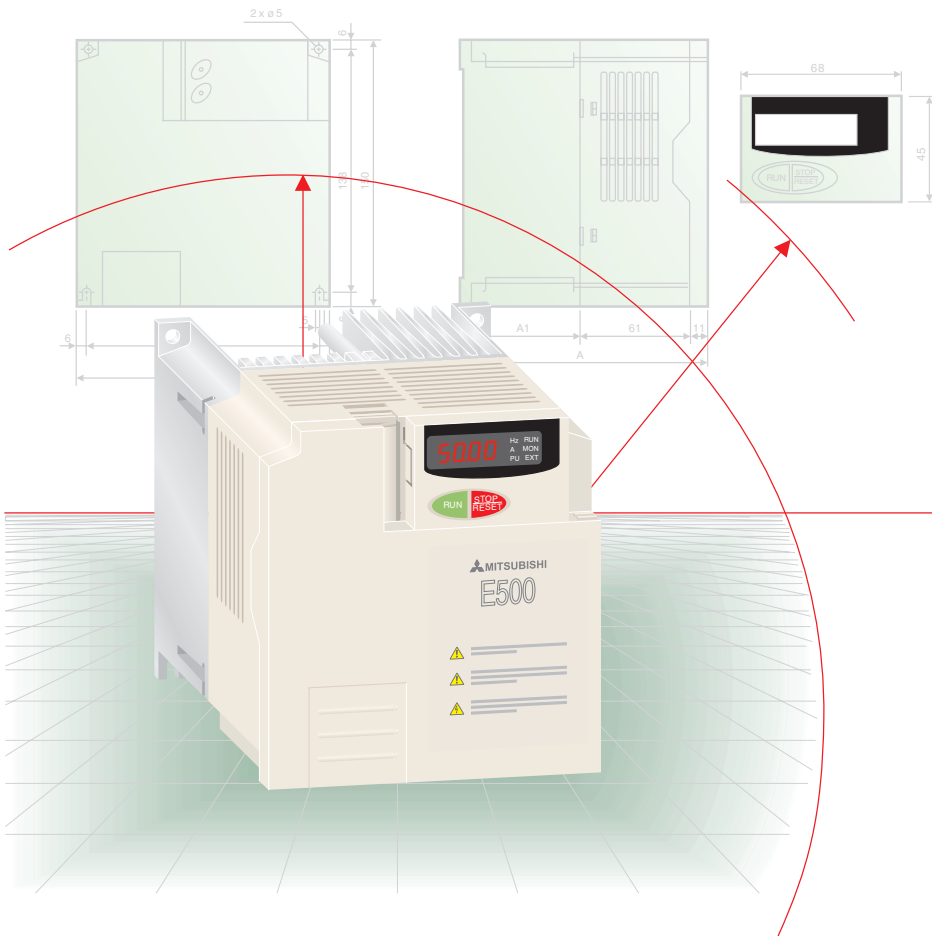
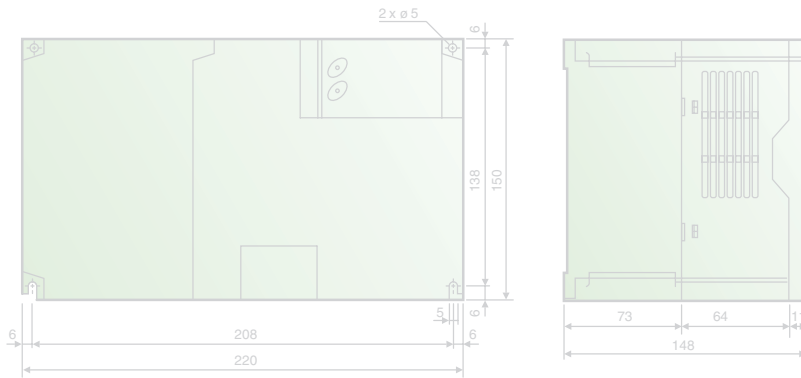


Frequency  
Inverter

FR-E 500 EC



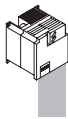
Technical Catalogue



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## FR-E 500 EC Frequency Inverters

**The Compact  
All-Rounder**



With the FR-E500 series frequency inverters MITSUBISHI ELECTRIC offers high-tech equipment at particular compact dimensions. These frequency inverters are designed especially for low to medium capacity drive tasks.

The inverters are available for a performance range of 0.4 to 2.2 kW (1 phase) and 0.4 to 7.5 kW (3 phase).

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## Further Publications within the Factory Automation Range

**Technical  
Catalogues**

### **Technical catalogues FR-A 500, FR-F 500 and FR-S 500**

Product catalogues for frequency inverters and accessories of the FR-A 500 (L-G) EC, FR-F 500L and FR-S 500 series

### **Technical catalogues MELSERVO and Motion Controllers**

Product catalogues for MR-J2S series amplifiers, servo motors and motion controllers with SSCNET connection

### **Technical catalogues PLC and HMI**

Product catalogues for programmable logic controllers, operator terminals, software, and accessories of the MELSEC PLC series

### **Technical catalogue Networks**

Product catalogue for Master and Slave modules as well as accessories for the use of programmable logic controllers and frequency inverters in open and MELSEC networks (art. no. 136730)

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### **Additional services**

You will find current information on updates, alterations, new items, and technical support on MITSUBISHI ELECTRIC's web pages ([www.mitsubishi-automation.com](http://www.mitsubishi-automation.com)). The products section of the MITSUBISHI home site includes various documentations of the whole product range by MITSUBISHI ELECTRIC as well as the current version of this catalogue on hand. All manuals and catalogues can be downloaded. The content is updated daily and to date is provided in German and English.

### **About this product catalogue**

This catalogue is periodically updated due to product range enlargement, technical changes or new or changed features. Texts, figures and diagrams shown in this product catalogue are intended exclusively for explanation and assistance in planning and ordering the frequency inverter series FR-E 500 EC/ECR and the associated accessories. Only the manuals supplied with the devices are relevant for installation, commissioning and handling of the devices and the accessories. The information given in these manuals must be read before installation and commissioning of the devices or software.

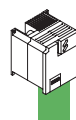
Should questions arise with regard to the planning of devices described in this product catalogue, do not hesitate to contact MITSUBISHI ELECTRIC EUROPE B.V. in Ratingen (Germany) or one of its distributors (see cover page).

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## FREQUENCY INVERTER FR-E 500 EC

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### The Frequency Inverter FR-E 500 EC

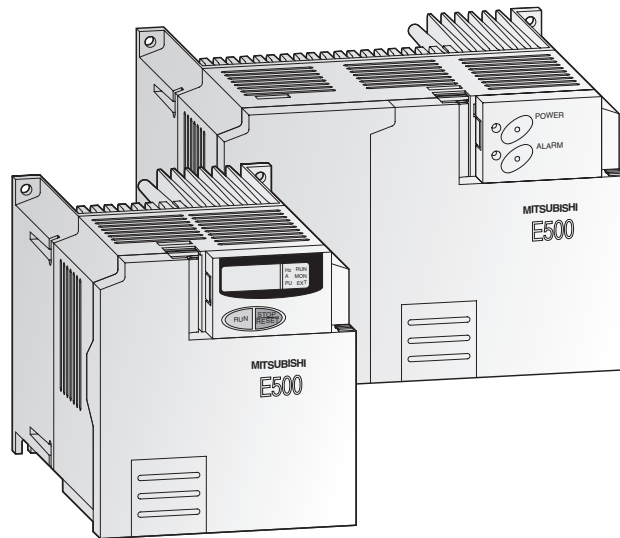
Due to its versatility and compact dimensions the FR-E 500 EC is a frequency inverter solving most effectively your individual drive tasks.

Its extensive functions allow flexible applications. The outstanding drive features of the FR-E 500 EC suits various needs:

- Textile machines such as spinning machines, knitting machines, weaving looms
- Material transport systems such as chain, belt, and screw conveyors
- Door and gate drives
- Machines for working of metal, stone, wood, and plastics
- Palettisers, material-handling technology
- Pumps and ventilating

The inverters are available for a performance range of 0.4 to 2.2 kW (1 phase) and of 0.4 to 7.5 kW (3 phase).

The output frequency ranges from 0.2 to 400 Hz.



### Full Product Line-Up

#### Communications capability as a standard function

An RS485 interface for data communications is standard equipment of the FR-E 500. The interface can be accessed after removing the parameter unit and serves for data exchange for example with a personal computer.

#### Compatible with many new applications

- PID control  
The integrated PID control facilitates for example flow control using pumps.
- Stop selection  
Select either decelerating stop or coasting stop, depending on machine specification.

#### Comprehensive protection functions for safe operation

- Instantaneous power failure stop restart function.
- Built-in electronic overcurrent protection
- Free selection of the protection function for automatic retry after alarm occurrence.

#### Compatible with numerous I/Os

- Multi-speed operation  
(15 different pre-selected speeds are available)
- 0/4 to 20 mA control input
- Multi-input terminals:  
select four inputs from 11 possible input types
- Multi-output terminals:  
select three outputs from 12 possible output types
- 24 V external power supply output  
(permissible values: 24 V DC/0.1 A)

#### Operating functions and other convenient functions

- Frequency jumps (three points) to avoid the machine's resonant frequency
- Fast acceleration/deceleration mode
- Full monitoring capabilities for monitoring actual operating time and much more
- Switch between two sets of motor characteristics by means of a second parameter function
- Zero current detection

## Optimised Drive Characteristics

### Advanced flux vector control

The original flux vector control developed by MITSUBISHI ELECTRIC offers new performance characteristics in drive technology.

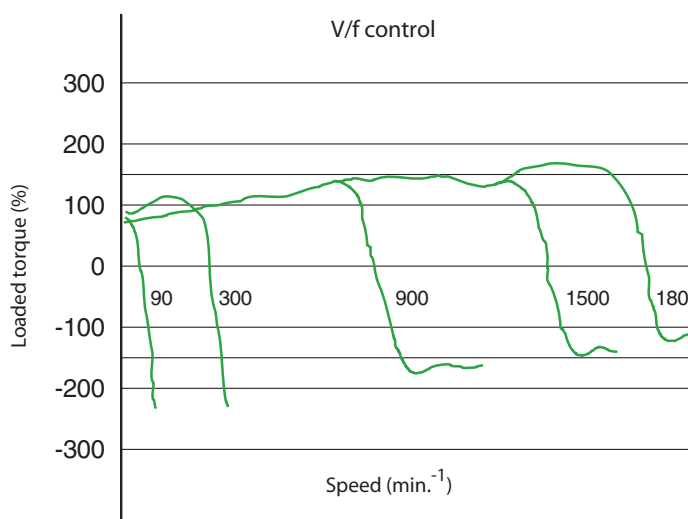
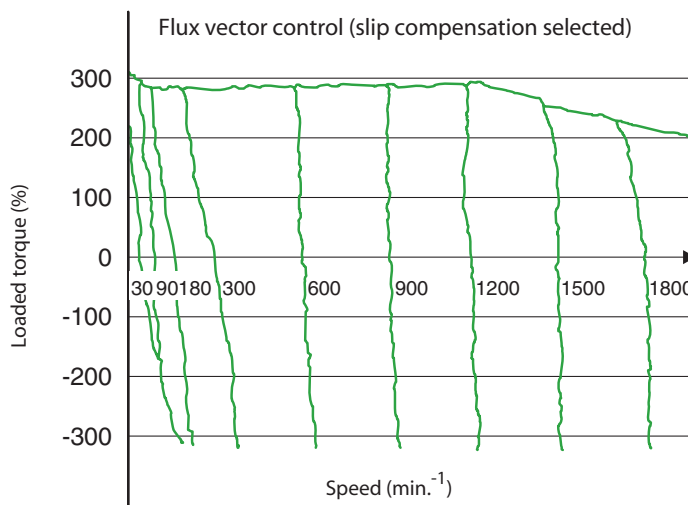
### High torque (150 %) at very low frequencies (1 Hz)

By combining slip compensation and flux vector control MITSUBISHI ELECTRIC has achieved a loaded torque of 150 % at a frequency of 1 Hz. Due to the integrated auto-tuning function the flux vector control is even provided for widely varying motor characteristics.

The figures compare rational speed/load torque characteristics and rational speed/motor current for general purpose flux vector control and V/F control (motor 0.75 kW).

### Inrush current limiter

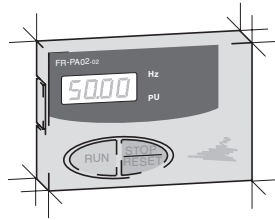
All inverters are equipped with an inrush current limiter providing a protection of the connected components.



**User-friendly Operation**

**Easy operation**

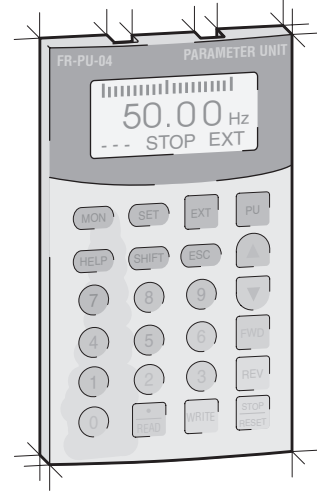
- The parameter unit **FR-PA02-02** is available for all frequency inverters. It provides a clear and easy operation of the inverter and displays several operational and alarm signals. The parameter unit can be connected remotely via an extension cable and an adapter (see accessories).
  - The **FR-PU04** control panel is optionally available. It provides a long-life backlight LC display. Operational data is directly input via the numeric keypad. Eight different selectable languages are supported on the display. The integrated copy function transfers the entire parameter settings to other inverters and thus shortens the initialization time significantly.
- This parameter unit will be connected remotely via an optional extension cable.



FR-PA02-02

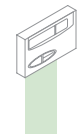
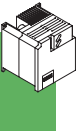
The inverter can be controlled alternatively via the parameter unit or through an RS485 interface via a personal computer.

For setting, parameterizing, and monitoring via a personal computer the VFD Setup Software is required (refer to page 15 for further details).



FR-PU04

All parameters can be assigned to user groups thus supplying only the required parameters for specific applications.



Pr. 01

**Simplified Maintenance**

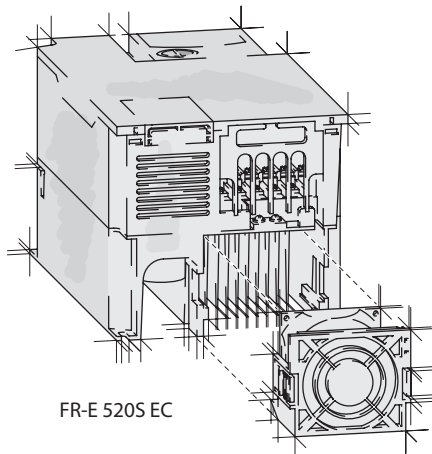
**Easy access to cooling fans**

The easily accessible cooling fans can be replaced quickly and easily if required. The lifetime of the cooling fans can be extended significantly through a selective ON/OFF control specified by parameter 244.

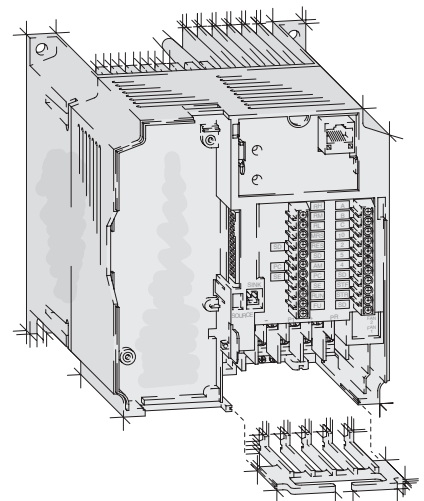
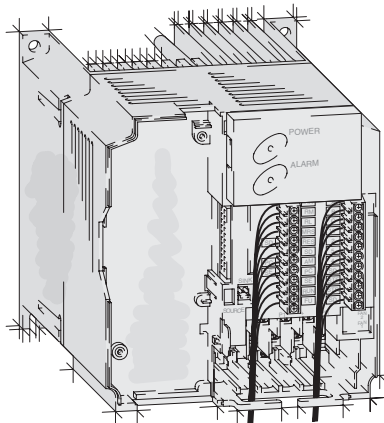
**Easy installation and maintenance**

Since the control and power terminal block is easy of access, the installation and maintenance of the inverter is also very easy. All connection points are designed as screw terminals.

The housing includes a cable routing facility which can be removed for installing.



FR-E 520S EC



## Environmentally Friendly Operation

### Soft-PWM control

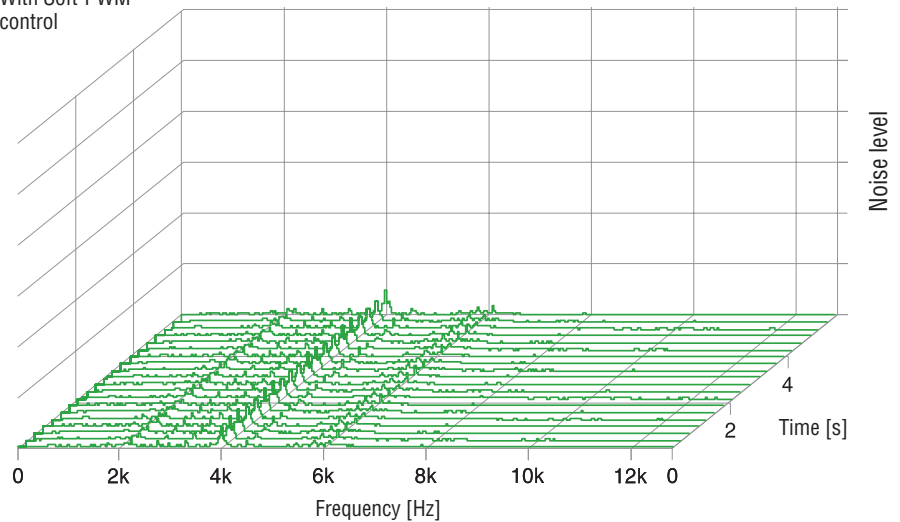
In addition to the conventional low-noise mode, MITSUBISHI ELECTRIC has developed its original Soft-PWM control that suppresses acoustic noise and limits RFI noise to a minimum.

The switchable PWM control facilitates a motor noise as silent as whisper even at low carrier frequencies. The diagrams illustrate the difference.

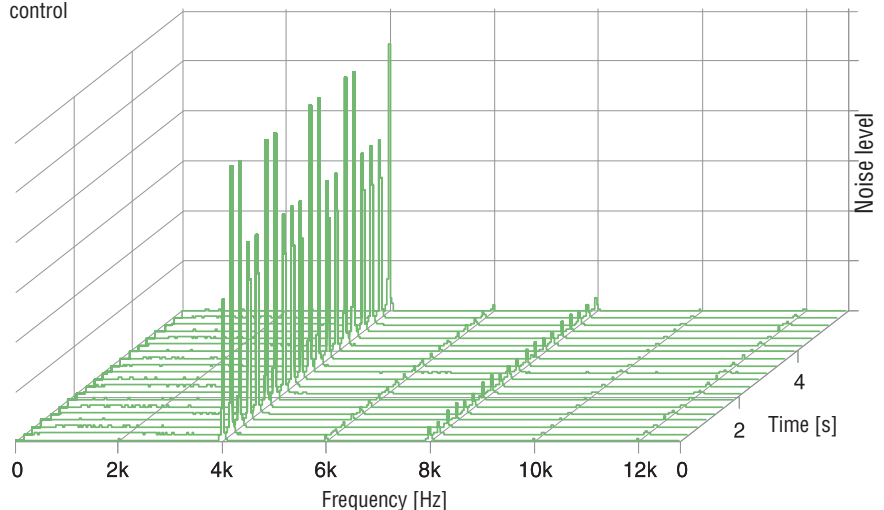
In the upper diagram the frequency pulse patterns are dispersed: The inverter only generates little noise that might be compared to the sound of flowing water. The noise does not sound unpleasant.

In the lower diagram the frequency pulse patterns are concentrated: The inverter generates the typical grating metallic noise.

With Soft-PWM control



Without Soft-PWM control



### EMC compatibility

The FR-E 500 EC inverter regarding its electromagnetic compatibility complies with the European EMC directives. To meet these standards specially adjusted compact noise filters ("foot print") have been developed for each performance range.

Additionally, for the single-phase inverter FR-E 520S EC built-on filters are available. These filters can be installed easily on the rear side of the inverter into a prepared compartment. There is no need for additional room or extended dimensions. Refer to page 23 for further details.

To limit the inrush current and reduce mains conducted emissions the inverter can be equipped with an input reactor upon the inputs. A DC reactor can be installed as well.

### Standards

The devices of the FR-E 500 EC product line are designed to be used world-wide without further effort or certifications.

- Compliant with world-wide standards CE, UL, cUL
- Selectable sink or source logic  
The logic for input and output signals can be freely selected. The result is a flexible and easy customisation of the units to the needs of the world market.
- Extended rated input voltage  
1~ 200–240 V; 50/60 Hz (FR-E 520S EC)  
3~ 380–480 V; 50/60 Hz (FR-E 540 EC)  
Tolerance: –15 %; +10 %
- Multi-language parameter unit (8 languages) available as option

- Due to the integrated PID control the frequency inverter for instance can be used for temperature control without further requirements.
- All inverters are equipped with an inrush current limiter providing a protection of the connected components.
- MS-Windows compatible world-wide standardised multi-language parameterising software (VFD-Setup)

The FR-E 500 EC therefore is a world product complying with all relevant standards and easily adopting to the according needs of a country.

## Specifications FR-E 500 EC

Product line			FR-E 520S EC				FR-E 540 EC						
			0.4 k	0.75k	1.5 k	2.2 k	0.4 k	0.75 k	1.5 k	2.2 k	3.7k	5.5 k	7.5 k
Output	Rated motor capacity [kW] ①	150 % Overload capacity ①	0.75	1.1	2.2	3	0.75	1.1	2.2	3	4	7.5	11
		200 % Overload capacity ②	0.4	0.75	1.5	2.2	0.4	0.75	1.5	2.2	4	5.5	7.5
	Rated current [A] ⑤	150 % Overload capacity ①	3.6	5	9.6	12	1.8	3	4.9	6.7	9.5	14	21
		200 % Overload capacity ②	2.5	4	7	10	1.6 (1.4)	2.6 (2.2)	4 (3.8)	6 (5.4)	9.5 (8.7)	12	17
	Rated output capacity	kVA	0.95	1.5	2.7	3.8	1.2	2.0	3.0	4.6	7.2	9.1	13.0
	Overload capacity ②	① ②	150 % of rated motor capacity for 0.5 s; 120 % for 1 min. (max. ambient temperature = 50 °C) 200 % of rated motor capacity for 0.5 s; 150 % for 1 min. (max. ambient temperature = 50 °C)										
Voltage ③		3-phase, 0 V up to power supply voltage											
Input	Power supply voltage		1-phase, 200–240 V AC, –15 % / +10 %				3-phase, 380–480 V AC, –15 % / +10 %						
	Voltage range		170–264 V AC at 50 / 60 Hz				323–528 V AC at 50 / 60 Hz						
	Frequency range		50 / 60 Hz ± 5 %				50 / 60 Hz ± 5 %						
	Rated input capacity ④		kVA	1.5	2.3	4.0	5.2	1.5	2.5	4.5	5.5	9	12
Control specifications	Control method		Extended flux vector control with online auto tuning of motor data or V/f control										
	Modulation control		Sine evaluated PWM, Soft PW										
	Carrier frequency		0.7–14.5 kHz (user adjustable)										
	Frequency range		0.2–400 Hz										
	Frequency resolution	Analog	From terminals 2-5: 1/500 of maximum set frequency (input 5 V DC); 1/1000 (input 10 V, 20 mA DC)										
		Digital	0.01 Hz / 50 Hz										
	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 400 Hz; constant torque or variable torque selectable										
	Possible starting torque		≥ 150 % / 1 Hz, ≥ 200 % / 3Hz (for vector control oder slip compensation)										
	Torque boost		Manual torque boost; selectable between 0–30 %										
	Acceleration / deceleration time		0.01; 0.1 to 3600 s individual settings										
	Acceleration / deceleration characteristics		Linear or S-form course, user selectable										
	Braking torque	Regenerative ⑦	0.4 k and 0.75 k: 100 % or more; 1.5 k: 50 % or more; 2.2 k to 7.5 k: 20 % or more										
		DC braking	Braking time and braking moment adjustable, Operating frequency: 0–120 Hz, operating time: 0–10 s, 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	0–5 V DC, 0–10 V DC, 0/4–20 mA											
	Digital input	From control panel (parameter unit), RS-485 or network											
Control signals for operation	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 400 Hz; 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 20 mA DC										
	Input signals	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										
	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 (230 V AC; 0.3 A / 30 V DC; 0.3 A)										
	Analog signal		One of the following output types can be selected: output frequency, motor current, output voltage, analog output (0–10 V DC).										



Product line			FR-E 520S EC				FR-E 540 EC					
			0.4 k	0.75k	1.5 k	2.2 k	0.4 k	0.75 k	1.5 k	2.2 k	3.7k	5.5 k
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 <sup>⑥</sup> , instantaneous power failure <sup>⑥</sup> , overload cutoff (electronic thermal relay), brake transistor error, ground fault overcurrent, output short circuit, stall prevention, overload warning, brake transistor overheating, fin overheating, fan error <sup>⑧</sup> , option error, parameter error, PU connection error, output phase error										
	Protection rating	IP 20										
Others	Cooling	Self-cooling		Fan cooling		Self-cooling		Fan cooling				
	Weight (kg)	1.9	1.9	2.0	2.0	1.9	1.9	2.0	2.1	2.1	3.8	3.8

- ① The specifications of the rated motor capacity are related to a motor voltage of 230 V resp. 400 V.
- ② The overload capacity indicated in % is the ratio of the overload current to the inverters rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperature and 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 (PWM frequency selection) value set to 2 kHz or higher.
- ⑥ 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.
- ⑦ The braking torque indicated is short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 50 Hz 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 inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. A brake unit BU may also be used.
- ⑧ Not valid for the inverters FR-E 540-0.4 k, -0.75 k EC and FR-E 520S-0.1 k to -0.4 k EC which are not equipped with a cooling fan.

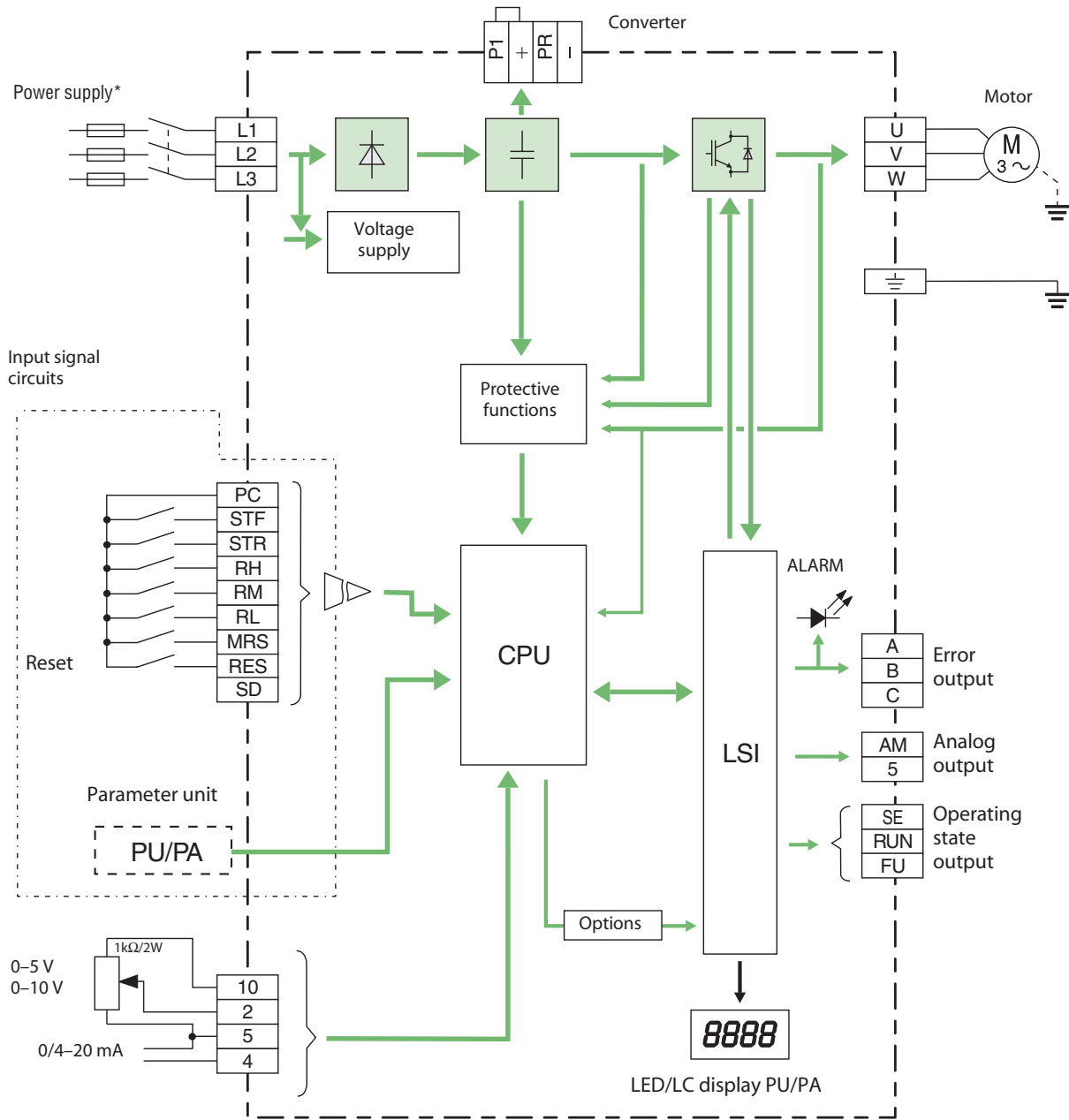
Product line		FR-E 520S EC				FR-E 540 EC						
		0.4 k	0.75k	1.5 k	2.2 k	0.4 k	0.75 k	1.5 k	2.2 k	3.7 k	5.5 k	7.5 k
Order information	Art. no.	102938	102939	102940	102941	69197	69198	69200	69201	69204	102942	102943

## General Operating Conditions

Item	Specifications
Ambient temperature in operation	-10 °C to +50 °C (non-freezing) For selection of the load characteristics with variable torque the max. temperature is 40 °C.
Storage temperature <sup>⑨</sup>	-20 to +65 °C
Ambient humidity	Max. 90 % RH (non-condensing)
Altitude	Max. 1000 m above sea level; After that derate by 3 % for every extra 500 m up to 2500 m (91 %).
Protection rating	IP 20
Shock resistance	10 G (3 times each in 3 directions)
Vibration resistance	0.6 G: resistance to vibrations from 10 to 55 Hz for 2 hours along all 3 axes
Ambient conditions	For indoor use only, avoid environments containing corrosive gases, install in a dust-free location.
Certifications	UL / CSA / CE / EN

⑨ Temperature to which units can be exposed for a short time, such as during transportation.


Block Diagram (Source Logic)



## Terminal Assignment of Signal Terminals

Function	Terminal	Terminal name	Description
Control connection	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	Preset of 15 different output frequencies; programmable.
	MRS	Output stop	The signal stops the output frequency without regard to the delay time; programmable.
	RES	RESET input	An activated protective circuit is reset, if a signal is applied to the terminal RES ( $t > 0,1$ s).
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. The SD terminal is isolated from the digital circuits via optocouplers. Common reference potential (sink logic) for 24 V DC/0.1 A output (PC terminal).
	PC	+24 V DC output	24 V DC/0.1 A output; reference potential for source logic
Setting value specification	10	Voltage output for potentiometer	Output voltage 5 V DC Max. output current 10 mA Recommended potentiometer: 1 k $\Omega$ , linear
	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 0–5 V. The input resistance is 10 k $\Omega$ .
	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 <b>must not be earthed</b> .
	4	Input for current setting value signal 0/4–20 mA DC	The current setting value signal (0/4–20 mA DC) is applied to this terminal. The input resistance is 250 $\Omega$ .
Signal outputs	A, B, C	Potential free alarm output	The alarm is output via relay contacts; programmable. The maximum contact load is 230 V AC / 0,3 A or 30 V DC / 0,3 A.
	RUN	Signal output for motor operation	The output is switched low, if the inverter output frequency is equal to or higher than the starting frequency. The output is switched high, if no frequency is output or the DC brake is in operation. (programmable)
	FU	Signal output for monitoring output frequency	The output is switched low once the output frequency exceeds a value preset in parameter 42 (or 43). Otherwise the FU output is switched high. (programmable)
	SE	Reference potential for signal outputs	Reference potential for the signals RUN and FU. This terminal is isolated from the reference potential of the control circuit PC/SD.
	AM	Analog output	One of 3 monitoring functions can be selected, e.g. external frequency output. The functions are determined by parameters. A DC voltmeter can be connected. The max. output voltage is 10 V.
Interface	—	Connection of control panel (RS485)	Communications via RS485 I/O standard: RS485, Multi-Drop operation, max. 19200 Baud

## Terminal Assignment of Main Circuit Terminals

Function	Terminal	Terminal name	Description
Main circuit connection	L1, L2, L3*	Power supply connection	Power supply of the inverter (380–480 V AC, 50/60 Hz)
	+, –	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, +	Converter choke coil connection	An optional choke coil can be connected to the terminals P1 and +. Disconnect the jumper from terminals P1 and + before.
	U, V, W	Motor connection	Voltage output of the inverter (3-phase, 0 V up to power supply voltage, 0.2–400 Hz)
		PE	Protective earth connection of inverter

\* L1, N for 1-phase connection

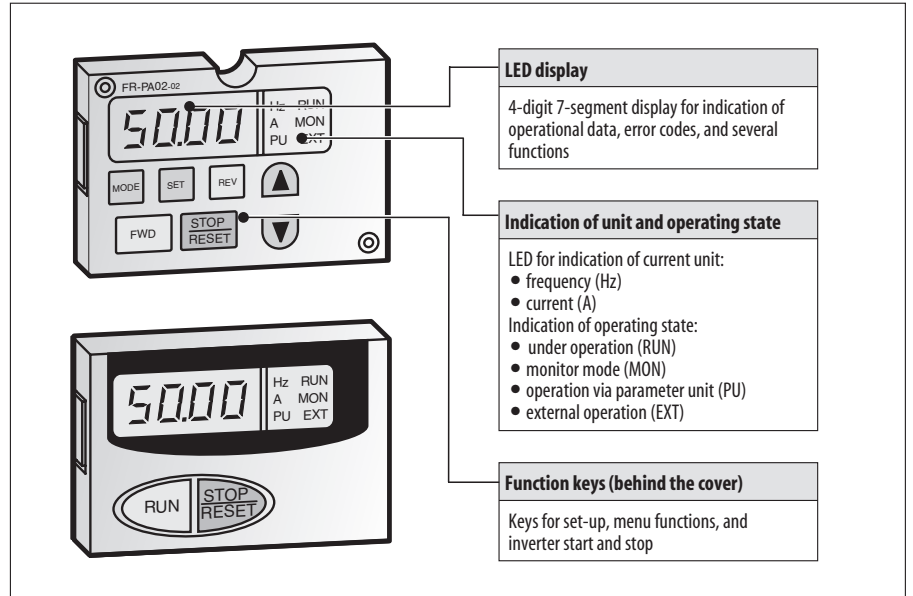
**Parameter Unit FR-PA02-02 (optional)**

The parameter unit FR-PA02-02 is the standard control device for the frequency inverter FR-E 500 EC. It fulfils the major tasks for operating the inverter achieving a particular cost effectiveness.

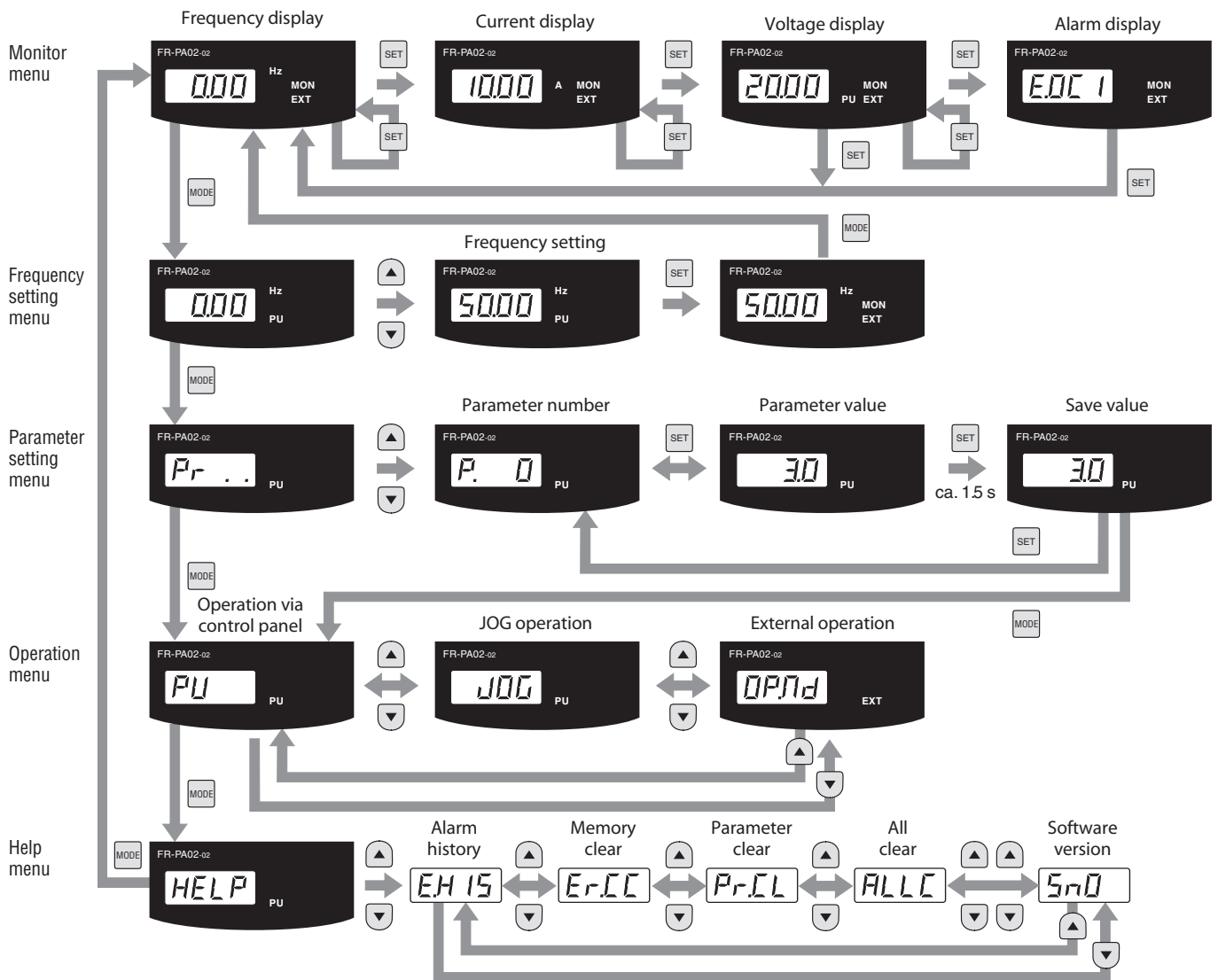
The parameter unit supports the input and display of several control variables (parameters) and monitors and indicates current operational data. The data is displayed on a 4-digit LED display.

Besides displaying and setting parameters all operating states of the inverter and motor can be monitored. Faults are indicated by error codes.

The parameter unit can alternatively be attached directly on the inverter or via cable connection and an adapter (see accessories) mounted remotely, e.g. in a control cabinet.



**Menu Guide to the Parameter Unit FR-PA02-02**

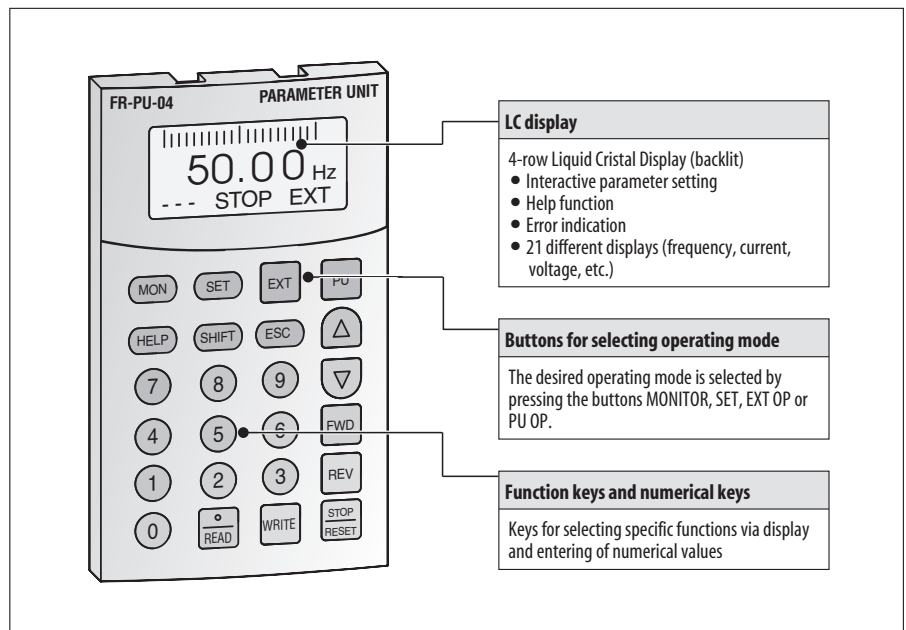


### Parameter Unit FR-PU04 (optional)

The parameter unit FR-PU04 including extended functions is available as optional accessory. It provides a 10-key keypad for entering directly numerical values. A 4-row LC display returns operational data, parameter names or status and error messages in uncoded text. The parameter unit displays text in the following selectable languages: English, German, French, Spanish, Swedish, Italian, Finnish, and Japanese.

In addition to the functions of the standard parameter unit the FR-PU04 displays and monitors 21 different values and states in total.

The decentralized connection of the parameter unit FR-PU04, e.g. in a cabinet door, is possible with the optional available extension cable FR-A5CBL.



### Menu Guide to the Parameter Unit FR-PU04

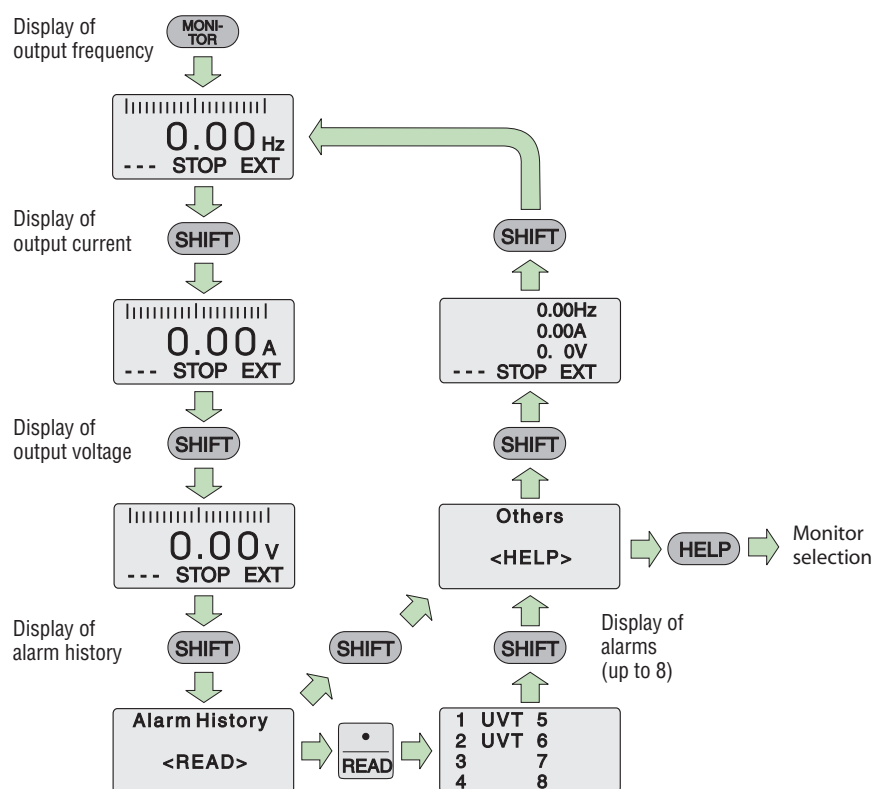
#### Displaying parameter lists

Press the SET key to enter the parameter setting menu. Then press the HELP key to display the parameter lists. After pressing the READ key, the according parameter value will be read in.

#### Copying parameters

Press the SET key and then the ▲ key to enter the copy mode. There are the following three possibilities:

- Press the READ key to read out all parameters from the inverter.
- Press the WRITE key to write parameters to the inverter.
- Press the ▼ key to verify the values stored in the parameter unit and the inverter.

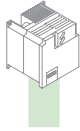


**Operating Modes**

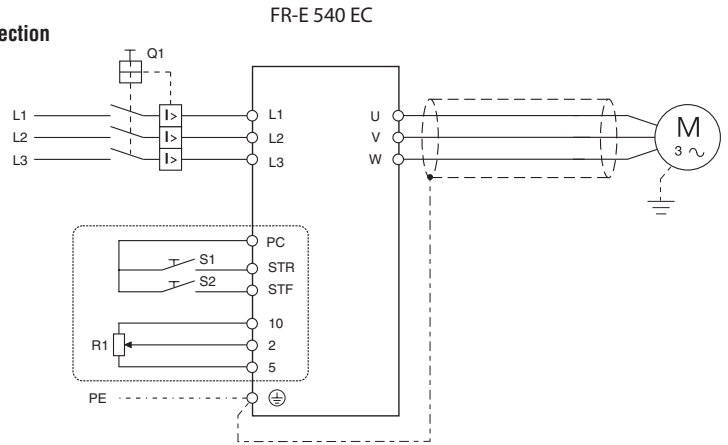
The inverter can alternatively be operated via external signals or directly via the parameter units FR-PA02-02 or FR-DU04. A combined operation is possible too.

The operating mode on the parameter unit FR-PA02-02 is selected within the operation mode menu.

With the parameter unit FR-PU04 the selection is done by pressing the EXT OP key for external signal operation and PU OP for control panel operation.



**Sample connection**



These connections are required for combined operation or operation by external signals.

**Operation via the parameter unit**

The direction of rotation and frequency setting of the inverter are controlled via the parameter unit.

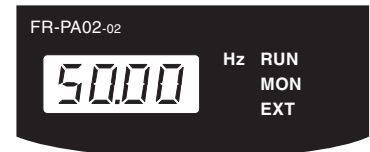
The setting of the output frequency is increased or decreased via the keys ▲ and ▼.



The example below shows the operational steps for a frequency setting including following motor start and motor stop.

**Operation via external signals**

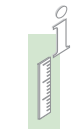
The direction of rotation and frequency setting of the inverter are controlled by external signals. The following figure shows the display on the parameter unit FR-PA02-02 for forward rotation of the motor and a frequency of 50 Hz.



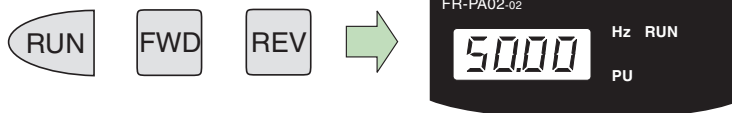
① Press the MODE key



② Set frequency with SET key



③ Start motor



or

④ Stop motor



**Combined operation**

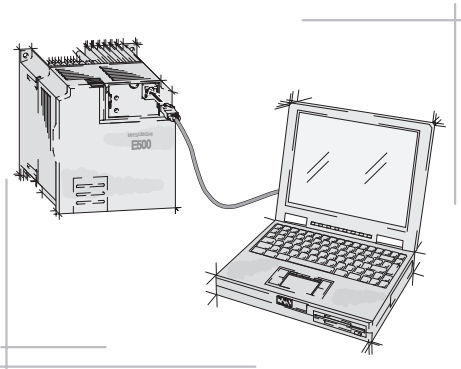
In addition to the operation via external signals and via parameter unit (FR-PA02-02 / FR-PU04) the inverter can be operated in combined operation mode.

- Setting value preset via the parameter unit and external starting signal
- External setting value signal and starting signal via the parameter unit

## VFD Setup Software

The VFD Setup Software is a powerful tool for the operation of your frequency inverter. The software (version 2.4) is MS Windows 95/98/XP and NT/2000 compatible, and therefore allows the inverter operation via any conventional personal computer. Several frequency inverters can be set up, operated, and monitored simultaneously across a network or via a personal computer or notebook. The software is designed for all frequency inverters of the MITSUBISHI FR-A 500, FR-E 500, FR-F 500 and FR-S 500 series.

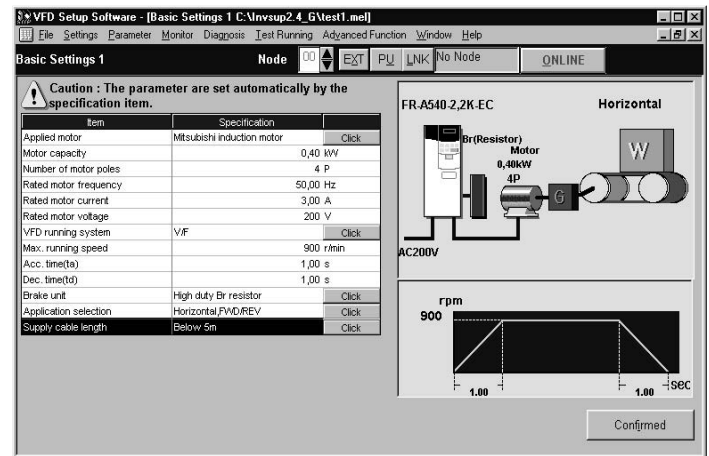
The connection between personal computer and inverter is established either via an RS485 network or directly via an SC-FR PC adapter cable available separately.



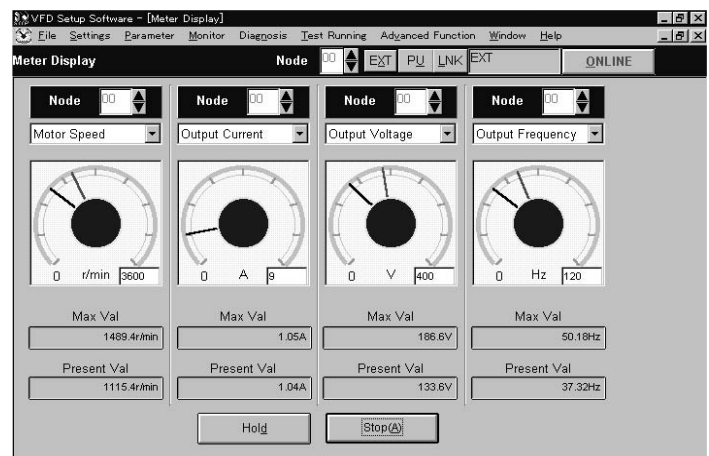
### Benefits

- **System settings**  
Due to the network capabilities of the inverter up to 32 frequency inverters can be operated simultaneously.
- **Parameter settings**  
By means of overall and function related overviews different parameters can be adjusted easily.
- **Display functions**  
The comprehensible display functions enable data, analog, oscillograph, and alarm displays.
- **Diagnosis**  
The analysis of the inverter status provides a thorough error correction.
- **Test operation**  
The test operation provides a simulation of the operation and adjustment via the auto-tuning function.
- **File management**  
Parameters can be saved on the personal computer and printed out.
- **Help**  
The extensive online help provides support concerning all questions regarding settings and operation.

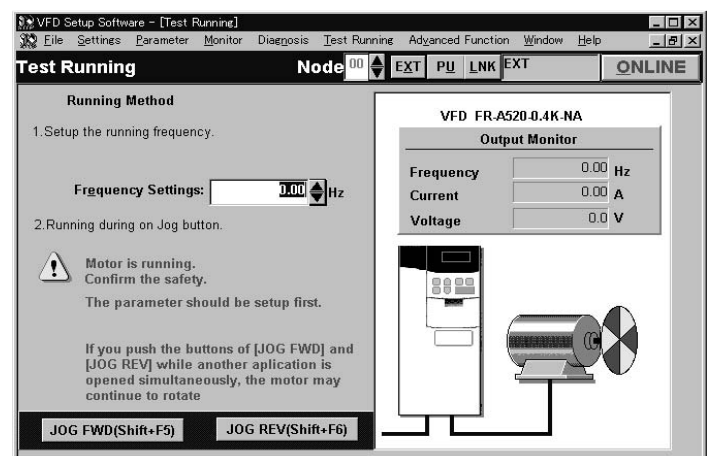
### Parameter setting



### Display and monitor



### Test operation



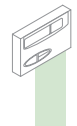


## Overview of Parameters

Function	Parameter	Meaning	Setting range	Default setting	
<b>Basic parameters</b>	0	Torque boost (manual) <sup>①</sup>	0–30 %	6 % / 4 % <sup>⑦</sup>	
	1	Maximum output frequency	0–120 Hz	120 Hz	
	2	Minimum output frequency	0–120 Hz	0 Hz	
	3	V/f characteristics (base frequency) <sup>①</sup>	0–400 Hz	50 Hz	
	4	1. Multispeed (high) preset - RH <sup>⑥</sup>	0–400 Hz	60 Hz	
	5	2. Multispeed (high) preset - RM <sup>⑥</sup>	0–400 Hz	30 Hz	
	6	3. Multispeed (high) preset - RL <sup>⑥</sup>	0–400 Hz	10 Hz	
	7	Acceleration time	0–360 s / 0–3600 s	5 s / 10 s <sup>③</sup>	
	8	Deceleration time	0–360 s / 0–3600 s	5 s / 15 s <sup>③</sup>	
<b>Parameters for standard drive operation</b>	9	Electronic thermal overload relay (motor protection)	0–500 A	Rated current <sup>④</sup>	
	10	DC injection brake (initial frequency)	0–120 Hz	3 Hz	
	11	DC injection brake (operation time)	0–10 s	0,5 s	
	12	DC injection brake (voltage)	0–30 %	6 %	
	13	Starting frequency	0–60 Hz	0.5 Hz	
	14	Selection of load pattern <sup>①</sup>	0–3	0	
	15	JOG frequency	0–400 Hz	5 Hz	
	16	JOG acceleration and deceleration time	0–360 s / 0–3600 s	0.5 s	
	18	High-speed max. frequency	120–400 Hz	120 Hz	
	19	Max. output voltag e <sup>①</sup>	0–1000 V/8888/9999	8888	
	20	Acceleration / deceleration reference frequency	1–400 Hz	50 Hz	
	21	Acceleration / deceleration time increments	0 / 1	0	
	22	Stall prevention operation level <sup>⑥</sup>	0–200 %	150 %	
	23	Stall prevention operation at double speed <sup>⑤</sup>	0–200 % / 9999	9999	
	24	4. Multispeed preset <sup>⑥</sup>	0–400 Hz / 9999	9999	
	25	5. Multispeed preset <sup>⑥</sup>	0–400 Hz / 9999	9999	
	26	6. Multispeed preset <sup>⑥</sup>	0–400 Hz / 9999	9999	
	27	7. Multispeed preset <sup>⑥</sup>	0–400 Hz / 9999	9999	
	29	Acceleration / deceleration pattern	0 / 1 / 2	0	
	30	Regenerative function selection	0 / 1	0	
	31	Frequency jump 1A	0–400 Hz / 9999	9999	
	32	Frequency jump 1B	0–400 Hz / 9999	9999	
	33	Frequency jump 2A	0–400 Hz / 9999	9999	
	34	Frequency jump 2B	0–400 Hz / 9999	9999	
	35	Frequency jump 3A	0–400 Hz / 9999	9999	
	36	Frequency jump 3B	0–400 Hz / 9999	9999	
	37	Speed display	0 / 0.1–9998	0	
	38	Frequency at 5 V (10 V) input voltage	1–400 Hz	50 Hz <sup>②</sup>	
	39	Frequency at 20 mA input current	1–400 Hz	50 Hz <sup>②</sup>	
	<b>Settings of control outputs</b>	41	Setting value / current value comparison (SU output)	0–100 %	10 %
		42	Output frequency monitoring (FU output)	0–400 Hz	6 Hz
		43	Output frequency detection for reverse rotation	0–400 Hz / 9999	9999
	<b>2nd parameter settings</b>	44	2. Acceleration / deceleration	0–360 s / 0–3600 s	5 s / 10 s <sup>③</sup>
		45	2. Deceleration time	0–360 s / 0–3600 s / 9999	9999
		46	2. Manual torque boost <sup>①</sup>	0–30 % / 9999	9999
		47	2. V/f characteristics (base frequency) <sup>①</sup>	0–400 Hz / 9999	9999
		48	2. Electronic overcurrent protection	0–500 A / 9999	9999
	<b>Display functions</b>	52	Control panel (PU) main display data selection <sup>⑦</sup>	0 / 23 / 100	0
		55	Frequency monitoring reference <sup>⑦</sup>	0–400 Hz	50 Hz
56		External current monitoring reference <sup>⑦</sup>	0–500 A	Rated current	
<b>Restart</b>	57	Restart coasting time after power failure	0–5 s / 9999	9999	
	58	Restart cushion time before automatic synchronisation	0–60 s	1 s	
<b>Aux. function</b>	59	Selection of digital motor potentiometer	0 / 1 / 2	0	



Function	Parameter	Meaning	Setting range	Default setting
Operation settings	60	Shortest acceleration/deceleration mode	0 / 1 / 2 / 11 / 12	0
	61	Reference current	0–500 A / 9999	9999
	62	Current limit for intelligent mode (acceleration)	0–200 % / 9999	9999
	63	Current limit for intelligent mode (deceleration)	0–200 % / 9999	9999
	65	Retry selection	0 / 1 / 2 / 3	0
	66	Starting frequency <sup>⑤</sup> for stall prevention at boost frequency	0–400 Hz	50 Hz
	67	Number of restart retries	0–10 / 101–110	0
	68	Waiting time for automatic restart retry	0.1–360 s	1 s
	69	Retry count display erasure	0	0
	70	Special regenerative brake duty	0–30 %	0 %
	71	Motor selection <sup>⑤</sup>	0/1/3/5/6/13/15/16/ 100/101/103/105/106/113/115/116	0
	72	PWM function <sup>⑥</sup>	0–15	1
	73	Specification of setting value input data	0 / 1 / 10 / 11 <sup>⑧</sup>	1
	74	Setting value signal filter	0–8	1
	75	Reset condition / connection error / stop	0–3 / 14–17	14
77	Write protection for parameters	0 / 1 / 2	0	
78	Prevention of reverse rotation	0 / 1 / 2	0	
79	Operation mode selection <sup>⑤</sup>	0–4 / 6–8	0	
Motor constants	80	Rated motor capacity for flux vector control	0.2–7.5 kW / 9999	9999
	82	Motor excitation current	0–500 A / 9999	9999
	83	Rated voltage of motor for auto-tuning	0–1000 V	200 V / 400 V
	84	Rated motor frequency	50–120 Hz	50 Hz
	90	Motor constant A <sup>⑤</sup>	0–50 Ω / 9999	9999
	96	Auto-tuning setting/status <sup>⑥</sup>	0 / 1	0
Communications parameter	117	Station number	0–31	0
	118	Communication speed	48 / 96 / 192	192
	119	Stop bit length/data length <sup>⑩</sup>	0 / 1 / 100 / 101 data length 8 10 / 11 / 110 / data length 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	0–999.8 s / 9999	9999
	123	Wait time setting	0–150 ms / 9999	9999
PID control	124	CR / LF absence/presence selection	0 / 1 / 2	1
	128	PID action selection	0 / 20 / 21	0
	129	PID proportional band	0.1–1000 % / 9999	100 %
	130	PID integral time	0.1–3600 s / 9999	1 s
	131	Upper limit for actual value	0–100 % / 9999	9999
	132	Lower limit for actual value	0–100 % / 9999	9999
	133	PID action set point for PU operation	0–100 %	0 %
Auxiliary functions	134	PID differential time	0.01–10.00 s / 9999	9999
	145	Language selection	0–7	1
Current detection	146	Parameter set by manufacturer. Do not set.	—	—
	150	Output current detection level	0–200 %	150 %
	151	Output current detection period	0–10 s	0
	152	Zero current detection level	0–200 %	5 %
Sub functions	153	Zero current detection period	0.05–1 s	0.5 s
	156	Stall prevention operation selection	0–31/100	0
Additional functions	158	AM terminal function selection	0 / 1 / 2	0
	160	User group read selection	0 / 1 / 10 / 11	0
	168	Parameter set by manufacturer. Do not set.	—	—
Initial monitor	169	Parameter set by manufacturer. Do not set.	—	—
	171	Actual operation hour meter clear	0	0



## PARAMETER

Function	Parameter	Meaning	Setting range	Default setting
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	0–8 / 16 / 18	0
	181	RM terminal function selection	0–8 / 16 / 18	1
	182	RH terminal function selection	0–8 / 16 / 18	2
	183	MRS terminal function selection	0–8 / 16 / 18	6
	190	RUN terminal function selection	0–99	0
	191	FU terminal function selection	0–99	4
Multi-speed operations	192	ABC terminals function selection	0–99	99
	232	Multi-speed setting (speed 8) <sup>⑥</sup>	0–400 Hz / 9999	9999
	233	Multi-speed setting (speed 9) <sup>⑥</sup>	0–400 Hz / 9999	9999
	234	Multi-speed setting (speed 10) <sup>⑥</sup>	0–400 Hz / 9999	9999
	235	Multi-speed setting (speed 11) <sup>⑥</sup>	0–400 Hz / 9999	9999
	236	Multi-speed setting (speed 12) <sup>⑥</sup>	0–400 Hz / 9999	9999
	237	Multi-speed setting (speed 13) <sup>⑥</sup>	0–400 Hz / 9999	9999
	238	Multi-speed setting (speed 14) <sup>⑥</sup>	0–400 Hz / 9999	9999
Sub functions	239	Multi-speed setting (speed 15) <sup>⑥</sup>	0–400 Hz / 9999	9999
	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	0.01–10 s	0.5 s
Stop selection function	247	Constant output region slip compensation selection	0 / 9999	9999
Additional functions	250	Stop selection	0–100 s / 1000–1100 s / 8888 / 9999	9999
	251	Output phase failure protection selection	0 / 1	1
	254	Analog polarity reversible lower limit <sup>⑩</sup>	0–100 % / 9999	9999
	338	Operation command right <sup>⑨</sup>	0 / 1	0
	339	Speed command right <sup>⑨</sup>	0 / 1	0
	340	Link start mode selection <sup>⑨</sup>	0 / 1	0
Calibration functions	342	E <sup>2</sup> PROM write selection	0 / 1	0
	901	AM terminal calibration	Calibration range	—
	902	Frequency setting voltage bias	0–60 Hz / [0–10 V]	0 Hz / [0 V]
	903	Frequency setting voltage gain	1–400 Hz / [0–10 V]	50 Hz / [5 V]
	904	Frequency setting current bias	0–60 Hz / [0–20 mA]	0 Hz / [4 mA]
Help functions	905	Frequency setting current gain	1–400 Hz/[0–20 mA]	50 Hz / [20 mA]
	990	Beep signal at key operation	0 / 1	1
	991	Contrast setting for LCD display	0–63	53

Remarks to the table:

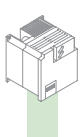
- ① The parameter setting is ignored, if the general purpose flux vector control is activated.
- ② Since calibration is made before shipment from the factory, the setting differs slightly between inverters. The inverter is preset to provide a frequency slightly higher than 50 Hz.
- ③ The setting depends on the inverter capacity. Range splitting: (0.4–3.7 k = 5 s) / (5.5–7.5 k = 10 s).
- ④ Set to 85 % of the rated inverter current for 0.4 k and 7.5 k type.
- ⑤ If "2" is set in parameter 77 (parameter write inhibit selection), the setting cannot be changed during operation.
- ⑥ The half-tone screened parameters allow their settings to be changed during operation if "0" (factory setting) has been set in parameter 77 (parameter write inhibit selection).
- 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 7581A.

**Overview of protective functions**

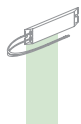
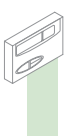
The inverter FR-E 500 EC provides a large number of protective functions that protect the drive and the inverter against damage in case of any malfunction.

If an error occurs, the output of the inverter is suspended and the control panel returns an error message.

Refer to the following table for detailed information concerning these error messages.



Display on control panel FR-PA02-02	Meaning	Description	Remedy
E.OC1	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).
E.OC2	Overcurrent 2 (constant speed)		
E.OC3	Overcurrent 3 (deceleration)		
E.OV1	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 by connecting an external brake unit.  An overvoltage in the mains power supply activates this protective function as well.
E.OV2	Overvoltage 2 (constant speed)		
E.OV3	Overvoltage 3 (deceleration)		
E.THN	Overload (motor)	The electronic overload protection for the motor or inverter was activated.	Decrease the motor load to avoid an activation.
E.THT	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.	
E.F1n	Fin overheat	If the cooling fin overheats, the fin overheat sensor activates and halts inverter output.	Check environmental temperature.
Fn	Fan breakdown	The cooling fan breaks down or an operation different from the setting of parameter 244 (cooling fan operation selection) is performed. Inverter output does not stop.	Check parameter 244 and replace the cooling fan if necessary.
E.bE	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.
E.OF	Ground failure	An overcurrent occurred due to a ground failure upon the inverter output (load side).	Check load connections (motor circuit).
E.OTH	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.
E.OLT	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).
E.OPT	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.
E.PE	Memory error	Error on access of the data memory of the inverter.	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs again.
E.PUE	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.
E.rET	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.



Display on control panel FR-PA02-02	Meaning	Description	Remedy
E.CPU	CPU error	Scan time of CPU was exceeded. Failure on CPU printed circuit board.	Restart the inverter. Contact the customer service if the error occurs again.
E.3	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
E.6	Fault 6 (CPU error)	This functions 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.
E.7	Fault 7 (CPU error)		
E.LF	Open output phase protection	One of the phases (U, V, W) is not connected.	Check the connections.
E.P24	Shortcut at 24 V DC	A shortcut at the 24 V output has occurred (PC terminal).	Remove the shortcut!
PS	Inverter was stopped via control panel	STOP key on the control panel was pressed during external operating mode.	Check parameter 75.
OL	Motor run under overload? Sudden deceleration? oL: Overvoltage OL: Overcurrent	The load is too large or the brake frequency is too high.	Reduce the load or the brake frequency.
Err	Error	CPU error has occurred.	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs repeatedly.

## Activating a protective function and resetting methods

When a protective function is activated, the output of the inverter is switched off. The motor runs until stop. The output remains switched off until the error cause is eliminated and the inverter is reset. The inverter can be reset following four different methods:

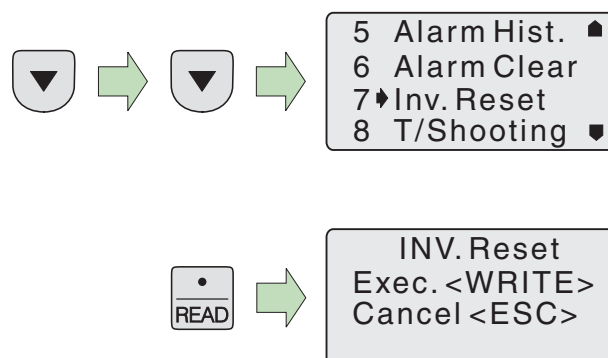
- Switch the power supply OFF and ON again.
- Switch the reset signal ON for at least 0.1 s and switch it OFF again.
- Press the RESET key on the control panel.
- Menu-guided reset via the optional parameter unit FR-PU04

If the reset signal is ON continuously, the control panel FR-PA02-02 returns an error message while the control unit FR-PU04 indicates that the reset procedure is in progress.

When a protective function is activated, the control panel FR-PA02-02 returns an error code as listed in the table above. The parameter unit FR-PU04 indicates a more detailed error message.

If an error occurs and the input protection contactor is toggled the error message cannot be retained, since there is no power supply for the control circuit.

### Menu-guided reset with FR-PU04



## Sample Applications

### Automatic operation using DC (0/4–20 mA) current signals

The figure on the right shows the layout of a circuit for operation in combination with a temperature sensor for air-conditioners.

The motor can be switched from inverter operation to commercial power supply operation and vice versa. The operating mode can be determined by a switch. To switch from commercial power supply operation to inverter operation, the motor has to be stopped first.

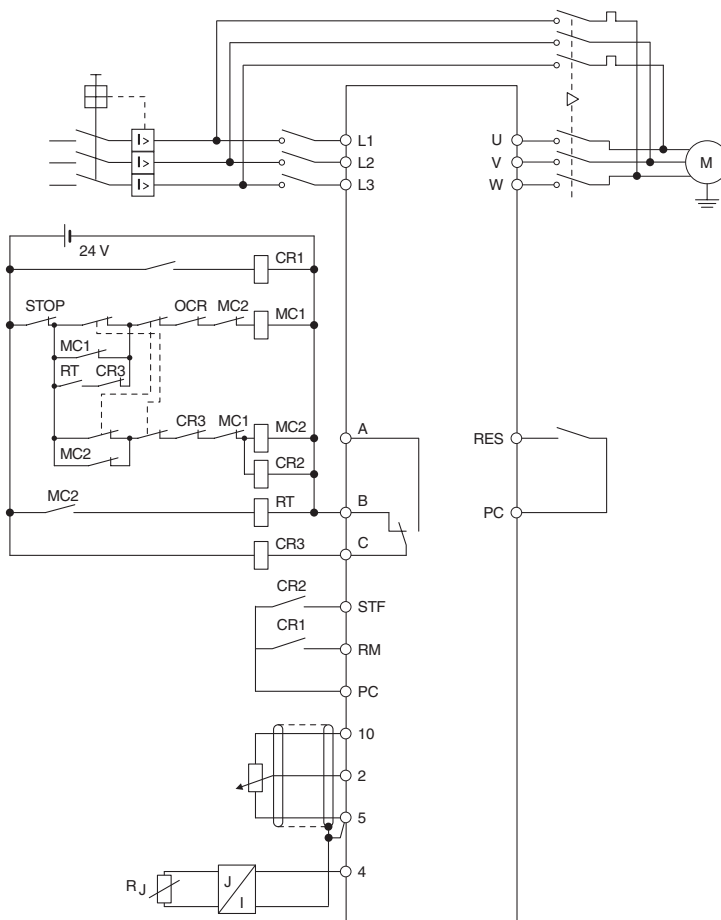
Operation automatically switches to commercial power supply operation when an alarm stop occurs in the inverter.

Assign the AU signal to the RM terminal to switch between an external current signal and a manual voltage signal from the speed setter potentiometer.

Parameter 75 should be set so that the inverter can only be reset after a protective function has been activated.

Relevant parameters:

Pr. 75 "Reset selection" and Pr. 180 to Pr. 183 "Input terminal function selection"



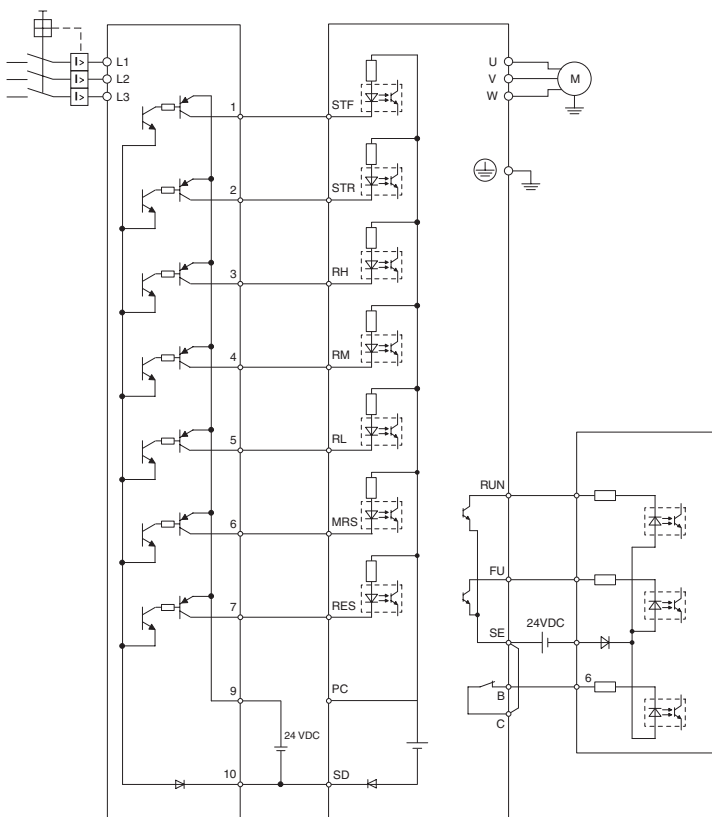
### Multi-speed operation (with Mitsubishi PLC)

The figure on the right shows the layout of a sample circuit for multi-speed operation with a Mitsubishi PLC. The PLC is equipped with a digital output module AY80.

To prevent wrap-arounds, the output modules common pin 10 for preventing wrap-arounds must be connected to inverter terminal SD.

A variety of functions for the inverters transistor output signals (RH, RM, STOP etc.) are selectable using parameter 180 to 183. These inverter output signals, however, can be received at a separate digital input module.

Up to 15 speeds can be set with the multi-speed setter, but additional two speeds can be obtained by shorting terminals 10 and 2 for an upper limit frequency setting (Pr. 1) and terminals 2 and 5 for a lower limit frequency setting (Pr. 2).

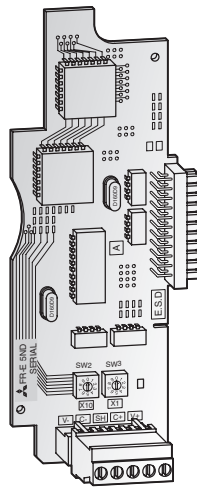


Internal and External Options

A large number of options allows an individual adoption of the inverter to the according task. The options can be installed quickly and easily. Detailed information on installation and functions is included in the manual of the options.

The options can be divided into two major categories:

- internal options
- external options



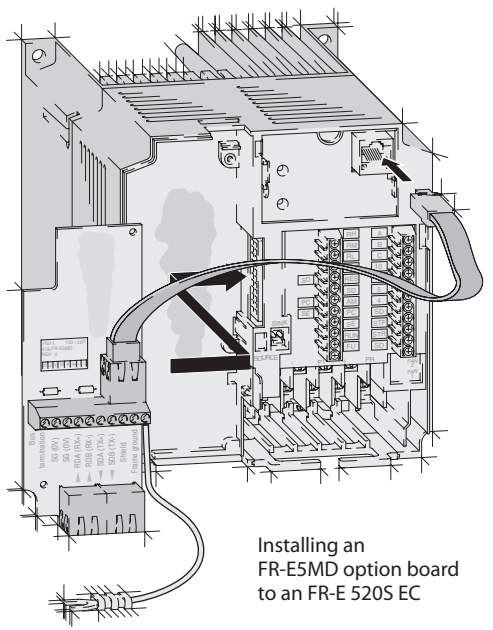
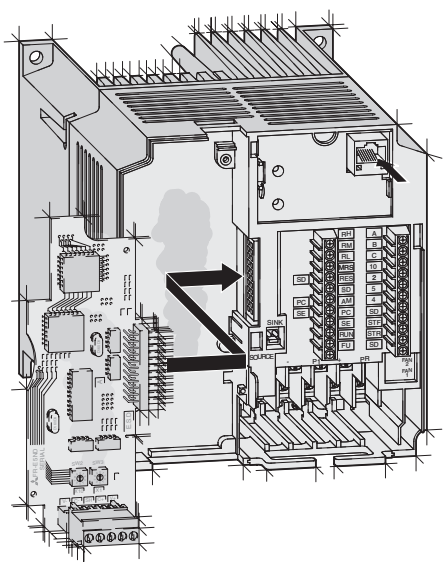
Internal options

The internal options comprise communications options supporting the operation of the inverter within a network or connected to a personal computer or PLC.

Option	Type	Description	Remarks / specifications	Art. no.		
Internal options	Communications boards	Profibus/DP	FR-E5NP	Option board for the integration of a frequency inverter into a Profibus/DP network. The operation, display functions, and parameter settings can be controlled by a computer (PC etc.) or a PLC.	Connection for up to 42 inverters supported	104556
		DeviceNet™	FR-E5ND	Option board for the integration of a frequency inverter into a DeviceNet. The operation, display functions, and parameter settings can be controlled by a computer (PC etc.) or a PLC.	Maximum transfer rate: 10 Mbaud	104557
		CC-Link	FR-E5NC	Option board for the integration of frequency inverter into a CC-Link system. The operation, display functions, and parameter settings can be controlled by a PLC.	Maximum transfer distance: 1200 m (at 156 x 10 kbaud)	104558
		CAN Open	OI-FR-E5NCO	Option board for the integration of a frequency inverter into a Can-Open network. Operation, indicating functions, and parameter settings can be controlled via a personal computer or a PLC.	Maximum transfer rate: 1 Mbaud	139378
Accessories	PCMCIA communications card	SioCard	Connection between mobile PC (PCMCIA) and frequency inverter RS485 (RJ45); no external power supply necessary	Length 3 m; for parametrization and programming of the frequency inverter; it can be used for example with the VFD Setup Software	69946	
	Connection cable	SC-FR-PC	Connection between PC (RS232) and frequency inverter RS485 (RJ45); no external power supply necessary		88426	

Mounting examples for an internal option

Installing an option board to an FR-E 520S EC



Installing an FR-E5MD option board to an FR-E 520S EC

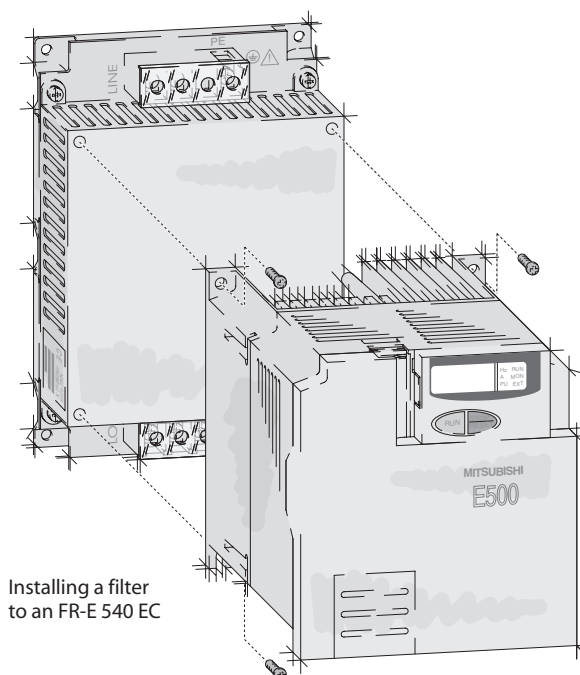
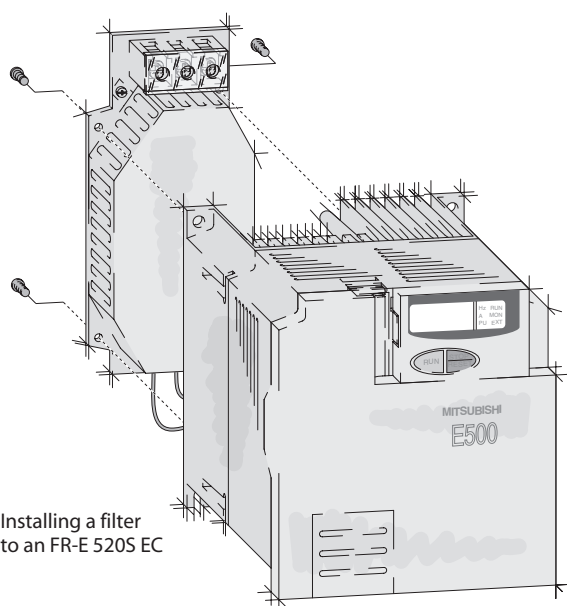
**External options**

Besides the parameter unit FR-PU04 that provides an interactive control of the inverter the external options include noise

filters complying with the EMC directives, filters improving the efficiency as well as brake units and brake resistors.

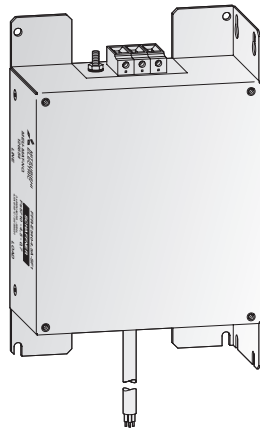
Option	Type	Description	Remarks / specifications	Art. no.	
Control panel	FR-PA02-02	Interactive standard control panel	Refer to p.12 for detailed description.	103686	
Control panel (8 languages)	FR-PU04	Interactive control panel with LC display	Refer to p.13 for detailed description.	67735	
Connection cable for the control panel	FR-A5 CBL	Cable for a remote connection of the parameter unit FR-PA02-02 or FR-PU04.	Available length: 1; 2.5 and 5 m	1 m: 70727 2.5 m: 70728 5 m: 70729	
Cover for the control panel	FR-ESP	Cover for the backside of the parameter unit FR-PA02-02 to use e.g. for cabinet installation , connection adapter included	Connection adapter integrated into the cover.	125323	
Interface cable	SC-FR PC	Communications cable for RS232 or RS485 interface to connect an external personal computer	Length 3 m; can be used for example with the VFD Setup Software	88426	
VFD Setup Software	FR-SW0-SETUP-W□	Parameter and setup software for the FR-A, FR-E, FR-F and FR-S series inverters	English / German	149718	
EMC noise filter	FR-E 520 S EC	FR-E5NFS-□□k FFR-E520□□□	Noise filter for compliance with EMC directives	Refer to p.24 for detailed description.	see p. 24
	FR-E 540 EC	FR-E5NF-H□□k FFR-E540□□□			
Brake units	FR-E 520 S EC	BU-UFS-□□J	For an improvement of the brake capacity. For loads with high moment of inertia or negative loads. Used in combination with a resistor unit.	Refer to p.25 for detailed description.	see p. 25
	FR-E 540 EC	BU-UFS-□□			
External brake resistor	FR-E 520 S EC	FR-ABR	The connection of an external brake resistor improves the brake capacity of the inverter.	Refer to p.25 for detailed description.	see p. 25
	FR-E 540 EC	FR-ABR-H			
DC converter circuit choke coil	FR-E 520 S EC	—	For increasing efficiency and compensating voltage fluctuations.	—	on request
	FR-E 540 EC	FR-BEL-(H)□□			
Mains circuit choke coil	FR-E 520 S EC	—	For increasing efficiency and compensating voltage fluctuations.	Refer to p.24 for detailed description.	see p. 24
	FR-E 540 EC	FR-BAL-(B)□□			

Mounting examples for external options

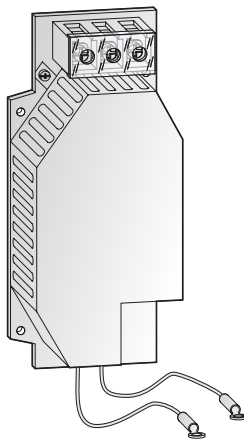




**■ Noise Filters for FR-E 540/520**



Type SF-1



Built-on filter SC1

**Noise filters**

For complying with the EMC directives of the European Community regarding the electromagnetic compatibility, the FR-E 500 EC inverter has to be equipped with a noise filter across the input circuit. Additionally it has to be installed and wired according to the EMC directives. The filters are designed to reduce conducted noise voltages to comply with the limits defined for Environments 1 and 2.

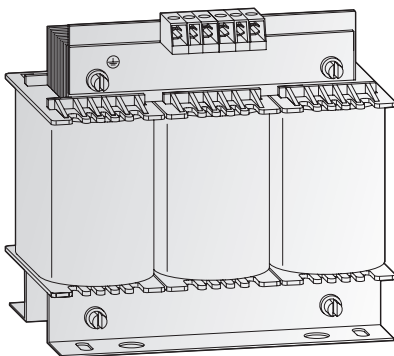
To ensure a proper and safe operation of the components follow the points below:

- Ground the filter prior to applying the power supply.
- For the selection of a ground fault protective switch or relay take the leakage current of the filter into account.
- Ensure a perfect grounding of the filter, if you do not intend to use a protective switch or relay across the input circuit.

Filter	Inverter		Power loss [W]	Leakage current [mA]	Weight [kg]	Art. no.
	FR-E 520S EC	FR-E 540 EC				
FFR-E540-4.5A-SF1	—	0.4 k–0.75 k	4	< 30	1.3	126654
FFR-E540-15A-SF1	—	1.5 k–3.7 k	12	< 30	1.45	126655
FFR-E540-27A-SF1	—	5.5 k–7.5 k	25	< 30	1.7	126656
FFR-E520S-14A-SC1	0.4 k – 0.75 k	—	11	< 30	1.3	152727
FFR-E520S-26A-SC1	1.5 k – 2.2 k	—	17	< 30	1.3	152730

The filters can provide conformity with the limits for Environment 1 (unrestricted distribution) with motor cable lengths of up to 20m (shielded) and for Environment 1 (restricted distribution) with motor cable lengths of up to 100m (shielded), and thus also with the 100A limits of Environment 2 with motor cable lengths of up to 100m.

**■ Input Reactors for Three-Phase Current FR-BAL-B-□□k**



**Three-phase input reactors**

The three-phase input reactors FR-BAL-B-□□k for the frequency inverters FR-E 540 EC compensate voltage fluctuations and simultaneously increase the efficiency.

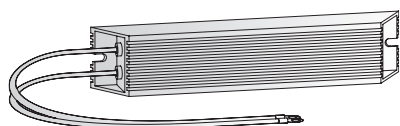
Applying the appropriate input reactors an overall efficiency of up to 90 % can be achieved.

The use of an input reactor is especially recommended for main circuits where high capacities are switched, for example, via thyristors.

Inverter	Input reactors	Power capacity	L [mH]	Current [A]	Power loss [W]	Insulation class	Weight [kg]	Art. no.
FR-E 540 EC	FR-BAL-B-4.0 k	FR-E 540-0.4 k – 4.0 k	2.340	12	31	T40/E	3.0	87244
	FR-BAL-B-5.5k	FR-E 540-5.5 k	1.750	16	44	T40/E	3.7	87245
	FR-BAL-B-7.5 k	FR-E 540-7.5 k	1.220	23	59	T40/E	5.5	87246



External Brake Resistors FR-ABR-(H)□□k



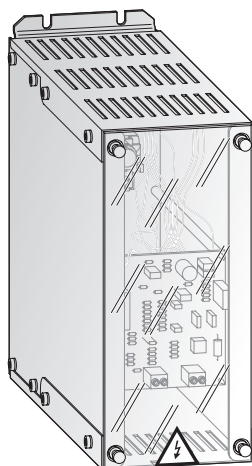
Among the capacity range of 0.4 k to 7.5 k the inverter is equipped with an internal brake chopper as standard.

An improvement of the brake duty is achieved by the use of an external brake resistor with a higher rated capacity.

The duty cycle is selectable via parameter 30 and can be specified to up to 30 % via parameter 70.

Inverter	Brake resistor	Regenerative brake duty	Resistor [Ω]	Art. no.
FR-E 520S EC	FR-ABR-0.4 k	10 % (ED)	200	46788
	FR-ABR-0.75 k	10 % (ED)	100	46602
	FR-ABR-2.2 k	10 % (ED)	60	46787
FR-E 540 EC	FR-ABR-H0.4 k	10 % (ED)	1200	46601
	FR-ABR-H0.75 k	10 % (ED)	700	46411
	FR-ABR-H1.5 k	10 % (ED)	350	46603
	FR-ABR-H2.2 k	10 % (ED)	250	46412
	FR-ABR-H3.7 k	10 % (ED)	150	46413
	FR-ABR-H5.5 k	10 % (ED)	110	50045
	FR-ABR-H7.5 k	10 % (ED)	75	50049

Brake Units



For a braking torque higher than 20 % or a duty cycle higher than 30 % an external brake unit including the adequate brake resistors has to be installed.

The brake units BU-UFS listed below are cascable so that the optimum dimensioning can always be achieved.

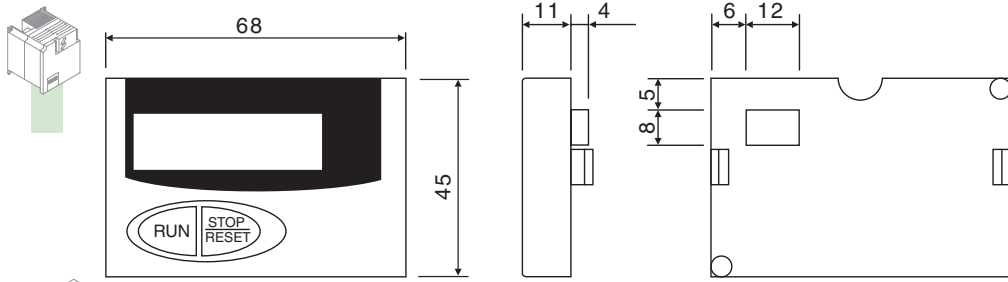
Suggestions regarding an adequate dimensioning of brake resistors can be

found in the operating manual for the brake unit. Like any other documentation of frequency inverters you will find the operating manual on the MITSUBISHI ELECTRIC homepage.

Inverter	Brake unit	Application	Rated voltage	Braking torque	Art no.
FR-E 520S EC	BU-UFS22J	FR-E 520	230 V	100 %, 15 s	127962
FR-E 540 EC	BU-UFS22	FR-E 540	400 V	100 %, 15 s	127947

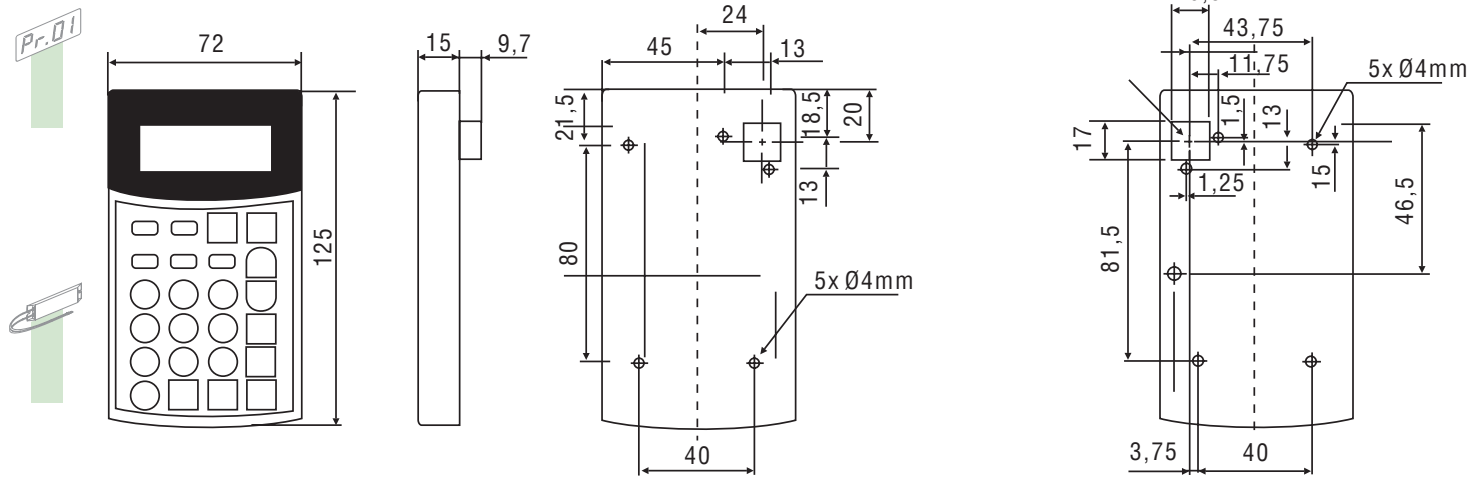
# DIMENSIONS

## Parameter Unit FR-PA02-02



All dimensions in mm

## Parameter Unit FR-PU04



All dimensions in mm

### Connecting the parameter unit

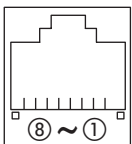
After the protective cover has been removed, the parameter unit can be installed directly on the inverter. The parameter unit can be connected to the inverter remotely via the connecting cable FR-A5-CBL (1m; 2.5m; 5m). You must use the original MITSUBISHI ELECTRIC cable only. This cable is available as an optional accessory.

Plug the cable in the according connectors on the parameter unit and the inverter.

The figure at the left shows the pin assignment of the connector plugs.

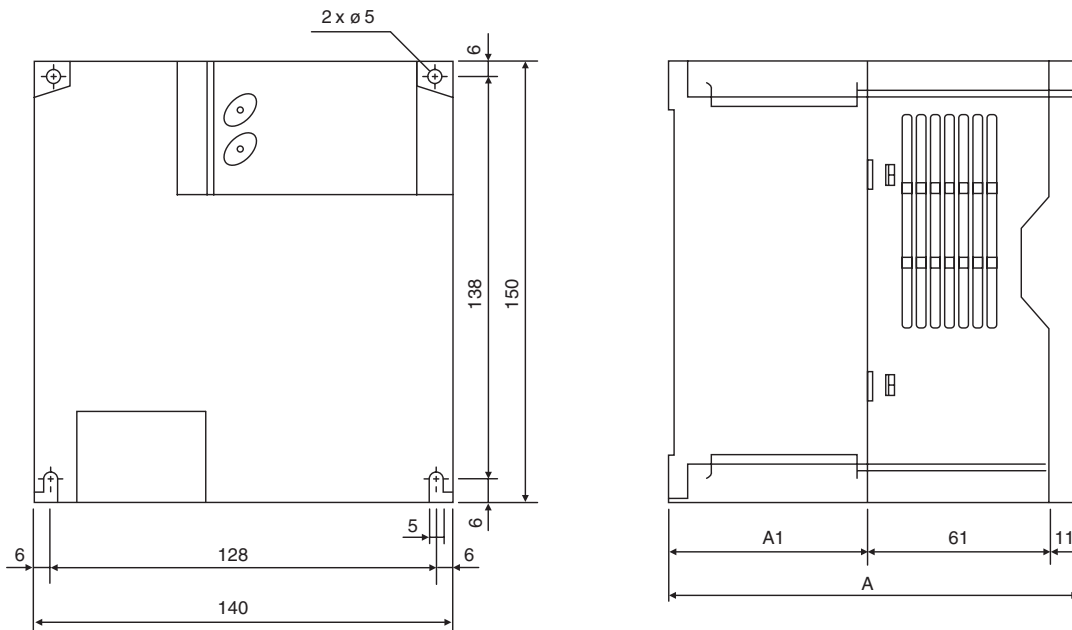
Do not connect fax modems, LAN network boards, or modular telephone plugs with the connectors. Otherwise, the inverter might be damaged.

By means of the communications cable it is also possible to connect the parameter unit to a personal computer.



- ① SG
- ② P5S
- ③ RDA
- ④ SDB
- ⑤ SDA
- ⑥ RDB
- ⑦ SG
- ⑧ P5S

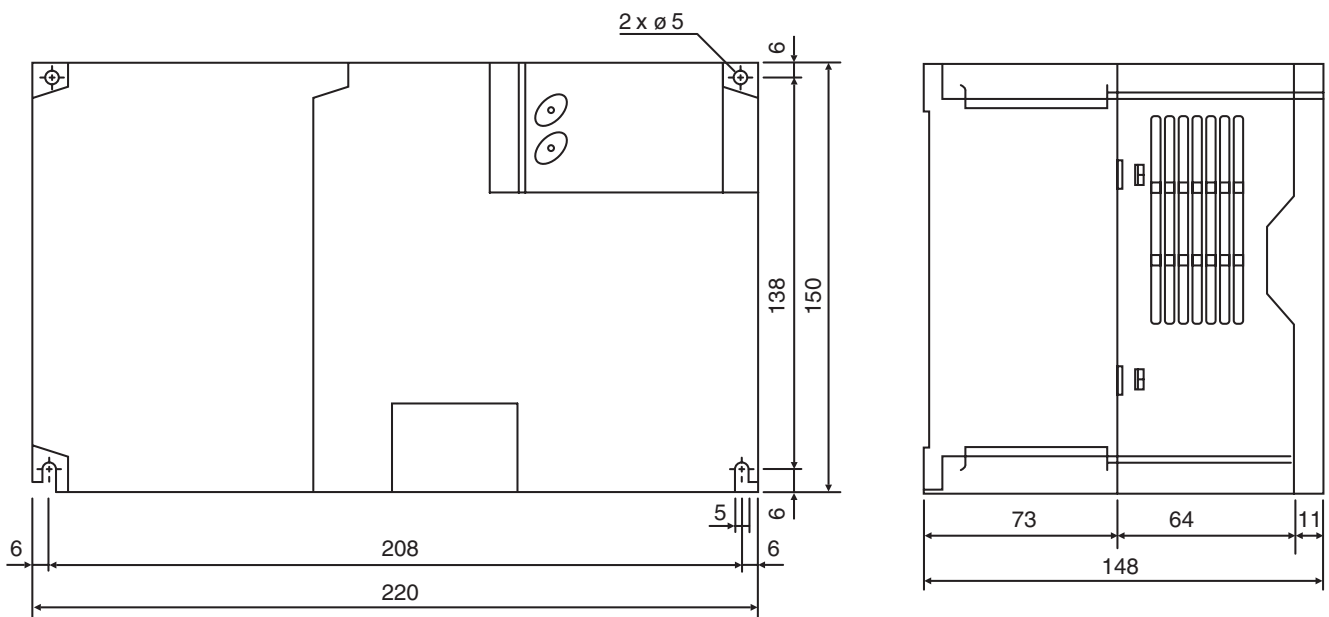
**FR-E 540-0.4 k to 3.7 k EC and FR-E 520S-04 k to 2.2 k EC**



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

All dimensions in mm

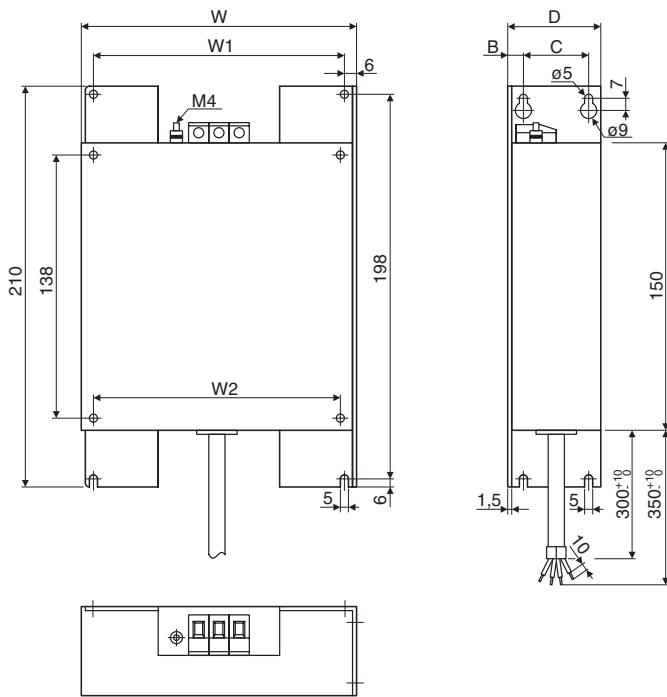
**FR-E 540-5.5 k and 7.5 k EC**



All dimensions in mm

## DIMENSIONS

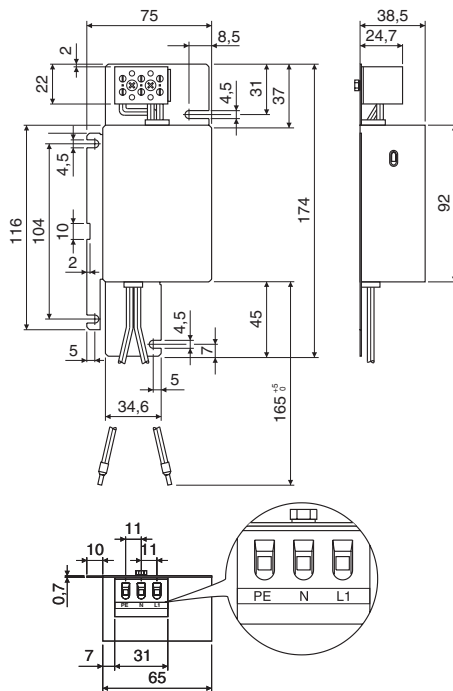
### Noise Filters FFR-E540-4,5A – FFR-E540-27A-SF1



Filter	W	W1/W2	B	C	D
FFR-E540-4,5A-SF1	140	128	8	30	46
FFR-E540-15A-SF1	140	128	8	30	46
FFR-E540-27A-SF1	220	208	12,5	30	55

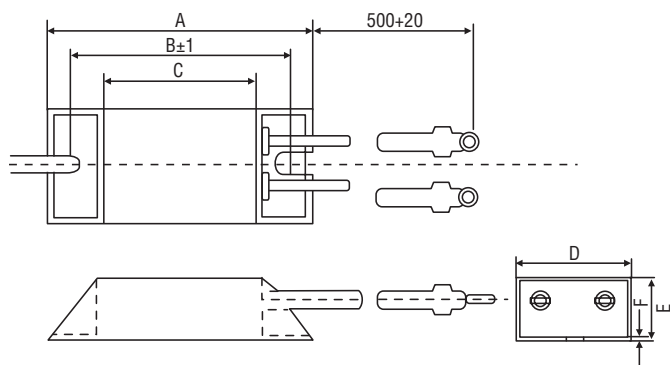
All dimensions in mm

### Noise Filters FFR-E520S-14A-SC1 and FFR-E520S-26A-SC1



All dimensions in mm

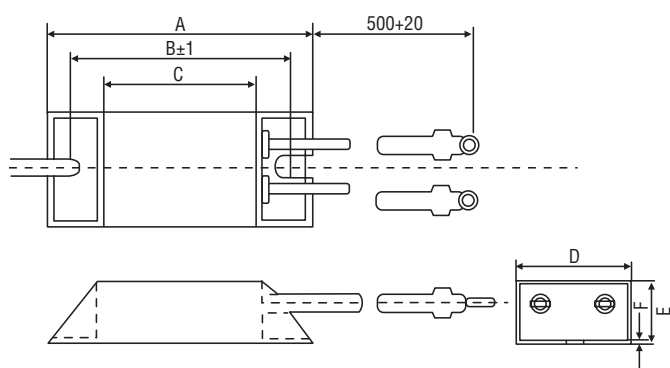
**External Brake Resistors FR-ABR-□□k**



Brake resistor	A	B	C	D	E	F	Weight [kg]
FR-ABR-0.4 k	115	100	75	40	20	2.5	0.2
FR-ABR-0.75 k	140	125	100	40	20	2.5	0.2
FR-ABR-1.5 k	215	200	175	40	20	2.5	0.4
FR-ABR-2.2 k	240	225	200	50	25	2.0	0.5

All dimensions in mm

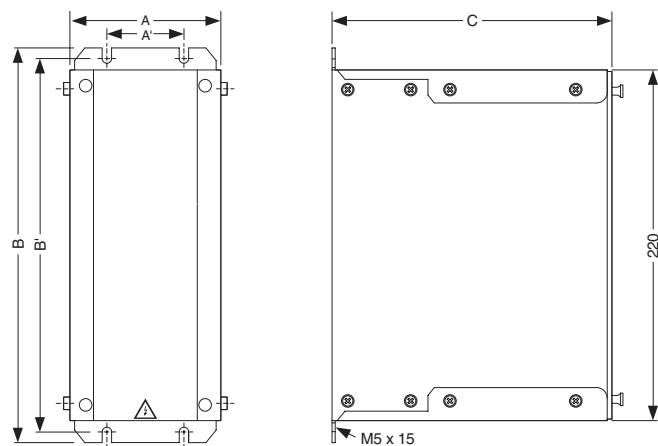
**External Brake Resistors FR-ABR-H□□k**



Brake resistor	A	B	C	D	E	F	Weight [kg]
FR-ABR-H0.4 k	115	100	75	40	20	2.5	0.2
FR-ABR-H0.75 k	140	125	100	40	20	2.5	0.2
FR-ABR-H1.5 k	215	200	175	40	20	2.5	0.4
FR-ABR-H2.2 k	240	225	200	50	25	2.0	0.5
FR-ABR-H3.7 k	215	200	175	60	30	2.5	0.8
FR-ABR-H5.5 k	335	320	295	60	30	2.5	1.3
FR-ABR-H7.5 k	400	385	360	80	40	2.5	2.2

All dimensions in mm

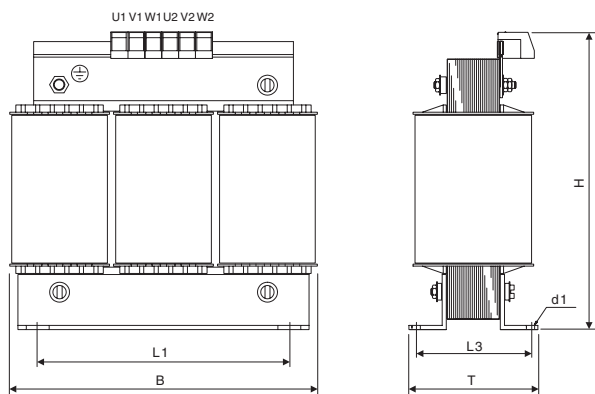
**Brake Units BU-UFA**



Brake unit	A	A'	B	B'	C	Weight [kg]
BU-UFS22J	100	50	250	240	175	2.4
BU-UFS22	100	50	250	240	175	2.4

All dimensions in mm

**Input Reactors FR-BAL-B-□□k**



Input reactor	Inverter	B	T	H	L1	L3	d1	Weight [kg]
FR-BAL-B-4.0 k	FR-E 540-0.4 k-4.0 k	125	82	130	100	56	5 x 8	3.0
FR-BAL-B-5.5 k	FR-E 540-5.5 k	155	85	145	130	55	8 x 12	3.7
FR-BAL-B-7.5 k	FR-E 540-7.5 k	155	100	150	130	70	8 x 12	5.5

All dimensions in mm



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