

FR-E 500

Frequency Inverter

Installation Manual

FR-E 520S EC

FR-E 540 EC

About this Manual

The texts, illustrations, diagrams, and examples contained in this manual are only intended as aids to help explain the installation, set-up, and starting of the frequency inverters FR-E 520S EC and FR-E 540 EC.

If you have any questions concerning the programming and operation of the equipment described in this manual, please contact your relevant sales office or department (refer to back of cover). Current information and answers to frequently asked questions are also available through the Internet (www.mitsubishi-automation.com).

MITSUBISHI ELECTRIC EUROPE B.V. reserves the right to make changes both to this manual and to the specifications and design of the hardware at any time without prior notice.

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Contents

1	Introduction	
1.1	General Description	7
2	Specifications	
2.1	Model Specifications FR-E 520S EC (1-phase connection)	8
2.2	Model Specifications FR-E 540 EC (3-phase connection)	9
2.3	Model Specifications FR-E 500 EC	10
3	Appearance and Structure	
3.1	Description of the Case	12
4	Wiring	
4.1	Overview	13
4.2	Wiring of the Main Circuit	14
4.2.1	Mains, Motor and Ground Terminal Connections	14
4.2.2	Main Circuit Terminals	16
4.3	Wiring of the Control Circuit	17
5	Parameter	
5.1	Overview and Setting Ranges	20
6	Protective Functions	
6.1	Error Messages and Remedies	24
7	Dimensions	
7.1	Dimensions of the Frequency Inverters	27

Safety instructions

For qualified staff only

This manual is only intended for use by properly trained and qualified electrical technicians who are fully acquainted with automation technology safety standards. All work with the hardware described, including system design, installation, set-up, maintenance, service and testing, may only be performed by trained electrical technicians with approved qualifications who are fully acquainted with the applicable automation technology safety standards and regulations. Any operations or modifications of the hardware and/or software of our products not specifically described in this manual may only be performed by authorised Mitsubishi staff.

Proper use of equipment

The devices of the FR-E series are only intended for the specific applications explicitly described in this manual. Please take care to observe all the installation and operating parameters specified in the manual. The design, manufacturing, testing and documentation of these products have all been carried out in strict accordance with the relevant safety standards. Under normal circumstances the products described here do not constitute a potential source of injury to persons or property provided that you precisely observe the instructions and safety information provided for proper system design, installation and operation. However, unqualified modification of the hardware or software or failure to observe the warnings on the product and in this manual can result in serious personal injury and/or damage to property. Only accessories specifically approved by MITSUBISHI ELECTRIC may be used with the frequency inverters FR-E 520S EC and FR-E 540 EC. Any other use or application of the products is deemed to be improper.

Relevant safety regulations

All safety and accident prevention regulations relevant to your specific application must be observed in the system design, installation, setup, maintenance, servicing and testing of these products.

The regulations listed below are particularly important. This list does not claim to be complete; however, you are responsible for knowing and applying the regulations applicable to you.

- VDE/EN Standards
 - VDE 0100
(Regulations for electrical installations with rated voltages up to 1,000V)
 - VDE 0105
(Operation of electrical installations)
 - VDE 0113
(Electrical systems with electronic equipment)
 - EN 50178
(Configuration of electrical systems and electrical equipment)
- Fire prevention regulations
- Accident prevention regulations
 - VBG No. 4 (electrical systems and equipment)

General safety informations and precautions

The following safety precautions are intended as a general guideline for using the frequency inverter together with other equipment. These precautions must always be observed in the design, installation and operation of all control systems.



DANGER:

- *Observe all safety and accident prevention regulations applicable to your specific application. Installation, wiring and opening of the assemblies, components and devices may only be performed with all power supplies disconnected.*
- *Assemblies, components and devices must always be installed in a shockproof housing fitted with a proper cover and protective equipment.*
- *Devices with a permanent connection to the mains power supply must be integrated in the building installations with an all-pole disconnection switch and a suitable fuse.*
- *Check power cables and lines connected to the equipment regularly for breaks and insulation damage. If cable damage is found, immediately disconnect the equipment and the cables from the power supply and replace the defective cabling.*
- *Before using the equipment for the first time check that the power supply rating matches that of the local mains power.*
- *Residual current protective devices pursuant to DIN VDE Standard 0641 Parts 1–3 are not adequate on their own as protection against indirect contact for installations with frequency inverter systems. Additional and/or other protection facilities are essential for such installations.*
- *EMERGENCY OFF facilities pursuant to VDE 0113 must remain fully operative at all times and in all control system operating modes. The EMERGENCY OFF facility reset function must be designed so that it cannot cause an uncontrolled or undefined restart.*
- *You must also implement hardware and software safety precautions to prevent the possibility of undefined control system states caused by signal line cable or core breaks.*



CAUTION:

All relevant electrical and physical specifications must be strictly observed and maintained for all the frequency inverters in the installation. The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.

Safety warnings

In this manual special warnings that are important for the proper and safe use of the products are clearly identified as follows:



DANGER:

Personnel health and injury warnings. Failure to observe the precautions described here can result in serious health and injury hazards.



CAUTION:

Equipment and property damage warnings. Failure to observe the precautions described here can result in serious damage to the equipment or other property.

1 Introduction

This Installation Manual includes a brief summary of the main specifications of the FR-E 500 frequency inverters, which should be sufficient to enable experienced users to install and configure the inverter. For further information on the functions and parametrization please refer to the Instruction Manual of the frequency inverter FR-E 500. This Installation Manual is intended exclusively as an installation and setup guide and a brief reference. It does not replace the main product manual.

1.1 General Description

The inverters of the FR-E 520S EC series are available with outputs from 0.4 to 2.2kW (1-phase). The inverters of the FR-E 540 EC series are available with outputs from 0.4 to 7.5kW (3-phase). The output frequency ranges from 0.2 to 400Hz.

Features of the frequency inverters

- Communication ability and networking
For the integration in an automation plant a serial interface RS485 is included as standard equipment. Through this interface up to 32 inverters can be linked up. Open communications with standardised industrial bus systems as Profibus/DP, DeviceNet, CC-Link, CAN Open, or Modbus Plus can be realised easily via optional interface cards.
- Compatibility with a lot of new applications
 - PID Control
The inverter can be used to exercise process control, e.g. flow rate for pumps
 - Stop function selection (terminal MRS)
This function is used to select the stopping method (deceleration to a stop or coasting).
- Large number of protective functions for safe operation
 - Automatic restart after instantaneous power failure
 - Built-in overcurrent protection
 - Retry function after alarm occurrence
- Compatibility with numerous I/O's
 - Multi-speed operation
(15 different pre-selected speeds are available)
 - 0/4 to 20mA (0–10V) control input
 - Multi-input terminals:
select 4 inputs from 11 possible input types (e.g. digital potentiometer)
 - Multi-output terminals:
select three outputs from 12 possible output types
 - 24V external power supply output
(permissible values: 24V DC/0.1A)

2 Specifications

2.1 Model Specifications FR-E 520S EC (1-phase connection)

Type		FR-E 520S EC			
		0.4 k	0.75 k	1.5 k	2.2 k
Rated motor capacity [kW]	150% Overload capacity ① ^①	0.75	1.1	2.2	3
	200% Overload capacity ②	0.4	0.75	1.5	2.2
Rated current [A]	150% Overload capacity ①	3.6	5	9.6	12
	200% Overload capacity ②	2.5	4	7	10
Rated output capacity [kVA]		0.95	1.5	2.7	3.8
Output	Overload capacity ②	①	150% of rated motor capacity for 0.5s; 120% for 1min (max. ambiente temperature 40°C)		
		②	200% of rated motor capacity for 0.5s; 150% for 1min (max. ambiente temperature 50°C)		
	Voltage ③	3-phase, 0V up to power supply voltage			
Input	Power supply voltage	1-phase, 200–240V AC, –15% / +10%			
	Permissible AC voltage fluctuation	170–264V AC at 50 / 60Hz			
	Power supply frequency	50 / 60Hz ± 5%			
	Rated input capacity [kVA] ④	1.5	2.3	4.0	5.2
Protection		IP 20			
Cooling		Self-cooling		Fan-cooling	
Weight [kg]		1.9	1.9	2.0	2.0

NOTES

Special notes referring to the table:

- ① The applicable motor capacity refers to a motor voltage of 230V.
- ② The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- ③ The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage.
- ④ The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).

2.2 Model Specifications FR-E 540 EC (3-phase connection)

Type		FR-E 540 EC						
		0.4 k	0.75 k	1.5 k	2.2 k	3.7 k	5.5 k	7.5 k
Rated motor capacity [kW]	150% Overload capacity ① ^①	0.75	1.1	2.2	3	4	7.5	11
	200% Overload capacity ②	0.4	0.75	1.5	2.2	4	5.5	7.5
Rated current [A]	150% Overload capacity ①	1.8	3	4.9	6.7	9.5	14	21
	200 % Overload capacity ② ^⑤	1.6 (1.4)	2.6 (2.2)	4 (3.8)	6 (5.4)	9.5 (8.7)	12	17
Output	Rated output capacity [kVA]	1.2	2.0	3.0	4.6	7.2	9.1	13.0
	Overload capacity ②	①	150% of rated motor capacity for 0.5s; 120% for 1min (max. ambient temperature 40°C)					
		②	200% of rated motor capacity for 0.5s; 150% for 1min (max. ambient temperature 50°C)					
	Voltage ③	3-phase, 0V up to power supply voltage						
Input	Power supply voltage	3-phase, 380–480V AC, –15% / +10%						
	Voltage range	323–528V AC at 50 / 60Hz						
	Frequency range	50 / 60Hz ± 5%						
	Rated input capacity [kVA] ④	1.5	2.5	4.5	5.5	9	12	17
Protection	IP 20							
Cooling	Self-cooling			Fan-cooling				
Weight [kg]	1.9	1.9	2.0	2.1	2.1	3.8	3.8	

NOTES

Special notes referring to the table:

- ① The applicable motor capacity refers to a motor voltage of 400V.
- ② The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- ③ The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage.
- ④ The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
- ⑤ The rated output current in the parentheses applies when low acoustic noise operation is to be performed at an ambient temperature higher than 40°C with the parameter 72 value set to 2kHz or higher.

2.3 Model Specifications FR-E 500 EC

The following datas refer to the frequency inverters FR-E 520S EC und FR-E 540 EC.

Type		Description
Control method		Extended flux vector control with online auto tuning of motor data or V/f control
Modulation control		Sine evaluated PWM, Soft PWM
Carrier frequency		0.7–14.5kHz (user adjustable)
Frequency range		0.2–400Hz
Frequency resolution	Analog	From terminals 2-5: 1/500 of maximum set frequency (input 5V DC); 1/1000 (input 10V, 20mA DC)
	Digital	0.01Hz / 50Hz
Frequency precision		±0.5% of max. output frequency (temperature range 25°C ± 10°C) during analog input; ±0.01% of max. output frequency during digital input
Voltage/ Frequency characteristics		Base frequency adjustable from 0 to 400Hz; constant torque or variable torque selectable
Possible starting torque		≥ 150% / 1Hz, ≥ 200% / 3Hz (for vector control or slip compensation)
Torque boost		Manual torque boost; selectable between 0–30%
Acceleration/deceleration time		0.01; 0.1 to 3600s individual settings
Acceleration/deceleration characteristics		Linear or S-form course, user selectable
Braking/ torque	Regenerative ^③	0.4k and 0.75k: 100% or more; 1.5k: 50% or more; 2.2k to 7.5k: 20% or more
	DC-braking	Braking time and braking moment adjustable, Operating frequency: 0–120Hz, operating time: 0–10s, voltage: 0–30%
Current stall prevention operation level		Operation current level setting possible (0–200% variable), enable/disable selection
Voltage stall prevention operation level		Operation level is fixed, enable/disable selection
High-response current restriction level		Operation level is fixed, enable/disable selection
Motor protection		Electronic motor protection relay (rated current user adjustable)
Frequency setting values	Analog input	0–5V DC, 0–10V DC, 0/4–20mA
	Digital	From control panel (parameter unit), RS485 or network
Input signals	Starting signal	Individual selection of forward / reverse run Starting signal self retaining input
	Multi-speed selection	Up to 15 set speeds (each speed can be set between 0 and 400Hz; speed can be changed via control panel or during operation)
	2nd function	Selects 2nd function (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection)
	Selection of current input	Frequency setting via current input signal 0/4 to 20mA DC
	External thermal input	Stopping the inverter with an externally mounted thermal relay
	PU<->external operation	Switch over between the operating modes “PU” and “External”
	V/F<->flux vector control	External switching between V/F control and general-purpose flux vector control
	Output stop	Instant cutoff of inverter output (frequency and voltage)
	Error reset	The error indication (alarm signal) is reset with the reset of the protective function

Type		Description	
Control inputs	Operation functions	Maximum and minimum frequency setting, frequency jump operation, external thermal input selection, instantaneous power failure restart operation, forward run/reverse run prevention, slip compensation, operation mode selection, off-line auto tuning function, PID control, computer link operation (RS485), open network operation	
	Output signals	Operation status	2 output types (open collector output) can be selected: inverter running, frequency reached, frequency detection, overload warning, zero return detection, output current detection, maximum PID, minimum PID, PID forward run, PID reverse run, operation ready, minor failure and error. 1 relay contact can be selected for the output (230V AC; 0.3A / 30V DC; 0.3A)
		Analog signal	One of the following output types can be selected: output frequency, motor current, output voltage, analog output (0–10V DC).
Display option	Displayed on control panel (FR-PU04/FR-PA02-02)	Operating state	Output frequency, motor current, output voltage, frequency setting value, operation speed
		Alarm display	Error messages are displayed after a protective function is activated. Up to 4 error codes can be stored.
	Additional displays on control panel FR-PU04	Operating state	Signal status of input and output terminals
		Interactive operating guide	Interactive guide for operation and troubleshooting via help function
Protection	Functions	Overcurrent cutoff (during acceleration, deceleration, constant speed), regenerative overvoltage cutoff, undervoltage ^① , instantaneous power failure ^① , overload cutoff (electronic thermal relay), brake transistor error, ground fault overcurrent, output short circuit, stall prevention, overload warning, brake transistor overheating, fan overheating, fan error ^④ , option error, parameter error, PU connection error, output phase error	
Ambient humidity	Ambient temperature	–10°C to +50°C (non-freezing) (For selection of the overload capacity of 150% the max. temperature is 40°C)	
	Storage temperature ^②	–20°C to +65°C	
	Ambient humidity	Max. 90% RH (non-condensing)	
	Ambient conditions	For indoor use only, avoid environments containing corrosive gases, install in a dust-free location.	
	Altitude	Max. 1000m above sea level; After that derate by 3% for every extra 500m up to 2500m (91 %).	
	Shock resistance	10g (3 times each in 3 directions)	
	Vibration resistance	0.6g: resistance to vibrations from 10 to 55Hz for 2 hours along all 3 axes	
	Certifications	UL / CSA / CE / EN	

NOTES

Special notes referring to the table:

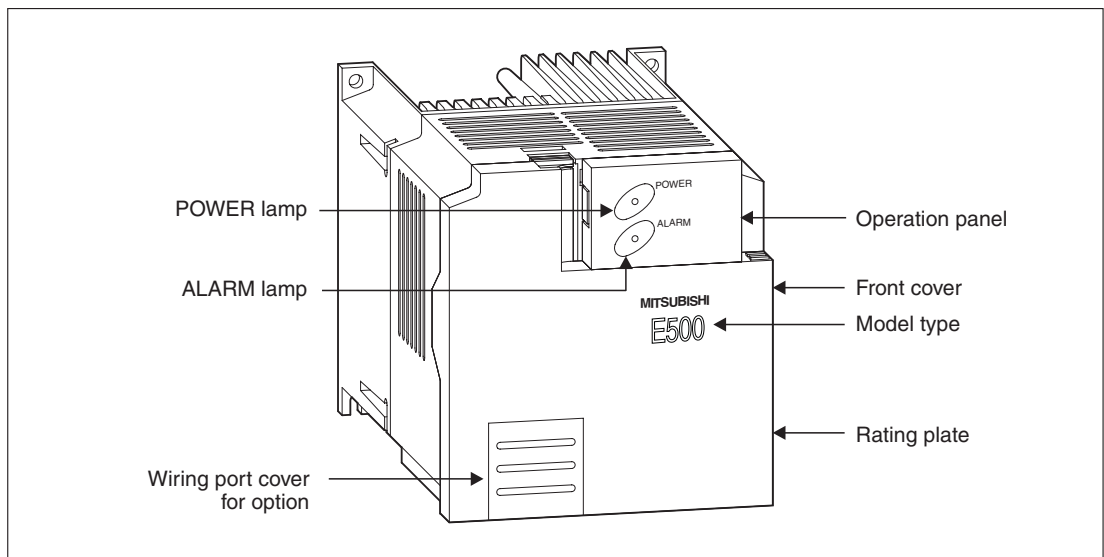
- ① When undervoltage or instantaneous power failure has occurred, alarm display or alarm output is not provided but the inverter itself is protected. Overcurrent, regenerative overvoltage or other protection may be activated at power restoration according to the operating condition.
- ② Temperature applicable for a short period in transit, etc.
- ③ The braking torque indicated is short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 50Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverters of the FR-E500 EC Series does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. A brake unit BU may also be used.
- ④ Not valid for the inverters FR-E 520S-0.4 k, -0.75 k EC and FR-E 540-0.4 k, -0.75 k EC which are not equipped with a cooling fan.

3 Appearance and Structure

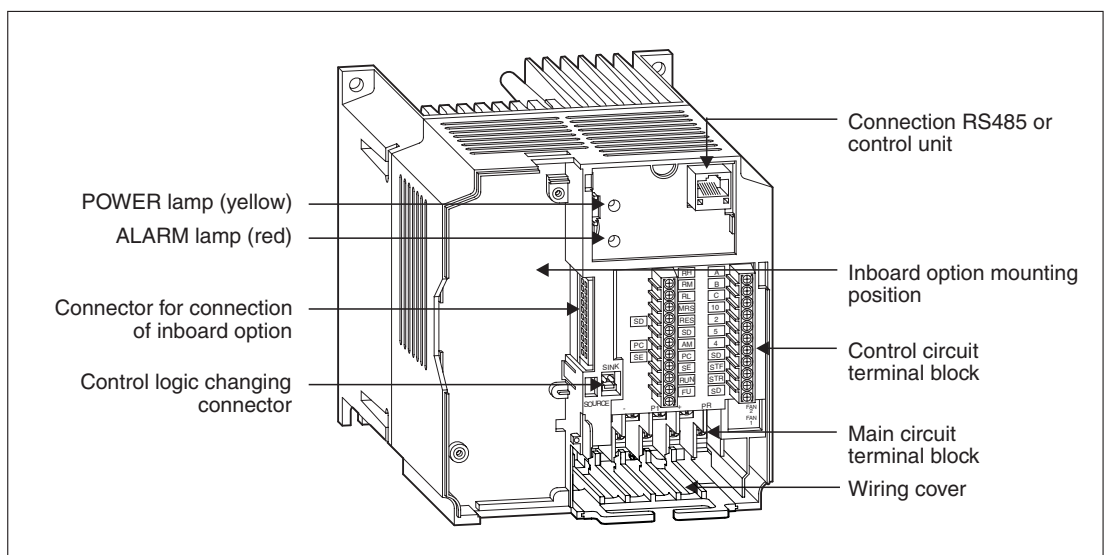
3.1 Description of the Case

Depending on the capacity class the frequency inverter is delivered in two different structural shapes of the case. The following drawings show a structured view of the single case components.

Frequency inverter FR-E 500 EC with front cover



Frequency inverter FR-E 500 EC without front cover

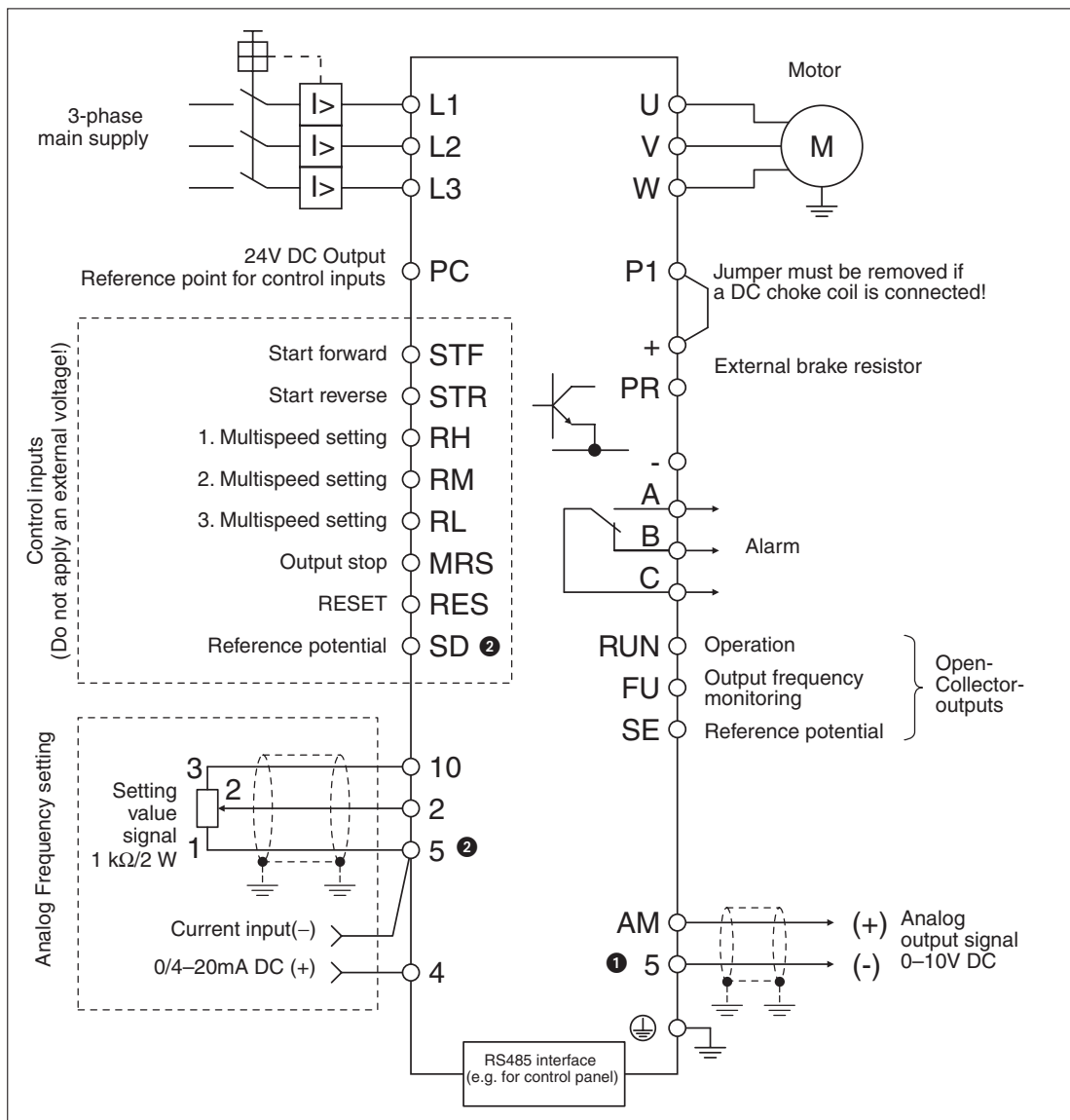


4 Wiring

4.1 Overview


CAUTION:

The terminals PC-SD of the 24V DC power supply must not be shorted. Otherwise the inverter will be damaged.



- ① Terminals 5, SD and SE are isolated.
- ② The terminals SD and 5 are reference potentials. They must not be grounded.

4.2 Wiring of the Main Circuit



DANGER:

The frequency inverter must always be powered off completely before performing any wiring work. Before starting rewiring or other work after performing operation once, check the voltage with a meter etc. more than 10 minutes after power-off. For some time after power-off, there is a dangerous voltage in the capacitor.



CAUTION:

The inverter must be grounded using the dedicated ground terminal. Power must not be applied to the output terminals (U, V, W) of the inverter. Otherwise the inverter will be damaged.

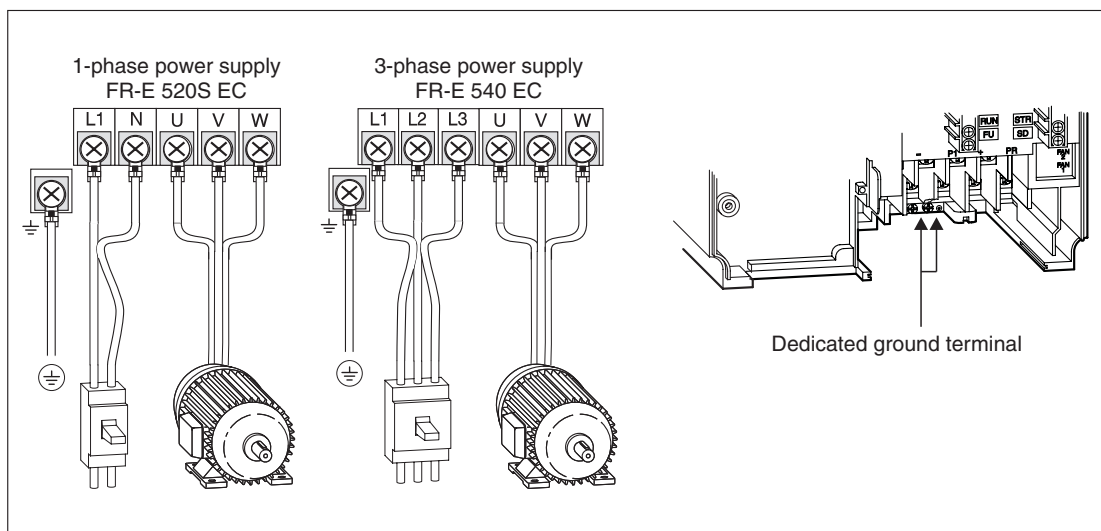
4.2.1 Mains, Motor and Ground Terminal Connections

The terminal blocks for connection of the frequency inverter can be accessed by removing the front cover and the wire cover. Connect a 1-phase power supply to the terminals L1 and N when using the inverter FR-S 520S EC/ECR and a 3-phase power supply to the terminals L1, L2 and L3 when using the inverter FR-S 540 EC/ECR. The required power supply is 200–240V AC, –15% / +10% for the inverter type FR-S 520S EC/ECR and 380–480V AC, –15% / +10% for the inverter type FR-S 540 EC/ECR. The main frequency is 50–60Hz ± 5% for all types.

Connect the motor cables to terminals U, V and W. The illustration below shows the correct assignments for the power connections. Please see the main frequency inverter manual for details on the required cable dimensions for your model.

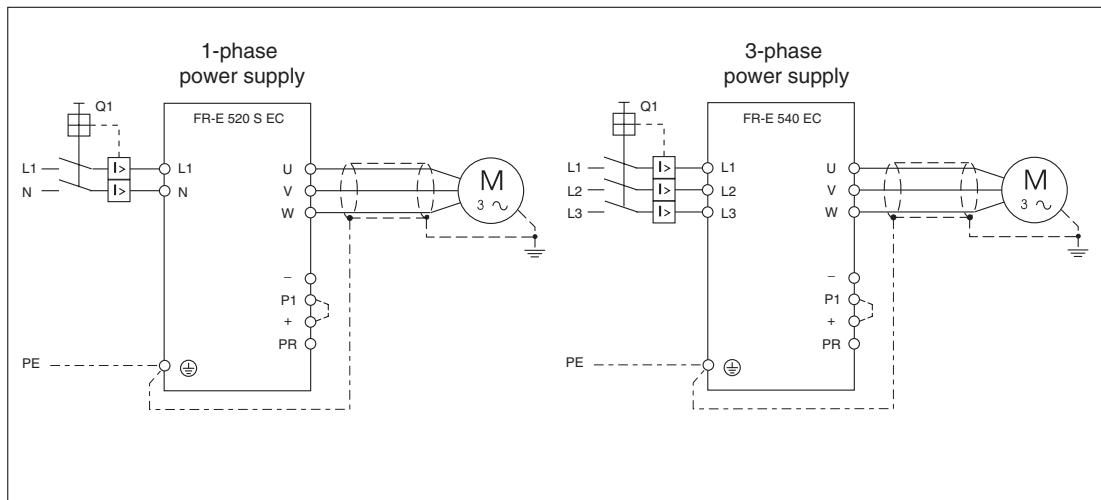
NOTE

The inverter must be grounded using the dedicated ground terminal.



NOTE


It is recommended to use a shielded motor cable in order to reduce cable radiation.



The maximum wiring length of the motor cable

Capacity Classes FR-E 500		0.4 k	0.75 k	1.5 k	2.2 k	≥ 3.7 k
Non-low acoustic noise mode	200V class	300m	500m	500m	500m	500m
	400V class	200m	200m	300m	500m	500m
Low acoustic noise mode	200V class	200m	300m	500m	500m	500m
	400V class	30m	100m	200m	300m	500m

The following table shows the terminal assignment of circuit terminals

	Terminal	Terminal name	Description
Main circuit connector	L1, N L1, L2, L3	Mains supply connection	Mains power supply of the inverter
	+, -	External brake unit connection	An external brake unit can be connected to the terminals + and -.
	+, PR	Optional external brake resistor connection	An optional external brake resistor can be connected to the terminals + and PR.
	P1, +	DC choke coil connection	An optional choke coil can be connected to the terminals P1 and +. Remove the jumper before installing the optional choke coil.
	U, V, W	Motor connection	Voltage output of the inverter (3-phase, 0V up to power supply voltage, 0.2–400Hz)
		PE	Protective earth connection of inverter

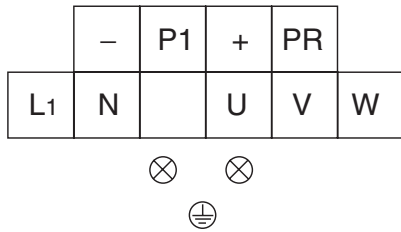


CAUTION:

Switching the unit off and on repeatedly with the mains power supply at short intervals can damage the switch-on current limiter. Because of this the unit should always be started and stopped with the control unit or via the STF/STR and STOP control signals.

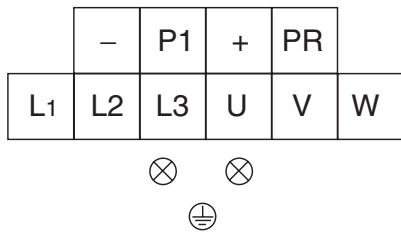
4.2.2 Main Circuit Terminals

Terminal assignment for 1-phase power supply



Screw size: M4
Screw tightening torque: 1.5Nm

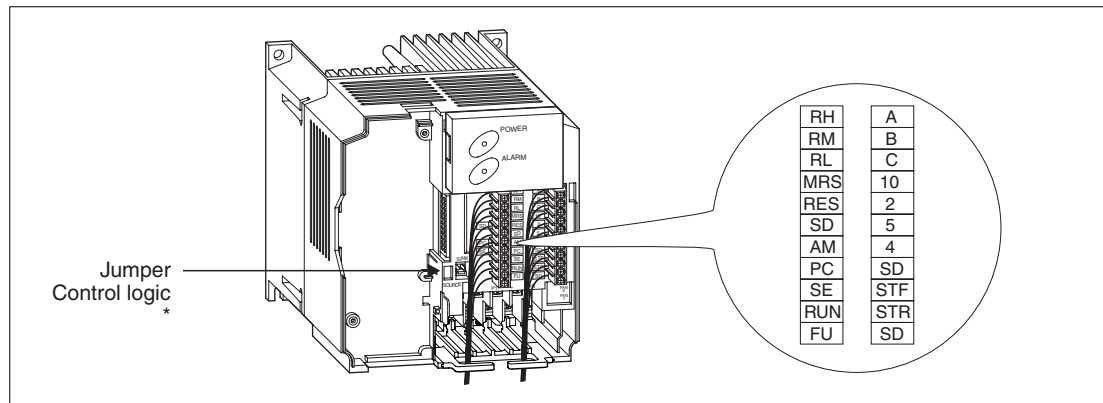
Terminal assignment for 3-phase power supply



Screw size: M4
Screw tightening torque: 1.5Nm

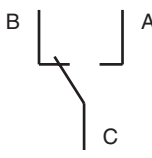
4.3 Wiring of the Control Circuit

The following picture shows the arrangement of the terminal for the control circuit of the inverter:



* The control signal level can be adjusted with the jumper. At the factory the jumper on the EC units is set to the “Source” position (positive logic, 24V DC corresponds to logical 1). If you want to use negative logic (0V corresponds to logical 1) you must move the jumper to the “Sink” position. Use tweezers or thin-nosed pliers to move the jumper.

Signal	Terminal	Terminal name	Description	
Input signals	Contact inputs	STF	Forward rotation start	The motor rotates forward, if a signal is applied to terminal STF.
		STR	Reverse rotation start	The motor rotates reverse, if a signal is applied to terminal STR.
		RH, RM, RL	Multi-speed selection	Up to 15 different output frequencies can be preset.
		MRS	Output stop	Turn on the MRS signal (20ms or longer) to stop the inverter output.
		RES	RESET input	Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1 second then turn it off.
Common	Common	SD	Common sink for contact input/reference potential	A determined control function is activated, if the corresponding terminal is connected to the terminal SD (sink logic). The SD terminal is isolated from the digital circuits via optocouplers. The terminal is isolated from the reference potential of the control circuit. Common output terminal for 24V DC / 0.1A power output (PC terminal).
		PC	24V DC output and control input common if source logic type is activated	24V DC/0.1A output With negative logic and control via open collector transistors (e.g. a PLC) the positive pole of an external power source must be connected to the PC terminal. With positive logic the PC terminal is used as a common reference for the control inputs. This means that when positive logic is selected (default setting of the EC units) the corresponding control function is activated by connecting its terminal to the PC terminal.

Signal	Terminal	Terminal name	Description	
Analog	Setting value specification	10 (output voltage 5V DC)	Voltage output for potentiometer Output voltage 5V DC Max. output current 10mA. Recommended potentiometer: 1kΩ, 2W linear, multiturn potentiometer	
		2	Input for frequency setting-value signal The voltage setting value 0–5 (10) V is applied to this terminal. The voltage range is preset to 0–5V. (Parameter 73). The input resistance is 10kΩ; The maximum permitted voltage is 20V.	
		5	Reference point for frequency setting value signal Terminal 5 is the reference point for all analog setting values and for the analog output signal AM. The terminal is not isolated from the reference potential of the control circuit and must not be earthed .	
		4	Input for current setting value signal 0/4–20mA DC The current setting value signal (0/4–20mA DC) is applied to this terminal. The input is active only if the AU signal is set. The function of the AU signal is assigned via parameters 180 to 183. The input resistance is 250Ω, the max current is 30mA.	
Signalausgänge	Contact	A, B, C	Potential free alarm output The alarm is output via relay contacts. The block diagram shows the normal operation and voltage free status. If the protective function is activated, the relay picks up.  The maximum contact load is 230V / 0.3A AC or 30V / 0.3A DC.	Output terminal function selection (Pr. 190 to Pr. 192) changes the terminal functions.
		Open Collector	RUN	
	FU		Frequency detection Switched low when the output frequency has reached or exceeded the detection frequency set as appropriate. Switched high when below the detection frequency (*1). The maximum contact load is 24V DC / 0.1A.	
	SE	Reference potential for signal outputs Reference potential for the Signals RUN and FU		

Signal	Terminal	Terminal name	Description
Output signals Analog	AM	Analog output	One of the following monitoring functions can be selected: output frequency, motor current or motor voltage. E.g. a DC voltmeter can be connected. Factory setting of output item: output frequency The max. output voltage is 10V, the max. current is 1mA.
Commun. RS485	—	Connection of control panel (RS485)	Communication operation can be performed through RS485. I/O standard: RS485, Multi-Drop operation, max. 19200 Baud, over all length max. 500m

**CAUTION:**

Terminals 10 and 5 must not be connected to each other. Otherwise the internal voltage output for the connection of the potentiometer will be damaged.

NOTE

The control terminals RL/RM/RH/MRS (input terminals) and RUN/FU/A, B, C (output terminals) can be assigned to other functions or signals with the help of the control unit (FR-PA02-02 or FR-PU04), the PC software or a field bus system. Please see the frequency inverter manual for details on the procedure for this.

Please note the following important points for proper frequency inverter control performance:

- The following conditions must be fulfilled for the frequency inverter to output a rotating field correctly:
 - The inverter lock must be deactivated (see below).
 - You must input both a direction of rotation signal and a frequency setpoint value to the inverter.
- If the frequency inverter does not work properly even though the wiring of the control terminals block appears to be correct please check the following points:
 - Is the frequency inverter reporting an error condition (red alarm LED)?
 - Is the correct operating mode selected (EXT mode for control via the terminal block, PU mode for control via the control unit)?
 - Is the inverter lock (terminal MRS) deactivated and is the inverter receiving a rotation start signal (terminal STF or STR)?
 - Is the inverter receiving a valid frequency setpoint value > the start frequency (voltage signal on terminal 2, current signal on terminal 4, preset frequency digital inputs)?
 - Are the control terminals you are using programmed correctly?

5 Parameter

5.1 Overview and Setting Ranges

Function	Parameter	Meaning	Setting range	Default
Basic functions	0	Torque boost (manual) ^①	0–30%	6% / 4% ^⑦
	1	Maximum frequency	0–120Hz	120Hz
	2	Minimum frequency	0–120Hz	0Hz
	3	Base frequency ^①	0–400Hz	50Hz
	4	Multi-speed setting (high speed) ^⑥	0–400Hz	60Hz
	5	Multi-speed setting (middle speed) ^⑥	0–400Hz	30Hz
	6	Multi-speed setting (low speed) ^⑥	0–400Hz	10Hz
	7	Acceleration time	0–360s / 0–3600s	5 s / 10s ^③
	8	Deceleration time	0–360s / 0–3600s	5 s / 15s ^③
	9	Electronic thermal overload relay	0–500A	Rated current ^④
Parameters for standard drive operation	10	DC injection brake operation frequency	0–120Hz	3Hz
	11	DC injection brake operation time	0–10s	0.5 s
	12	DC injection brake voltage	0–30%	6 %
	13	Starting frequency	0–60Hz	0.5Hz
	14	Load pattern selection ^①	0–3	0
	15	Jog frequency	0–400Hz	5Hz
	16	Jog acceleration/deceleration time	0–360s / 0–3600s	0.5s
	18	High-speed max. frequency	120–400Hz	120Hz
	19	Base frequency voltage ^①	0–1000V/8888/9999	8888
	20	Acceleration / deceleration reference frequency	1–400Hz	50Hz
	21	Acceleration / deceleration time increments	0 / 1	0
	22	Stall prevention operation level ^⑥	0–200%	150%
	23	Stall prevention operation at double speed ^⑤	0–200% / 9999	9999
	24	Multi-speed setting (speed 4) ^⑥	0–400Hz / 9999	9999
	25	Multi-speed setting (speed 5) ^⑥	0–400Hz / 9999	9999
	26	Multi-speed setting (speed 6) ^⑥	0–400Hz / 9999	9999
	27	Multi-speed setting (speed 7) ^⑥	0–400Hz / 9999	9999
	29	Acceleration / deceleration pattern	0 / 1 / 2	0
	30	Regenerative function selection	0 / 1	0
	31	Frequency jump 1A	0–400Hz / 9999	9999
	32	Frequency jump 1B	0–400Hz / 9999	9999
	33	Frequency jump 2A	0–400Hz / 9999	9999
	34	Frequency jump 2B	0–400Hz / 9999	9999
	35	Frequency jump 3A	0–400Hz / 9999	9999
	36	Frequency jump 3B	0–400Hz / 9999	9999
	37	Speed display	0 / 0.1–9998	0
	38	Frequency at 5V (10V) input voltage	1–400Hz	50Hz ^②
39	Frequency at 20mA input current	1–400Hz	50Hz ^②	
Setting of control outputs	41	Up-to-frequency sensitivity	0–100%	10%
	42	Output frequency detection	0–400Hz	6Hz
	43	Output frequency detection for reverse rotation	0–400Hz / 9999	9999

Function	Parameter	Meaning	Setting range	Default
Second functions	44	Second acceleration/deceleration time	0–360s / 0–3600s	5s / 10s ^③
	45	Second deceleration time	0–360s / 0–3600s / 9999	9999
	46	Second torque boost ^①	0–30% / 9999	9999
	47	Second V/F (base frequency) ^①	0–400Hz / 9999	9999
	48	Second stall prevention operation current	0–500A / 9999	9999
Display functions	52	Control panel/PU main display data selection ^④	0 / 23 / 100	0
	55	Frequency monitoring reference ^⑥	0–400Hz	50Hz
	56	Current monitoring reference ^⑥	0–500A	Rated current
Automatic restart functions	57	Restart coasting time	0–5 s / 9999	9999
	58	Restart cushion time	0–60s	1s
Additional function	59	Remote setting function selection	0 / 1 / 2	0
Operation selection functions	60	Shortest acceleration/ deceleration mode	0 / 1 / 2 / 11 / 12	0
	61	Reference current	0–500A / 9999	9999
	62	Reference current for acceleration	0–200% / 9999	9999
	63	Reference current for deceleration	0–200% / 9999	9999
	65	Retry selection	0 / 1 / 2 / 3	0
	66	Stall prevention operation level reduction starting frequency ^⑤	0–400Hz	50Hz
	67	Number of retries at alarm occurrence	0–10 / 101–110	0
	68	Retry waiting time	0.1–360s	1s
	69	Retry count display erasure	0	0
	70	Special regenerative brake duty	0–30%	0%
	71	Applied motor ^⑤	0/1/3/5/6/13/15/16/100/101/103/105/106/113/115/116	0
	72	PWM frequency selection ^④	0–15	1
	73	0–5V / 0–10V selection	0 / 1 / 10 / 11 ^⑧	0
	74	Filter time constant	0–8	1
	75	Reset selection / disconnected PU detection / PU stop selection ^⑥	0–3 / 14–17	14
77	Parameter write disable selection ^④	0 / 1 / 2	0	
78	Reverse rotation prevention selection	0 / 1 / 2	0	
79	Operation mode selection ^⑤	0–4 / 6–8	0	
Motor constants	80	Motor capacity ^⑤	0.2–7.5kW / 9999	9999
	82	Motor exciting current	0–500A / 9999	9999
	83	Rated motor voltage ^⑤	0–1000V	200V / 400V
	84	Rated motor frequency ^⑤	50–120Hz	50Hz
	90	Motor constant A	0–50Ω / 9999	9999
	96	Auto-tuning setting / status ^⑤	0 / 1	0
Communication functions	117	Station number	0–31	0
	118	Communication speed	48 / 96 / 192	192
	119	Stop bit length / data length ^⑩	0 / 1 / 100 / 101 Datenlänge 8 10 / 11 / 110 / 111 Datenlänge 7	1
	120	Parity check presence / absence	0 / 1 / 2	2
	121	Number of communication retries	0–10 / 9999	1
	122	Communication check time interval	0–999.8s / 9999	9999
	123	Waiting time setting	0–150ms / 9999	9999
	124	CR / LF presence/absence selection	0 / 1 / 2	1

Function	Parameter	Meaning	Setting range	Default
PID control	128	PID action selection	0 / 20 / 21	0
	129	PID proportional band	0.1–1000% / 9999	100%
	130	PID integral time	0.1–3600s / 9999	1s
	131	Upper limit	0–100% / 9999	9999
	132	Lower limit	0–100% / 9999	9999
	133	PID action set point for PU operation	0–100%	0%
	134	PID differential time	0.01–10.00s / 9999	9999
Additional functions	145	PU language selection	0–7	1
	146	Parameter set by manufacturer: Do not set!		
Current detection	150	Output current detection level	0–200%	150%
	151	Output current detection period	0–10s	0
	152	Zero current detection level	0–200%	5%
	153	Zero current detection period	0.05–1s	0.5s
Sub functions	156	Stall prevention operation selection	0–31/100	0
	158	AM terminal function selection	0 / 1 / 2	0
Additional functions	160	User group read selection ^④	0 / 1 / 10 / 11	0
	168	Parameters set by manufacturer: Do not set!		
	169			
Initial monitor	171	Actual operationhour meter clear	0	0
User functions	173	User group 1 registration	0–999	0
	174	User group 1 deletion	0–999 / 9999	0
	175	User group 2 registration	0–999	0
	176	User group 2 deletion	0–999 / 9999	0
Terminal assignment functions	180	RL terminal function selection ^⑤	0–8 / 16 / 18	0
	181	RM terminal function selection ^⑤	0–8 / 16 / 18	1
	182	RH terminal function selection ^⑤	0–8 / 16 / 18	2
	183	MRS terminal function selection ^⑤	0–8 / 16 / 18	6
	190	RUN terminal function selection ^⑤	0–99	0
	191	FU terminal function selection ^⑤	0–99	4
	192	ABC terminals function selection ^⑤	0–99	99
Multi-speed operations	232	Multi-speed setting (speed 8) ^⑥	0–400Hz / 9999	9999
	233	Multi-speed setting (speed 9) ^⑥	0–400Hz / 9999	9999
	234	Multi-speed setting (speed 10) ^⑥	0–400Hz / 9999	9999
	235	Multi-speed setting (speed 11) ^⑥	0–400Hz / 9999	9999
	236	Multi-speed setting (speed 12) ^⑥	0–400Hz / 9999	9999
	237	Multi-speed setting (speed 13) ^⑥	0–400Hz / 9999	9999
	238	Multi-speed setting (speed 14) ^⑥	0–400Hz / 9999	9999
	239	Multi-speed setting (speed 15) ^⑥	0–400Hz / 9999	9999
Sub functions	240	Soft-PWM setting	0 / 1	1
	244	Cooling fan operation selection	0 / 1	0
	245	Rated motor slip	0–50% / 9999	9999
	246	Slip compensation response time	0.01–10s	0.5s
	247	Constant output region slip compensation selection	0 / 9999	9999
Stop selection function	250	Stop selection	0–100s / 1000–1100s / 8888 / 9999	9999

Function	Parameter	Meaning	Setting range	Default
Additional functions	251	Output phase failure protection selection	0 / 1	1
	254	Analog polarity reversible lower limit ^⑩	0–100% / 9999	9999
	338	Operation command write ^{⑨ ⑩}	0 / 1	0
	339	Speed command write ^{⑨ ⑩}	0 / 1	0
	340	Link start mode selection ^{⑨ ⑩}	0 / 1	0
	342	E ² PROM write selection	0 / 1	0
DeviceNet-functions	345	DeviceNet address (lower byte) ^⑪	0–255	63 (0x3F)
	346	DeviceNet baudrate (lower byte) ^⑪	0–255	132 (0x84)
	347	DeviceNet Address (higher byte) ^⑪	0–255	160 (0xA0)
	348	DeviceNet Baudrate (higher byte) ^⑪	0–255	80 (0x50)
Additional function	500	Communication error recognition waiting time ^{⑩ ⑫}	0–999.8s	0
	501	Communication error occurrence count display ^{⑩ ⑫}	0	0
	502	Error time stop mode selection ^{⑩ ⑫}	0 / 1 / 2	0
Calibration functions	901	AM terminal calibration ^④	Calibration range	—
	902	Frequency setting voltage bias	0–60Hz / [0–10V]	0Hz / [0V]
	903	Frequency setting voltage gain	1–400Hz / [0–10V]	50Hz / [5V]
	904	Frequency setting current bias	0–60Hz / [0–20mA]	0Hz / [4mA]
	905	Frequency setting current gain	1–400Hz/[0–20mA]	50Hz / [20mA]
Help functions	990	Beep signal at key operation	0 / 1	1
	991	Contrast setting for LCD display	0–63	53

Remarks to the table:

- ① The parameter setting is ignored, if the general purpose flux vector control is activated.
- ② Since calibration is made before shipment from the factory, the setting differs slightly between inverters.
- ③ The setting depends on the inverter capacity. Range splitting: (0.4–3.7k = 5s) / (5.5–7.5k = 10s).
- ④ Set to 85% of the rated inverter current for 0.4k and 7.5k type.
- ⑤ If “2” is set in parameter 77 (parameter write inhibit selection), the setting cannot be changed during operation.
- ⑥ These parameters allow their settings to be changed during operation if “0” (factory setting) has been set in parameter 77.
- ⑦ The setting depends on the inverter capacity. Range splitting: 4% for FR-E 540-5.5 k EC and FR-E 540-7.5 k EC.
- ⑧ To set “10” or “11” in parameter 73, first “801” must be set in parameter 77.
- ⑨ Parameter 338 to 340 are displayed only when the communication option is fitted or when Pr. 119 is “100”, “101”, “110” or “111”.
- ⑩ New setting ranges or parameter available from firmware version V7471C
- ⑪ Pr. 345 to Pr. 348 are displayed only when the option FR-E5ND is fitted.
- ⑫ Pr. 500 to Pr. 502 are displayed only when the communication option is fitted.

NOTE

To change the inverter settings a parameter unit (FR-PA02-02 or FR-PU04 with extension cable FR-A5 CBL1) or a personal computer with installed VFD Setup Software in conjunction with a converter (RS232 → RS485) is required.

6 Protective Functions

6.1 Error Messages and Remedies

Error message		Meaning	Description	Remedy
Display FR-PU04	Display FR-PA02-02			
OC During Acc.	<i>EOL1</i>	Overcurrent 1 (acceleration)	A) The output current of the inverter has reached or exceeded 200% of the rated current during acceleration, deceleration, or at constant speed. B) The temperature of the main circuits of the inverter rises rapidly.	The cause for the activation of the protective function is a short circuit or a ground fault across the main outputs, an exceeding moment of inertia of the load (GD ₂), too short acceleration / deceleration time presets, restart during a motor idling phase, operation of a motor with an exceeding capacity. Overheating due to insufficient cooling (defective cooling fan or choked heat sink).
Stedy Spd OC	<i>EOL2</i>	Overcurrent 2 (constant speed)		
OC During Decn	<i>EOL3</i>	Overcurrent 3 (deceleration)		
OV During Acc	<i>EOL1</i>	Overvoltage 1 (acceleration)	The converter voltage has increased highly due to regenerative energy. The overvoltage limit was exceeded during acceleration, deceleration, or at constant speed.	In most cases the protective function is activated due to a too short deceleration time preset or a regenerative overload. Increase the deceleration time or connect an external brake unit. An overvoltage in the mains power supply activates this protective function as well.
Stedy Spd OV	<i>EOL2</i>	Overvoltage 2 (constant speed)		
OV Du- ring Dec	<i>EOL3</i>	Overvoltage 3 (deceleration)		
Motor Overload	<i>EFHN</i>	Overload (motor)	The electronic overload protection for the motor or inverter was activated.	Decrease the motor load to avoid an activation. Check whether the performance range of the motor and inverter correspond.
Inv. Overload	<i>EFHF</i>	Overload (inverter)	The electronic motor protection switch continually detects the motor current and the output frequency of the inverter. If a self-cooling motor operates over a long period at low speed but high torque, the motor is thermally overloaded and the protective function is activated. If several motors are operated by one inverter the motor protection switch will not operate properly. In this case deactivate the motor protection and replace it by external protection switches.	
H/Sink O/Temp	<i>EFIn</i>	Fin overheat	If the cooling fin overheats, the fin overheat sensor activates and halts inverter output.	Check environmental temperature.
Fan Failure	<i>Fn</i>	Fan breakdown	The cooling fan breaks down or an operation different from the setting of parameter 244 (cooling fan operation selection) is performed.	Replace the cooling fan

Error message		Meaning	Description	Remedy
Display FR-PU04	Display FR-PA02-02			
Br. Cct. Fault	<i>EbE</i>	Brake transistor failure	A) The integrated brake transistor does not operate properly. B) Possibly, a thermal overload occurred.	Check the relative operating time of the brake resistor. In case of thermal difficulties use an external brake resistor or an inverter of higher capacity.
Ground Fault	<i>EGF</i>	Ground failure	An overcurrent occurred due to a ground failure upon the inverter output (load side).	Check load connections (motor circuit).
OH Fault	<i>EOHF</i>	Activation of an external motor protection relay (thermal contact)	An external motor protective switch was activated. If an external motor protective switch for thermal monitoring is used, this switch can activate the protective function of the inverter.	Check motor load and drive.
Stll Prev STP	<i>EDLF</i>	Stall prevention overload	A long lasting excess of the current limit (OL display) shuts down the inverter.	Reduce the load. Check the preset values for the current limit (parameter 22) and the stall prevention selection (parameter 156).
Option Fault	<i>EOPT</i>	Error in an optional unit	A dedicated inboard option does not operate properly. The protective function is activated, if an internal option is improperly installed or connected.	Check connections and connectors of the optional unit.
Corrupt Memory	<i>EPE</i>	Memory error	Error on access of the data memory of the inverter.	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs again.
PU Leave Out	<i>EPUE</i>	Control panel connection error	A connection error between inverter and control panel occurred during operation. This alarm is only returned, if parameter 75 is set to "2", "3", "16", or "17".	Check the connection of control panel.
Retry No Over	<i>ErEr</i>	Automatic restart retry exceeded	After activation of a protective function the inverter failed to be restarted automatically within the number of retries specified in parameter 67.	Remedy the actual cause of the original protective function.
CPU Fault	<i>ECPU</i>	CPU error	Failure on CPU printed circuit board.	Contact the MITSUBISHI ELECTRIC customer service
Fault 3	<i>E. 3</i>	Fault 3 (option error)	The dedicated option used in the inverter results in setting error or connection fault.	Check the function setting of the option board. Check that the communication option is plugged in the connector securely
Fault 6	<i>E. 6</i>	CPU error	This function stops the inverter output if a communication error occurs in the built-in CPU.	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs repeatedly.
Fault 7	<i>E. 7</i>			
—	<i>ELF</i>	Open output phase protection	One of the phases (U, V, W) is not connected.	Check the connections.
—	<i>EP24</i>	Shortcut at 24V DC	A shortcut at the 24 V output has occurred (PC terminal).	Remove the shortcut!
PS	<i>PS</i>	Inverter was stopped via control panel	STOP key on the control panel was pressed during external operating mode.	Check parameter 75.

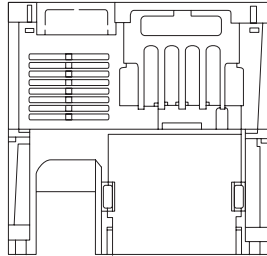
Error message		Meaning	Description	Remedy
Display FR-PU04	Display FR-PA02-02			
OL	OL	Overcurrent during acceleration	If a current of more than 150% ^① of the rated inverter current flows in the motor, this function stops the increase of the frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency again.	Change the acceleration/deceleration time. Increase the stall prevention operation level with Pr. 22. Disable stall prevention with Pr. 156.
		Overcurrent during constant-speed operation	If a current of more than 150% ^① of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency up to the set value.	
		Overcurrent during deceleration	If a current of more than 150% ^① of the rated inverter current flows in the motor, this function stops the decrease in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function decreases the frequency again.	
OL	OL	Overvoltage during deceleration	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.	Increase the deceleration time using Parameter 8.
UFU	Err	Error	This alarm appears if: <ul style="list-style-type: none"> ● the RES signal is on ● you attempted to set any parameter value in the external operation mode ● you attempted to change the operation mode during operation ● you attempted to set any parameter value outside its setting range ● you attempted to set any parameter value during operation (while signal STF or STR is ON). ● you attempted to set any parameter value while parameter write is being inhibited in Pr. 77 "parameter write inhibit selection" 	Perform operation correctly.

^① The stall prevention operation level (Pr. 22) is adjustable. It is factory-set to 150%.

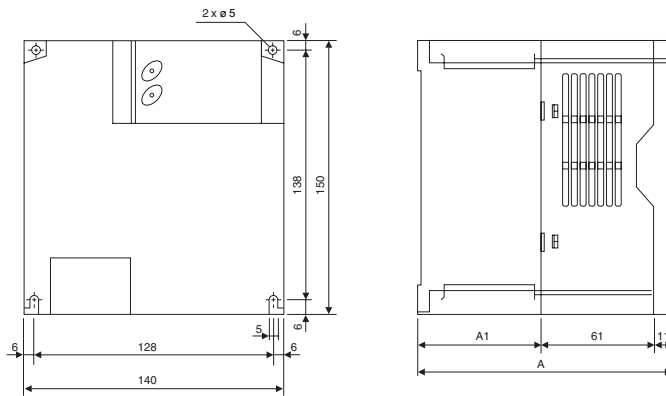
7 Dimensions

7.1 Dimensions of the Frequency Inverters

FR-E 520S-0.4 k bis 2.2 k EC and FR-E 540-0.4 k to 3.7 k EC



Type	A	A1
FR-E 520S-0.4 k / 0.75 k EC	136	64
FR-E 520S-1.5 k / 2.2 k EC	156	84
FR-E 540-0.4 k / 0.75 k EC	116	44
FR-E 540-1.5 k bis 3.7 k EC	136	64

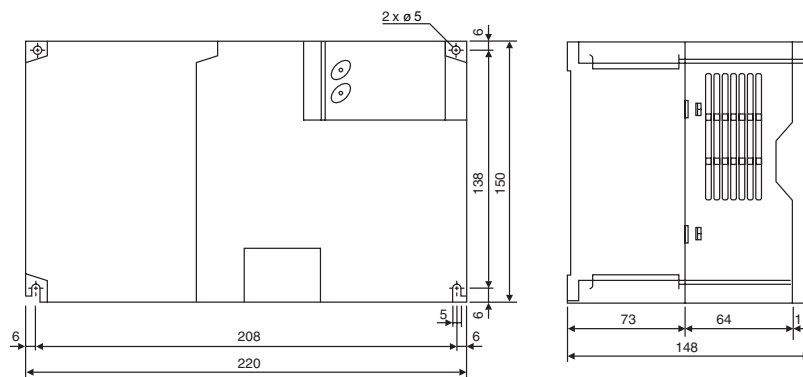
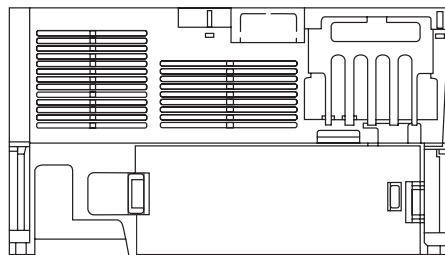


Unit: mm

NOTE

| There is no cooling fan in the FR-E 520S-0.4 k/0.75 k-EC and FR-E 540-0.4 k/0.75 k-EC.

FR-E 540-5.5 k und 7.5 k EC



Unit: mm

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