Α	335	317	60	_	30	2.5	_	500	1.03	Alumi.
0260-N400R-D	400	260		215	197	60	_	30	2.5	_	500	0.62	Alumi.
0500-N550R-D	550	500		335	317	60	_	30	2.5	_	500	1.03	Alumi.
0150-N700R-D	700	150		215	197	40	-	20	2.5	_	500	0.32	Alumi.
0080-N750R-D	750	80		140	123	40	_	20	2.5	_	500	0.20	Alumi.
1K56-N040R-D	40	1560		485	470	50	30	107	2.5	M6	_	4.35	Alumi.
02K0-N047R-D	47	2000		550	534	50	30	107	4.0	M6	-	4.90	Alumi.
1K04-N050R-D	50	1040		400	384	50	30	107	2.5	M6	-	4.35	Alumi.
01K5-N068R-D	68	1500		485	470	50	30	107	2.5	M6	-	3.60	Alumi.
1K56-N070R-D	70	1560		485	470	50	30	107	2.5	M6	-	2.20	Alumi.
0780-N075R-D	75	780	В	400	382	61	40.5	59	2.5	M6	-	4.35	Alumi.
1K04-N090R-D	90	1040		400	384	50	30	107	2.5	M6	_	3.60	Alumi.
02K0-N110R-D	110	2000		550	534	50	30	107	4.0	M6	_	2.20	Alumi.
0780-N140R-D	140	780		400	382	61	40.5	59	2.5	M6	_	4.35	Alumi.
01K5-N150R-D	150	1500		485	470	50	30	107	2.5	M6	_	4.90	Alumi.
01K2-N180R-D	180	1200		450	434	50	30	107	2.5	M6	-	4.00	Alumi.
0800-N275R-D	275	800		400	382	61	40.5	59	2.5	M6	-	2.20	Alumi.

Tab. 10-12: Aluminum brake resistor dimensions

B

Alumi.: Brake resistor in aluminum housing.

Brake resistor box

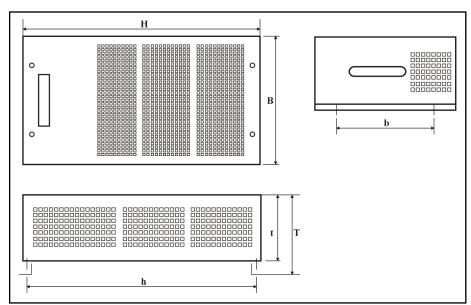


Fig. 10-16: Brake resistor box dimensions drawing

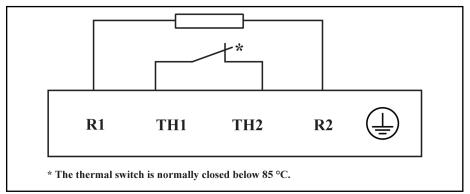


Fig. 10-17: Brake resistor box terminals

Brake resistor	Impedance	Power			Dimer	nsions			Wiring	Terminal	Weight	T
typecode	[Ω]	[kW]	В	Н	t	Т	h	b	[mm ²]	[mm]	[kg]	Туре
09K6-N13R6-A	13.6	9.6	410	685	145	170	642	340	6.0	M6	18.5	box
09K6-N016R-A	16	9.6	410	685	145	170	642	340	6.0	M6	18.5	box
12K5-N017R-A	17	12.5	410	685	145	170	642	340	6.0	M6	20.5	box
12K5-N018R-A	18	12.5	410	685	145	170	642	340	6.0	M6	20.5	box
12K5-N020R-A	20	12.5	410	685	145	170	642	340	6.0	M6	20.5	box
06K0-N020R-A	20	6.0	340	600	145	170	580	291	4.0	M6	14.0	box
10K0-N022R-A	22	10.0	410	685	145	170	642	340	6.0	M6	18.5	box
12K5-N022R-A	22	12.5	410	685	145	170	642	340	6.0	M6	20.5	box
10K0-N024R-A	24	10.0	410	685	145	170	642	340	6.0	M6	18.5	box
08K0-N027R-A	27	8.0	410	685	145	170	642	340	6.0	M6	16.5	box
10K0-N27R2-A	27.2	10.0	410	685	145	170	642	340	6.0	M6	18.5	box
04K8-N27R2-A	27.2	4.8	340	600	145	170	580	291	4.0	M6	12.0	box
10K0-N028R-A	28	10.0	410	685	145	170	642	340	6.0	M6	18.5	box
10K0-N032R-A	32	10.0	410	685	145	170	642	340	6.0	M6	18.5	box
04K8-N032R-A	32	4.8	340	600	145	170	580	291	4.0	M6	12.0	box
06K0-N040R-A	40	6.0	340	600	145	170	580	291	4.0	M6	14.0	box
04K5-N055R-A	55	4.5	340	600	145	170	580	291	4.0	M6	12.0	box

Tab. 10-13: Brake resistor box dimensions

图

box: Brake resistor box.

10.3 Communication Interface

10.3.1 PROFIBUS Adapter

The PROFIBUS adapter (FVAA01.1-P-NNNN-01V01) is used to convert Fv serial RS485 interface (ModBus) to PROFIBUS DP standard.

Please refer to chapter 12 "Communication Protocols" on page 201.

10.3.2 ModBus Adapter

The ModBus adapter (FVAA01.1-M-NNNN-01V01) is used to connect the RS485 interface (ModBus) with a PC or another control unit.

10.4 Accessories for Control Cabinet Mounting

10.4.1 Remote Operation

The operating panel (FVCC) is mounted at the control cabinet. The user can operate the frequency converter from the outside of the control cabinet conveniently. To realize this function, the user needs order the remote operation adapter (FVAM) and its accessories additionally.

Replace the operating panel with the remote operation adapter

Remove operating panel from the frequency converter and place the remote operation adapter instead.

Recommended opening dimensions at control cabinet

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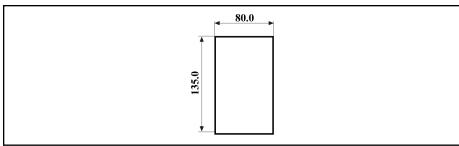


Fig. 10-18: Recommended opening dimensions at control cabinet

Direct mounting of FVCC at the control cabinet with mounting plate

 When the opening dimensions at the control cabinet are in compliance with the recommendation, FVCC can be mounted directly at the control cabinet with the mounting plate buckles.

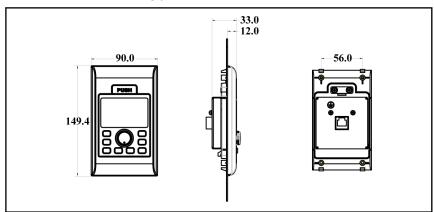


Fig. 10-19: Direct mounting of FVCC at the control cabinet with mounting plate

Mounting of FVCC at the control cabinet with mounting plate and fixing metal strips

When the opening dimensions are larger than the recommendations, 2 fixing metal strips and 4 M4x10 screws are necessary to fix the mounting plate. Please refer to figures below for detailed information.

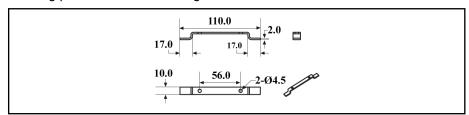


Fig. 10-20: Fixing metal strip

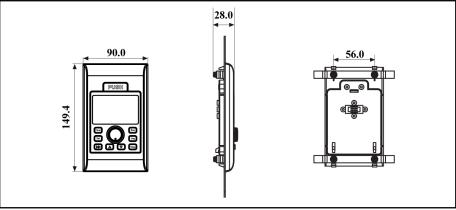


Fig. 10-21: Mounting of FVCC at the control cabinet with mounting plate and fixing metal strips

Rexroth Frequency Converter Fv

Accessories

Connecting the remote operation adapter and the mounting plate with remote connection cable The remote connection cable needs to be grounded.

- Stripping the cable insulation.
- Connecting the shielding layer with the metal buckle tightly (as close as possible to the frequency converter to achieve good grounding effect).
- Fixing the metal buckle on the inner wall of the control cabinet.

10.4.2 Operating Panel Cable for Control Cabinet Mounting

Please use shielded twisted pair cables with the length within 15 m. If you need cables from Bosch Rexroth, please order it with the type code of FRKS0003/015,0.

10.5 Engineering Software

ConverterPC_Fv is an engineering software that allows user to commission and parameterize the frequency converters. Parameters are set on the PC and transferred to the frequency converters via serial RS485 (ModBus) interface. Together with the engineering software is the ConverterPC_Fv user manual available.

196/241

Rexroth Frequency Converter Fv

11 Additional Information

11.1 Simple Applications of Process Control

11.1.1 Automatic Constant Pressure Water Control System

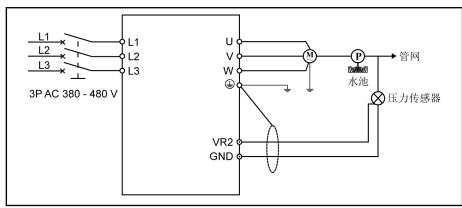


Fig. 11-1: Automatic constant pressure water control system

- The set value of pressure is set by analog value digital setting E3.01.
 The pressure feedback from output VR2 corresponds to a value of 0 V to 10 V.
- [E3.00]=2, [E3.03]=1. E3.04, E3.05, E3.06, and E3.07 are set depending on actual conditions.

11.1.2 Closed-loop Speed Control System

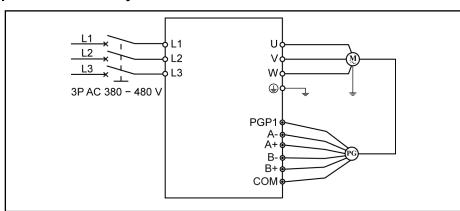


Fig. 11-2: Closed-loop speed control system

Conditions and requirements:

PGP1 is connected to the operational power supply of pulse encoder, and the set value of speed is set by rotation speed digital setting E3.02. [E3.00]=4, S2.12 is set according to the specification of the feedback encoder.

Additional Information

11.2 **Discharging of Capacitors**

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11.2.1 Discharging of DC Bus Capacitors

In the frequency converters, capacitors are used in the DC bus as energy stores. Energy stores maintain their energy even when the supply voltage has been cut off and have to be discharged before somebody gets in contact with them. Discharging devices have been integrated in the frequency converters; within the indicated discharging time, these devices discharge the voltage below the allowed 50 V.

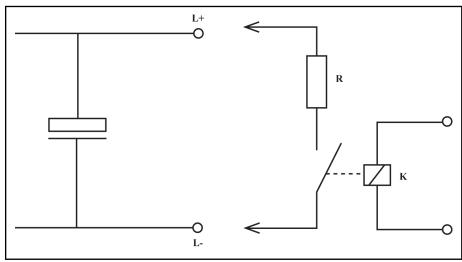
Frequency converters have been dimensioned in such a way that after the supply voltage was cut off, the voltage value falls below 50 V within a discharging time of a maximum of 30 minutes.

To shorten the waiting time until voltage has fallen below 50 V, you can use a discharging device described below.

11.2.2 **Discharging Device**

Operating principle

A contactor is installed to switch a resistor to the terminals L+ and L- of the DC bus connection to discharge the capacitors. The contactor is activated via a control input which is supplied with appropriate control voltage.



Discharging resistor Contactor contact

Fig.11-3: Operating principle of discharging device

Dimensioning

The individual components have to be sufficiently dimensioned:

- Value of the discharging resistor: 1000Ω and at least 1000 W;
- The discharging resistor and the contactor contact have to withstand the loads of practical operation (for example in the case of frequent use of the discharging device of the occurring continuous power);
- The contactor contact has to withstand the occurring direct voltage of a minimum of 1000 V:
- The contactor contact has to withstand the occurring discharge current according to the resistance value that is used, i.e. 1 A with 1000 Ω .

Additional Information

Installation

▲ WARNING

Lethal electric shock caused by live parts with more than 50 V!

Before working on live parts: De-energize the installation and secure the power switch against unintentional or unauthorized re-energization.

Wait at least **30 minutes** after switching off the power supply voltages to allow discharging.

Check whether voltages have fallen below 50 V before touching live parts!

A CAUTION

Risk of damage by intense heat!

During the discharging process, the discharging resistor generates intense heat. Therefore, place the discharging resistor as far as possible from heat-sensitive components.

How to install the discharging device

 Preferably install discharging device before switching on supply voltage of the first time.

If you install discharging device after having switched on supply voltage for the first time, wait 30 minutes to allow discharging. Check whether voltage has fallen below 50 V before touching live parts!

Place discharging resistor as far as possible from heat-sensitive components.

Activation

Observe the following order for activating the discharge device:

- 1. De-energize installation and secure power switch against unintentional or unauthorized re-energization.
- 2. Activate discharging device.

Rexroth Frequency Converter Fv

Communication Protocols

12 Communication Protocols

12.1 Introduction

Fv provides standard RS485 communication port to realize the communication between the master station and the slave station via ModBus or PROFIBUS protocols. With the help of a PC, an SPS or an external computer a "single master/ multiple slaves" network control can be realized (setting of frequency control command and running frequency, modification of function parameters, monitoring of frequency converter running status and error messages) to address the specific requirements of applications.

12.2 ModBus Protocol

12.2.1 Protocol Descriptions

Introduction

ModBus is a master/slave protocol. Only one device may send commands in the network at a particular time.

The master station manages message exchange by polling the slave stations. Unless being approved by the master station, no station may send message.

In case of an error during data exchange, if no response is received, the master station will query the slave stations absent from the polling.

If a slave station is not able to understand a message from the master station, it will send an exception response to the master station.

Slave stations can not communicate with each other but through the master's software, which reads data from one slave station and sends them to another

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).

Transmission

The transmission is of RTU (remote terminal unit) mode with frames containing no message header or end mark. A typical RTU frame format is shown in table below.

Slave address	ModBus function code	Data	CRC16 check information
(1 byte)	(1 byte)	(Multiple bytes)	(2 bytes)

Tab. 12-1: Typical RTU frame format

REP.

Data are transmitted in binary codes.

If an interval is 3.5 characters or longer, it is taken as the end of the frame. Therefore, all information in a frame must be transmitted in a continuous data flow. If an interval of 3.5 characters or longer occurs before a complete frame is sent out, the receiving device will consider the information has ended and start processing it, and mistake following bytes for a new frame's address. 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 error.

Data format and sending sequence of one byte:

- 1 start bit, 8 data bits
- 1 parity check bit or no parity check bit
- 1 or 2 stop bits

CRC (Cyclic redundancy check):

CRC16, lower bytes first and higher bytes later

Slave address:

- The address of a frequency converter may be any between 1 and 247.
- The address 0 is reserved for broadcasting. Frequency converters will act upon the request but make no acknowledgement.
- Each address must be unique in the network.

12.2.2 Interface

The RJ11 communication interface of Fv is shown in figure below.

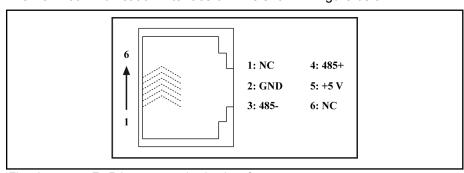


Fig. 12-1: Fv RJ11 communication interface

12.2.3 Protocol Functions

Supported functions

The main function of ModBus is to read and to write parameters. Different function codes decide different operation requests. ModBus functions managed by Fv and their limits are shown in table below.

Function code	Meaning	Broadcast	Maximum value of N
3=0x03	Read N register parameters	NO	16 characters in maximum
6=0x06	Rewrite a register with information stored even after power off	YES	-
8=0x08	Loop test	NO	-
16=0x10	Rewrite N registers with information stored even after power off	YES	16 characters in maximum
23=0x17	Read from and write to N registers	NO	16 characters in maximum

Tab. 12-2: ModBus functions managed by Fv and their limits

图

"Read" and "Write" are considered from the prospect of the master station.

If the device fails to act upon the request, it responds with an error code and exception code. The error code is the function code plus 0x80. An example of exception code is shown in table below.

Error code	Meaning	Possible reason
1	Password locked	User password locked
2	Function code error	Function code is not 03, 06, 08, 16, 23
3	Invalid address	Undefined address
4	Invalid data	Data exceeds limit
5	Parameters can not be modified in run mode	Frequency converter is in run mode
6	Read only	Not allowed to write in read only parameters
7	Invalid operation	Function code does not support write via external computer or multiple write
8	CRC check failure	Data error or discontinuous frame
9	EEPROM read/write error	EEPROM write does not finish

Tab.12-3: Error codes_meanings_reasons

Function descriptions

Function 0x03: Read N words, range: 1 to 16.

For example, it is necessary to read 2 continuous words starting from communication register 0100H of a slave frequency converter addressed at 01H. The frame structure is described in tables below.

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	03H
Higher byte of start address	01H
Lower byte of start address	00H
Higher byte of data	00H
Lower byte of data	02H
CRC lower byte	C5H
CRC higher byte	F7H
Message end	Transmission time for 3.5 bytes

Tab.12-4: Function 0x03_master request

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	03H
Bytes of data	04H
Higher byte of data in register 0100H	00H
Lower byte of data in register 0100H	05H
Higher byte of data in register 0101H	00H
Lower byte of data in register 0101H	00H
CRC lower byte	EAH
CRC higher byte	32H
Message end	Transmission time for 3.5 bytes

Tab.12-5: Function 0x03_slave response

Function 0x06: Write a word.

Example: Write 0000H to communication register address 0006H of a slave frequency converter addressed at 01H. The frame structure is described in tables below.

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	06H
Higher byte of write register address	00H
Lower byte of write register address	06H
Higher byte of write data	00H
Lower byte of write data	00H
CRC lower byte	69H
CRC higher byte	СВН
Message end	Transmission time for 3.5 bytes

Tab.12-6: Function 0x06_master request

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	06H
Higher byte of write register address	00H
Lower byte of write register address	06H
Higher byte of write data	00H
Lower byte of write data	00H
CRC lower byte	69H
CRC higher byte	СВН
Message end	Transmission time for 3.5 bytes

Tab.12-7: Function 0x06_slave response

Function 0x08: Loop test. The same message is returned.

To test the communication loop of 2 continuous words 1234H and 5678H with a frequency converter addressed at 01H, the frame structure is described in tables below.

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	08H
Higher byte of test word 1	12H
Lower byte of test Word 1	34H
Higher byte of test data Word 2	56H
Lower byte of test Word 2	78H
CRC lower byte	9BH
CRC higher byte	3FH
Message end	Transmission time for 3.5 bytes

Tab.12-8: Function 0x08_master request

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	08H
Higher byte of test word 1	12H
Lower byte of test word 1	34H
Higher byte of test data word 2	56H
Lower byte of test word 2	78H
CRC lower byte	9BH
CRC higher byte	3FH
Message end	Transmission time for 3.5 bytes

Tab.12-9: Function 0x08_slave response

Function 0x10: Write N words, range: 1 to 16.

Example: To modify 2 continuous resisters start from 0109H with words 003CH and 0050H with a slave frequency converter addressed at 01H. The frame structure is described in tables below.

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	10H
Higher byte of write register start address	01H
Lower byte of write register start address	09H
Higher byte of register number	00H
Lower byte of register number	02H
Bytes of data	04H
Higher byte of data in register 0109H	00Н
Lower byte of data in register 0109H	зсн
Higher byte of data in register 010AH	00Н
Lower byte of data in register 010AH	50H
CRC lower byte	FEH
CRC higher byte	65H
Message end	Transmission time for 3.5 bytes

Tab.12-10: Function 0x10_master request

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	10H
Higher byte of register start address	01H
Lower byte of register start address	09H
Higher byte of register number	00H
Lower byte of register number	02H
CRC lower byte	90H
CRC higher byte	36H
Message end	Transmission time for 3.5 bytes

Tab.12-11: Function 0x10_slave response

Function 0x17: Read/write N words, range: 1 to 16

Example: To read data in 2 continuous registers starting from address 0100H, write 0064H and 00C8H to 2 continuous registers starting from address 0109H with a slave frequency converter addressed at 01H. The frame structure is described in tables below.

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	17H
Higher byte of read register start address	01H
Lower byte of read register start address	00H
Higher byte of read register number	00H
Lower byte of read register number	02H
Higher byte of write register start address	01H
Lower byte of write register start address	09H
Higher byte of write register number	00H
Lower byte of write register number	02H
Bytes of data for writing	04H
Higher byte of data in address 0109H	00H
Lower byte of data in address 0109H	64H
Higher byte of data in address 010AH	00H
Lower byte of data in address 010AH	С8Н
CRC lower byte	48H
CRC higher byte	72H
Message end	Transmission time for 3.5 bytes

Tab.12-12: Function 0x17_master request

Message start	Transmission time for 3.5 bytes
Slave address	01H
ModBus function code	17H
Bytes of read register	04H
Higher byte of read register 0100H	00H
Lower byte of read register 0100H	05H
Higher byte of read register 0101H	00H
Lower byte of read register 0101H	00H
CRC lower byte	Е9Н
CRC higher byte	26H
Message end	Transmission time for 3.5 bytes

Tab.12-13: Function 0x17_slave response

12.2.4 Communication Mapping Register Address Distribution

Introduction

The communication mapping registers of ModBus are in four types, frequency converter parameter registers, communication control registers, communication state feedback register and communication monitor registers.

Frequency converter parameter registers

Frequency converter parameter registers correspond to the function codes one-to-one. Reading and writing of related function codes can be achieved through reading and writing of the contents in frequency converter parameter registers via ModBus communication. The characteristics and scope of reading and writing function codes are in compliance with the frequency converter function code description. The address of a frequency converter parameter register consists of one word. The higher byte 0x00 to 0x0C represents the function code group, and the relationship is shown in table below; the lower byte represents the function code within the code group.

Function group	Mapping address	Function group	Mapping address
b0	0x00	b1	0x01
S0	0x02	S1	0x03
S2	0x04	S3	0x05
E0	0x06	E1	0x07
E2	0x08	E3	0x09
E4	0x0A	E5	0x0B
H0	0x0C		

Tab.12-14: Relationship between frequency converter parameter register addresses and corresponding function codes

Example: Parameter register 0x0103, the higher byte 0x01 represents group b1, the lower byte 0x03 represents the 4th function code.

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Communication control registers (0x4000, 0x4001, 0x4002)

The address of command word register for communication control is 0x4000. This register is write-only. The frequency converter is controlled through writing data into the address. The definition of each bit is shown in table below.

bit	Value	Description			
15 to 8	_	Reserved			
7	1	Inactive			
,	0	Active			
6	1	Stop acceleration/deceleration active			
	0	Inactive			
5	1	Reset active			
3	0	Inactive			
4	1	E-Stop active			
4	0	Inactive			
3	1	Stop according to parameter setting			
3	0	Inactive			
2	1	Reverse			
2	0	Forward			
1	1	Jog active			
'	0	Inactive			
0	1	General control active			
	0	Inactive			

Tab.12-15: Communication control registers (0x4000, 0x4001, 0x4002)_bit definition

The address of frequency setting register for communication control is 0x4001. This register is write-only. When 'Frequency setting mode' b1.00 is set to '5: Set via communication', the frequency converter can be set with writing data to this address.

The address of torque setting register for communication control is 0x4002. This register is write-only. When 'Torque control reference' S1.05 is set to '3: Set by communication', the torque command can be set with writing data to this address.

Communication state feedback register (0x5000)

The frequency converter state can be monitored by reading the register. This register is read-only. The definition of each bit is shown in table below.

bit	Value	Description			
15 to 11	_	Error code			
10 to 8	_	Reserved			
7	1	Error			
/	0	No error			
6	1	Stall over current			
0	0	Normal			
5	1	Stall over voltage			
5	0	Normal			
4	1	Decelerating			
4	0	Not in deceleration			
3 1		Accelerating			
3	0	Not in acceleration			
2	1	Jogging			
2	0	Not in jog			
1	1	In run			
1	0	In stop			
0	1	Reverse			
U	0	Forward			

Tab.12-16: Communication state word register (0x5000)_bit definition The meanings of error codes are described in table below.

No.	Error code name				
0	No error record				
1	Over current at constant speed (O.C1)				
2	Over current in acceleration (O.C2)				
3	Over current in deceleration (O.C3)				
4	Over voltage at constant speed (O.E1)				
5	Over voltage in acceleration (O.E2)				
6	Over voltage in deceleration (O.E3)				
7	Frequency converter overload (O.L1)				
8	Motor overload (O.L2)				
9	CPU read/write error (R.E.)				
10	Operating panel read/write error (KEY-)				
11	External error (ESt)				

No.	Error code name			
12	Communication error (R.S.)			
13	Circuit disconnection (C.F.)			
14	Encoder speed detection error (PULS)			
15	Motor overheat (M.O.H.)			
16	EMI (CPU-)			
17	Short circuit (S.C.)			
18	Reserved			
19	L1, L2, L3 phase failure (IPH.L)			
20	U, V, W phase failure (OPH.L)			
21	Frequency converter overheat (C.O.H.)			
22	Parameter setting error (PRSE)			
23	Parameter auto-tuning error (TUNE)			
24	Frequency converter over load pre-warning 2 (O.L3)			

Tab.12-17: Error codes and meanings_ModBus

Communication monitor registers (0x5001 to 0x5013)

Communication monitor registers are read-only. The relationship between the register addresses and monitored values are shown in table below.

Register address	Monitored value
0x5001	Output frequency
0x5002	Reference frequency
0x5003	Output current
0x5004	DC bus voltage
0x5005	Heat sink temperature
0x5006	Output voltage
0x5007	Output power
0x5008	Torque current
0x5009	Exciting current
0x500A	Output speed
0x500B	Reference speed
0x500C	User-defined reference value
0x500D	User-defined output value
0x500E	Reference torque
0x500F	Digital inputs status
0x5010	Encoder speed feedback
0x5011	Torque limit setting

Rexroth Frequency Converter Fv

Communication Protocols

Register address	Monitored value	
0x5012	Speed limit setting	
0x5013	Multi-monitoring display	

Tab.12-18: Addresses of monitor registers and monitored values

• "0" is returned when the communication address is 0x5013.

12.2.5 ModBus Communication Example

One slave address is 01H. The frequency setting of the frequency converter has been set to "external computer frequency setting" and the source of running commands is "external computer control". It is required for the motor connected to the frequency converter to run with 50 Hz (forward rotation). The operation can be achieved with function 0x10 of the ModBus protocol. The messages of the requests from the master and responses from the slave are shown in table below.

Evernle 1	Stort 01# frogue	nov convert	or for forward rat	otion of fraguence	of E0 00H= (re	epresented by 5000	internelly)
Example 1.	Slave address	Function code	Start address	Number of address	Bytes of data	Data content	CRC code
Request	0x01	0x10	0x4000	0x0002	0x04	0x0001,0x1388	0xFA9E
Response	0x01	0x10	0x4000	0x0002	N/A	N/A	0x0854
Example 2:	Read the output	voltage of 0	1# frequency co	nverter and set f	requency		
	Slave address	Function code	Start address	Number of address	Bytes of data	Data content	CRC code
Request	0x01	0x03	0x5001	0x0002	N/A	N/A	0xCB84
Response	0x01	0x03	N/A	N/A	0x04	0x1388, 0x1388	0xCB73
Example 3:	Example 3: Stop 01# frequency converter according to the stop mode set with the function code						
	Slave address	Function code	Start address	Number of address	Bytes of data	Data content	CRC code
Request	0x01	0x06	0x4000	N/A	N/A	0x0008	0xCC9D
Response	0x01	0x06	0x4000	N/A	N/A	0x0008	0xCC9D

Tab. 12-19: Example of ModBus communication

12.2.6 Special Notes

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- 1. The external computer can not write to function codes b0.03, b0.08, b0.09 and S2.10.
- 2. b0.00 and b0.02 do not support multiple write including single write in multiple write; parameters of motor name plate and motor can not be written at the same time; Terminals X1 to X8 can not be rewritten if they are not 0.
- 3. If the communication protocol is changed, baud rate, data frame and local address will be restore to factory default.
- 4. The read response of user password and factory password is '0000' in case of external computer reading.
- 5. External computer can not set, modify or cancel user password; external computer can only write 0 in case of no password or write correct password in case of with password; if a password is active, the external computer only has the access to modify the parameters after input of the correct password; After the external has the access to modify the parameters, if the previous password is input again, the modification access is disabled.
- 6. The access to control registers and state registers is not limited by user password.
- 7. The frequency converter can not communicate in the process of autotuning; the communication will be recovered when auto-tuning is complete.

12.2.7 Communication Networking

Networking

The communication network is shown in figure below. Network terminal slaves at both ends need external resistance with a recommended value of 120 Ω , 0.25 W.

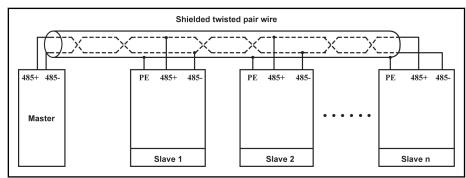


Fig. 12-2: ModBus networking

A WARNING

Cables may only be connected when drive is turned off!

Recommendations on networking

- Use shielded twisted pair cable to connect RS485 links.
- ModBus cable should be adequately away from power cables (30 cm in minimum).
- Avoid crossing of ModBus cables and power cables and use orthogonal crossing if crossing must be used.
- The shield layer of cables should be connected to protected ground or to equipment ground if the equipment ground has already been connected to protected ground. Do not directly ground any point of the RS485 network.
- In no circumstance should ground cables constitute a loop.

12.3 PROFIBUS Protocol

12.3.1 Protocol Description

PROFIBUS is an open serial communication standard, which enables data exchange among various automatic control devices. PROFIBUS mainly includes three types: PROFIBUS-FMS (Fieldbus Message Specifications), PROFIBUS-DP (Distributed Peripheral Equipment) and PROFIBUS-PA (Process Automation). Rexroth PROFIBUS adapter module supports PROFIBUS-DP protocol.

PROFIBUS is widely used in various industries such as manufacturing automation and process automation, building, transportation, electronics, etc. Through PROFIBUS, automation equipments from different manufacturers can be easily connected into the same network for data exchange. The frame structure of data information in PROFIBUS network is shown in table below. Contents of user data will be described in communication protocol section.

Protocol frame	User data	Protocol frame
(header)	(control information/status information)	(end)

Tab. 12-20: PROFIBUS Frame format

Physical transmission medium for PROFIBUS is twisted-pair cable (RS-485 standard). Maximum length of bus cable is within the scope of 100 to 1200 m, depending on the set transmission rate. When no repeater is used, 32 nodes at maximum can be connected to the same PROFIBUS network; if a repeater is used, nodes connected to the network may be increased to 126. In PROFIBUS communication, the master is usually a programmable logic controller, which is able to select the nodes responsive to commands from the master. In PROFIBUS network, no communication can be achieved among nodes.



PROFIBUS protocol is described in detail in standard EN 50170. For further information regarding PROFIBUS, please refer to standard EN 50170.

12.3.2 PROFIBUS-Adapter

Technical data

Technical parameters	Performance	
Input voltage	+ 5 VDC, ±10 %, 80 mA	
Baud rate (DP interface communication)	9.6 kbps to 12 Mbps	
EMC requirement	IEC 1000-4	

Tab. 12-21: PROFIBUS-Adapter technical parameters and performance

Functions

PROFIBUS-Adapter is able to control Fv through PROFIBUS-DP fieldbus. Main functions of the fieldbus adapter are as below:

- Sending control commands to frequency converter (such as start, stop, jog, etc.).
- Sending frequency setting signal to frequency converter.
- Reading working status information from frequency converter (such as run, rotation direction, rotation speed, error message, etc.).
- Reading or modifying frequency converter parameters.

Resetting frequency converter in case of error.

Network structure

Fv PROFIBUS network connection via PROFIBUS-Adapter is shown in figure below.

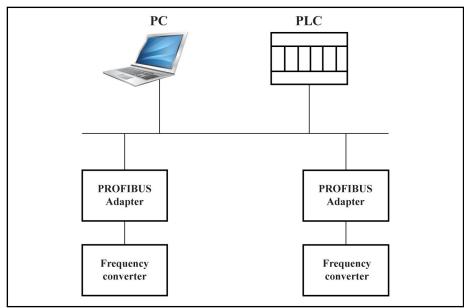


Fig. 12-3: Fv PROFIBUS network

12.3.3 Electrical Installations

Outline structure

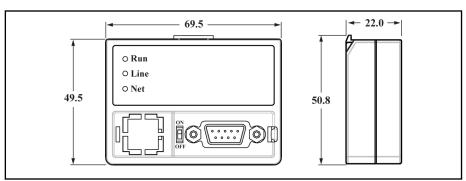


Fig. 12-4: PROFIBUS adapter dimensions

Adapter terminal configuration

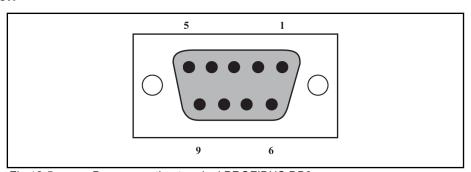


Fig. 12-5: Bus connection terminal PROFIBUS DB9

Pin No.	Terminal sign	Terminal name	Function description
1	PE	Terminal of bus cable shield	Connects with bus cable shield
2	NC	_	Reserved
3	PROFIBUS_B	PROFIBUS terminal_B	PROFIBUS data cable B
4	RTS	Request for signal sending	-
5	GND	Power-	_
6	Vcc	Power+	_
7	NC	_	Reserved
8	PROFIBUS_A	PROFIBUS terminal_A	PROFIBUS data cable A
9	NC	_	Reserved

Tab. 12-22: Definition of PROFIBUS DB9 Pins

Requirements for PROFIBUS link

Cable used is shielded twisted pair cable. The shield is able to improve electromagnetic compatibility (EMC) ability. Unshielded twisted pair cable may be used if there is less electromagnetic interference (EMI).

Impedance of the cable should be within 100 Ω to 200 Ω . Cable capacity (among conductors) should be < 60 pF/m, and conductor cross section should be \geq 0.22 (24 AWG). Two kinds of cables are used for PROFIBUS with detail definitions stated in table below.

Cable parameters	Type A	Type B	
Impedance	135 to 165 Ω (f = 3 to 20 MHz)	100 to 130 Ω (f > 100 kHz)	
Capacity	< 30 pF/m	< 60 pF/m	
Resistance	≤ 110 Ω/km	≤ 110 Ω/km	
Conductor cross section	≥ 0.34 (22 AWG)	≥ 0.22 (24 AWG)	

Tab. 12-23: Type of PROFIBUS-adapter cable



Standard Siemens PROFIBUS cable is (MLFB) 6XV1830-0EH10 (Type A), and connector is 6ES7972-0BA12-0XA0.

Relationship between communication rate and cables

Relationship between adapter's communication rate and cable length is described in table below.

Baud rate	Maximum length for each cable in [m] (Type A)	Maximum length for each cable in [m] (Type B)
9.6 to 93.75 kbps	1000	1000
187.5 kbps	1000	600
500 kbps	400	200
1.5 Mbps	200	200
3 to 12 Mbps	100	100

Tab.12-24: Relationship between communication rate and cable length

EMC measures

- Conductor of bus cable (signal cable) must be twisted, and shielded and installed separately with electrical power cable with a distance of at least 20 cm. Bus cable shielding layer should be grounded at one end. Terminal PE at terminal block X2 is taken as connecting terminal of the shielding layer. The terminal PE is only valid at the 1st pin of DB9 socket or when DB9 metal cover is connected with the shielding layer of bus cable.
- Conductors of communication connection cable (signal cable) for adapter and frequency converter must be twisted, and shielded and installed separately at a reasonable distance. Shielding layer for communication cable should be grounded at one end.
- Signal cable and electric power cable should be orthogonal in case of crossing.
- Signal cable should be as short as possible.
- Large area is required for the connection of shielding layer.

12.3.4 Periodical Data Communication

PPO data type

PROFIBUS-DP defines data structure for periodical data communication as PPO (the Parameter Process date Object). Rexroth PROFIBUS adapter supports 5 PPO types shown in figure below. PPO message is divided into two data areas in terms of transmission data contents:

Parameter area (PKW area): read or overwrite the parameter of a certain function code of slave.

Process data area (PZD area): including control word and reference frequency (data flow from master to slave), or status word, actual output frequency and other status monitoring values of slave (data flow from slave to master). For detail descriptions of PKW area and PZD area, please refer to chapter "PKW parameter area" on page 220 and chapter "PZD process data area" on page 224.

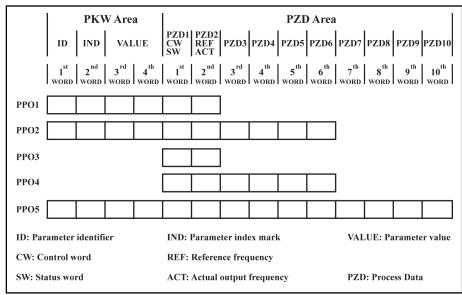


Fig. 12-6: PPO type

PKW parameter area

This data area is composed of ID, IND, VALUE_high and VALUE_low, as shown in figure below. They are used to read or modify the parameter of a certain function code of frequency converter, but only one function code can be read or modified each time. When master gives request and slave makes response, bit definition for each specific word in PKW area is shown in tab. 12-25 "Request data frame in PKW area_from master to slave" on page 220 and tab. 12-26 "Response data frame in PKW area_from slave to master" on page 221. If frequency converter fails to execute PKW area request command, it will return error code to the master in VALUE_low. Refer to tab. 12-27 "PKW area error codes" on page 221 for details.

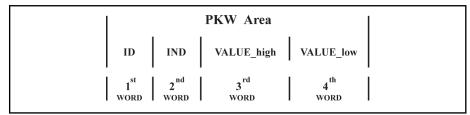


Fig.12-7: PKW area data format

Request data frame in PKW area

Word	Identifier	bit	Value	Description	
			0000B	No task	
		15 to 12	0001B	Request to read function code parameter	
		13 (0 12	0010B	Request to modify function code parameter	
1 st	ID		Others	Illegal command code	
		11 0/1B		Reserved	
		10 to 8	000B	Group No. for function code parameter	
			xxH	- Group No. for function code parameter	
2 nd	IND	15 to 8	xxH	Index serial number of function code within the group	
2	IND	7 to 0	0	Reserved, default is 0	
3 rd	VALUE_high	15 to 0	0	Reserved, default is 0	
				1. When reading parameters, default is 0.	
4 th	VALUE_low	.UE_low 15 to 0 xxxxxH	xxxxH	2. When modifying parameters, it is modified value.	
				3. It can be of any value in case of no operation.	

Tab.12-25: Request data frame in PKW area_from master to slave



For addressing of parameter function group and the index serial No. within the group, please refer to chapter "Addressing of communications function code parameter group number and index number within the group" on page 229.

Response data frame in PKW area

Word	Identifier	bit	Value	Description
			0000B	No task
		15 to 12	0001B	Correct in reading or modifying function code parameter
1 st			0111B	Wrong in reading or modifying function code parameter, and error message is show in VALUE_low
		11	0	Reserved , default is 0
	10 to 8		000B	Group No. of function code parameter
		7 to 0	xxH	Group No. or function code parameter
2 nd	IND	15 to 8	xxH	Index serial number of function code parameter within the group
2	IND	7 to 0	0	Reserved , default is 0
3 rd	VALUE_high	15 to 0	0	Reserved , default is 0
				When reading parameters, it returns to read parameter value.
	4 th VALUE_low	/ALUE low 15 to 0 xxxxH	xxxxH	2. when modifying parameters, it is modified value.
4		13 10 0	JUU XXXXII	3. It returns 0 in case of no operation.
				4. It returns error code when PKW area execution fails.

Tab.12-26: Response data frame in PKW area_from slave to master

Error message after execution failure in PKW area

Error code	Meaning	Reason	
1	Password locked	User password is locked	
2	Invalid command codes in PKW area	Command codes (bit15 to 12 of ID) are not 0, 1 or 2.	
3	Invalid parameter addresses in PKW area	Invalid function group or index number of the function group, or insufficient access/rights	
4	Invalid parameter value in PKW area	Data to write out of range	
5	In running, can not be modified	Frequency converter is running	
6	Read-only parameters	Parameter are read-only, can not be written	
7	Invalid operation	Function code does not support write or multiple write via external computer	
8	Communication data error in PKW	Conductor interference	
9	EEPROM read/write error	EEPROM write operation is not complete	

Tab. 12-27: PKW area error codes



Communication line which is subject to hardware disconnection error will also lead to execution failure in PKW area. The error code will be given in status word of PZD area.

Example of parameter operation in PKW area

In real application, the PROFIBUS adapter communicates with the master through messages in PPO structure. Among the 5 PPOs stated in fig. 12-6 "PPO type" on page 219, PPO 1, PPO 2 and PPO5 apply both PKW area and PZD area. In following examples, PKW area data frames are taken from complete PPO message to describe its request and response data frames.

The following examples are based on Fv and PROFIBUS-Adapter.

Example 1

Reading value of parameter 'Skip frequency range' [S3.06]. 0×05 is the function group, 0×06 is the index serial No. of the parameter within the group, then request and response data frames in PKW area are shown in table below.

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x1005 (or 0x1805)	0x0600	0x0000	0x0000
Response data frame of PKW area	0x1005	0x0600	0x0000	0x0000

Tab. 12-28: Example 1_request and response data frames of PKW area



ID of request data frame could be 0×1000 or 0×1800, because the 11th digit of ID in tab. 12-25 "Request data frame in PKW area_from master to slave" on page 220 can be 0 or 1. 0 is strongly recommended. In following examples, only ID value of 0with this digit is given.

Example 2

Reading value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×06 is the index serial No. of the parameter within the group. If the index serial No. of group S3 is miswritten as 0×20 (0×20, exceeds specified limit in group S), then request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x1005	0x2000	0x0000	0x0000
Response data frame of PKW area	0x7005	0x2000	0x0000	0x0003

Tab.12-29: Example 2_request and response data frames of PKW area

Example 3

Modifying value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×03 is the index serial No. within the group, 0×0BB8 is the modified value, then request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2005	0x0600	0x0000	0x0 BB 8
Response data frame of PKW area	0x1005	0x0600	0x0000	0x0 BB 8

Tab.12-30: Example 3_request and response data frames of PKW area

Example 4

Modifying value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×06 is the index serial No. within the group, and 0×1388 (0×1388 exceeds upper limit of parameter S3.06) is the modified value, then request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2005	0x0600	0x0000	0x1388
Response data frame of PKW area	0x7005	0x0600	0x0000	0x0004

Tab.12-31: Example 4_request and response data frames of PKW area

Example 5

Modifying value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×06 is the index serial No. within the group, and 0×0BB8 is the modified value. But, PPO command code (bit15-12 of ID) is miswritten as 8 (illegal command code), then request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x8005	0x0600	0x0000	0x0BB8
Response data frame of PKW area	0x7005	0x0600	0x0000	0x0002

Tab.12-32: Example 5_request and response data frames of PKW area

Example 6

If the user password is available, to modify the value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×06 is the index serial No. within the group, and 0x0BB8 is the modified value, then the request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2005	0x0600	0x0000	0x0BB8
Response data frame of PKW area	0x7005	0x0600	0x0000	0x0001

Tab.12-33: Example 6_after user password modified_request and response data frames of PKW area

Example 7

Forward run the frequency converter at 50.00 Hz (0x1388), then modify the value of parameter 'Skip frequency range' S3.06. 0×05 is the function group, 0×06 is the index serial No. within the group, and 0x0BB8 is the modified value, then the request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2005	0x0600	0x0000	0x0BB8
Response data frame of PKW area	0x7005	0x0600	0x0000	0x0005

Tab.12-34: Example 7_request and response data frames of PKW area

Example 8

Modify the value of parameter 'Heat sink temperature' b0.12. 0x00 is the function group, 0x0C is the index serial No. within the group, and 0x0001 is the modified value, then the request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2000	0x0C00	0x0000	0x0001
Response data frame of PKW area	0x7000	0x0C00	0x0000	0x0006

Tab.12-35: Example 8_request and response data frames of PKW area

Example 9

Modify the value of parameter 'LCD display in run mode' b0.08. 0x00 is the function group, 0x08 is the index serial No. within the group, and 0x0BB8 is the modified value, then the request and response data frames in PKW area are shown in table below:

	ID	IND	VALUE_high	VALUE_low
Request data frame of PKW area	0x2000	0x0800	0x0000	0x0001
Response data frame of PKW area	0x7000	0x0800	0x0000	0x0007

Tab.12-36: Example 9_request and response data frames of PKW area

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PZD process data area

When the master is sending a request message to the slave, PZD1 and PZD2 in PZD process data area are respectively corresponding to control word (CW) and reference frequency (REF) and PZD3 to PZD10 (number depending on PPO type) are written as 0. When the slave returns a response message to the master, PZD1 and PZD2 in PZD process data area are respectively corresponding to status word (SW) and actual output frequency (ACT), and PZD3-PZD10 are corresponding to status monitoring values (such as output current, output voltage, AC bus voltage, etc.) set by function code parameter H0.04 to H0.07.

Control word (CW)

bit	Value	Description
15 to 8	_	Reserved
7	0	Control active
1	1	Control inactive
6	0	Inactive
0	1	SCI stop acceleration/deceleration
5	0	Error reset inactive
3	1	Error reset active
4	0	E-Stop inactive
4	1	E-Stop active
3	0	Inactive
3	1	Stop as parameter setting mode
2	0	Forward
2	1	Reverse
1	0	Jog inactive
l l	1	Jog active
0	0	Run inactive
U	1	Run active

Tab. 12-37: bit definition of control word

When bit7 is 1, command is invalid.

• Status word (SW)

bit	Value	Description
11 to 15	_	Frequency converter error codes
10	_	Reserved
	000	Normal
	001	Communication hardware circuit error (SW feedback has no meaning when there is circuit error in communication hardware)
7 to 9	010	Communication data error in PZD area
	011	Reference frequency exceeds limit in PZD area
	100 to 111	Reserved
6	0	Normal
0	1	Stall over current
5	0	Normal
3	1	Stall over voltage
4	0	Not in deceleration
4	1	Decelerating
3	0	Not in acceleration
3	1	Accelerating
2	0	Not in jog
2	1	Jogging
1	0	In stop
'	1	In run
0	0	Forward
0	1	Reverse

Tab.12-38: bit definition of status word



In case of system errors, error records can be read in parameters E4.13 to E4.15.

No.	Error code name	No.	Error code name
0	No error record	13	Circuit disconnection (C.F.)
1	Over current at constant speed (O.C1)	14	Encoder speed detection error (PULS)
2	Over current in acceleration (O.C2)	15	Motor overheat (M.O.H.)
3	Over current in deceleration (O.C3)	16	EMI (CPU-)
4	Over voltage at constant speed (O.E1)	17	Short circuit (S.C.)
5	Over voltage in acceleration (O.E2)	18	Reserved
6	Over voltage during deceleration (O.E3)	19	L1, L2, L3 phase failure (IPH.L)
7	Frequency converter overload (O.L1)	20	U, V, W phase failure (OPH.L)
8	Motor overload (O.L2)	21	Frequency converter overheat (C.O.H.)
9	CPU read/write error (R.E.)	22	Parameter setting error (PRSE)
10	Operating panel read/write error (KEY-)	23	Parameter auto-tuning error (TUNE)
11	External error (ESt)	24	Frequency converter over load pre-warning 2 (O.L3)
12	Communication error (R.S.)	_	-

Tab.12-39: Error codes and meanings_PROFIBUS

B

When system is subject to error, please read value of function code E45 of frequency converter.

Example 1 If the Maximum frequency of the frequency converter is set at 100 Hz, to forward run the frequency converter ward run at 200 Hz (0x4E20) (exceeds the maximum frequency), then the PPO request and response messages are shown in table below.

	PZD1	PZD2
PPO request message	CW	REF
	0x0001	0x4E20
PPO response message	SW	ACT
	0x0180	0x4E20

Tab.12-40: Example 1_PPO request and response messages

B

In this example, the feedback status word is 0x0180, bit 7 to 9 of status word is 011 (PZD area set frequency exceeds limit).

Example 2 The frequency converter is first forward run at 50 Hz (0x1388), the hardware circuit of communication is then disconnected, then the PPO request and response messages are shown in table below.

	PZD1	PZD2
PPO request message	CW	REF
	0x0001	0x1388

	PZD1	PZD2
PPO response message	SW	ACT
	0x0080	0x1388

Tab.12-41: Example 2_PPO request and response messages

B

In this example, the feedback status word is 0x0080, bit 7 to 9 of status word is 001 (Communication hardware circuit error).

Process data PZD3 to PZD10

One of parameters H0.04 to H0.07 can set 2 PZDs. For example, H0.04 sets PZD3 and PZD4, with bit0 to bit3 setting of PZD3, bit4 to bit7 setting of PZD4, then the maximum range of the function code is 00 to FFH (hex) or 0 to 255 (decimal). The corresponding relationship between the set value (4 bits) and monitored value is shown in table below.

Output current
Reference frequency
Output current
DC bus voltage
Heat sink temperature
Output voltage
Output power
Torque current
Exciting current
Output speed
Reference speed
User-defined reference value
User-defined output value
Reference torque
Digital inputs status
Encoder speed feedback

Tab.12-42: Process data PZD3 to PZD 10 values and function code settings

Examples for operation of PZD process data area

Example 1

The master communicates with the slave via PPO4. From fig. 12-6 "PPO type" on page 219 and tab. 12-42 "Process data PZD3 to PZD 10 values and function code settings" on page 227, we need to set status monitoring value corresponding to PZD3 - PZD6 in parameters of Fv.

If we need to start frequency converter for forward rotation at 50.00 Hz (0×1388), and request PZD3 to reflect output current, PZD4 to reflect output voltage, PZD5 to reflect DC bus voltage, PZD6 to reflect radiator temperature, respective function codes are set as: [H0.04]=82; [H0.05]=67. Complete PPO request and response messages are shown in table below.

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	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
PPO request message	CW	REF	0x0000	0x0000	0x0000	0x0000
11 O request message	0x0001	0x1388	0.0000	00000		
DDO response message	SW	ACT	0x0000	0x0206	0x02DD	0x0019
PPO response message	0x0002	0x1388	0.0000	0x0206	UXUZDD	0.0019

Tab. 12-43: Example 1 for PZD process data area_request and response messages of PPO



In this example, request and response data frame is the message of frequency converter at stable operation. Actually, at the instant start-up of the frequency converter, response data frame in PZD area is "000× 0000 0001 0000 1369 0019" (× means rotation direction is not certain at the instant of activation).

Example 2 When the frequency converter forward runs at 50 Hz, to stop the frequency converter as parameter settings, please refer to example 1.

	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
PPO request message	CW	REF	0x0000	0x0000	0x0000	0x0000
	0x0008	0x1388	0.0000			
DDO rospones massage	SW	ACT	0,0000	0x0000	0x0049	0v0012
PPO response message	0x0000	0x0000	0x0000	00000	030049	0x0013

Tab. 12-44: Example 2 for PZD process data area_request and response messag-

Example 3 To reverse start the frequency converter at 50 Hz, please refer to example 1 for parameter settings.

	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
PPO request message	CW	REF	0x0000	0x0000	0x0000	0x0000
	0x0005	0x1388	0.0000	0.0000		
PPO response message	SW	ACT	0,,000	0.0206	0x02DA	0×004 A
	0x0003	0x1388	0x0000	0x0206	UXUZDA	0x001A

Example 3 for PZD process data area_request and response messag-Tab. 12-45:

Example 4 When the frequency converter reverse runs at 50 Hz, to stop the frequency converter as parameter settings, please refer to example 1.

	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
PPO request message	CW	REF	0x0000	0x0000	0x0000	0x0000
FFO request message	0x000C	0x1388	0.0000			
DDO recepence message	SW	ACT	0x0000	0x0000	0x0040	0x0013
PPO response message	0x0001	0x0000	0.0000	0.0000	0.0040	00013

Tab. 12-46: Example 3 for PZD process data area_request and response messages of PPO

Addressing of communications function code parameter group number and index number within the group

The communication function code address of the frequency converter is in strict correspondence with the function code. It consists of function code group No. and index of parameters within the group. Reading and writing function codes are possible through reading and writing contents of function code address of PROFIBUS communication. Reading and writing property as well as value taking range for the function code should follow the User Manual for the frequency converter.

A complete communication function code address of frequency converter consists of 19 bits, where high 11 bit is communication function code group No., and low 18 bit is index of parameters within the group. Index of parameters within the group for a certain function code refers to sexadecimal expression group No. of such function code. For example, if it is function code E03 (programmable skip frequency range), it is numbered as 3 in Group E. So its index of parameters within the group is 0×03. As high 3 bit of 11 bit function code (bit10 to bit 8 of ID) must be 000B, in order to describe it in sexadecimal system, function code group No. stated in this manual only refers to its low 8 bit (i.e., bit7 to bit 10 of ID). For example, if it is function code E03 (programmable skip frequency range), its function code group No. is 0×01. The function code group No. mentioned above is the same as this number. Addressing the range for PROFIBUS adapter communication function code group No. and index of parameter within the group is shown in table below.

Function code group	b0	b1	S0	S1	S2	S3
Mapping address	0x00	0x01	0x02	0x03	0x04	0x05
Index serial No. within the group	0x00 to 0x0F	0x00 to 0x17	0x00 to 0x0A	0x00 to 0x06	0x00 to 0x0F	0x00 to 0x10
Function code group	E0	E1	E2	E3	E4	E5
Mapping address	0x06	0x07	0x08	0x09	0x0A	0x0B
Index serial No. within the group	0x00 to 0x18	0x00 to 0x11	0x00 to 0x34	0x00 to 0x0D	0x00 to 0x10	0x00 to 0x0F
Function code group	H0	_	-	-	-	-
Mapping address	0x0C	_	-	-	-	_
Index serial No. within the group	0x00 to 0x0A	-	-	-	_	-

Tab.12-47: Addressing range of function code group and index serial No. withing the group

12.3.5 Communication Parameter Configuration

Communication related parameter settings in Fv

Function code	Function name	Setting range of parameter
b1.00	Frequency setting mode	5: Set via communication
b1.02	Frequency converter control commands	2: Set control commands via communication
H0.00	Communication protocols selection	1: PROFIBUS protocols
H0.03	Local address	1 to 126
H0.04	PZD4, PZD3 setting	0 to 255
H0.05	PZD6, PZD5 setting	0 to 255
H0.06	PZD8, PZD7 setting	0 to 255
H0.07	PZD10, PZD9 setting	0 to 255
H0.08	Communication disconnection detection time	0.0 to 60.0s (0.0s: deactivated)
H0.09	Communication disconnection action	0: Stop
	Communication disconnection action	1: Continue running

Tab. 12-48: Fv PROFIBUS-DP communication parameters



If parameter [b00]=5, when the frequency converter is stopped by the **Stop** key on the operating panel, adapter is isolated from communication software of the frequency converter. If communication is to be re-established, **Stop** and **Reset** commands must be sent to the frequency converter by the adapter.

Parameter configuration of master

Parameter configuration for related master may refer to instructions for the master. The address configured for slave in the master should be consistent with the parameter address configured for the slave. Communication baud rate and PPO type is determined by the master.

GSD file

Users may log on the website of the company at www.boschrexroth.com/fv to download electronic database document (RXFVDP01.gsd) and bit map document (RX_FV*.bmp) pack for fieldbus adapter. For specific operation and PROFIBUS system configuration method, please refer to related system configuration documents.

12.3.6 Errors and Analysis

LED display analysis

Run

This light indicates if PROFIBUS adapter is running normally. If PROFIBUS adapter is correctly connected to the frequency converter, and related parameter configuration for the frequency converter is correct, this light is always on after power is switched on. If this light is flashing, please switch off the power supply first, and then check if PROFIBUS adapter is correctly connected with the frequency converter, if frequency converter parameters are correctly configured, and if PROFIBUS adapter power connection is reliable. After that, switch power on for PROFIBUS adapter. If this problem still exists, please contact your dealer.

Line

This light indicates the status of communication between the PROFIBUS adapter and the frequency converter. It indicates normal communication if this light is always on. If this light is off, it indicates disconnection between the adapter and the frequency converter. Then, please check hardware connection between PROFIBUS adapter and frequency converter. If this light is flashing, it indicates abnormal connection between the adapter and the frequency converter. Then, please check hardware connection between the PROFIBUS adapter and the frequency converter.

Net

This light indicates the status of communication between the PROFIBUS adapter and PROFIBUS master. If this light is always flashing, it indicates normal communication. If this light is off, please check hardware wiring between the PROFIBUS adapter and master, and check if the master configuration is correct.

Diagnosis information of master

From diagnosis of the adapter by master, 6-byte diagnosis information is obtained. Detailed meanings for each byte are as below:

First byte (Station_Status_1)

0	Diag.Station_Non_Existent (set by master, reset by slave) 1: slave does not exist
	1. Sidvo does not exist
1	Diag.Station_Non_Ready (set by slave)
'	1: slave is not ready for data exchange
2	Diag.Cfg_Error (set by slave)
	1: Adapter data received does not match with originally configured data
3	Diag.Ext_Diag (set by slave)
3	1: diagnosis entrance is at undetermined diagnosis area of the slave
4	Diag.Not-Supported (set by slave)
4	1: service not supported by slave
_	Diag.Invalid_Slave_Response (set by master, reset by slave)
5	1: invalid response of slave
6	Diag.Prm_Error (set by slave)
6	1: invalid parameter or parameter value
7	Diag.Master_Lock (set by master, reset by slave)
7	1: parameters of slave are set by other masters

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• Second byte (Station_Status_2)

0	Diag.Prm_Req (set by slave)
	1: Slave needs to be reconfigurated, parameters need to be set again.
1	Diag.Stat_Diag (set by slave)
'	1: Static diagnosis, slave fails (temporarily) to provide valid data.
2	Always set as 1 by slave
3	Diag.WD_On (set by slave)
3	1: watchdog is on
4	Diag.Freeze_Mode (set by slave)
4	1: freezing command received by slave
E	Diag.Sync_Mode (set by slave)
5	1: synchronizing command received by slave
6	Reserved
7	Diag.Deactivated (set by master, reset by slave)
1	1: slave inactive

Third byte (Station_Status_3)

0 to 6	Reserved
7	Diag.Ext_Diag_Overflow (set by slave) 1: more diagnosis information in Ext_Diag_Date than what specified information

• Fourth byte (Diag.Master_Add)

Log in address of PROFIBUS master which parameterizes this PROFIBUS slave in this eight-bit set. If there is no such master which parameterizes this PROFIBUS slave, address 255 of this PROFIBUS slave will be logged in this octet.

• Fifth and sixth bytes (Ident_Number)

The identifier of the adapter.

Service and Support

13 Service and Support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the Service Helpdesk & Hotline under:

Phone: +49 9352 40 5060 Fax: +49 9352 18 4941

E-mail: service.svc@boschrexroth.de
Internet: http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances resulting in the malfunction
- Type plate name of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your email address)

Environmental Protection and Disposal

Environmental Protection and Disposal 14

Environmental Protection 14.1

Production Processes

The products are made with energy- and resource-optimized production processes which allow re-using and recycling the resulting waste. We regularly try to replace pollutant-loaded raw materials and supplies by more environment-friendly alternatives.

No Release of Hazardous Sub-

stances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Normally, our products will not have any negativ influences on the environment.

Significant Components

Basically, our products contain the following components:

Electronic devices	Motors
• steel	steel
aluminum	 aluminum
• copper	copper
 synthetic materials 	brass

electronic components and modules

· magnetic materials · electronic components and modules

Disposal 14.2

Return of Products

Our products can be returned to our premises free of charge for disposal. It is a precondition, however, that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign material or foreign components.

Send the products "free domicile" to the following address:

Bosch Rexroth AG Electric Drives and Controls Buergermeister-Dr.-Nebel-Strasse 2 97816 Lohr am Main, Germany

Packaging

The packaging materials consist of cardboard, wood and polystyrene. These materials can be recycled anywhere without any problem.

For ecological reasons, please refrain from returning the empty packages to

Batteries and Accumulators

Batteries and accumulators can be labeled with this symbol.

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

The end user within the EU is legally obligated to return used batteries. Outside the validity of the EU Directive 2006/66/EC keep the stipulated directives.

Used batteries can contain hazardous substances, which can harm the environment or the people's health when they are improper stored or disposed of.

After use, the batteries or accumulators contained in Rexroth products have to be properly disposed of according to the country-specific collection.

Recycling

Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Environmental Protection and Disposal

Metals contained in electric and electronic modules can also be recycled by means of special separation processes.

Products made of plastics can contain flame retardants. These plastic parts are labeled according to EN ISO 1043. They have to be recycled separately or disposed of according to the valid legal requirements.

Index

Index

0 9	D
3-Level Menu Structure	Definition
	Definition for braking ratio OT % 18
Α	Definition of PROFIBUS DB9 Pins21
Accessories	Delivery and Storage1
Accessories for Control Cabinet Mounting 193	Derating and Ambient Temperature 15
Accumulators	Derating and Mains Voltage15
Additional Information	Derating of Electrical Data
Allowed mounting mode of the components 30	Derating of the Output Current Depending
Analog input terminals (±10 V, VR1, VR2,	on the Pulse Frequency15
	Description of Attribute Symbols in Parame-
GND, +I)	ter Tables
Analog Outputs	Design and installation in area A – interfer-
Appropriate Use	ence-free area of control cabinet
Automatic Constant Pressure Water Control	Design and installation in area B – interfer-
System	
_	ence –susceptible area of control cabinet 17
В	Design and installation in area C – strongly
Batteries	interference-susceptible area of control cabi-
Block Diagram	net
Brake Chopper 181	Digital Outputs7
Brake chopper terminals 183	Dimensions and weight
Brake Components	Dimensions diagram
Brake Resistor	Direct mounting of FVCC at the control cabi-
Brake resistor box	net with mounting plate19
Brake resistor in aluminum housing	Discharging Device
Brake resistor selection	Discharging of Capacitors
Brake resistor type coding 12	Discharging of DC Bus Capacitors
Bus connection terminal PROFIBUS DB9 217	Disposal23
	Drive System Wiring 3
C	
Cable and Fuse Dimensions	E
Category b: Basic Parameters91	Electrical Data15
Category E: Extended Parameters	Electromagnetic Compatibility (EMC) 16
Category H: Advanced Parameters	EMC Filter 17
Category S: Standard Parameters	EMC filter type coding1
Causes of noise emission	EMC Measures for Design and Installation 16
CE certification	EMC Requirements16
	EMC-optimal installation in facility and con-
Certification	trol cabinet16
Chapters and Contents	Encoder Signal Selection 5
Closed-loop Speed Control System	Engineering Software
Commission Process	Engineering software type coding1
Communication Interface	Ensuring the EMC Requirements
Communication Protocols	Environmental protection
Contained substances	Error message after execution failure in
see "Significant components"	
Control cabinet mounting according to inter-	PKW area
ference areas – exemplary arrangements 169	Error Types and Solutions
Control circuit terminals description 50	Errors and Analysis
Control circuit terminals illustration 52	Example of Operating Panel Operation
Control Circuit Wiring43	Example of parameter operation in PKW area. 22
Control Command	Example: Commissioning of Frequency Con-
Control word (CW)	verter with Potentiometer
Cooling Types	Examples for operation of PZD process data
-	area22
	External brake chopper

Bosch Rexroth AG

Index

External brake chopper type coding 13	M	
External EMC Filter Type 175	Main circuit terminals description	49
	Main circuit terminals illustration	49
F	Main Circuit Wiring	38
Feedback7	Main circuit wiring diagram	39
Frequency Setting	Main circuit wiring steps	
Frequency Setting via Analog and Pulse Inputs. 70	Main Functions	
Fv Basic Parameter Fast Setting	ModBus Adapter	
Fv Description	ModBus Communication Example	
Fv Dimensions	ModBus networking	
Fv Disassembly and Assembly	ModBus Protocol	
Fv Figure	Mounting of adapter	
Fv Mounting	Mounting of FVCC at the control cabinet	
Fv PROFIBUS network	with mounting plate and fixing metal strips	194
Fv PROFIBUS-DP communication parameters 230	Mounting of operating panel	
Confindincation parameters 250	Multiple Function Digital Inputs	
G	, , , , , , , , , , , , , , , , , , , ,	
General Technical Data	N	
Ground connections	Noise emission of the drive system	162
Group b0: System parameters	Noise immunity in the drive system	
Group b1: Basic parameters	Noise immunity limit values	
Group E0: Analog and digital inputs	Notes on Frequent Start and Stop	
Group E1: Analog and digital outputs	Notes on Function Groups	
Group E2: Multi-Speed and logic control 133	NPN/ PNP Jumper SW1	
Group E3: PID control	NPN/PNP modes and signal inputs	
Group E4: Protection parameters	141 147 141 modes and signal inputs	0 1
Group E5: Extended parameters	0	
	•	
Group H0: Communication parameters 149	Operating Panel	57
Group S0: V/F control	Operating Panel Cable for Control Cabinet	405
Group S1: Vector control	Mounting	
Group S2: Motor and encoder parameters 111	Operating panel cable type coding	
Group S3: Control parameters	Operating panel type coding	
GSD File	Operation Mode Description	
	Optional accessories	14
Н		
Hazardous substances	P	
How to install the discharging device 199	Packaging	235
	Parameter Settings	63
	Parameters Functions	75
Important Directions for Use	Periodical Data Communication	219
Inappropriate Use	PID Control	69
Installing signal lines and signal cables 173	PKW parameter area	220
Interface adapter cable type coding 11	PPO data type	
Interface adapter type coding11	Process data PZD3 to PZD10	
Interfaces	Production processes	
Internal brake chopper	PROFIBUS Adapter	
Introduction	PROFIBUS adapter dimensions	217
Introduction to the Documentation	PROFIBUS Frame format	
Throughout to the Bocamentation	PROFIBUS Protocol	
1	PROFIBUS-Adapter	
J	Properties of the Basic Device Fv	
Jumper Wiring53	PZD process data area	
L		
Limit values for line-based disturbances 162	R	
Linear/S-curve Acceleration/Deceleration 67	Recommendation for design of the fuses	47
Logic Control	Recommendation on cable dimensioning	44

Index

Recommended opening dimensions at conrol cabinet	184 235 193 11 36 35 220 218 221
Scope of Supply Significant components Simple Applications of Process Control Solutions for Simple Error during Commissioning Standard supply Start Control Status word (SW) Stop Control Storage of the Components Support See service hotline	235 197 62 14 65 225 66 15
Γ Fechnical Data Fechnical specifications Fhe Function of EMC Filter. Fhe settings of the brake chopper Fransport of the Components Fype Coding Fype Coding of Fv Fype of PROFIBUS-adapter cable	182 175 184 15 9
J JL Certification	17
Niring dimensions for terminals Niring on each terminal of brake choppers Niring Terminals Description	183

Rexroth Frequency Converter Fv

Notes



Bosch Rexroth (Xi'an)
Electric Drives and Controls Co., Ltd.
No. 3999, Shangji Road,
Economic and Technological Development
Zone, 710021 Xi'an, P.R. China
Phone +49 9352 40 5060
Fax +49 9352 18 4941
service.svc@boschrexroth.de
www.boschrexroth.com

