

FR-F 500

Frequency Inverter

Installation Manual

FR-F 540L 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 inverter FR-F 540L 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.

Installation Manual FR-F 540L EC Art. No.:158131			
Version			Changes / Additions / Corrections
A	05/04	pdp – gb	First issue

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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-F 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 inverter FR-F 540L 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 information 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-F 500L 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-F 500L. 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-F 540L EC series are available with outputs from 75k to 530k. The device is designed for the connection to 3~ 380 to 480V (50/60Hz). The output frequency ranges from 0.5 to 120Hz.

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 31 inverters can be linked up. Open communications with standardised industrial bus systems as Profibus/DP, DeviceNet or CC-Link 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).
 - Switch-over to commercial power supply
- Large number of protective functions for safe operation
 - Automatic restart after instantaneous power failure
The inverter can be started without stopping the motor (with the motor coasting).
 - Built-in overcurrent protection
 - Retry function after alarm occurrence
- Automatic torque boost

2 Specifications

2.1 Model Specifications

Type			FR-F 540L										
			75 k	90 k	110 k	132 k	160 k	185 k	220 k	280 k	375 k	450 k	530 k
Output	Rated motor capacity [kW] ^①	120% Overload capacity ^⑥	75	90	132	160	185	220	250	315	400	530	530
		150% Overload capacity	75	90	110	132	160	185	220	280	375	450	530
	Rated current [A]	120% Overload capacity ^⑥	144	180	260	302	360	432	477	610	750	1010	1010
		150% Overload capacity	144	180	216	260	302	360	432	547	722	866	1010
	Rated output capacity [kVA]	120% Overload capacity ^⑥	110	137	198	230	274	329	417	464	571	770	770
		150% Overload capacity	110	137	165	198	230	274	329	417	550	660	770
	Overload capacity ^②	120% Overload capacity	120% of rated motor capacity for 0.5s; 110% for 1min (max. ambient temperature 40°C); typical e.g. for pumps and fans										
		150% Overload capacity	150% of rated motor capacity for 0.5s; 120% for 1min (max. ambient temperature 50°C); typical e.g. for Conveyor belts and Centrifuges										
	Rated input AC voltage ^③		3-phase, 0V up to power supply voltage										
	Frequency range		0.5–120Hz										
Control method		V/f control or optimum excitation control											
Modulation control		Sine elevated PWM, Soft PWM											
Carrier frequency		0.7kHz / 1kHz / 2.5kHz, (user adjustable)											
Input	Power supply voltage		3-phase, 380–480V AC, –15% / +10%										
	Permissible AC voltage fluctuation		323–528V AC at 50 / 60Hz										
	Power supply frequency		50 / 60Hz ± 5%										
	Rated input capacity [kVA] ^④	120% Overload capacity ^⑥	110	137	198	230	274	329	364	464	571	770	770
150% Overload capacity		110	137	165	198	230	274	329	417	550	660	770	
Power loss [W]	120% Overload capacity ^⑥	2250	2750	4120	4800	5550	6750	8590	11250	9000	10600	10600	
	150% Overload capacity	2250	2750	3375	4120	4800	5550	6750	8590	11250	9000	10600	

NOTE

The rating 120% is available with serial marking “type02” only (shipping from the middle of 2003).

Please observe the notes on page 10!

Type		FR-F 540L										
		75 k	90 k	110 k	132 k	160 k	185 k	220 k	280 k	375 k	450 k	530 k
Control specifications	Frequency setting value	Analog	0.015Hz / 50Hz (connecting terminal 2: 12 Bit / 0–10V; 11 Bit / 0–5V, connecting terminal 1: 12 Bit / –10–+10V; 11 Bit / –5–+5V)									
		Digital	0.01 Hz									
	Frequency precision		±0.2% of max. output frequency (temperature range 25°C ± 10°C) during analog input; ±0.01% of max. output frequency during digital input									
	Voltage/frequency characteristic		Base frequency adjustable from 0 to 120Hz; constant torque or variable torque selectable; optional flexible flexible 5-Point-V/f-characteristics									
	Acceleration/deceleration time		0; 0.1 to 3600s individual settings									
	Acceleration/deceleration characteristics		Linear or S-form course, user selectable									
	DC-braking		Braking time and braking moment adjustable, operation frequency: 0–120Hz, operation time: 0–10s, Voltage: 0–30%									
	Torque boost		Manual and automatic torque boost									
	Stall prevention		Responds threshold 0–150%, user adjustable, also via analog input									
	Motor protection		Electronic motor protection relay (rated current user adjustable)									
Control signals for operation	Frequency setting values	Analog input	0–5V DC, 0–10V DC, 0–±10V DC, 0/4–20mA									
		Digital	From control panel or optional circuit board									
	Input signals	Starting signal	Individual selection of forward / reverse run Start signal self retaining input.									
		Speed selection	Up to 7 speed settings can be selected (each speed can be preset from 0 to 120Hz). The current speed can be changed via the control panel during operation.									
		2nd/3rd acceleration/ deceleration time	0 to 3600 seconds (Acceleration and deceleration time can be set individually.)									
		JOG operation	Jog operation via control panel or special JOG-terminal									
		Current input selection	Frequency setting via current input signal 0/4 to 20mA DC									
		Automatic restart	Selection of whether automatic restart is made or not after an instantaneous power failure									
		External thermal input	Stopping the inverter with an externally mounted thermal relay									
		MT-HC connection	Inverter operation enable input and instantaneous power failure detection input									
		External DC dynamic brake	External input for DC dynamic braking start									
		PID control	Select PID control									
		PU <-> External operation	Switch between the operating modes “PU” and “External”									
		PU operation external interlock	External interlock switch-over of PU operation									
		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.										
	Output signals	Operation state	5 five output types can be selected: inverter running, instantaneous power failure (undervoltage), frequency detection, 2nd frequency detection, in PU operation, overload warning, electronic thermal relay pre-alarm, zero current detection, PID lower limit, PID upper limit, PID forward run, PID reverse run, commercial power supply-inverter switchover MC1-2-3, operation ready, fan trouble, overheat fin pre-alarm (open-collector-output)									
		Alarm functions	Relay output ... contactor (230V AC / 0.3A, 30V DC / 0.3A) Open collector output ... error message through alarm code (4 bits)									
		Analog signal or pulse train	One of the following output types can be selected: output frequency, motor current (constant or peak value), output voltage, frequency setting value, operation speed, converter output voltage (constant or peak value), regenerative brake duty, electronic thermal relay load rate, input power, output power, load meter, pulse train output (1440Hz / full scale), or analog output (0–10V DC).									

Please observe the notes on page 10!

Type		FR-F 540L										
		75 k	90 k	110 k	132 k	160 k	185 k	220 k	280 k	375 k	450 k	530 k
Display	Displayed on control panel (FR-PU04/FR-DU04)	Operating state	Output frequency, motor current (constant or peak value), output voltage, frequency setting value, operation speed, overload, converter output voltage (constant or peak value), electronic thermal relay load rate, input power, output power, load meter, cumulative power ON time, current operation time, cumulative power and motor load rate.									
		Alarm display	Error details are displayed after a protective function is activated. Up to 8 error codes can be stored.									
	Additional displays on control panel FR-PU04	Operating state	Signal state of input and output terminals.									
		Alarm display	Output voltage, output current, output frequency, cumulative power ON time before activation of protective function									
		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, instantaneous power failure, overload cutoff (electronic thermal relay), ground fault overcurrent, output short circuit, overheating of main circuit, stall prevention, overload warning, fan overheating, fan error, option error, parameter error, PU connection error, No. of retries over, output open phase, CPU error, 24V DC power supply output short circuit, operation panel power supply short circuit, output of group error message via relay contact (230V AC / 0.3A; 30V DC / 0.3A).										
Environment	Protective structure	IP 00										
	Ambient temperature in operation	-10°C to +50°C (non freezing) (For selection of the overload capacity of 120% the max. temperature is 40°C.										
	Storage temperature ^⑤	-20°C to +65°C										
	Ambient humidity	Max. 90% RH (non-condensing)										
	Ambience condition	For indoor use only, avoid environments containing corrosive gases, no oil mist, install in a dust-free location										
	Altitude	Max. 1000m above n.N.										
	Vibration resistance	Max. 0.6g										
	Cooling	Fan-cooling										
	Weight [kg]	41	57	66	66	68	120	120	220	235	490	500

NOTES

Special notes referring to the table:

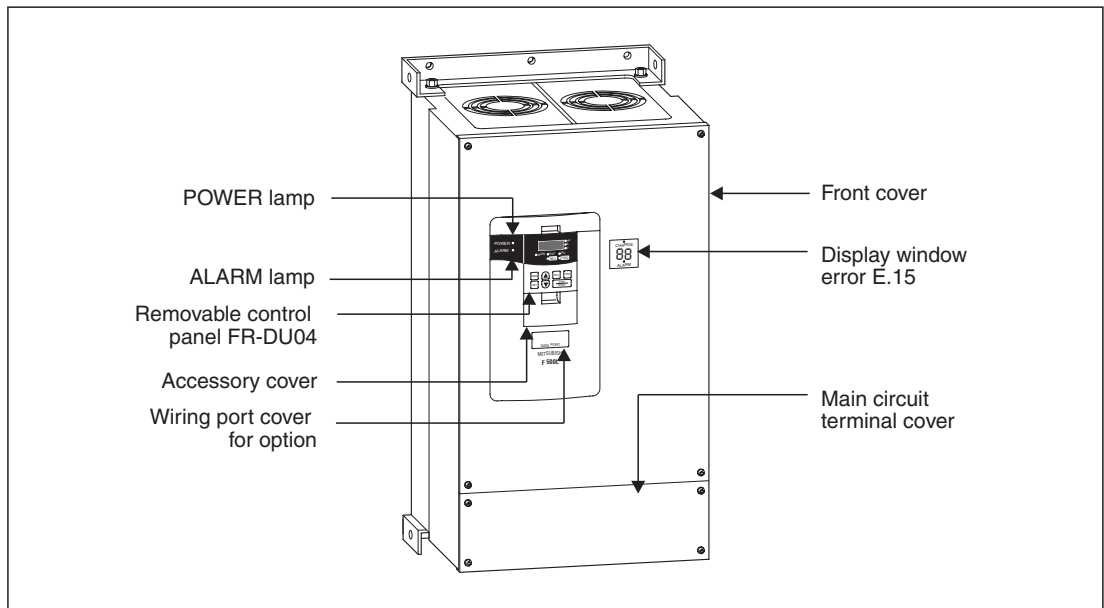
- ① The applicable motor capacity refers to a motor voltage of 400V.
- ② The overload capacity indicated in % describes the ratio to the inverter's rated current according to the operation mode. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load. The calculation of the pause times is made by using the effective current calculation method ($I^2 \times t$). That means, that you have to know the working cycle.
- 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 Temperature applicable for a short period in transit, etc.
- ⑥ At 120% rating a maximum ambient temperature of 40°C is allowed.

3 Appearance and Structure

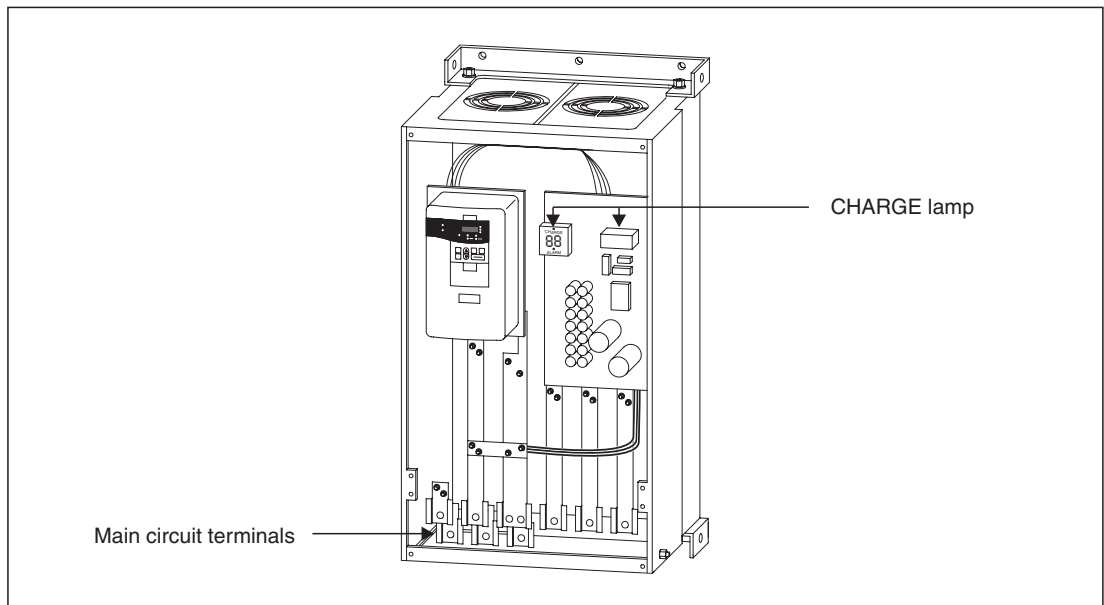
3.1 Description of the Case

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

Frequency inverter FR-F 540L EC with front cover



Frequency inverter FR-F 540L EC without front cover

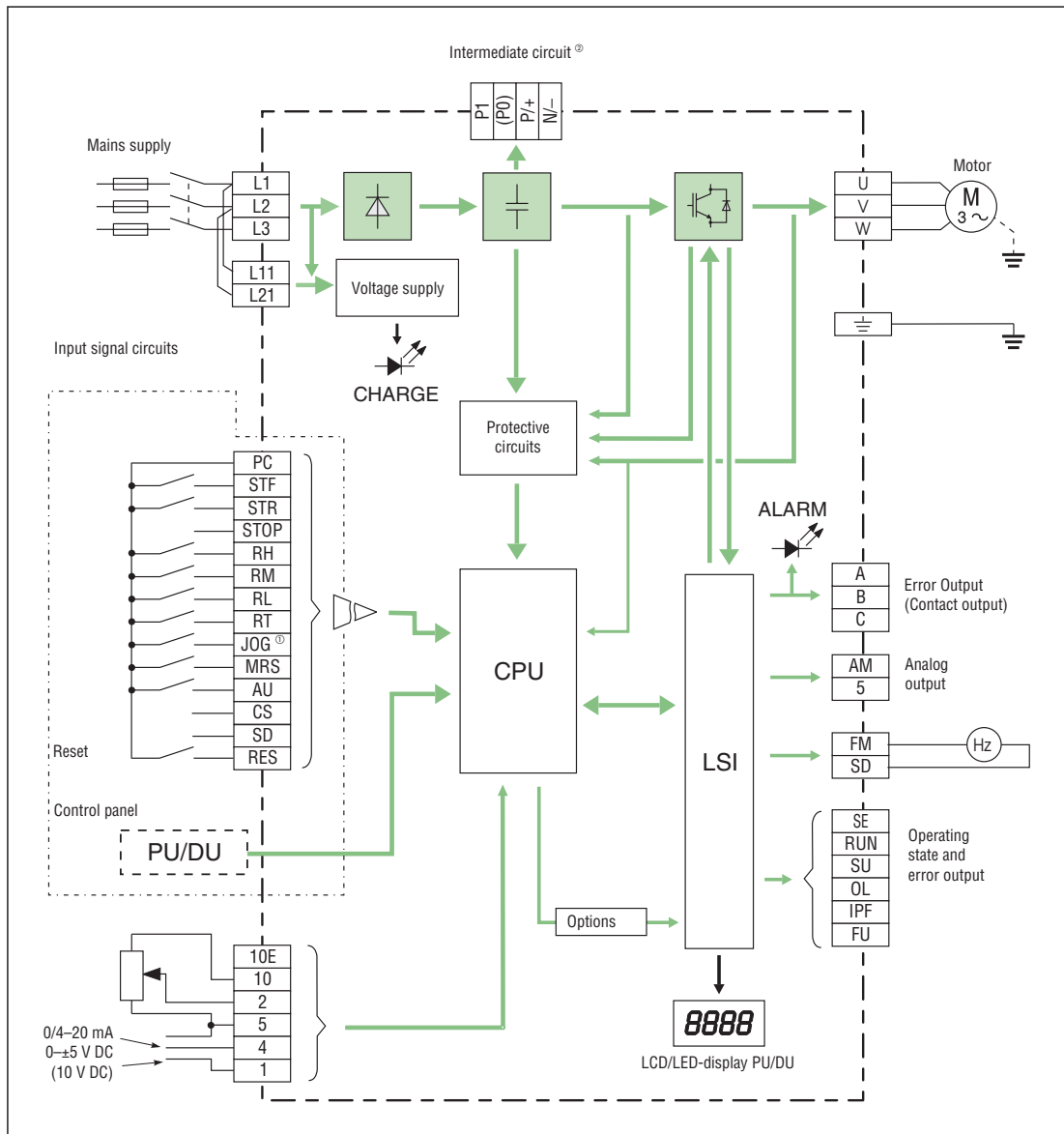


4 Wiring

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 The JOG terminal is connected internally for the frequency inverters FR-A 540L-G375 k and G450 k and cannot be used by the customer.
- ② The designations and wiring of the intermediate circuit connections varies depending on the output of the frequency inverter model (see also section 4.2.1).

NOTE

| The connection of the enclosed DC choke coil is described on page 14.

4.2 Wiring of the Main Circuit



DANGER:

The frequency inverter must always be powered off completely before performing any wiring work. To ensure that no residual charge is present check that both the POWER and CHARGE LEDs are off before starting work!



CAUTION:

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

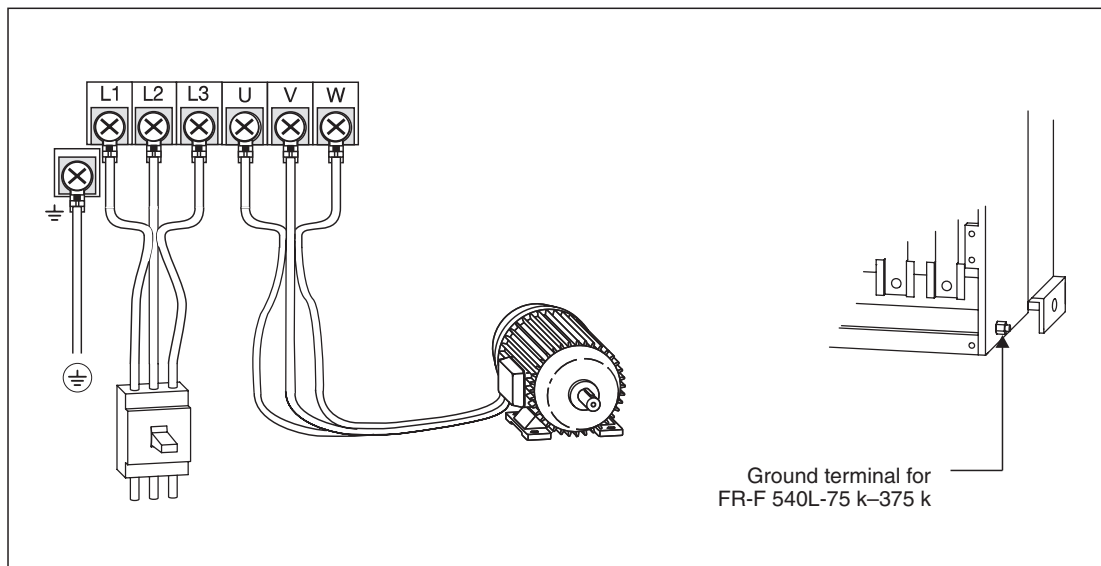
4.2.1 Mains, Motor and Ground Terminal Connections

The terminal blocks for connection of the frequency inverter can be accessed by removing the terminal block cover. The mains power supply is connected to terminals L1, L2 and L3. Required power supply: 380–480V, –15% / +10%; 50–60Hz ± 5%.

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.

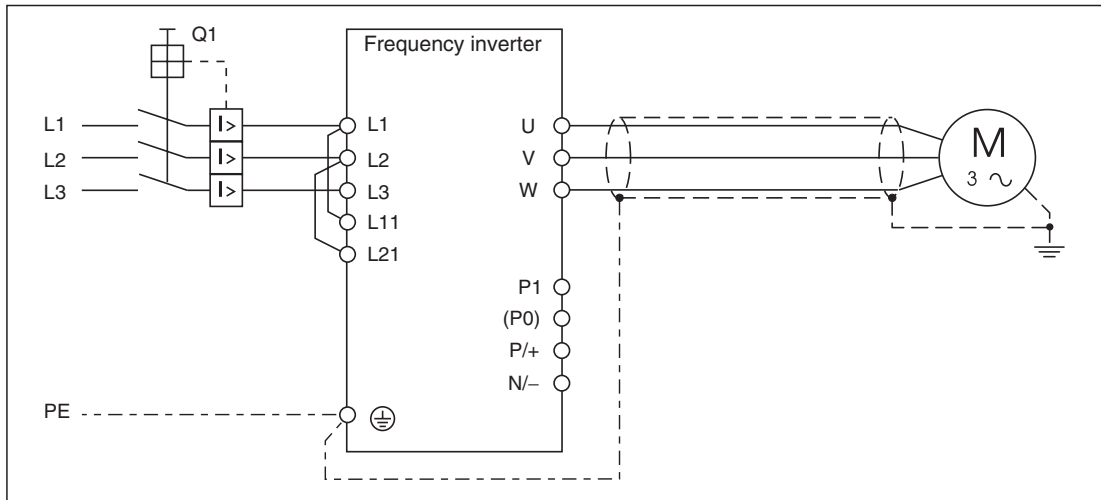
NOTE

| 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.



NOTE

The maximum wiring length of the motor cable is 500m.

The following table shows the terminal assignment of main circuit terminals.

	Terminal	Terminal name	Description
Main circuit connector	L1, L2, L3	Mains supply connection	Mains power supply of the inverter (380–480V AC, 50/60Hz)
	P/+, N/-	External brake unit connection	An external brake unit can be connected to the terminals P/+ and N/-.
	P1, P/+ (P0, P1)	DC choke coil connection	An optional choke coil can be connected to the terminals P1 and P/+ (up to 375k) or between P0 and P1 (450k to 530k) respectively. The supplied choke coil has to be installed to the mentioned terminals.
	U, V, W	Motor connection	Voltage output of the inverter (3 ~ 0V– power supply voltage, 0.5–120Hz)
	L11, L21	Control circuit mains supply connection	Mains power supply input for a separate supply of the control circuit (refer to paragraph 4.2.2).
		PE	Protective earth connection of inverter

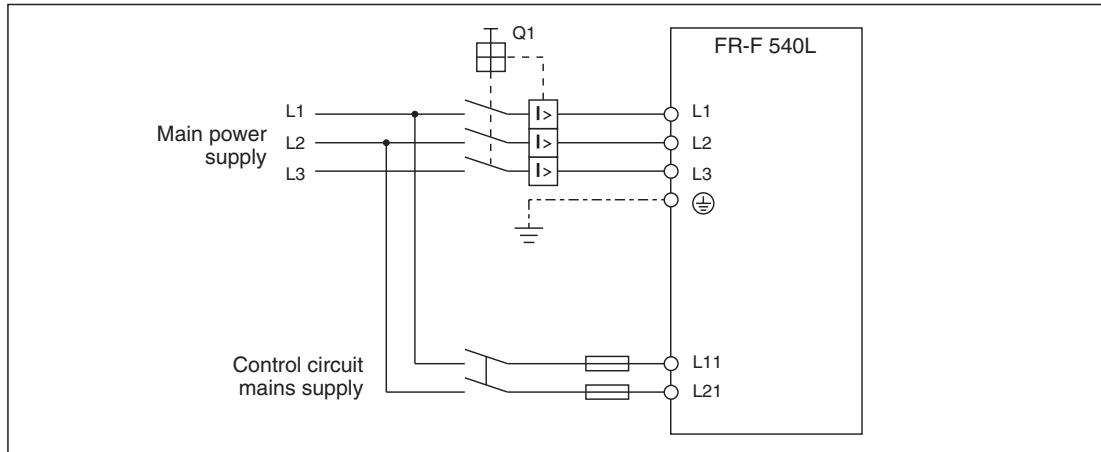


CAUTION:

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 Separate Power Supply for the Control Circuit

In an alarm condition the frequency inverter's integrated alarm relay only remains active as long as there is a mains power supply on terminals L1, L2 and L3. If you want the alarm signal to remain active after the frequency inverter has been switched off a separate power supply for the control circuit is required, which should be connected as shown in the circuit diagram below. Remove the shorting jumpers from the terminal block and connect the 380–480V AC, 50/60Hz mains power supply to terminals L11 and L21. The control circuit power consumption on L11/L21 is 120VA. We recommend using a fuse with a rating of at least 5A to protect the circuit.

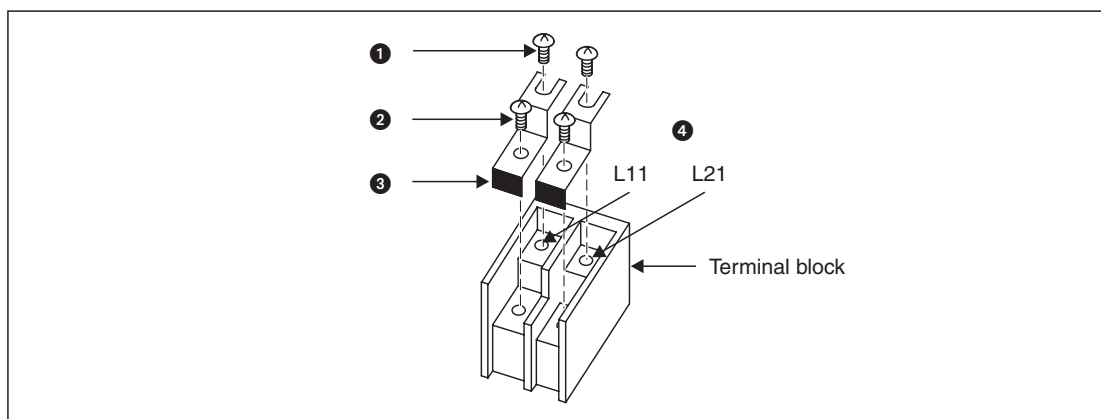


CAUTION:

When using a separate power supply, the jumpers must be removed and the terminals L11 and L21 of the terminal block must be connected.

Remove the jumpers as follows:

- ① Loosen the upper screws ① and then the lower screws ②.
- ② Pull out and remove the jumper ③.
- ③ Connect the separate power supply for control circuits to the upper terminals ④ L11 and L21.

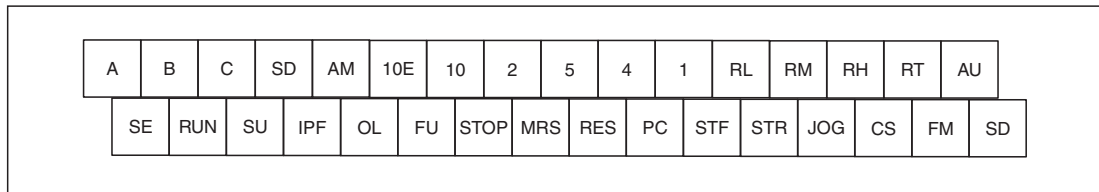


CAUTION:

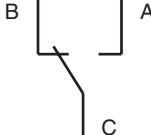
The separate power supply must not be connected to the lower terminals. Otherwise the inverter may be damaged.

4.3 Wiring of the Control Circuit

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



	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.
	STOP	Start self-retaining selection	The start signals are self-retaining, if a signal is applied to terminal STOP.
	RH, RM, RL	Multi-speed selection	Preset of 15 different output frequencies
	JOG	JOG mode selection	The JOG mode is selected, if a signal is applied to terminal JOG (factory setting). The start signals STF and STR determine the rotation direction. The inverters FR-F 540L-450 k and 530 k are not equipped with a JOG terminal.
	RT	Second parameter settings	A second set of parameter settings is selected, if a signal is applied to terminal RT.
	MRS	Output stop	The inverter lock stops the output frequency without regard to the delay time.
	RES	RESET input	An activated protective circuit is reset, if a signal is applied to the terminal RES ($t > 0.1$ s).
	AU	Current input selection	Only if the AU signal is ON, the inverter can be operated with the 0/4–20mA frequency setting signal.
	CS	Automatic restart after power failure selection	The inverter restarts automatically after a power failure, if a signal is applied to the terminal CS. Note that this operation requires restart parameters to be set. When the inverter is shipped from the factory, it is set to disallow restart.
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. Reference potential for the pulse output FM. The terminal is isolated from the reference potential of the control circuit. Common reference potential for 24V DC/0.1A output (PC terminal).
	PC	24V DC output and control input common if source logic type is activated	24-V-DC-/0.1-A-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.

	Terminal	Terminal name	Description
Setting value specification	10 E (output voltage 10V DC)	Voltage output for potentiometer	Output voltage 10V DC Max. output current 10mA. Recommended potentiometer: 1k Ω , 2W linear, multiturn potentiometer
	10 (output voltage 5V DC)		Output voltage 5V DC Max. output current 10mA. Recommended potentiometer: 1k Ω , 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 10 k Ω .
	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 ter- minal is not isolated from the reference potential of the control circuit and must not be earthed .
	1	Auxiliary input for frequency setting value signal 0– \pm 5 (10)V DC	An additional voltage setting value signal of 0– \pm 5 (10)V DC can be applied to terminal 1. The vol- tage range is preset to 0– \pm 10V DC. The input resis- tance is 10k Ω .
	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 resistance is 250 Ω , the max current is 30mA.
Signal outputs	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 / 0.3 ADC.
	RUN	Signal output for motor operation (Open Collector)	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 fre- quency is output or the DC brake is in operation.
	SU	Signal output for frequency setting value / current value comparison (Open Collector)	The SU output supports a monitoring of frequency setting value and frequency current value. The output is switched low, once the frequency current value (output frequency of the inverter) ap- proaches the frequency setting value (determined by the setting value signal) within a preset range of tolerance (parameter 41).
	IPF	Signal output for instantaneous power failure (Open Collector)	The output is switched low for a temporary power failure within a range of 15ms \leq t _{IPF} \leq 100ms or for undervoltage.
	OL	Signal output for overload alarm (Open Collector)	The OL is switched low, if the output current of the inverter exceeds the current limit preset in param- eter 22 and the stall prevention is activated. If the output current of the inverter falls below the cur- rent limit preset in parameter 22, the signal at the OL output is switched high.

	Terminal	Terminal name	Description
Signal outputs	FU	Signal output for monitoring output frequency (Open Collector)	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.
	SE	Reference potential for signal outputs	Reference potential for the signals RUN, SU, OL, IPF, and FU. This terminal is isolated from the reference potential of the control circuit SD.
	FM	Pulse output	One of 16 monitoring functions can be selected, e.g. external frequency output (parameter 54; parameter 158). FM and AM output can be used simultaneously. The functions are determined by parameters. Either a moving coil gauge (measuring range: 1mA) or a pulse counter with an initial setting of 1440pulses/s at 50Hz output frequency.
	AM	Analog output	One of 16 monitoring functions can be selected, e.g. external frequency output (parameter 54; parameter 158). FM and AM output can be used simultaneously. The functions are determined by parameters. A DC voltmeter can be connected. The max. output voltage is 10V, the max. current is 1mA.
	—	Connection of control panel (RS485)	Communications via RS485 I/O-Standard: RS485, Multi-Drop operation, max. 19200Baud, Overall length max. 500m



CAUTION:

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

NOTES

The control signal level can be adjusted with the jumper on the underside of the removable control terminal block (unscrew the two retaining screws to remove). 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.

The control terminals RL/RM/RH/RT/AU/JOG/CS (input terminals) and RUN/SU/IPF/OL/FU/A, B, C (output terminals) can be assigned to other functions or signals with the help of the control unit (FR-DU04 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 Parameters

5.1 Overview and Setting Ranges

Parameter 160 is factory set to “9999”. That means that only the half-tone screened parameters in the following table are accessible. Set parameter 160 to “0” to access other or all parameters.

Function	Parameter	Meaning	Setting range	Default setting
Basic functions	0	Torque boost (manual)	0–30%	1%
	1	Maximum frequency	0–120Hz	60Hz
	2	Minimum frequency	0–120Hz	0Hz
	3	Base frequency	0–120Hz	50Hz
	4	Multi-speed setting (high speed) ②	0–120Hz	60Hz
	5	Multi-speed setting (middle speed) ②	0–120Hz	30Hz
	6	Multi-speed setting (low speed) ②	0–120Hz	10Hz
	7	Acceleration time	0–360s / 0–3600s	15s
	8	Deceleration time	0–360s / 0–3600s	30
	9	Electronic thermal overload relay	0–3600A	Rated current
Standard operation functions	10	DC injection brake operation frequency	0–120Hz / 9999	3Hz
	11	DC injection brake operation time	0–10s / 8888	0.5s
	12	DC injection brake voltage	0–30%	1%
	13	Starting frequency	0–60Hz	0.5Hz
	14	Load pattern selection	0 / 1	1
	15	JOG frequency	0–120Hz	5Hz
	16	JOG acceleration / deceleration time	0–360s / 0–3600s	0.5s
	17	MRS input selection	0 / 2	0
	19	Base frequency voltage	0–1000V/8888/9999	8888
	20	Acceleration / deceleration reference frequency	1–120Hz	50Hz
	21	Acceleration / deceleration time increments	0 / 1	0
	22	Stall prevention operation level ②	0–150% / 9999	120%
	23	Stall prevention operation at double speed	0–200% / 9999	9999
	24	Multi-speed setting (speed 4) ②	0–120Hz / 9999	9999
	25	Multi-speed setting (speed 5) ②	0–120Hz / 9999	9999
	26	Multi-speed setting (speed 6) ②	0–120Hz / 9999	9999
	27	Multi-speed setting (speed 7) ②	0–120Hz / 9999	9999
	28	Multi-speed input compensation	0 / 1	0
	29	Acceleration / deceleration pattern	0 / 1 / 2 / 3	0
	30	Regenerative function selection	0 / 1 / 2	0

Function	Parameter	Meaning	Setting range	Default setting
Standard operation functions	31	Frequency jump 1A	0–120Hz / 9999	9999
	32	Frequency jump 1B	0–120Hz / 9999	9999
	33	Frequency jump 2A	0–120Hz / 9999	9999
	34	Frequency jump 2B	0–120Hz / 9999	9999
	35	Frequency jump 3A	0–120Hz / 9999	9999
	36	Frequency jump 3B	0–120Hz / 9999	9999
	37	Speed display	0 / 1–9998	0
	38	Automatic torque boost (motor capacity)	0–200%	0
	39	Automatic torque boost operation starting current	0–3600A	0
Output terminal functions	41	Up-to-frequency sensitivity	0–100%	10%
	42	Output frequency detection (FU-Output)	0–120Hz	6Hz
	43	Output frequency detection for reverse rotation	0–120Hz / 9999	9999
Second functions	44	Second acceleration/deceleration time	0–360s / 0–3600s	5s
	45	Second deceleration time	0–360s / 0–3600s / 9999	9999
	46	Second torque boost	0–30% / 9999	9999
	47	Second V/F (base frequency)	0–120Hz / 9999	9999
	48	Second stall prevention operation current	0–150%	120%
	49	Second stall prevention operation frequency	0–120Hz / 9999	0
	50	Second output frequency detection	0–120Hz	30Hz
Display functions	52	DU/PU main display data selection ^②	0 / 5 / 6 / 8 / 10–14 / 17 / 20 / 23 / 24 / 25 / 100	0
	53	PU level display data selection ^②	0–3 / 5 / 6 / 8 / 10–14 / 17	1
	54	FM terminal function selection ^②	1–3 / 5 / 6 / 8 / 10–14 / 17 / 21	1
	55	Frequency monitoring reference ^②	0–120Hz	50Hz
	56	Current monitoring reference ^②	0–3600A	Rated current
Automatic restart functions	57	Restart coasting time	0–30s / 9999	9999
	58	Restart cushion time	0–60s	1s
Additional function	59	Remote setting function selection	0 / 1 / 2	0
Operation selection functions	60	Intelligent mode selection	0 / 3 / 4 / 9	0
	61	Reference I for intelligent mode	0–3600A / 9999	9999
	62	Reference I for intelligent mode (acceleration)	0–150% / 9999	9999
	63	Reference I for intelligent mode (deceleration)	0–150% / 9999	9999
	65	Retry selection	0–5	0
	66	Stall prevention operation reduction starting frequency	0–120Hz	50Hz
	67	Number of retries at alarm occurrence	0–10 / 101–110	0
	68	Retry waiting time	0–10s	1s
	69	Retry count display erasure	0	0
	70	Special regenerative brake duty	0–100%	0%

Function	Parameter	Meaning	Setting range	Default setting
Operation selection functions	71	Applied motor	0 / 1 / 2	0
	72	PWM frequency selection ②	0 / 1 / 2 / 17	1
	73	0–5V / 0–10V selection	0–5 / 10–15	1
	74	Filter time constant	0–8	1
	75	Reset selection / disconnected PU detection / PU stop selection ②	0–3 / 14–17	14
	76	Alarm code output selection	0 / 1 / 2	0
	77	Parameter write disable selection ②	0 / 1 / 2	0
	78	Reverse rotation prevention selection	0 / 1 / 2	0
	79	Operation mode selection	0–4 / 6–8	0
5-point flexible V/f characteristics	100	V/f1 (first frequency)	0–120Hz / 9999	9999
	101	V/f1 (first frequency voltage)	0–1000V	0
	102	V/f2 (second frequency)	0–120Hz / 9999	9999
	103	V/f2 (second frequency voltage)	0–1000V	0
	104	V/f3 (third frequency)	0–120Hz / 9999	9999
	105	V/f3 (third frequency voltage)	0–1000V	0
	106	V/f4 (fourth frequency)	0–120Hz / 9999	9999
	107	V/f4 (fourth frequency voltage)	0–1000V	0
	108	V/f5 (fifth frequency)	0–120Hz / 9999	9999
	109	V/f5 (fifth frequency voltage)	0–1000V	0
Communications functions	117	Station number	0–31	0
	118	Communication speed	48 / 96 / 192	192
	119	Stop bit length / data length	0 / 1 Data length 8 10 / 11 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	0–999.8s / 9999	9999
	123	Waiting time setting	0–150ms / 9999	9999
	124	CR / LF presence / absence selection	0 / 1 / 2	1
PID-Regelung	128	PID action selection	10 / 11 / 20 / 21	10
	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
Commercial power supply-inverter switch-over	135	Commercial power supply-inverter switch-over sequence output terminal selection	0 / 1	0
	136	MC switch-over interlock time	0–100.0s	1.0s
	137	Start waiting time	0–100.0s	0.5s
	138	Commercial power supply-inverter switch-over selection at alarm occurrence	0 / 1	0
	139	Automatic inverter-commercial power supply switch-over frequency	0–60Hz / 9999	9999

Function	Parameter	Meaning	Setting range	Default setting
Backlash	140	Backlash acceleration stopping frequency ^①	0–120Hz	1.00Hz
	141	Backlash acceleration stopping time ^①	0–360s	0.5s
	142	Backlash deceleration stopping frequency ^①	0–120Hz	1.00Hz
	143	Backlash deceleration stopping time ^①	0–360s	0.5s
Display	144	Speed setting switchover	0 / 2 / 4 / 6 / 8 / 10 / 102 / 104 / 106 / 108 / 110	4
	145	PU language selection	0–7	1
Additional functions	148	Stall prevention level at 0V input	0–150%	120%
	149	Stall prevention level at 10V input	0–150%	150%
Current detection	152	Zero current detection level	0–200.0%	5%
	153	Zero current detection period	0–1s	0.5s
Help functions	154	Voltage reduction selection during stall prevention operation	0 / 1	1
	155	RT activated condition	0 / 10	0
	156	Stall prevention operation selection	0–31/100 / 101	0
	157	OL signal waiting time	0–25s	0
	158	AM terminal function selection	1–3 / 5 / 6 / 8 / 10–14 / 17 / 21	1
Additional functions	160	User group read selection ^②	0 / 1 / 10 / 11 / 9999	9999
Automatic restart after instantaneous power failure	162	Automatic restart after instantaneous failure selection	0 / 1	0
	163	First cushion time for restart	0–20s	0s
	164	First cushion voltage for restart	0–100%	0%
	165	Restart stall prevention operation level	0–150%	120%
Additional functions	168	Parameter set by manufacturer: Do not set!		
	169			
Initial monitor	170	Watt-hour meter clear	0	0
	171	Actual operation hour meter clear	0	0
User group	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 function selection	180	RL terminal function selection	0–7 / 10–14 / 16 / 9999	0
	181	RM terminal function selection		1
	182	RH terminal function selection		2
	183	RT terminal function selection		3
	184	AU terminal function selection		4
	185	JOG terminal function selection ^③		5
	186	CS terminal function selection		6
	190	RUN terminal function selection	0	
	191	SU terminal function selection	0–5 / 8 / 10 / 11 / 13–19 / 26 / 98–105 / 108 / 110 / 111 / 113–116 / 126 / 198 / 199 / 9999	1
	192	IPF terminal function selection		2
	193	OL terminal function selection		3
	194	FU terminal function selection		4
	195	ABC terminal function selection		99
Additional function	199	User initial value setting	0–999 / 9999	0

Function	Parameter	Meaning	Setting range	Default setting	
Auxiliary functions	240	Soft-PWM setting ^②	0 / 1	1	
	244	Cooling fan operation selection	0 / 1	0	
Supplementary functions	251	Output phase failure protection selection	0 / 1	1	
	252	Override bias	0–200%	50%	
	253	Override gain	0–200%	150%	
Parameter für Optionen	300	BCD code input bias	0–400Hz	0Hz	
	301	BCD code input gain	0–400Hz / 9999	50Hz	
	302	Binary input bias	0–400Hz	0Hz	
	303	Binary input gain	0–400Hz / 9999	50Hz	
	304	Selection of digital input type/analog compensation input enable/disable	0 / 1 / 2 / 3 / 9999	9999	
	305	Data read timing signal on-off selection	0 / 1	0	
	306	Analog output signal selection	1–24	2	
	307	Setting for zero analog output	0–100%	0%	
	308	Setting for maximum analog output	0–100%	100%	
	309	Voltage / current selection for analog output signal	0 / 1 / 10 / 11	0	
	310	Analog meter voltage output selection	1–24	2	
	311	Setting for zero analog meter voltage output	0–100%	0%	
	312	Setting for maximum analog meter voltage output	0–100%	100%	
	313	Y0 output selection	0–199 / 9999	9999	
	314	Y1 output selection	0–199 / 9999	9999	
	315	Y2 output selection	0–199 / 9999	9999	
	316	Y3 output selection	0–199 / 9999	9999	
	317	Y4 output selection	0–199 / 9999	9999	
	318	Y5 output selection	0–199 / 9999	9999	
	319	Y6 output selection	0–199 / 9999	9999	
	320	RA1 output selection	0–99 / 9999	0	
	321	RA2 output selection	0–99 / 9999	1	
	322	RA3 output selection	0–99 / 9999	2	
	330	RA output selection	0–20 / 25–31 / 98 / 99 / 9999	9999	
	331	Station number	0–31	0	
	332	Communication speed	3 / 6 / 12 / 24 / 48 / 96 / 192	96	
	333	Stop bit length/Data length	0 / 1 / 10 / 11	1	
	334	Parity check presence / absence	0 / 1 / 2	2	
	335	Number of communication retries	0–10 / 9999	1	
	336	Communication check time interval	0–999.8s / 9999	0	
	337	Waiting time setting	0–150ms / 9999	9999	
	Communication	338	Operation command write	0 / 1	0
		339	Speed command write	0 / 1	0
340		Link start mode selection	0 / 1 / 2	0	
341		CR, LF presence / absence selection	0 / 1 / 2	1	
Supplementary function	342	E ² PROM write yes/no	0 / 1	0	

Function	Parameter	Meaning	Setting range	Default setting
Advanced PID control	500	Auxiliary motor operation selection	0 / 1 / 2 / 3	0
	501	Motor switch-over selection	0 / 1 / 2	0
	502	MC switching interlock time	0–100s	1s
	503	Start waiting time	0–100s	1s
	504	Auxiliary motor connection-time deceleration time	0–3600s	1s
	505	Auxiliary motor disconnection-time acceleration time	0–3600s / 9999	1s
	506	Output stop detection time	0–3600s / 9999	9999
	507	Output stop detection level	0–120Hz	0Hz
	508	Output stop cancel process value level	0–100%	100%
	509	Auxiliary motor 1 starting frequency	0–120Hz	50Hz
	510	Auxiliary motor 2 starting frequency	0–120Hz	50Hz
	511	Auxiliary motor 3 starting frequency	0–120Hz	50Hz
	512	Auxiliary motor 1 stopping frequency	0–120Hz	0Hz
	513	Auxiliary motor 2 stopping frequency	0–120Hz	0Hz
	514	Auxiliary motor 3 stopping frequency	0–120Hz	0Hz
	515	Auxiliary motor start delay frequency	0–3600s	5s
516	Auxiliary motor stop delay frequency	0–3600s	5s	
Supplementary functions	570	CT / VT selection (only Version "Type 02")	1 / 2	1
	571	Start holding time	0–10s / 9999	9999
Calibration functions	900	FM terminal calibration ^②	Calibration range	—
	901	AM terminal calibration ^②	Calibration range	—
	902	Frequency setting voltage bias	0–60Hz / [0–10V]	0Hz / [0V]
	903	Frequency setting voltage gain	1–120Hz / [0–10V]	50Hz / [5V]
	904	Frequency setting current bias	0–60Hz / [0–20mA]	0 Hz / [4mA]
	905	Frequency setting current gain	1–120Hz / [0–20mA]	50Hz / [20mA]
Additional functions	990	Buzzer control	0 / 1	1
	991	LCD contrast	0–63	53

Remarks on the table:

- ① Can only be accessed, if parameter 23 is set to the value 3.
- ② These parameters allow their settings to be changed during operation if 0 (factory setting) has been set in Pr. 77 (Note that the Pr. 72 and Pr. 240 settings cannot be changed during external operation.). Whether a parameter can be changed during operation depends also on the setting of parameter 160.
- ③ This terminal is connected internally for the frequency inverters FR-F 540L-450 k and 530 k and cannot be used by the customer.

6 Protective Functions

6.1 Error Messages and Remedies

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
OC Dur- ing Acc.	<i>EOL1</i>	Overcurrent 1 (acceleration)	A) The output current of the in- verter has reached or exceeded 150% of the rated current during acceleration, deceleration, or at constant speed. B) The temperature of the main cir- cuits 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, re- start 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 (const. speed)		
OC Dur- ing Dec.	<i>EOL3</i>	Overcurrent 3 (deceleration)		
OC Dur- ing Acc	<i>EOV1</i>	Overvoltage 1 (acceleration)	The converter voltage has in- creased highly due to regenerative energy. The overvoltage limit was exceeded during acceleration, de- celeration, or at constant speed.	In most cases the protective function is activated due to a too short deceleration time preset or a regenerative overload. Remedy by increasing the de- celeration time of connecting an external brake unit. An overvoltage in the mains power supply activates this pro- tective function as well.
Stedy Spd OV	<i>EOV2</i>	Overvoltage 2 (const. speed)		
OV Dur- ing Dec	<i>EOV3</i>	Overvoltage 3 (deceleration)		
Motor Overload	<i>ESHM</i>	Overload (Motor)	The electronic overload protec- tion for the motor or inverter was activated.	Decrease the motor load to avoid an activation.
Inv. Overload	<i>ESHF</i>	Overload (inverter)	The electronic motor protection switch continually detects the motor current and the output fre- quency of the inverter. If a self-cooling motor operates over a long period at low speed but high torque, the motor is ther- mally overloaded and the protec- tive 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 ex- ternal protection switches.	Check whether the performance range of the motor and inverter correspond.

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
Inst. Pwr. Loss	<i>E. IPF</i>	Instantaneous power failure protection	The output of the inverter is suspended and the alarm message returned, if the power supply fails for more than 15ms. If the power supply fails for more than 100ms, the inverter shuts down completely. In this case after restoring the power supply the inverter is in the power ON state. If the power failure stays below 15ms, the operation is proceeded normally.	Check the power supply.
Under Voltage	<i>EUUF</i>	Undervoltage	The input voltage of the inverter has fallen below the minimum value. The protective function is activated, if the input voltage falls below the minimum value.	An undervoltage can occur, if the capacity of the mains transformer is not sufficient or if a high capacity motor is turned ON connected to the same mains supply circuit.
H/Sink O/TEMP	<i>EF In</i>	Overheating of heat sink	In case of an overheating of the heat sink the temperature sensor responds and the inverter is stopped.	Check ambient temperature.
Ground Fault	<i>EGF</i>	Ground failure	An overcurrent occurred due to a ground failure upon the inverter output (load).	Check load connections (motor circuit).
OH Fault	<i>EQHF</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>EOLP</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>EOPF</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.
	<i>EOP1 to EOP3</i>	Error in an optional unit	The protective function is activated for a fault (e.g. transmission error) of an internal optional unit.	Check the function settings 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 repeatedly.
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>EREF</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>ELPU</i>	CPU Fault	Scan time of CPU was exceeded.	Contact the customer service if the error occurs again.

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
Error 6	<i>E. 6</i>	CPU Fault	Scan time of CPU was exceeded.	Contact the customer service if the error occurs again.
Error 7	<i>E. 7</i>			
—	<i>Err</i>	Error	CPU error	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs repeatedly.
—	<i>ELF</i>	Open output phase protection	One of the phases (U, V, W) is not connected.	Check the connections.
—	<i>EP24</i>	24V DC power output short circuit	The 24V DC output at the PC terminal is short circuited.	Eliminate short circuit.
—	<i>E.C.F.E</i>	Short circuit in the control panel	The power supply of the control unit is short circuited.	Eliminate short circuit. Check the control panel and the connecting cable.
—	<i>PS</i>	Inverter was stopped via control panel	STOP key on the control panel was pressed during external operating mode.	Check the parameter 75
OL	<i>OL</i>	Overcurrent during acceleration	If a current of more than 120% ^② 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 120%, this function increases the frequency again.	Change the acceleration/deceleration time. Increase the stall prevention operation level via Pr. 22. Disable the stall prevention via Pr. 156.
		Overcurrent during constant speed	If a current of more than 120% ^② of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 120%, this function increases the frequency up to the set value.	
		Overcurrent during deceleration	If a current of more than 120% ^② of the rated inverter current flows in the motor, this function stops the decrease 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 120%, this function decreases the frequency again.	
oL	<i>oL</i>	Overvoltage during deceleration	If the regenerative energy of the motor exceeds the brake capacity of the inverter, this function stops the decrease of the frequency to prevent overvoltage shut-off. When the regenerative energy has reduced, deceleration resumes. As soon as the regenerative energy has reduced, deceleration resumes.	Increase the deceleration time using Pr. 8 "deceleration time".

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
—	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 	Perform operation correctly.
E.15	E.15	Main circuit failure ^①	The heat sink of brake unit is overheated	Reduce the load moment or brake frequency; clean the heat sink; replace the cooling fan
			DC fuse is blown	Eliminate the short-circuit and replace the fuse
			The control board is overheated	Replace the cooling fan; check the ambient temperature
			An overcurrent on the output has occurred	Eliminate the short-circuit or short to ground; replace the motor; increase the brake time; reduce the load fluctuations; increase the acceleration time; check the brake operation
			Power supply for cooling fan fails	Eliminate the short-circuit; replace the power supply for cooling fan; replace the fuse
			General overcurrent	Eliminate the short-circuit and replace the fuse; eliminate the short-circuit on output or short to ground; replace the motor and reduce the load
			The heat sink is overheated	Clean or replace the heat sink; check the ambient temperature
			A gate power supply failure has occurred	Eliminate the short-circuit; replace the gate power supply

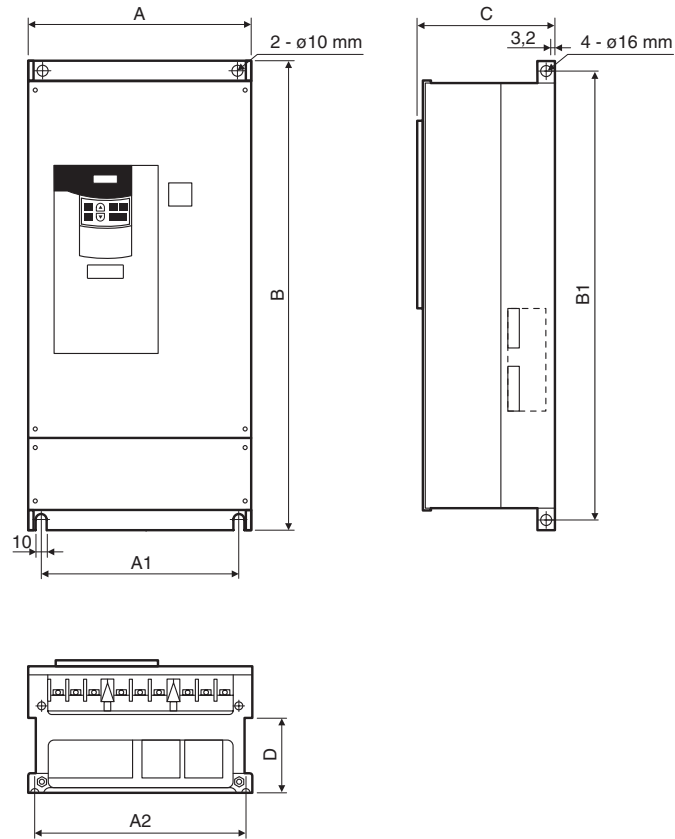
① Refer to the instruction manual of the frequency inverter for a detailed description of the error message E.15.

② The stall prevention operation level (Pr. 22) is adjustable. It is factory-set to 120%.

7 Dimensions

7.1 Inverters

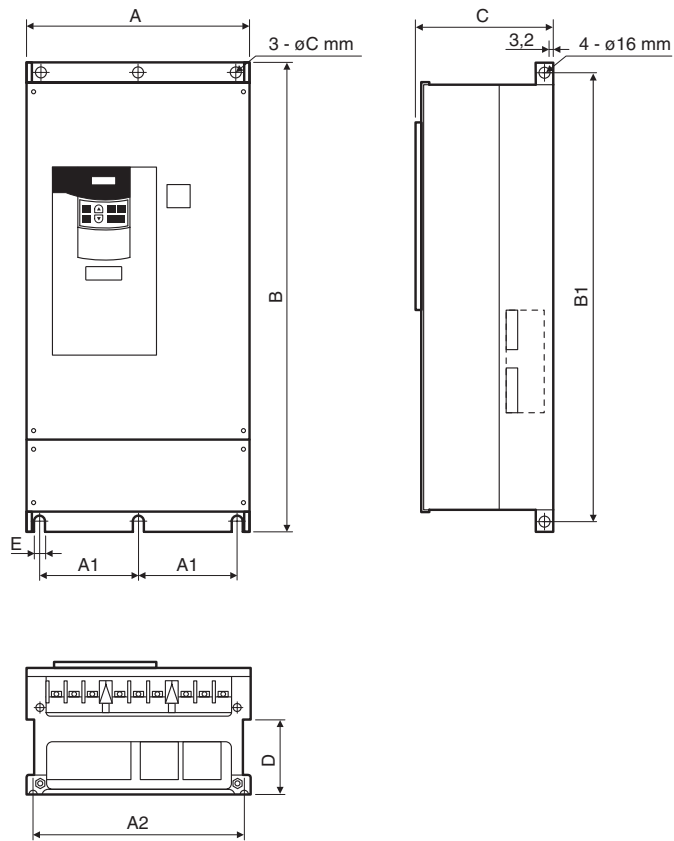
7.1.1 Capacity Classes 75 k to 160 k



Unit: mm

Type	A	A1	A2	B	B1	C	D
FR-F 540L-75 k	360	260	336	610	584	360	160
FR-F 540L-90 k / 110 k / 132 k / 160 k	480	400	456	740	714	360	160

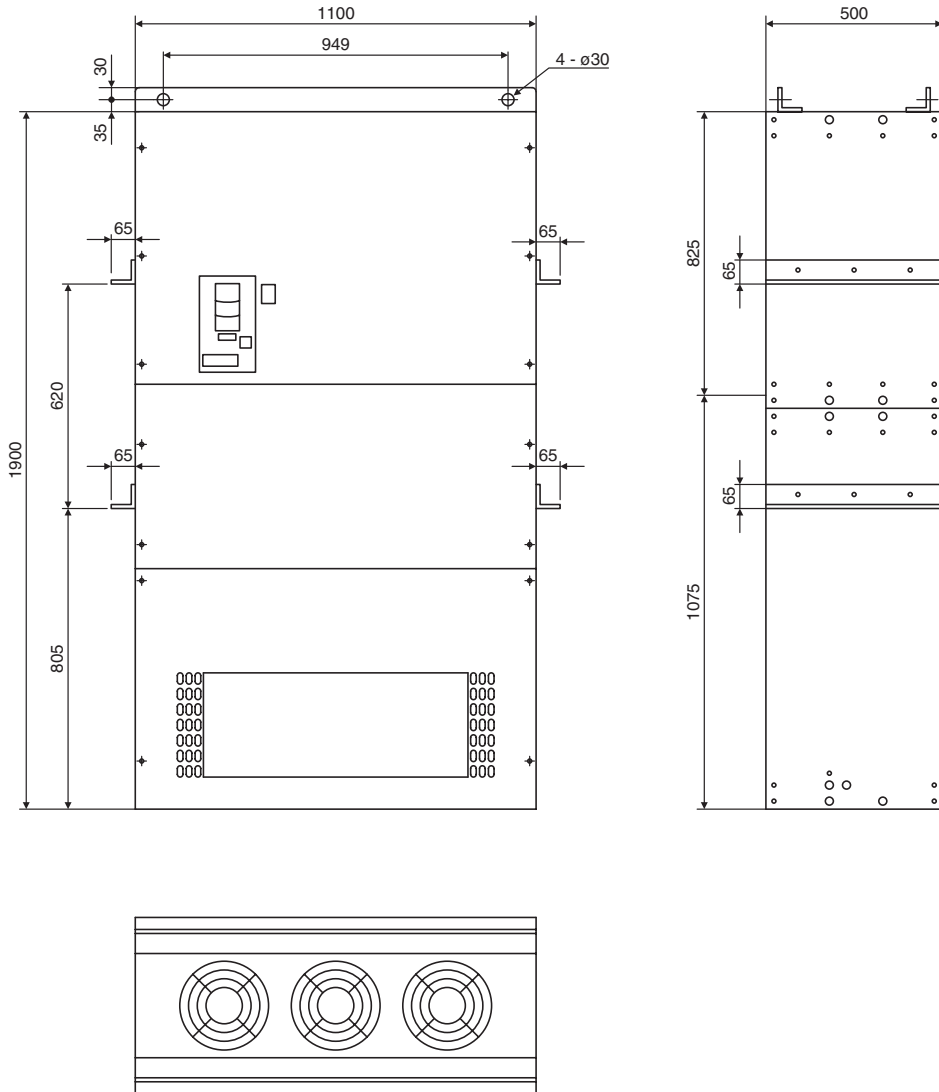
7.1.2 Capacity Classes 185 k to 375 k



Unit: mm

Type	A	A1	A2	B	B1	C	D	E
FR-F 540L-185 k / 220 k	498	200	474	1010	984	380	185	10
FR-F 540L-280 k	680	300	656	1010	984	380	185	10
FR-F 540L-375 k	790	315	766	1330	1300	440	196	12

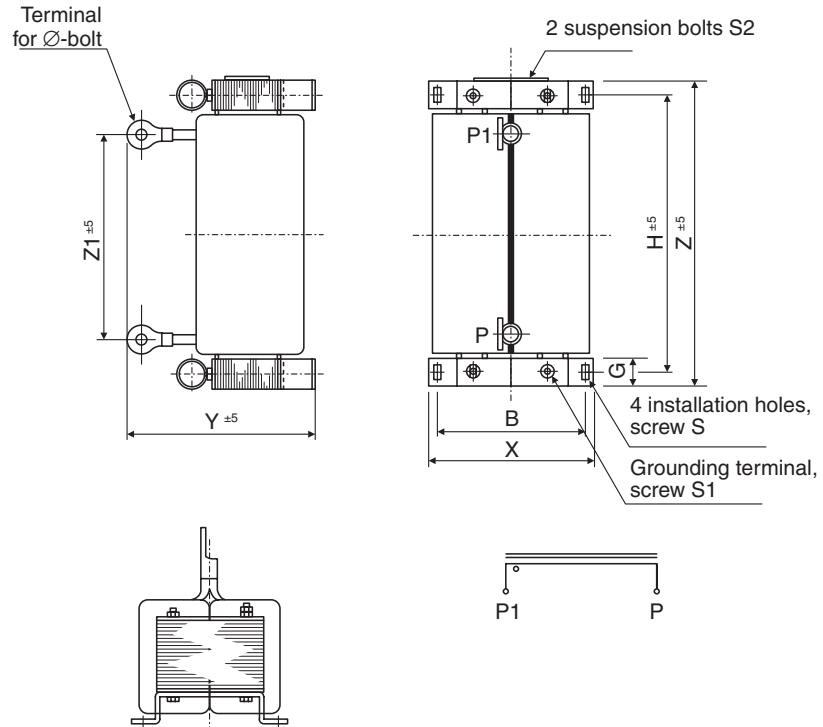
7.1.3 Capacity Classes 450 k and 530 k



Unit: mm

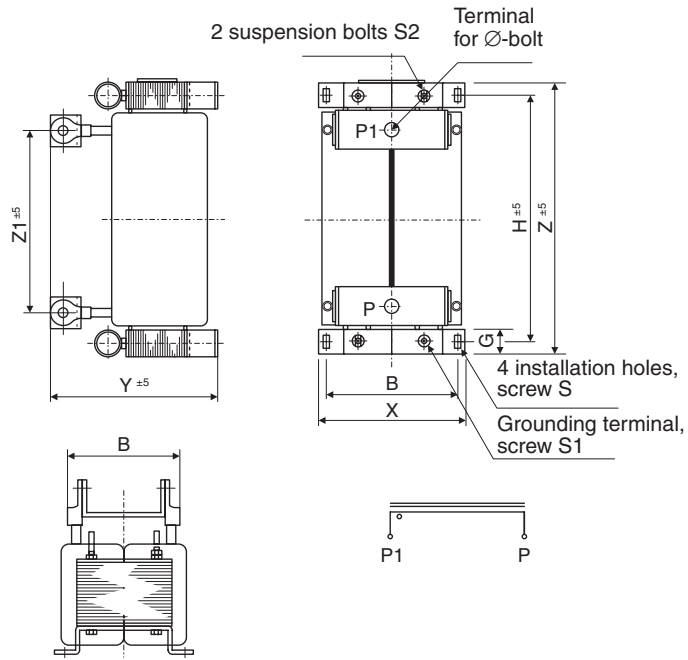
7.2 Converter Chokes

7.2.1 Capacity Classes 75 k to 280 k



Type	Dimensions											Weight [kg]
	X	Y	Z	Z1	B	H	G	S	S1	S2	Ø	
FR-F 540L-75 k	140	170	320	230	120	295	25	M6	M6	—	M10	14
FR-F 540L-90 k	150	175	337	265	130	310	25	M6	M6	—	M12	18
FR-F 540L-110 k	150	180	337	255	130	310	25	M6	M6	—	M12	19
FR-F 540L-132 k	175	185	400	300	150	365	32	M8	M6	—	M12	22
FR-F 540L 160 k	175	190	400	315	150	365	32	M8	M6	—	M12	22
FR-F 540L-185 k	175	225	400	285	150	365	32	M8	M6	—	M12	29
FR-F 540L-220 k	190	225	438	305	165	400	38	M8	M8	M8	M12	36
FR-F 540L-280 k	210	235	495	350	185	450	44	M10	M8	M8	M16	48

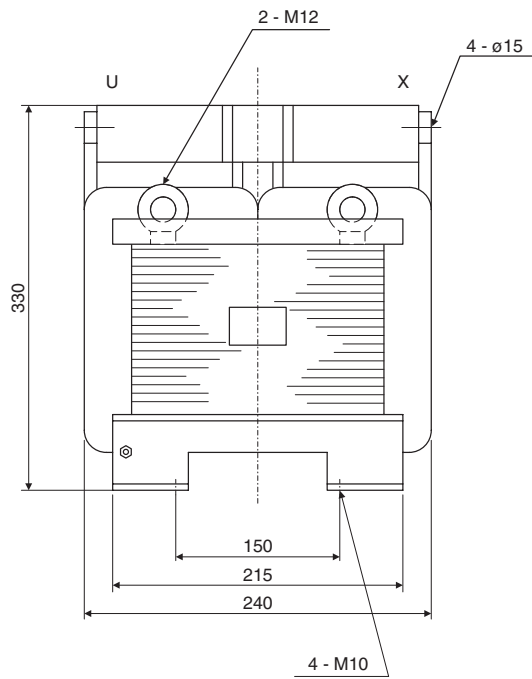
7.2.2 Capacity Class 375 k



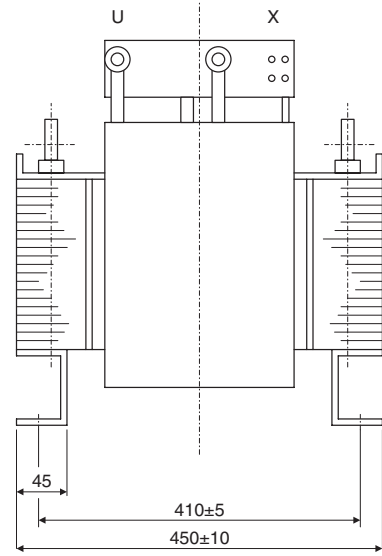
Unit: mm

Type	Dimensions											Weight [kg]
	X	Y	Z	Z1	B	H	G	S	S1	S2	Ø	
FR-F 540L-375 k	220	250	495	380	195	450	44	M10	M8	M8	M16	57

7.2.3 Capacity Classes 450 k and 530 k



Weight: 100kg



Unit: mm

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